Proofs for file C:\Escher\Customers\prang-cpp\prang.cpp

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Escher Verification Studio file versions

EscherTool 7.00 ecv 7.00.00.00 rubric 7.00.00.01

Proved 65 of 72 verification conditions.

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Proof of verification condition: Precondition of 'div' satisfied
In the context of class: WHPrang, declared at:
C:\Escher\Customers\prang-cpp\prang.cpp (18,1)
Condition generated at: C:\Escher\Customers\prang-cpp\prang.cpp
(60,18)
Condition defined at: C:\Escher\ecv\standard\stdlib.h (94,10)
To prove: 0 <
asType<integer>(static_cast<int>($heap_{tuncstart\_1032,1}.a1))
Given:
heap_{init}.LIMIT == (int)80
heap_{init}.class WHPrang \in M1 == (int)30269
heap_{init}.class WHPrang \in r1 == (int)171
heap_{init}.class WHPrang \in a1 == (int)177
heap_{init}.class WHPrang \in b1 == (int)2
heap_{init}.class WHPrang \in M2 == (int)30307
heap_{init}.class WHPrang \in r2 == (int)172
heap_{init}.class WHPrang \in a2 == (int)176
heap_{init}.class WHPrang \in b2 == (int)35
heap_{init}.class WHPrang \in M3 == (int)30323
heap_{init}.class WHPrang \in r3 == (int)170
heap_{init}.class WHPrang \in a3 == (int)178
heap_{init}.class WHPrang \in b3 == (int)63
Proof:
[Take goal term]
[1.0] 0 < asType<integer>(static_cast<int>($heap_{funcstart\_1032,1}.a1))
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\rightarrow [const static or extern object]
[1.1] 0 < asType < integer > (static\_cast < int > ($heap_{init}.a1))
\rightarrow [expand definition of constant 'a1' at prang.cpp (30,26)]
[1.2] 0 < asType<integer>(static_cast<int>((int)177))
\rightarrow [simplify]
[1.6] true
Proof of verification condition: Assertion valid
In the context of class: WHPrang, declared at:
C:\Escher\Customers\prang-cpp\prang.cpp (18,1)
Condition generated at: C:\Escher\Customers\prang-cpp\prang.cpp
(61.48)
To prove: (asType<integer>(heap_{funcstart\_1032,1}.a1) \leq
asType<integer>(operator*(heapIs $heap_{funcstart\_1032,1}, this).p1)) =>
!(0 == asType < integer > (div1.quot))
Given:
heap_{init}.LIMIT == (int)80
heap_{init}.class WHPrang \in M1 == (int)30269
heap_{init}.class WHPrang \in r1 == (int)171
heap_{init}.class WHPrang \in a1 == (int)177
heap_{init}.class WHPrang \in b1 == (int)2
heap_{init}.class WHPrang \in M2 == (int)30307
heap_{init}.class WHPrang \in r2 == (int)172
heap_{init}.class WHPrang \in a2 == (int)176
heap_{init}.class WHPrang \in b2 == (int)35
heap_{init}.class WHPrang \in M3 == (int)30323
heap_{init}.class WHPrang \in r3 == (int)170
heap_{init}.class WHPrang \in a3 == (int)178
heap_{init}.class WHPrang \in b3 == (int)63
\operatorname{div1} == \operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_1032,1},
\mathbf{static\_cast} {<} \mathbf{int} {>} (\mathbf{operator^*(heapIs}\ \$heap_{funcstart\_1032,1},\ \mathbf{this}).p1),
\mathbf{static\_cast} < \mathbf{int} > (\$ \mathbf{heap}_{funcstart\_1032,1}.\mathbf{a1}))
(asType < integer > (static\_cast < int > (operator*(heapIs)))
heap_{funcstart\_1032,1}, this).p1) /
asType < integer > (static\_cast < int > (\$heap_{funcstart\_1032.1}.a1))) = =
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asType<integer>(div1.quot)
(asType<integer>(static_cast<int>(operator*(heapIs
heap_{funcstart\_1032,1}, this).p1) %
asType < integer > (static\_cast < int > (\$heap_{funcstart\_1032.1}.a1))) = =
asType<integer>(div1.rem)
(asType < integer > (operator*(heapIs $heap_{funcstart\_1032,1}, this).p1) < footnote{the content of the conte
asType < integer > (\$heap_{funcstart\_1032,1}.a1)) = >
(asType<integer>(div1.rem) == asType<integer>(operator*(heapIs
heap_{funcstart\_1032,1}, this).p1)
Proof:
[Take given term]
[2.0] div1 == div(heapIs $heap_{funcstart\_1032,1},
static\_cast < int > (operator*(heapIs $heap_{funcstart\_1032,1}, this).p1),
\mathbf{static\_cast}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_1032,1}.\mathrm{a1}))
→ [expand definition of operator '*' in class 'pointer' at built in declaration]
[2.1] \operatorname{div1} == \operatorname{div}(\mathbf{heapIs} \ \text{$heap}_{funcstart\_1032,1},
\mathbf{static\_cast} {<} \mathbf{int} {>} (\mathbf{this.\$r.value}(\mathbf{heapIs}\ \$ \mathbf{heap}_{funcstart\_1032,1}).\mathbf{p1}),
static\_cast < int > (\$heap_{funcstart\_1032,1}.a1))
\rightarrow [simplify]
[2.2] \operatorname{div1} == \operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_1032,1}, \mathbf{this}.\$ r. \mathbf{value}(\mathbf{heapIs}))
\theta_{funcstart\_1032,1}.p1, \theta_{funcstart\_1032,1}.a1)
\rightarrow [const static or extern object]
[2.3] \operatorname{div1} == \operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_1032,1}, \mathbf{this}.\$ r. \mathbf{value}(\mathbf{heapIs})
\$ heap_{funcstart\_1032,1}).p1, \ \mathbf{static\_cast} < \mathbf{int} > (\$ heap_{init}.a1))
\rightarrow [expand definition of constant 'a1' at prang.cpp (30,26)]
[2.4] \text{ div1} == \text{div}(\text{heapIs } \text{heap}_{funcstart\_1032,1}, \text{this.}\text{\$r.value}(\text{heapIs})
\theta_{funcstart\_1032,1}.p1, \theta_{funcstart\_1032,1}.p1, \theta_{funcstart\_1032,1}.p1, \theta_{funcstart\_1032,1}.p1, \theta_{funcstart\_1032,1}.p1, \theta_{funcstart\_1032,1}.p1, \theta_{funcstart\_1032,1}.p2, \theta_{funcstart\_1032,1}.p2, \theta_{funcstart\_1032,1}.p2, \theta_{funcstart\_1032,1}.p2, \theta_{funcstart\_1032,1}.p2, \theta_{funcstart\_1032,1}.p3, \theta_{funcstart\_1032,1}.p4, \theta_{funcstart\_1032,1}.p4, \theta_{funcstart\_1032,1}.p4, \theta_{funcstart\_1032,1}.p5, \theta_{funcstart\_1032,1
\rightarrow [simplify]
[2.6] div1 == div(heapIs $heap_{funcstart\_1032,1}, this.$r.value(heapIs)
heap_{funcstart_{1032,1}}.p1, 177)
[Take goal term]
[1.0] (asType<integer>($heap_{funcstart\_1032,1}.a1) \leq
\mathbf{asType} < \mathbf{integer} > (\mathbf{operator}^*(\mathbf{heapIs} \ \$ \mathbf{heap}_{funcstart\_1032,1}, \ \mathbf{this}).\mathrm{p1})) = >
!(0 == asType < integer > (div1.quot))
\rightarrow [const static or extern object]
[1.1] (asType<integer>(\theta_{init}.a1) \leq
\mathbf{asType} < \mathbf{integer} > (\mathbf{operator}^*(\mathbf{heapIs} \ \$ \mathbf{heap}_{funcstart\_1032,1}, \ \mathbf{this}).\mathrm{p1})) = >
!(0 == asType < integer > (div1.quot))
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\rightarrow [expand definition of constant 'a1' at prang.cpp (30,26)]
[1.2] \ (as Type < integer > ((int)177) \leq as Type < integer > (operator * (heap Is the first operator * (int) 177) \leq as Type < (int) 177) < (i
\theta
\rightarrow [simplify]
[1.4] (177 \le asType < integer > (operator*(heapIs $heap_{funcstart\_1032,1}, for all the start of the start 
this).p1)) => !(0 == asType < integer > (div1.quot))
→ [expand definition of operator '*' in class 'pointer' at built in declaration]
[1.5] (177 \le asType<integer>(this.\frac{1}{2}r.value(heapIs)
heap_{funcstart\_1032,1}.p1) => !(0 == asType < integer > (div1.quot))
\rightarrow [simplify]
[1.8] (176 < this.$r.value(heapIs $heap_{tuncstart\_1032.1}).p1) => !(0 ==
asType<integer>(div1.quot))
\rightarrow [from term 2.6, div1 is equal to div(heapIs $heap_{funcstart\_1032,1},
this.r.value(heapIs $heap_{funcstart\_1032,1}).p1, 177)
[1.9] (176 < this.$r.value(heapIs $heap_{funcstart\_1032,1}).p1) => !(0 ==
asType<integer>(div(heapIs $heap_funcstart_1032.1, this.$r.value(heapIs
heap_{funcstart_1032,1}.p1, 177).quot)
\rightarrow [simplify]
[1.13]!(0 == div(\mathbf{heapIs} \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}))
\$heap_{funcstart\_1032,1}).p1,\,177).quot) \,\vee\, (\text{-}177 < -\textbf{this}.\$r.\textbf{value}(\textbf{heapIs}))
heap_{funcstart_1032.1}.p1
\rightarrow [negate goal and search for contradiction]
[1.14] (0 == div(heapIs $heap<sub>funcstart_1032.1</sub>, this.$r.value(heapIs)
\theta_{funcstart\_1032,1}.p1, 177).quot) \wedge !(-177 < -this.r.value(heapIs)
heap_{funcstart\_1032,1}.p1
\rightarrow [simplify]
[1.17] (0 == \operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_1032,1}, \ \mathbf{this}.\$ r. \mathbf{value}(\mathbf{heapIs})
\theta_{funcstart\_1032,1}.p1, 177).quot \land (176 < this. r.value(heapIs)
heap_{funcstart\_1032,1}.p1
\rightarrow [separate conjunction and work on first sub-term]
[1.18] 0 == div(heapIs $heap<sub>funcstart_1032,1</sub>, this.$r.value(heapIs)
heap_{funcstart\_1032,1}.p1, 177).quot
[Assume known post-assertion, class invariant or type constraint for term 2.6]
[7.0] (0 < asType<integer>(this.$r.value(heapIs
\verb§heap$_{funcstart\_1032,1}).p1)) \&\& (\mathbf{asType} < \mathbf{integer} > (\mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}))) \&\& (\mathbf{asType} < \mathbf{integer} > (\mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})))) \&\& (\mathbf{asType} < \mathbf{integer} > (\mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})))) \&\& (\mathbf{asType} < \mathbf{integer} > (\mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})))) \&\& (\mathbf{asType} < \mathbf{integer} > (\mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})))))
\rho_{tuncstart\_1032.1}).p1) < asType<integer>(\rho_{tuncstart\_1032.1}).p1) < asType<integer>(\rho_{tuncstart\_1032.1}).p1)
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M1)

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\rightarrow [simplify]
[7.2] (0 < this.$r.value(heapIs \rho_{funcstart\_1032,1}).p1) &&
(this.$r.value(heap
Is \theta_{funcstart\_1032,1}).p1 <
asType < integer > (\text{$heap.class WHPrang} \in M1))
\rightarrow [const static or extern object]
[7.3] (0 < this.$r.value(heapIs \rho_{funcstart\_1032,1}).p1) &&
(this.$r.value(heap
Is \rho_{funcstart\_1032,1}).p1 <
asType < integer > (\$heap_{init}.class WHPrang \in M1))
→ [expand definition of constant 'M1' at prang.cpp (28,26)]
[7.4] (0 < this.$r.value(heap
Is \rho_{funcstart\_1032,1}).p1) &&
(this.$r.value(heapIs heap_{funcstart\_1032,1}).p1 <
asType < integer > ((int)30269))
\rightarrow [simplify]
[7.10] (-30269 < -this.$r.value(heapIs $heap_{tuncstart\_1032.1}).p1) \land (0 <
this.r.value(heapIs $heap_{funcstart\_1032,1}).p1)
[Work on sub-term 2 of conjunction in term 7.10]
[8.0] 0 < this.$r.value(heapIs $heap_{tuncstart\_1032,1}).p1
[Assume known post-assertion, class invariant or type constraint for term 2.6]
[9.0] (asType<integer>(this.$r.value(heapIs $heap_{tuncstart\_1032,1}).p1) /
asType<integer>(177)) == asType<integer>(div(heapIs
\rho_{tuncstart=1032.1}, this.r.value(heapIs \rho_{tuncstart=1032.1}).p1,
177).quot)
\rightarrow [simplify]
[9.2] (this.$r.value(heapIs heap_{funcstart\_1032,1}).p1 / 177) ==
asType<integer>(div(heapIs $heap_{funcstart\_1032,1}, this.$r.value(heapIs
heap_{funcstart_{-1032,1}}.p1, 177).quot
→ [expand definition of operator './' in class 'int' at built in declaration]
[9.3] ([asType<integer>(this.$r.value(heapIs \theta_{funcstart\_1032,1}).p1) <
0]: -(-asType < integer > (this. r.value(heapIs $heap_{funcstart\_1032,1}).p1) /
177), \parallel: asType<integer>(this.$r.value(heapIs \theta_{funcstart\_1032,1}).p1) /
177) == asType<integer>(div(heapIs $heap_{tuncstart\_1032.1},
this.r.value(heapIs \ heap_{funcstart\_1032.1}).p1, 177).quot)
\rightarrow [explicitly assert falsehood of skipped guards in subsequent guards]
[9.4] ([asType<integer>(this.$r.value(heapIs $heap_{tuncstart\_1032.1}).p1) <
0]: -(-asType < integer > (this. r.value(heapIs $heap_{funcstart\_1032,1}).p1)
177), [!(asType<integer>(this.$r.value(heapIs \rho_{tart_{-1032,1}}.p1) < 0.000
0)]: asType < integer > (this. r.value(heapIs <math>heapIs heap_{funcstart\_1032,1}).p1) / 
177) == asType<integer>(div(heapIs $heap_{tuncstart\_1032.1},
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this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177).quot)
\rightarrow [simplify]
[9.7] ([0 < -this.$r.value(heapIs $heap_{funcstart\_1032,1}).p1]:
-(-\mathbf{asType}{<}\mathbf{integer}{>}(\mathbf{this.\$r.value}(\mathbf{heapIs}\ \$\mathbf{heap}_{funcstart\_1032,1}).\mathbf{p1})\ /\\
177), [!(asType < integer > (this.\$r.value(heapIs \$heap_{funcstart\_1032,1}).p1) < ]
0)]: asType < integer > (this. r.value(heapIs  heap_{funcstart\_1032,1}).p1) / 
177) == asType < integer > (div(heapIs $heap_{funcstart\_1032.1},
this.r.value(heapIs $heap_{funcstart\_1032,1}).p1, 177).quot)
\rightarrow [from term 8.0, literala < -this.$r.value(heapIs $heap_{funcstart\_1032.1}).p1
is false whenever -2 < (0 + literala)
       Proof of rule precondition:
       [9.7.0] - 2 < (0 + 0)
       \rightarrow [simplify]
       [9.7.2] true
[9.8] ([false]: -(-asType<integer>(this.$r.value(heapIs
\label{eq:funcstart_1032,1} $$ \operatorname{heap}_{funcstart_1032,1}).p1) \ / \ 177), \ [!(asType < integer > (this.\$r.value(heapIs))] $$ \ / \ 177), \ [!(asType < integer > (this.\$r.value(heapIs))] $$ \ / \ 177), \ [!(asType < integer > (this.\$r.value(heapIs))] $$ \ / \ 177), \ [!(asType < integer > (this.\$r.value(heapIs))] $$ \ / \ 177), \ [!(asType < integer > (this.\$r.value(heapIs))] $$ \ / \ 177), \ [!(asType < integer > (this.\$r.value(heapIs))] $$ \ / \ 177), \ [!(asType < integer > (this.\$r.value(heapIs))] $$ \ / \ 177), \ [!(asType < integer > (this.\$r.value(heapIs))] $$ \ / \ 1770, \ [!(asType < integer > (this.\$r.value(heapIs))] $$ \ / \ 1770, \ [!(asType < integer > (this.\$r.value(heapIs))] $$ \ / \ 1770, \ [!(asType < integer > (this.\$r.value(heapIs))] $$ \ / \ 1770, \ [!(asType < integer > (this.\$r.value(heapIs))] $$ \ / \ 1770, \ [!(asType < integer > (this.\$r.value(heapIs))] $$ \ / \ 1770, \ [!(asType < integer > (this.\$r.value(heapIs))] $$ \ / \ 1770, \ [!(asType < integer > (this.\$r.value(heapIs))] $$ \ / \ 1770, \ [!(asType < integer > (this.\$r.value(heapIs))] $$ \ / \ 1770, \ [!(asType < integer > (this.\$r.value(heapIs))] $$ \ / \ 1770, \ [!(asType < integer > (this.\$r.value(heapIs))] $$ \ / \ 1770, \ [!(asType < integer > (this.\$r.value(heapIs))] $$ \ / \ 1770, \ [!(asType < integer > (this.\$r.value(heapIs))] $$ \ / \ 1770, \ [!(asType < integer > (this.\$r.value(heapIs))] $$ \ / \ 1770, \ [!(asType < integer > (this.\$r.value(heapIs))] $$ \ / \ 1770, \ [!(asType < integer > (this.\$r.value(heapIs))] $$ \ / \ 1770, \ [!(asType < integer > (this.\$r.value(heapIs))] $$ \ / \ 1770, \ [!(asType < integer > (this.\$r.value(heapIs))] $$ \ / \ 1770, \ [!(asType < integer > (this.\$r.value(heapIs))] $$ \ / \ 1770, \ [!(asType < integer > (this.\$r.value(heapIs))] $$ \ / \ 1770, \ [!(asType < integer > (this.\$r.value(heapIs))] $$ \ / \ 1770, \ [!(asType < integer > (this.\$r.value(heapIs))] $$ \ / \ 1770, \ [!(asType < integer > (this.\$r.value(heapIs))] $$ \ / \ 1770, \ [!(asType < integer > (this.\$r.value(heapIs))] 
\rho_{funcstart\_1032,1}.p1 < 0: asType<integer>(this.$r.value(heapIs)
\theta_{funcstart\_1032,1}.p1) / 177 == asType < integer > (div(heapIs))
\rho_{funcstart\_1032,1}, this. r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot)
\rightarrow [simplify]
[9.11] ([false]: -(-asType<integer>(this.$r.value(heapIs
\theta_{funcstart\_1032,1}.p1) / 177), [!(0 < -this. r.value(heapIs)]
\rho_{tuncstart_1032.1}.p1: asType<integer>(this.$r.value(heapIs)
\theta_{funcstart\_1032,1}.p1) / 177 = asType < integer > (div(heapIs))
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot)
\rightarrow [from term 8.0, literala < -this.$r.value(heapIs $heap_{funcstart\_1032,1}).p1
is false whenever -2 < (0 + literala)
       Proof of rule precondition:
       [9.11.0] - 2 < (0 + 0)
       \rightarrow [simplify]
       [9.11.2] true
[9.12] ([false]: -(-asType<integer>(this.$r.value(heapIs
\frac{\text{sheap}_{funcstart\_1032,1}.p1}{177}, [!false]:
asType<integer>(this.$r.value(heapIs $heap_{funcstart\_1032.1}).p1) / 177)
== asType < integer > (div(heapIs $heap_{funcstart\_1032.1},
this.$r.value(heapIs $heap_{tuncstart\_1032.1}).p1, 177).quot)
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\rightarrow [simplify]
[9.17] 0 == (-\text{div}(\mathbf{heapIs} \$ \text{heap}_{funcstart\_1032,1}, \mathbf{this}.\$ r. \mathbf{value}(\mathbf{heapIs}))
\theta_{tuncstart_{-1032,1}}.p1, 177.quot + (this.r.value(heapIs)
heap_{funcstart\_1032,1}.p1 / 177)
\rightarrow [from\ term\ 1.18,\ div(\textbf{heapIs}\ \$heap_{funcstart\_1032,1},\ \textbf{this}.\$r.\textbf{value}(\textbf{heapIs}
heap_{funcstart\_1032,1}.p1, 177).quot is equal to 0
[9.18] 0 == (-0 + (this.\$r.value(heapIs \$heap_{funcstart\_1032.1}).p1 / 177))
\rightarrow [simplify]
[9.20] 0 == (this.$r.value(heapIs heapIs heap_{funcstart\_1032,1}).p1 / 177)
[Work on sub-term 2 of conjunction in term 1.17]
\textit{[16.0]} \ 176 < \mathbf{this.\$r.value(heapIs} \ \$heap_{funcstart\_1032,1}).p1
[Create new term from term 9.20 using rule: condition for equality of division]
[17.0] ((0 * 177) < (1 + this.$r.value(heap
Is \rho_{uncstart\_1032,1}.p1)) \land
(this.$r.value(heapIs $heap_{funcstart\_1032,1}).p1 < (177 * (0 + 1)))
\rightarrow [simplify]
[17.3] (-1 < this.$r.value(heap
Is \rho_{funcstart\_1032,1}).p1) <math display="inline">\land
(this.$r.value(heapIs heap_{funcstart_1032.1}).p1 < (177 * (0 + 1)))
\rightarrow [from term 16.0, literala < this.$r.value(heapIs $heap_{funcstart\_1032,1}).p1
is true whenever (-1 + literala) < 176
   Proof of rule precondition:
   [17.3.0](-1+-1)<176
   \rightarrow [simplify]
   [17.3.2] true
[17.4] true \land (this.$r.value(heapIs $heap_{funcstart\_1032,1}).p1 < (177 * (0 +
1)))
\rightarrow [simplify]
[17.9] true \land (-177 < -this.$r.value(heapIs $heap_{funcstart\_1032,1}).p1)
\rightarrow [from term 16.0, literala < -this.$r.value(heapIs $heap_{funcstart\_1032.1}).p1
is false whenever -2 < (176 + literala)
   Proof of rule precondition:
   [17.9.0] - 2 < (-177 + 176)
   \rightarrow [simplify]
   [17.9.2] true
[17.10] true \wedge false
\rightarrow [simplify]
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Proof of verification condition: Assertion valid
In the context of class: WHPrang, declared at:
C:\Escher\Customers\prang-cpp\prang.cpp (18,1)
Condition generated at: C:\Escher\Customers\prang-cpp\prang.cpp
(61,20)
To prove: (asType<integer>(operator*(heapIs $heap_{funcstart\_1032,1},)
\mathbf{this}).\mathrm{p1}) < \mathbf{asType} < \mathbf{integer} > (\$ \mathrm{heap}_{funcstart\_1032,1}.\mathrm{a1})) = >
(asType<integer>(div1.rem) == asType<integer>(operator*(heapIs
heap_{funcstart_1032,1}, this).p1)
Given:
heap_{init}.LIMIT == (int)80
heap_{init}.class WHPrang \in M1 == (int)30269
heap_{init}.class WHPrang \in r1 == (int)171
heap_{init}.class WHPrang \in a1 == (int)177
heap_{init}.class WHPrang \in b1 == (int)2
heap_{init}.class WHPrang \in M2 == (int)30307
heap_{init}.class WHPrang \in r2 == (int)172
heap_{init}.class WHPrang \in a2 == (int)176
heap_{init}.class WHPrang \in b2 == (int)35
heap_{init}.class WHPrang \in M3 == (int)30323
heap_{init}.class WHPrang \in r3 == (int)170
heap_{init}.class WHPrang \in a3 == (int)178
heap_{init}.class WHPrang \in b3 == (int)63
\operatorname{div1} == \operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_1032,1},
\mathbf{static\_cast} {<} \mathbf{int} {>} (\mathbf{operator*}(\mathbf{heapIs}\ \$ \mathbf{heap}_{funcstart\_1032,1},\ \mathbf{this}).\mathbf{p1}),
static\_cast < int > (\$heap_{funcstart\_1032,1}.a1))
(asType < integer > (static\_cast < int > (operator*(heapIs)))
\theta_{funcstart\_1032,1}, this).p1)) /
\mathbf{asType} {<} \mathbf{integer} {>} (\mathbf{static\_cast} {<} \mathbf{int} {>} (\$ \mathbf{heap}_{funcstart\_1032,1}.\mathbf{a1}))) = =
asType<integer>(div1.quot)
(asType<integer>(static_cast<int>(operator*(heapIs
heap_{funcstart\ 1032.1}, this).p1)
\mathbf{asType} {<} \mathbf{integer} {>} (\mathbf{static\_cast} {<} \mathbf{int} {>} (\$ \mathbf{heap}_{funcstart\_1032,1}.\mathbf{a1}))) = =
asType<integer>(div1.rem)
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Proof:

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[Take given term]
[2.0] div1 == div(heapIs $heap_{funcstart\_1032,1},
static_cast<int>(operator*(heapIs $heap_{funcstart\_1032,1}, this).p1),
\mathbf{static\_cast}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_1032,1}.\mathrm{a1}))
→ [expand definition of operator '*' in class 'pointer' at built in declaration]
[2.1] \operatorname{div1} == \operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_1032,1},
static\_cast < int > (this. r.value(heapIs  heap_{funcstart\_1032,1}).p1),
static\_cast < int > (\$heap_{funcstart\_1032.1}.a1))
\rightarrow [simplify]
[2.2] \text{ div1} == \text{div(heapIs } \text{$heap}_{funcstart\_1032,1}, \text{this.} \text{$r.value(heapIs)}
\label{eq:cast_int} $$  \parbox{$heap_{funcstart\_1032,1}.p1, static\_cast< int>($heap_{funcstart\_1032,1}.a1))} $$
\rightarrow [const static or extern object]
[2.3] \text{ div1} == \text{div(heapIs } \text{$heap}_{funcstart\_1032,1}, \text{this.} \text{$r.value(heapIs)$}
\theta_{funcstart\_1032.1}.p1, \theta_{funcstart\_1032.1}.p1, \theta_{funcstart\_1032.1}.p1, \theta_{funcstart\_1032.1}.p1, \theta_{funcstart\_1032.1}.p1, \theta_{funcstart\_1032.1}.p1, \theta_{funcstart\_1032.1}.p2, \theta_{funcstart\_1032.1}.p2, \theta_{funcstart\_1032.1}.p2, \theta_{funcstart\_1032.1}.p2, \theta_{funcstart\_1032.1}.p2, \theta_{funcstart\_1032.1}.p3, \theta_{funcstart\_1032.1}.p2, \theta_{funcstart\_1032.1}.p3, \theta_{funcstart\_1032.1}.p4, \theta_{funcstart\_1032.1}.p4, \theta_{funcstart\_1032.1}.p4, \theta_{funcstart\_1032.1}.p5, \theta_{funcstart\_1032.1
\rightarrow [expand definition of constant 'a1' at prang.cpp (30,26)]
[2.4] \operatorname{div1} == \operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_1032,1}, \mathbf{this.}\$ r. \mathbf{value}(\mathbf{heapIs})
\theta_{funcstart\_1032,1}.p1, \theta_{funcstart\_1032,1}.p1, \theta_{funcstart\_1032,1}.p1, \theta_{funcstart\_1032,1}.p1, \theta_{funcstart\_1032,1}.p1, \theta_{funcstart\_1032,1}.p2, \theta_{funcstart\_1032,1}.p2, \theta_{funcstart\_1032,1}.p2, \theta_{funcstart\_1032,1}.p2, \theta_{funcstart\_1032,1}.p2, \theta_{funcstart\_1032,1}.p3, \theta_{funcstart\_1032,1}.p2, \theta_{funcstart\_1032,1}.p3, \theta_{funcstart\_1032,1}.p4, \theta_{funcstart\_1032,1}.p4, \theta_{funcstart\_1032,1}.p4, \theta_{funcstart\_1032,1}.p4, \theta_{funcstart\_1032,1}.p4, \theta_{funcstart\_1032,1}.p5, \theta_{funcstart\_1032,1
\rightarrow [simplify]
[2.6] \operatorname{div1} == \operatorname{div}(\mathbf{heapIs} \ \mathbf{\$heap}_{funcstart\_1032,1}, \ \mathbf{this}.\mathbf{\$r.value}(\mathbf{heapIs})
heap_{funcstart_{-1032,1}}.p1, 177
[Take goal term]
[1.0] (asType<integer>(operator*(heapIs heap_{funcstart\_1032,1}, this).p1)
< asType<integer>($heap<sub>funcstart_1032,1</sub>.a1)) =>
(asType<integer>(div1.rem) == asType<integer>(operator*(heapIs
heap_{funcstart\_1032,1}, this).p1)
→ [expand definition of operator '*' in class 'pointer' at built in declaration]
{\it [1.1]}~({\bf asType}{<}{\bf integer}{>}({\bf this.\$r.value}({\bf heapIs}~\${\bf heap}_{funcstart\_1032,1}).{\bf p1})<
asType < integer > (\$heap_{funcstart\_1032,1}.a1)) = >
(asType<integer>(div1.rem) == asType<integer>(operator*(heapIs
heap_{funcstart\_1032,1}, this).p1)
\rightarrow [simplify]
[1.2] (this.$r.value(heapIs $heap_{funcstart\_1032,1}).p1 <
asType < integer > (\$heap_{funcstart\_1032,1}.a1)) = >
(asType<integer>(div1.rem) == asType<integer>(operator*(heapIs
heap_{funcstart\_1032,1}, this).p1)
\rightarrow [const static or extern object]
```

```
[1.3] (this.$r.value(heap
Is \rho_{funcstart\_1032,1}).p1 <
asType < integer > (\$heap_{init}.a1)) => (asType < integer > (div1.rem) ==
\mathbf{asType}{<}\mathbf{integer}{>}(\mathbf{operator}^*(\mathbf{heapIs}\ \$\mathbf{heap}_{funcstart\_1032,1},\ \mathbf{this}).\mathtt{p1}))
\rightarrow [expand definition of constant 'a1' at prang.cpp (30,26)]
[1.4] (this.$r.value(heap
Is \rho_{funcstart\_1032,1}).p1 <
asType<integer>((int)177)) => (asType<integer>(div1.rem) ==
asType<integer>(operator*(heapIs $heap_{funcstart\_1032.1}, this).p1))
\rightarrow [simplify]
[1.9] (-177 < -this.$r.value(heapIs $heap_{funcstart\_1032,1}).p1) =>
(asType<integer>(div1.rem) == asType<integer>(operator*(heapIs
heap_{funcstart_1032,1}, this).p1)
\rightarrow [from term 2.6, div1 is equal to div(heapIs $heap_{funcstart\_1032,1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177)]
[1.10] (-177 < -this.$r.value(heapIs $heap_{funcstart\_1032.1}).p1) =>
(asType<integer>(div(heapIs $heap_{funcstart\_1032,1}, this.$r.value(heapIs
heap_{funcstart_{-1032.1}}.p1, 177).rem = 
asType < integer > (operator^*(heapIs \$heap_{funcstart\_1032,1}, this).p1))
\rightarrow [simplify]
[1.11] (-177 < -this.$r.value(heapIs $heap_{funcstart\_1032,1}).p1) =>
(\operatorname{div}(\mathbf{heapIs}\ \$ \operatorname{heap}_{funcstart\_1032,1},\ \mathbf{this}.\$ r. \mathbf{value}(\mathbf{heapIs}
heap_{funcstart_1032,1}.p1, 177).rem ==
asType < integer > (operator*(heapIs $heap_{funcstart\_1032,1}, this).p1))
→ [expand definition of operator '*' in class 'pointer' at built in declaration]
[1.12] (-177 < -this.$r.value(heapIs $heap_{funcstart\_1032,1}).p1) =>
(\text{div}(\mathbf{heapIs} \$ \text{heap}_{funcstart\_1032.1}, \mathbf{this}.\$ \text{r.value}(\mathbf{heapIs}))
heap_{funcstart_{1032,1}}.p1, 177).rem ==
asType < integer > (this. r.value(heapIs  heap_{funcstart\_1032,1}).p1))
\rightarrow [simplify]
[1.18] (0 == (-\text{this.} \text{sr.value}(\text{heapIs} \text{sheap}_{funcstart\_1032,1}).\text{p1} + \text{div}(\text{heapIs})
\rho_{funcstart\_1032,1}, this. r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).rem)) \vee (176 < this.$r.value(heapIs $heap<sub>funcstart_1032,1</sub>).p1)
\rightarrow [negate goal and search for contradiction]
[1.19] !(0 == (-this.$r.value(heapIs \theta_{funcstart\_1032,1}).p1 + div(heapIs
\rho_{funcstart\_1032,1}, this.\r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).rem)) \land!(176 < this.$r.value(heapIs $heap_{funcstart\_1032,1}).p1)
\rightarrow [simplify]
[1.21] !(0 == (-this.$r.value(heapIs \theta_{funcstart\_1032,1}).p1 + div(heapIs
\rho_{tuncstart\_1032.1}, this.r.value(heapIs \rho_{tuncstart\_1032.1}).p1,
177).rem)) \land (-177 < -this.$r.value(heapIs \rho_{funcstart\_1032,1}.p1)
```

```
\rightarrow [separate conjunction and work on first sub-term]
 \lceil 1.22 \rceil \text{ -177} < -\textbf{this.}\$r.\textbf{value}(\textbf{heapIs} \$ \text{heap}_{funcstart\_1032,1}).p1 
[Assume known post-assertion, class invariant or type constraint for term 2.6]
[7.0] (0 < asType<integer>(this.\fr.value(heapIs)
$heap_funcstart_1032.1).p1)) && (asType<integer>(this.$r.value(heapIs
\$ heap_{funcstart\_1032,1}).p1) < \mathbf{asType} < \mathbf{integer} > (\$ heap.\mathbf{class} \ WHPrang \in \texttt{Constart} = \texttt{Constart}
M1))
\rightarrow [simplify]
[7.2] (0 < this.$r.value(heap
Is $heap_{funcstart\_1032,1}).p1) &&
(this.r.value(heapIs $heap_{funcstart\_1032,1}).p1 <
asType < integer > (\$heap.class WHPrang \in M1))
\rightarrow [const static or extern object]
[7.3] (0 < this.$r.value(heap
Is \rho_{funcstart\_1032,1}).p1) &&
(this.r.value(heapIs $heap_{funcstart\_1032,1}).p1 <
asType < integer > (\$heap_{init}.class WHPrang \in M1))
\rightarrow [expand definition of constant 'M1' at prang.cpp (28,26)]
[7.4] (0 < this.\$r.value(heapIs \$heap_{funcstart_1032,1}).p1) &&
(this.$r.value(heapIs heap_{funcstart\_1032,1}).p1 <
asType < integer > ((int)30269))
\rightarrow [simplify]
[7.10] (-30269 < -this.$r.value(heapIs heap_{funcstart\_1032,1}).p1) \land (0 <
this.r.value(heapIs $heap_{funcstart\_1032,1}).p1)
[Work on sub-term 2 of conjunction in term 7.10]
[8.0] 0 < this.$r.value(heap
Is $heap_{funcstart\_1032,1}).p1
[Assume known post-assertion, class invariant or type constraint for term 2.6]
[10.0] (asType<integer>(this.$r.value(heapIs $heap_{funcstart\_1032,1}).p1) %
asType<integer>(177)) == asType<integer>(div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).rem)
\rightarrow [simplify]
[10.2] (this.$r.value(heapIs $heap_{funcstart\_1032,1}).p1 % 177) ==
\mathbf{asType} {<} \mathbf{integer} {>} ( \mathbf{div} (\mathbf{heapIs} \ \$ \mathbf{heap}_{funcstart\_1032,1}, \ \mathbf{this}.\$ \mathbf{r.value} (\mathbf{heapIs} \ \mathbf{heapIs}) )
heap_{funcstart\_1032,1}.p1, 177).rem
→ [expand definition of operator '.%' in class 'int' at built in declaration]
[10.3] ([asType<integer>(this.$r.value(heapIs $heap_{funcstart\_1032.1}).p1) <
0]: -(-asType < integer > (this. r.value(heapIs  heap_{funcstart\_1032,1}).p1) \%
177), []: asType<integer>(this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1)
\% 177) == asType<integer>(div(heapIs $heap_{tuncstart\_1032,1},
```

```
this.r.value(heapIs $heap_{funcstart\_1032,1}).p1, 177).rem)
→ [explicitly assert falsehood of skipped guards in subsequent guards]
[10.4] \; ([\mathbf{asType} < \mathbf{integer} > (\mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs} \; \$ \mathbf{heap}_{funcstart\_1032,1}).\mathbf{p1}) < \mathbf{p1}) 
0]: -(-asType < integer > (this. r.value(heapIs  heap_{funcstart\_1032,1}).p1) %
177), [!(asType<integer>(this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1) <
0)]: asType<integer>(this.$r.value(heapIs \theta_{funcstart\_1032,1}).p1) %
177) == asType < integer > (div(heapIs $heap_{funcstart\_1032.1},
this.r.value(heapIs $heap_{funcstart\_1032,1}).p1, 177).rem)
\rightarrow [simplify]
[10.7] ([0 < -this.$r.value(heapIs $heap_{tuncstart\_1032.1}).p1]:
-(-asType < integer > (this. r.value(heapIs  heap_{funcstart\_1032.1}).p1) \%
177), [!(asType<integer>(this.$r.value(heapIs $heap_{tuncstart_1032.1}).p1) <
0)]: asType<integer>(this.r.value(heapIs $heap_{funcstart\_1032,1}).p1) %
177) == asType<integer>(div(heapIs heap_{funcstart\_1032,1},
this.r.value(heapIs $heap_{funcstart\_1032,1}).p1, 177).rem)
\rightarrow [from term 8.0, literala < -this.$r.value(heapIs $heap_{funcstart\_1032,1}).p1
is false whenever -2 < (0 + literala)
      Proof of rule precondition:
      [10.7.0] - 2 < (0 + 0)
      \rightarrow [simplify]
      [10.7.2] true
[10.8] ([false]: -(-asType<integer>(this.$r.value(heapIs
$heap_tuncstart_1032.1).p1) % 177), [!(asType<integer>(this.$r.value(heapIs
\{\text{heap}_{funcstart\_1032.1}\}.p1) < 0)]: asType<integer>(this.\r.value(\text{heapIs})
\theta_{funcstart\_1032,1}.p1)\% 177 == asType < integer > (div(heapIs))
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).\text{rem}
\rightarrow [simplify]
[10.11] ([false]: -(-asType<integer>(this.$r.value(heapIs
heap_{funcstart\_1032,1}.p1) \% 177, [!(0 < -this. r.value(heapIs)]
\rho_{uncstart\_1032,1}.p1): asType<integer>(this.$r.value(heapIs)
\theta_{funcstart\_1032,1}.p1) \% 177 == asType < integer > (div(heapIs)) % 1
\rho_{tuncstart_1032,1}, this.r.value(heapIs \rho_{tuncstart_1032,1}).p1,
177).rem)
\rightarrow [from term 8.0, literala < -this.$r.value(heapIs $heap_{funcstart\_1032,1}).p1
is false whenever -2 < (0 + literala)
      Proof of rule precondition:
      [10.11.0] - 2 < (0 + 0)
```

 \rightarrow [simplify]

```
[10.11.2] true
[10.12] ([false]: -(-asType<integer>(this.$r.value(heapIs
heap_{funcstart_{1032,1}}.p1) \% 177, [!false]:
asType<integer>(this.$r.value(heapIs $heap_{funcstart\_1032,1}).p1) % 177)
== asType<integer>(div(heapIs $heap_{tuncstart\_1032.1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177).rem)
\rightarrow [simplify]
[10.17]~0 == (-\text{div}(\textbf{heapIs}~\$\text{heap}_{funcstart\_1032,1},\,\textbf{this}.\$\text{r.value}(\textbf{heapIs}
\$heap_{funcstart\_1032,1}).p1,\,177).rem\,+\,(\textbf{this}.\$r.\textbf{value}(\textbf{heapIs}
heap_{funcstart_{1032,1}}.p1 \% 177)
[Work on sub-term 2 of conjunction in term 1.21]
[15.0] !(0 == (-this.$r.value(heapIs $heap_{funcstart\_1032,1}).p1 + div(heapIs)
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).rem))
[Copy term 15.0]
[16.0] ! (0 == (-\mathbf{this.}\$r.\mathbf{value}(\mathbf{heapIs} \$ heap_{funcstart\_1032,1}).p1 + div(\mathbf{heapIs} \$ heap_{funcstart\_1032,1}).p2 + div(\mathbf{heapIs} \$ heap_{funcstart\_1032,1}).p2 + div(\mathbf{heapIs} \$ heap_{funcstart\_1032,1}).p2 + div(\mathbf{heapIs} \$ heap_{funcstart\_1
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).rem))
\rightarrow [from term 10.17, div(heapIs $heap_{funcstart\_1032,1}$, this.$r.value(heapIs)
heap_{funcstart\_1032,1}.p1, 177.rem is equal to this $r.value(heapIs)
heap_{funcstart\_1032,1}.p1 \% 177
 [16.1] ! (0 == (-\mathbf{this.}\$r.\mathbf{value}(\mathbf{heapIs} \ \$heap_{funcstart\_1032,1}).p1 + \\
(this.$r.value(heapIs heap_{funcstart\_1032,1}).p1 % 177)))
\rightarrow [remainder with larger divisor]
        Proof of rule precondition 1:
        [16.1.0.0] literald < -this.$r.value(heapIs $heap<sub>funcstart_1032.1</sub>).p1
        \rightarrow [unify with term 1.22]
        [16.1.0.1] true
        Proof of rule precondition 2:
        [16.1.1.0] literalc < this.$r.value(heapIs \theta_{funcstart\_1032,1}).p1
        \rightarrow [unify with term 8.0]
        [16.1.1.1] true
        Proof of rule precondition 3:
        [16.1.2.0] --177 \le 177
        \rightarrow [simplify]
        [16.1.2.2] true
```

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Proof of rule precondition 4:
          [16.1.3.0] - 2 < 0
          \rightarrow [simplify]
          [16.1.3.1] true
 [16.2] ! (0 == (-\mathbf{this.} \$r. \mathbf{value} (\mathbf{heapIs} \$heap_{funcstart\_1032,1}).p1 + \\
\textbf{this.}\$r.\textbf{value}(\textbf{heapIs}~\$heap_{funcstart\_1032,1}).p1))
\rightarrow [simplify]
[16.5] false
Proof of verification condition: Assertion valid
In the context of class: WHPrang, declared at:
C:\Escher\Customers\prang-cpp\prang.cpp (18,1)
Condition generated at: C:\Escher\Customers\prang-cpp\prang.cpp
(62,26)
To prove: !(0 == asType < integer > (div1.rem)) || !(0 ==
asType<integer>(div1.quot))
Given:
heap_{init}.LIMIT == (int)80
heap_{init}.class WHPrang \in M1 == (int)30269
heap_{init}.class WHPrang \in r1 == (int)171
heap_{init}.class WHPrang \in a1 == (int)177
heap_{init}.class WHPrang \in b1 == (int)2
heap_{init}.class WHPrang \in M2 == (int)30307
heap_{init}.class WHPrang \in r2 == (int)172
heap_{init}.class WHPrang \in a2 == (int)176
heap_{init}.class WHPrang \in b2 == (int)35
\text{$heap}_{init}.\mathbf{class} \text{ WHPrang} \in M3 == (\mathbf{int})30323
heap_{init}.class WHPrang \in r3 == (int)170
heap_{init}.class WHPrang \in a3 == (int)178
heap_{init}.class WHPrang \in b3 == (int)63
\operatorname{div} 1 == \operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_1032,1},
\mathbf{static\_cast} < \mathbf{int} > (\mathbf{operator}^*(\mathbf{heapIs}\ \$ \mathbf{heap}_{funcstart\_1032,1},\ \mathbf{this}).\mathbf{p1}),
static\_cast < int > (\$heap_{funcstart\_1032,1}.a1))
(asType < integer > (static\_cast < int > (operator*(heapIs)))
\theta_{100} = \theta_{1000} + \theta_{1000} +
```

```
asType < integer > (static\_cast < int > (\$heap_{funcstart\_1032.1}.a1))) = =
asType<integer>(div1.quot)
(asType<integer>(static_cast<int>(operator*(heapIs
heap_{funcstart\_1032,1}, this).p1) %
asType < integer > (static\_cast < int > (\$heap_{funcstart\_1032.1}.a1))) = =
asType<integer>(div1.rem)
(\mathbf{asType}{<}\mathbf{integer}{>}(\mathbf{operator}^*(\mathbf{heapIs}\ \$\mathbf{heap}_{funcstart\_1032,1},\ \mathbf{this}).\mathtt{p1}) <
asType < integer > (\$heap_{funcstart\_1032,1}.a1)) = >
(asType<integer>(div1.rem) == asType<integer>(operator*(heapIs
heap_{funcstart\ 1032.1}, this).p1)
(asType < integer > (\$heap_{funcstart\_1032,1}.a1) \le
asType<integer>(operator*(heapIs $heap_{funcstart\_1032,1}, this).p1)) =>
!(0 == asType < integer > (div1.quot))
Proof:
[Take given term]
[2.0] \operatorname{div1} == \operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_1032,1},
static_cast<int>(operator*(heapIs $heap_{funcstart\_1032,1}, this).p1),
\mathbf{static\_cast}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_1032,1}.\mathrm{a1}))
\rightarrow [expand definition of operator '*' in class 'pointer' at built in declaration]
[2.1] div1 == div(heapIs \theta_{funcstart\_1032,1},
static_cast<int>(this.$r.value(heapIs $heap_{funcstart\_1032,1}).p1),
static_cast<int>($heap_{tuncstart_1032.1}.a1))
\rightarrow [simplify]
[2.2] \text{ div1} == \text{div}(\text{heapIs } \text{heap}_{funcstart\_1032.1}, \text{this.} \text{$r.value}(\text{heapIs})
\$heap_{funcstart\_1032,1}).p1, \ \mathbf{static\_cast} < \mathbf{int} > (\$heap_{funcstart\_1032,1}.a1))
\rightarrow [const static or extern object]
[2.3] \operatorname{div1} == \operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_1032,1}, \mathbf{this.}\$ r. \mathbf{value}(\mathbf{heapIs})
\theta_{uncstart\_1032,1}.p1, \theta_{uncstart\_1032,1}.p2, \theta_{uncstart\_1032,1}.p3, \theta_{uncstart\_1032,1}.p4, \theta_{uncstart\_1032,1}.p4, \theta_{uncstart\_1032,1}.p4, \theta_{uncstart\_1032
\rightarrow [expand definition of constant 'a1' at prang.cpp (30,26)]
[2.4] \text{ div1} == \text{div}(\text{heapIs } \text{heap}_{funcstart\_1032,1}, \text{this.}\text{\$r.value}(\text{heapIs})
heap_{funcstart\_1032,1}.p1, static\_cast < int > ((int)177)
\rightarrow [simplify]
[2.6] \operatorname{div1} == \operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_1032,1}, \mathbf{this.}\$ r. \mathbf{value}(\mathbf{heapIs})
heap_{funcstart_{-1032,1}}.p1, 177
[Take goal term]
[1.0]!(0 == asType < integer > (div1.rem)) || !(0 ==
asType<integer>(div1.quot))
\rightarrow [from term 2.6, div1 is equal to div(heapIs $heap_{funcstart\_1032,1},
```

```
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177)]
[1.1] !(0 == asType<integer>(div(heapIs heap_{funcstart\_1032,1},
this.$r.value(heapIs \theta_{funcstart\_1032,1}).p1, 177).rem)) || !(0 ==
asType<integer>(div1.quot))
\rightarrow [simplify]
[1.2]!(0 == div(\mathbf{heapIs} \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}))
\label{eq:funcstart_1032,1} $\operatorname{heap}_{funcstart_1032,1}).p1,\ 177).rem)\ ||\ !(0 == \mathbf{asType} < \mathbf{integer} > (\operatorname{div}1.\operatorname{quot})) \\
\rightarrow [from term 2.6, div1 is equal to div(heapIs $heap_{funcstart\_1032,1},
this.$r.value(heapIs $heap_{tuncstart\_1032.1}).p1, 177)]
[1.3]!(0 == div(\mathbf{heapIs} \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}))
\rho_{tuncstart\_1032,1}.p1, 177).rem) || !(0 == asType<integer>(div(heapIs)
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot))
\rightarrow [simplify]
[1.5]!(0 == div(\mathbf{heapIs} \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}))
\text{heap}_{funcstart\_1032,1}.p1, 177).quot) \vee !(0 == \text{div}(\text{heapIs})
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).rem)
\rightarrow [negate goal and search for contradiction]
[1.6] (0 == div(heapIs $heap_{tuncstart\_1032,1}, this.$r.value(heapIs)
\text{Sheap}_{funcstart\_1032,1}.p1, 177).quot) \land (0 == \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_1032,1},
\mathbf{this.\$r.value}(\mathbf{heapIs}~\$\mathrm{heap}_{funcstart\_1032,1}).\mathrm{p1},~177).\mathrm{rem})
\rightarrow [separate conjunction and work on first sub-term]
[1.7] 0 == div(heapIs \rho_{funcstart\_1032,1}, his.\r.value(heapIs
heap_{funcstart\_1032,1}.p1, 177).quot
[Assume known post-assertion, class invariant or type constraint for term 2.6]
[7.0] (0 < asType<integer>(this.$r.value(heapIs
\theta_{funcstart\_1032.1}.p1) && (asType<integer>(this.$r.value(heapIs)
\label{eq:continuous_function} \$ \operatorname{heap}_{funcstart\_1032,1}).\mathrm{p1}) < \mathbf{asType} < \mathbf{integer} > (\$ \operatorname{heap}.\mathbf{class} \ \mathrm{WHPrang} \in \mathbb{R}^{n})
M1))
\rightarrow [simplify]
[7.2] (0 < this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1) \&\&
(this.r.value(heapIs \ heap_{funcstart \ 1032.1}).p1 <
asType < integer > (\text{heap.class WHPrang} \in M1))
\rightarrow [const static or extern object]
[7.3] (0 < this.$r.value(heap
Is \rho_{funcstart\_1032,1}).p1) &&
(this.r.value(heapIs $heap_{funcstart\_1032,1}).p1 <
asType < integer > (\$heap_{init}.class WHPrang \in M1))
```

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\rightarrow [expand definition of constant 'M1' at prang.cpp (28,26)]
[7.4] (0 < this.\$r.value(heapIs \$heap_{funcstart\_1032.1}).p1) &&
(this.$r.value(heapIs \theta_{funcstart\_1032,1}).p1 <
asType < integer > ((int)30269))
\rightarrow [simplify]
[7.10] (-30269 < -this.$r.value(heap
Is $heap_{funcstart\_1032,1}).p1) \wedge (0 <
this.r.value(heapIs $heap_{funcstart\_1032,1}).p1)
[Work on sub-term 2 of conjunction in term 7.10]
[8.0] 0 < this.$r.value(heap
Is \rho_{funcstart\_1032,1}).p1
[Work on sub-term 2 of conjunction in term 1.6]
[17.0] 0 == div(heapIs \rho_{funcstart\_1032,1}, his.\r.value(heapIs
heap_{funcstart\_1032,1}.p1, 177).rem
[Take given term]
[15.0] (asType<integer>(operator*(heapIs $heap_{funcstart\_1032,1}, this).p1)
< asType<integer>($heap_{funcstart\_1032,1}.a1)) =>
(asType<integer>(div1.rem) == asType<integer>(operator*(heapIs
heap_{funcstart\_1032,1}, this).p1)
→ [expand definition of operator '*' in class 'pointer' at built in declaration]
[15.1] (asType<integer>(this.$r.value(heapIs $heap_{tuncstart\_1032.1}).p1) <
asType < integer > (\$heap_{funcstart\_1032,1}.a1)) = >
(asType<integer>(div1.rem) == asType<integer>(operator*(heapIs
heap_{funcstart\_1032,1}, this).p1)
\rightarrow [simplify]
[15.2] (this.$r.value(heapIs \rho_{tuncstart\_1032.1}).p1 <
asType < integer > (\$heap_{funcstart\_1032,1}.a1)) = >
(asType<integer>(div1.rem) == asType<integer>(operator*(heapIs
heap_{funcstart\_1032,1}, this).p1)
\rightarrow [const static or extern object]
[15.3] (this.r.value(heapIs $heap_{funcstart\_1032,1}).p1 <
asType<integer>($heap_{init}.a1)) => (asType<integer>(div1.rem) ==
\mathbf{asType} < \mathbf{integer} > (\mathbf{operator}^*(\mathbf{heapIs} \ \$ \mathbf{heap}_{funcstart\_1032,1}, \ \mathbf{this}).\mathtt{p1}))
\rightarrow [expand definition of constant 'a1' at prang.cpp (30,26)]
[15.4] (this.$r.value(heap
Is \rho_{funcstart\_1032,1}).p1 <
asType < integer > ((int)177)) => (asType < integer > (div1.rem) ==
asType<integer>(operator*(heapIs $heap_{tuncstart\_1032.1}, this).p1))
\rightarrow [simplify]
[15.9] (-177 < -this.$r.value(heap
Is \rho_{funcstart\_1032,1}).p1) =>
(asType<integer>(div1.rem) == asType<integer>(operator*(heapIs
```

```
heap_{funcstart_1032,1}, this).p1)
\rightarrow [from term 2.6, div1 is equal to div(heapIs $heap_{funcstart\_1032,1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177)
[15.10] (-177 < -this.$r.value(heapIs \rho_{funcstart\_1032,1}).p1) =>
(\mathbf{asType} < \mathbf{integer} > (\mathbf{div}(\mathbf{heapIs} \ \$ \mathbf{heap}_{funcstart\_1032,1}, \ \mathbf{this}.\$ \mathbf{r.value}(\mathbf{heapIs} \ \mathsf{heap}_{funcstart\_1032,1}, \ \mathbf{this}.\$ \mathbf{r.value}(\mathbf{heapIs}))
heap_{funcstart_1032.1}.p1, 177).rem = =
\mathbf{asType} < \mathbf{integer} > (\mathbf{operator}^*(\mathbf{heapIs} \ \$ \mathbf{heap}_{funcstart\_1032,1}, \ \mathbf{this}).\mathtt{p1}))
\rightarrow [simplify]
[15.11] (-177 < -this.$r.value(heapIs \rho_{funcstart\_1032,1}).p1) =>
(\text{div}(\mathbf{heapIs} \$ \text{heap}_{funcstart\_1032,1}, \mathbf{this}.\$ r. \mathbf{value}(\mathbf{heapIs}))
heap_{funcstart=1032.1}).p1, 177).rem ==
\mathbf{asType} {<} \mathbf{integer} {>} (\mathbf{operator}^*(\mathbf{heapIs} \ \$ \mathbf{heap}_{funcstart\_1032,1}, \ \mathbf{this}).\mathtt{p1}))
→ [expand definition of operator '*' in class 'pointer' at built in declaration]
[15.12] (-177 < -this.$r.value(heapIs \rho_{funcstart\_1032,1}).p1) =>
(\text{div}(\mathbf{heapIs} \$ \text{heap}_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}))
heap_{funcstart_1032,1}.p1, 177).rem ==
asType < integer > (this. r.value(heapIs  heap_{funcstart\_1032,1}).p1))
\rightarrow [simplify]
[15.18] (0 == (-this.\$r.value(heapIs \$heap_{funcstart\_1032,1}).p1 + div(heapIs)
\rho_{funcstart\_1032,1}, this. r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).rem)) \vee (176 < this.$r.value(heapIs $heap_{funcstart\_1032,1}).p1)
\rightarrow [from term 17.0, div(heapIs $heap_{funcstart\_1032,1}$, this.$r.value(heapIs)
heap_{funcstart\_1032,1}.p1, 177).rem is equal to 0
[15.19] (0 == (-this.$r.value(heapIs $heap_{tuncstart\_1032.1}).p1 + 0)) \vee (176
< \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}~\$heap_{funcstart\_1032,1}).p1)
[15.20] (0 == -\text{this.}\$r.\text{value}(\text{heapIs} \$\text{heap}_{funcstart\_1032,1}).\text{p1}) \lor (176 <
this.r.value(heapIs $heap_{funcstart\_1032,1}).p1)
\rightarrow [from term 8.0, -this.$r.value(heapIs $heap_{funcstart\_1032,1}).p1 ==
literala is false whenever -1 < (0 + literala)
    Proof of rule precondition:
    [15.20.0] -1 < (0 + 0)
    \rightarrow [simplify]
    [15.20.2] true
[15.21] false \vee (176 < this.$r.value(heapIs $heap_{funcstart\_1032,1}).p1)
\rightarrow [simplify]
[15.22] 176 < this.$r.value(heapIs heap_{funcstart\_1032,1}).p1
```

```
[Take given term]
[16.0] (asType<integer>(heap_{funcstart\_1032,1}.a1) \leq
\mathbf{asType} < \mathbf{integer} > (\mathbf{operator}^*(\mathbf{heapIs} \ \$ \mathbf{heap}_{funcstart\_1032,1}, \ \mathbf{this}).\mathtt{p1})) = >
!(0 == asType < integer > (div1.quot))
\rightarrow [const static or extern object]
[16.1] (asType<integer>(\text{$heap}_{init}.a1) \leq
asType < integer > (operator*(heapIs $heap_{funcstart\_1032,1}, this).p1)) = >
!(0 == asType < integer > (div1.quot))
\rightarrow [expand definition of constant 'a1' at prang.cpp (30,26)]
[16.2] (asType<integer>((int)177) \leq
asType<integer>(operator*(heapIs $heap_{funcstart\_1032,1}, this).p1)) =>
!(0 == asType < integer > (div1.quot))
\rightarrow [simplify]
[16.4] (177 \leq asType<integer>(operator*(heapIs $heap<sub>funcstart_1032,1</sub>,
this).p1)) => !(0 == asType < integer > (div1.quot))
→ [expand definition of operator '*' in class 'pointer' at built in declaration]
[16.5] (177 \leq asType\leqinteger>(this.r.value(heapIs)
\text{Sheap}_{funcstart\_1032,1}).\text{p1}) => !(0 == asType < integer > (div1.quot))
\rightarrow [simplify]
[16.8] (176 < this.$r.value(heapIs $heap_{funcstart\_1032,1}).p1) => !(0 ==
asType<integer>(div1.quot))
\rightarrow [from term 2.6, div1 is equal to div(heapIs $heap_{funcstart\_1032,1},
this.r.value(heapIs \ heap_{funcstart\_1032.1}).p1, 177)
[16.9] (176 < this.$r.value(heapIs $heap_{funcstart\_1032,1}).p1) => !(0 ==
asType<integer>(div(heapIs $heap_{funcstart\_1032,1}, this.$r.value(heapIs
heap_{funcstart_{-1032,1}}.p1, 177).quot)
\rightarrow [simplify]
[16.13]!(0 == div(\mathbf{heapIs} \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})]
\theta_{funcstart\_1032,1}.p1, 177).quot) \vee (-177 < -this.\frac{1}{2}r.value(heapIs)
heap_{funcstart\_1032,1}.p1
\rightarrow [from term 15.22, literala < -this.$r.value(heapIs
heap_{funcstart\_1032,1}).p1 is false whenever -2 < (176 + literala)]
   Proof of rule precondition:
   [16.13.0] - 2 < (-177 + 176)
   \rightarrow [simplify]
   [16.13.2] true
[16.14] false \vee !(0 == div(heapIs $heap_{funcstart\_1032,1}, this.$r.value(heapIs)
```

```
heap_{funcstart_{-1032,1}}.p1, 177).quot
\rightarrow [from term 1.7, div(heapIs $heap_{funcstart\_1032.1}, this.$r.value(heapIs)]
heap_{funcstart\_1032,1}.p1, 177).quot is equal to 0
[16.15] false \vee !(0 == 0)
\rightarrow [simplify]
[16.18] false
Proof of verification condition: Precondition of 'div' satisfied
In the context of class: WHPrang, declared at:
C:\Escher\Customers\prang-cpp\prang.cpp (18,1)
Condition generated at: C:\Escher\Customers\prang-cpp\prang.cpp
(64,18)
Condition defined at: C:\Escher\ecv\standard\stdlib.h (94,10)
To prove: 0 <
asType < integer > (static\_cast < int > (\$heap_{funcstart\_1032,1}.a2))
Given:
heap_{init}.LIMIT == (int)80
heap_{init}.class WHPrang \in M1 == (int)30269
heap_{init}.class WHPrang \in r1 == (int)171
heap_{init}.class WHPrang \in a1 == (int)177
heap_{init}.class WHPrang \in b1 == (int)2
\text{$heap}_{init}.\mathbf{class} \text{ WHPrang} \in M2 == (\mathbf{int})30307
heap_{init}.class WHPrang \in r2 == (int)172
heap_{init}.class WHPrang \in a2 == (int)176
heap_{init}.class WHPrang \in b2 == (int)35
heap_{init}.class WHPrang \in M3 == (int)30323
heap_{init}.class WHPrang \in r3 == (int)170
heap_{init}.class WHPrang \in a3 == (int)178
heap_{init}.class WHPrang \in b3 == (int)63
\operatorname{div1} == \operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_1032,1},
\mathbf{static\_cast} < \mathbf{int} > (\mathbf{operator}^*(\mathbf{heapIs}\ \$ \mathbf{heap}_{funcstart\_1032,1},\ \mathbf{this}).\mathtt{p1}),
\mathbf{static\_cast} < \mathbf{int} > (\$ \mathbf{heap}_{funcstart\_1032,1}.\mathbf{a1}))
(\mathbf{asType} {<} \mathbf{integer} {>} (\mathbf{static\_cast} {<} \mathbf{int} {>} (\mathbf{operator}^* (\mathbf{heapIs}
heap_{funcstart\_1032,1}, this).p1)
asType<integer>(static_cast<int>($heap_{tuncstart\_1032.1}.a1))) ==
```

```
asType<integer>(div1.quot)
(asType<integer>(static_cast<int>(operator*(heapIs
heap_{funcstart\_1032,1}, this).p1) %
asType < integer > (static\_cast < int > (\$heap_{funcstart\_1032.1}.a1))) = =
asType<integer>(div1.rem)
(asType < integer > (operator*(heapIs $heap_{funcstart\_1032,1}, this).p1) < footnote{the content of the conte
\mathbf{asType} {<} \mathbf{integer} {>} (\$ \mathbf{heap}_{funcstart\_1032,1}.\mathbf{a1})) = {>}
(asType<integer>(div1.rem) == asType<integer>(operator*(heapIs
heap_{funcstart\_1032,1}, this).p1)
(\mathbf{asType} < \mathbf{integer} > (\$ \mathbf{heap}_{funcstart\_1032,1}.\mathbf{a1}) \le
asType < integer > (operator^*(heapIs \$heap_{funcstart\_1032,1}, this).p1)) = >
!(0 == asType < integer > (div1.quot))
!(0 == asType < integer > (div1.rem)) || !(0 ==
asType<integer>(div1.quot))
Proof:
[Take goal term]
[1.0] 0 < asType<integer>(static_cast<int>($heap_{funcstart\_1032,1}.a2))
\rightarrow [const static or extern object]
[1.1] 0 < asType < integer > (static_cast < int > ($heap_{init}.a2))
\rightarrow [expand definition of constant 'a2' at prang.cpp (35,26)]
[1.2] 0 < asType<integer>(static_cast<int>((int)176))
\rightarrow [simplify]
[1.6] true
Proof of verification condition: Assertion valid
In the context of class: WHPrang, declared at:
C:\Escher\Customers\prang-cpp\prang.cpp (18,1)
Condition generated at: C:\Escher\Customers\prang-cpp\prang.cpp
(65,48)
To prove: (asType<integer>(heap_{funcstart\_1032,1}.a2) \leq
asType < integer > (operator*(heapIs $heap_{funcstart\_1032.1}, this).p2)) =>
!(0 == asType < integer > (div2.quot))
Given:
heap_{init}.LIMIT == (int)80
heap_{init}.class WHPrang \in M1 == (int)30269
heap_{init}.class WHPrang \in r1 == (int)171
```

```
heap_{init}.class WHPrang \in a1 == (int)177
heap_{init}.class WHPrang \in b1 == (int)2
\text{$heap}_{init}.\mathbf{class} \text{ WHPrang} \in M2 == (\mathbf{int})30307
heap_{init}.class WHPrang \in r2 == (int)172
heap_{init}.class WHPrang \in a2 == (int)176
heap_{init}.class WHPrang \in b2 == (int)35
heap_{init}.class WHPrang \in M3 == (int)30323
heap_{init}.class WHPrang \in r3 == (int)170
heap_{init}.class WHPrang \in a3 == (int)178
heap_{init}.class WHPrang \in b3 == (int)63
div1 == div(\mathbf{heapIs} \$heap_{funcstart\_1032,1},
static\_cast < int > (operator*(heapIs $heap_{funcstart\_1032,1}, this).p1),
static\_cast < int > (\$heap_{funcstart\_1032,1}.a1))
(asType<integer>(static_cast<int>(operator*(heapIs
heap_{funcstart\_1032,1}, this).p1) /
\mathbf{asType} < \mathbf{integer} > (\mathbf{static\_cast} < \mathbf{int} > (\$ \operatorname{heap}_{funcstart\_1032,1}.a1))) = =
asType<integer>(div1.quot)
(\mathbf{asType} {<} \mathbf{integer} {>} (\mathbf{static\_cast} {<} \mathbf{int} {>} (\mathbf{operator}^* (\mathbf{heapIs}
heap_{funcstart\_1032,1}, this).p1) %
asType < integer > (static\_cast < int > (\$heap_{funcstart\_1032,1}.a1))) = =
asType<integer>(div1.rem)
(\mathbf{asType}{<}\mathbf{integer}{>}(\mathbf{operator}^*(\mathbf{heapIs}\ \$\mathbf{heap}_{funcstart\_1032,1},\ \mathbf{this}).\mathtt{p1}) <
asType < integer > (\$heap_{funcstart\_1032.1}.a1)) = >
(asType<integer>(div1.rem) == asType<integer>(operator*(heapIs
heap_{funcstart\_1032,1}, this).p1)
(\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathsf{heap}_{funcstart\_1032,1}.\mathsf{a1}) \leq
\mathbf{asType} < \mathbf{integer} > (\mathbf{operator}^*(\mathbf{heapIs} \ \$ \mathbf{heap}_{funcstart\_1032,1}, \ \mathbf{this}).\mathtt{p1})) = >
!(0 == asType < integer > (div1.quot))
!(0 == asType < integer > (div1.rem)) || !(0 ==
asType<integer>(div1.quot))
div2 == div(\mathbf{heapIs} \$heap_{funcstart\_1032,1},
\mathbf{static\_cast} {<} \mathbf{int} {>} (\mathbf{operator*}(\mathbf{heapIs}\ \$ \mathbf{heap}_{funcstart\_1032,1},\ \mathbf{this}).\mathbf{p2}),
\mathbf{static\_cast} < \mathbf{int} > (\$ \mathbf{heap}_{funcstart\_1032,1}.\mathbf{a2}))
(asType<integer>(static_cast<int>(operator*(heapIs
heap_{funcstart\_1032,1}, this).p2)
\mathbf{asType} {<} \mathbf{integer} {>} (\mathbf{static\_cast} {<} \mathbf{int} {>} (\$ \mathbf{heap}_{funcstart\_1032,1}.\mathbf{a2}))) = =
asType<integer>(div2.quot)
(asType<integer>(static_cast<int>(operator*(heapIs
```

```
\theta_{funcstart_{1032,1}}, this).p2))
asType < integer > (static\_cast < int > (\$heap_{funcstart\_1032.1}.a2))) = =
asType<integer>(div2.rem)
(\mathbf{asType}{<}\mathbf{integer}{>}(\mathbf{operator}^*(\mathbf{heapIs}\ \$\mathbf{heap}_{funcstart\_1032,1},\ \mathbf{this}).\mathtt{p2}) <
asType < integer > (\$heap_{funcstart\_1032,1}.a2)) = >
(asType<integer>(div2.rem) == asType<integer>(operator*(heapIs
heap_{funcstart\_1032,1}, this).p2)
Proof:
[Take given term]
[18.0] \operatorname{div2} == \operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_1032,1},
static_cast<int>(operator*(heapIs $heap_{tuncstart\_1032.1}, this).p2),
\mathbf{static\_cast} {<} \mathbf{int} {>} (\$ \mathbf{heap}_{funcstart\_1032,1}.\mathbf{a2}))
→ [expand definition of operator '*' in class 'pointer' at built in declaration]
[18.1] \operatorname{div2} == \operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_1032,1},
static\_cast < int > (this. r.value(heapIs $heap_{funcstart\_1032,1}).p2),
\mathbf{static\_cast}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_1032,1}.\mathrm{a2}))
\rightarrow [simplify]
[18.2] \operatorname{div2} == \operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_1032,1}, \ \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
\theta_{funcstart\_1032,1}.p2, \theta_{funcstart\_1032,1}.p2, \theta_{funcstart\_1032,1}.a2))
\rightarrow [const static or extern object]
[18.3] \text{div2} == \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.} \text{\$r.value}(\text{heapIs})
\$heap_{funcstart\_1032,1}).p2,\, \textbf{static\_cast} < \textbf{int} > (\$heap_{init}.a2))
\rightarrow [expand definition of constant 'a2' at prang.cpp (35,26)]
[18.4] div2 == div(\mathbf{heapIs} \ \hat{\mathbf{s}}_{heap}), \mathbf{this.} \cdot \mathbf{r.value}(\mathbf{heapIs})
\theta_{funcstart\_1032,1}.p2, \theta_{funcstart\_1032,1}.p2, \theta_{funcstart\_1032,1}.p2, \theta_{funcstart\_1032,1}.p2
\rightarrow [simplify]
[18.6] div2 == div(\mathbf{heapIs} \$ \mathbf{heap}_{funcstart\_1032,1}, \mathbf{this}.\$ \mathbf{r.value}(\mathbf{heapIs})
heap_{funcstart_{-1032,1}}.p2, 176)
[Take goal term]
[1.0] (asType<integer>(sheap_{funcstart\_1032,1}.a2) \leq
\mathbf{asType}{<}\mathbf{integer}{>}(\mathbf{operator}^*(\mathbf{heapIs}~\$\mathbf{heap}_{funcstart\_1032,1},~\mathbf{this}).\mathbf{p2})) =>
!(0 == asType < integer > (div2.quot))
\rightarrow [const static or extern object]
[1.1] (asType<integer>(heap_{init}.a2) \leq
\mathbf{asType}{<}\mathbf{integer}{>}(\mathbf{operator}^*(\mathbf{heapIs}~\$\mathbf{heap}_{funcstart\_1032,1},~\mathbf{this}).\mathbf{p2})) =>
!(0 == asType < integer > (div2.quot))
\rightarrow [expand definition of constant 'a2' at prang.cpp (35,26)]
```

```
[1.2] (asType<integer>((int)176) < asType<integer>(operator*(heapIs
\text{Sheap}_{funcstart\_1032,1}, \text{this}).p2)) => !(0 == asType < integer > (div2.quot))
\rightarrow [simplify]
[1.4] (176 \le asType < integer > (operator^*(heapIs \$heap_{funcstart\_1032,1},
this).p2)) => !(0 == asType < integer > (div2.quot))
→ [expand definition of operator '*' in class 'pointer' at built in declaration]
[1.5] (176 \leq asType<integer>(this.$r.value(heapIs
heap_{funcstart\_1032.1}(p2) = 10 = asType < integer > (div2.quot)
\rightarrow [simplify]
[1.8] (175 < this.$r.value(heapIs $heap_{tuncstart\_1032,1}).p2) => !(0 ==
asType<integer>(div2.quot))
\rightarrow [from term 18.6, div2 is equal to div(heapIs $heap_{funcstart\_1032,1},
this.$r.value(heapIs $heap_{funcstart\_1032,1}).p2, 176)]
[1.9] (175 < this.$r.value(heapIs $heap_{funcstart\_1032,1}).p2) => !(0 ==
asType<integer>(div(heapIs $heap_{tuncstart\_1032.1}, this.$r.value(heapIs
heap_{funcstart_{1032,1}}.p2, 176).quot)
\rightarrow [simplify]
[1.13]!(0 == div(\mathbf{heapIs} \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}))
\theta_{funcstart\_1032,1}.p2, 176).quot) \vee (-176 < -this.\frac{r.value(heapIs)}{}
heap_{funcstart\_1032,1}.p2
\rightarrow [negate goal and search for contradiction]
[1.14] (0 == div(heapIs $heap<sub>funcstart_1032,1</sub>, this.$r.value(heapIs)
\rho_{funcstart\_1032,1}.p2, 176.quot) \wedge !(-176 < -this.r.value(heapIs)
heap_{funcstart_{-1032,1}}.p2
\rightarrow [simplify]
[1.17] (0 == \operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_1032,1}, \ \mathbf{this}.\$ r. \mathbf{value}(\mathbf{heapIs})
\rho_{funcstart\_1032,1}.p2, 176.quot) \wedge (175 < this. r.value(heapIs)
heap_{funcstart_1032,1}.p2
\rightarrow [separate conjunction and work on first sub-term]
[1.18] 0 == div(heapIs $heap<sub>funcstart_1032,1</sub>, this.$r.value(heapIs)
heap_{funcstart\_1032,1}.p2, 176).quot
[Assume known post-assertion, class invariant or type constraint for term 18.6]
[23.0] (0 < asType<integer>(this.$r.value(heapIs
\label{eq:continuous} $\operatorname{heap}_{funcstart\_1032,1}).p2)) \&\& (\mathbf{asType}{<}\mathbf{integer}{>} (\mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})) \&\& (\mathbf{asType}{<}\mathbf{integer}{>} (\mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}))) \&\& (\mathbf{asType}{<}\mathbf{integer}{>} (\mathbf{heapIs})) \&\& (\mathbf{asType}{<}\mathbf{
\rho_{funcstart\_1032,1}.p2 < asType<integer>(\rho_{funcstart\_1032,1}.p2) < asType<integer>(\rho_{funcstart\_1032,1}.p2)
M2))
\rightarrow [simplify]
```

```
[23.2] (0 < this.$r.value(heapIs $heap_{funcstart\_1032,1}).p2) &&
(this.r.value(heapIs \ heap_{funcstart\_1032,1}).p2 <
asType < integer > (\$heap.class WHPrang \in M2))
\rightarrow [const static or extern object]
[23.3] (0 < this.r.value(heapIs \ heap_{funcstart\_1032,1}).p2) \&\&
(this.r.value(heapIs $heap_{funcstart\_1032.1}).p2 <
asType < integer > (\$heap_{init}.class WHPrang \in M2))
\rightarrow [expand definition of constant 'M2' at prang.cpp (33,26)]
[23.4] (0 < this.$r.value(heap
Is $heap_{funcstart\_1032,1}).p2) &&
(this.$r.value(heapIs heap_{funcstart\_1032,1}).p2 <
asType < integer > ((int)30307))
\rightarrow [simplify]
[23.10] (-30307 < -this.$r.value(heapIs $heap_{funcstart\_1032.1}).p2) \land (0 <
this.$r.value(heapIs $heap_{funcstart_1032.1}).p2)
[Work on sub-term 2 of conjunction in term 23.10]
[24.0] 0 < this.$r.value(heap
Is $heap_{funcstart\_1032,1}).p2
[Assume known post-assertion, class invariant or type constraint for term 18.6]
[25.0] (asType<integer>(this.$r.value(heapIs $heap_{funcstart\_1032,1}).p2) /
asType<integer>(176)) == asType<integer>(div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p2,
176).quot)
\rightarrow [simplify]
[25.2] (this.$r.value(heapIs \theta_{funcstart\_1032,1}).p2 / 176) ==
asType<integer>(div(heapIs $heap_{tuncstart\_1032,1}, this.$r.value(heapIs
heap_{funcstart_{1032,1}}.p2, 176).quot
→ [expand definition of operator './' in class 'int' at built in declaration]
[25.3] ([asType<integer>(this.$r.value(heapIs $heap_{funcstart\_1032,1}).p2) <
0]: -(-asType < integer > (this. r.value(heapIs  heap_{funcstart\_1032.1}).p2) / 
176), []: asType<integer>(this.$r.value(heapIs $heap_{funcstart\_1032,1}).p2) /
176) == asType<integer>(div(heapIs heap_{funcstart\_1032,1}),
\mathbf{this.\$r.value}(\mathbf{heapIs}\ \$\mathbf{heap}_{funcstart\_1032,1}).\mathbf{p}2,\ 176).\mathbf{quot})
→ [explicitly assert falsehood of skipped guards in subsequent guards]
[25.4] \; ([\mathbf{asType} < \mathbf{integer} > (\mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs} \; \$ \mathbf{heap}_{funcstart\_1032,1}).\mathbf{p2}) < \mathbf{p25.4}) 
0]: -(-asType < integer > (this. r.value(heapIs $heap_{tuncstart\_1032,1}).p2) / (this. r.value(heapIs $heap_{tuncstart\_1032,1}).p2)
176), [!(asType<integer>(this.$r.value(heapIs \rho_{tancetart_1032,1}).p2) <
0): asType<integer>(this.$r.value(heapIs $heap_{funcstart\_1032.1}).p2) /
176) == asType<integer>(div(heapIs $heap_{tuncstart\_1032.1},
this.r.value(heapIs \ heap_{funcstart\_1032.1}).p2, 176).quot)
```

```
\rightarrow [simplify]
[25.7] ([0 < -this.$r.value(heapIs $heap<sub>funcstart_1032,1</sub>).p2]:
-(-asType < integer > (this. r.value(heapIs $heap_{funcstart\_1032,1}).p2) / 
176), [!(asType<integer>(this.$r.value(heapIs $heap_{funcstart\_1032,1}).p2) <  
0)]: asType < integer > (this. r.value(heapIs  heap_{funcstart\_1032,1}).p2) / 
176) == asType < integer > (div(heapIs $heap_{funcstart\_1032,1},
this.r.value(heapIs $heap_{funcstart\_1032,1}).p2, 176).quot)
\rightarrow [from term 24.0, literala < -this.$r.value(heapIs $heap_{funcstart\_1032,1}).p2
is false whenever -2 < (0 + literala)
    Proof of rule precondition:
    [25.7.0] - 2 < (0 + 0)
    \rightarrow [simplify]
    [25.7.2] true
[25.8] ([false]: -(-asType<integer>(this.$r.value(heapIs
$heap_funcstart_1032,1).p2) / 176), [!(asType<integer>(this.$r.value(heapIs
\{\text{heap}_{funcstart\_1032,1}\}.p2) < 0): asType<integer>(this.r.value(\text{heapIs})
\theta_{uncstart\_1032,1}.p2) / 176 = asType < integer > (div(heapIs))
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p2,
176).quot)
\rightarrow [simplify]
[25.11] ([false]: -(-asType<integer>(this.$r.value(heapIs
\rho_{funcstart_{1032,1}} p2) / 176, [!\rho_{funcstart_{1032,1}} p2] / 176, [!\rho_{funcstart_{1032,1}} p2]
\rho_{funcstart_1032,1}.p2: asType<integer>(this.$r.value(heapIs)
\theta_{funcstart\_1032,1}.p2) / 176) == asType<integer>(div(heapIs)
\rho_{funcstart_1032,1}, this.r.value(heapIs \rho_{funcstart_1032,1}).p2,
176).quot)
\rightarrow [from term 24.0, literala < -this.$r.value(heapIs $heap_{tuncstart\_1032.1}).p2
is false whenever -2 < (0 + literala)
    Proof of rule precondition:
    [25.11.0] - 2 < (0 + 0)
    \rightarrow [simplify]
    [25.11.2] true
[25.12] ([false]: -(-asType<integer>(this.$r.value(heapIs
heap_{funcstart\_1032,1}.p2) / 176, [!false]:
asType<integer>(this.$r.value(heapIs $heap_{funcstart\_1032.1}).p2) / 176)
== asType<integer>(div(heapIs $heap_{funcstart\_1032,1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p2, 176).quot)
\rightarrow [simplify]
```

```
[25.17] 0 == (-\text{div}(\mathbf{heapIs} \$ \text{heap}_{funcstart\_1032,1}, \mathbf{this}.\$ \mathbf{r.value}(\mathbf{heapIs}))
\theta_{funcstart\_1032,1}.p2, 176.quot + (this.r.value(heapIs)
heap_{funcstart_{1032,1}}.p2 / 176)
$heap_{funcstart\_1032,1}).p2, 176).quot is equal to 0]
[25.18] 0 == (-0 + (this.\$r.value(heapIs \$heap_{funcstart\_1032,1}).p2 / 176))
\rightarrow [simplify]
[25.20] 0 == (this.$r.value(heapIs $heap_{funcstart\_1032,1}).p2 / 176)
[Work on sub-term 2 of conjunction in term 1.17]
| 32.0| 175 < this.$r.value(heapIs \rho_{funcstart\_1032,1}).p2
[Create new term from term 25.20 using rule: condition for equality of division]
[36.0] ((0 * 176) < (1 + this.$r.value(heap
Is \rho_{uncstart\_1032,1}).p2)) <math display="inline">\land
(this.$r.value(heapIs p_{funcstart_1032,1}).p2 < (176 * (0 + 1)))
\rightarrow [simplify]
[36.3] (-1 < this.$r.value(heap
Is \rho_{uncstart\_1032,1}).p2) \land
(this.$r.value(heapIs heap_{funcstart\_1032,1}).p2 < (176 * (0 + 1)))
\rightarrow [from term 32.0, literala < this.$r.value(heapIs $heap_{tuncstart\_1032.1}).p2
is true whenever (-1 + literala) < 175
   Proof of rule precondition:
   [36.3.0](-1+-1)<175
   \rightarrow [simplify]
   [36.3.2] true
[36.4] true \land (this.$r.value(heapIs $heap_{funcstart\_1032,1}).p2 < (176 * (0 +
1)))
\rightarrow [simplify]
[36.9] true \land (-176 < -this.$r.value(heap
Is \rho_{funcstart\_1032,1}).p2)
\rightarrow [from term 32.0, literala < -this.$r.value(heapIs $heap_{funcstart\_1032,1}).p2
is false whenever -2 < (175 + literala)
   Proof of rule precondition:
   [36.9.0] - 2 < (-176 + 175)
   \rightarrow [simplify]
   [36.9.2] true
[36.10] true \wedge false
\rightarrow [simplify]
[36.11] false
```

```
Proof of verification condition: Assertion valid
In the context of class: WHPrang, declared at:
C:\Escher\Customers\prang-cpp\prang.cpp (18,1)
Condition generated at: C:\Escher\Customers\prang-cpp\prang.cpp
(65,20)
To prove: (asType<integer>(operator*(heapIs $heap_{funcstart\_1032,1},
\mathbf{this}).\mathtt{p2}) < \mathbf{asType} < \mathbf{integer} > (\$ \mathrm{heap}_{funcstart\_1032,1}.\mathrm{a2})) = >
(asType<integer>(div2.rem) == asType<integer>(operator*(heapIs
heap_{funcstart\_1032,1}, this).p2)
Given:
heap_{init}.LIMIT == (int)80
heap_{init}.class WHPrang \in M1 == (int)30269
heap_{init}.class WHPrang \in r1 == (int)171
heap_{init}.class WHPrang \in a1 == (int)177
heap_{init}.class WHPrang \in b1 == (int)2
heap_{init}.class WHPrang \in M2 == (int)30307
heap_{init}.class WHPrang \in r2 == (int)172
heap_{init}.class WHPrang \in a2 == (int)176
heap_{init}.class WHPrang \in b2 == (int)35
\text{$heap}_{init}.\mathbf{class} \text{ WHPrang} \in M3 == (\mathbf{int})30323
heap_{init}.class WHPrang \in r3 == (int)170
heap_{init}.class WHPrang \in a3 == (int)178
heap_{init}.class WHPrang \in b3 == (int)63
\operatorname{div1} == \operatorname{div}(\mathbf{heapIs} \ \operatorname{\$heap}_{funcstart\_1032,1},
static\_cast < int > (operator*(heapIs $heap_{funcstart\_1032,1}, this).p1),
\mathbf{static\_cast}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_1032,1}.\mathrm{a1}))
(asType < integer > (static\_cast < int > (operator*(heapIs)))
heap_{funcstart\_1032,1}, this).p1)
asType < integer > (static\_cast < int > (\$heap_{funcstart\_1032,1}.a1))) = =
asType<integer>(div1.quot)
(asType<integer>(static_cast<int>(operator*(heapIs
heap_{funcstart\_1032,1}, this).p1) %
asType < integer > (static\_cast < int > (\$heap_{funcstart\_1032.1}.a1))) = =
asType<integer>(div1.rem)
(\mathbf{asType}{<}\mathbf{integer}{>}(\mathbf{operator}^*(\mathbf{heapIs}\ \$\mathbf{heap}_{funcstart\_1032,1},\ \mathbf{this}).\mathbf{p1}) <
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathrm{heap}_{funcstart\_1032,1}.\mathrm{a1})) =>
(asType<integer>(div1.rem) == asType<integer>(operator*(heapIs
```

```
heap_{funcstart_1032,1}, this).p1)
(asType < integer > (\$heap_{funcstart\_1032,1}.a1) \le
asType<integer>(operator*(heapIs $heap_{funcstart\_1032,1}, this).p1)) =>
!(0 == asType < integer > (div1.quot))
!(0 == asType < integer > (div1.rem)) || !(0 ==
asType<integer>(div1.quot))
\operatorname{div2} == \operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_1032,1},
\mathbf{static\_cast} {<} \mathbf{int} {>} (\mathbf{operator}^*(\mathbf{heapIs}\ \$ \mathbf{heap}_{funcstart\_1032,1},\ \mathbf{this}).\mathbf{p2}),
\mathbf{static\_cast}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_1032,1}.\mathrm{a2}))
(asType < integer > (static\_cast < int > (operator*(heapIs)))
heap_{funcstart=1032.1}, this).p2) /
asType < integer > (static\_cast < int > (\$heap_{funcstart\_1032.1}.a2))) = =
asType<integer>(div2.quot)
(asType < integer > (static\_cast < int > (operator*(heapIs
heap_{funcstart\_1032.1}, this).p2)
asType < integer > (static\_cast < int > (\$heap_{funcstart\_1032.1}.a2))) = =
asType<integer>(div2.rem)
Proof:
[Take given term]
[18.0] \operatorname{div2} == \operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_1032,1},
static\_cast < int > (operator*(heapIs $heap_{funcstart\_1032,1}, this).p2),
static\_cast < int > (\$heap_{funcstart\_1032.1}.a2))
→ [expand definition of operator '*' in class 'pointer' at built in declaration]
[18.1] div2 == div(heapIs $heap_{tuncstart\_1032.1},
static\_cast < int > (this. r.value(heapIs $heap_{funcstart\_1032,1}).p2),
\mathbf{static\_cast} {<} \mathbf{int} {>} (\$ \mathbf{heap}_{funcstart\_1032,1}.\mathbf{a2}))
\rightarrow [simplify]
[18.2] div2 == div(\mathbf{heapIs} \$ \mathbf{heap}_{funcstart\_1032,1}, \mathbf{this}.\$ \mathbf{r.value}(\mathbf{heapIs})
\theta_{funcstart\_1032,1}.p2, \theta_{funcstart\_1032,1}.p2, \theta_{funcstart\_1032,1}.a2))
\rightarrow [const static or extern object]
[18.3] div2 == div(heapIs heapIs = funcstart_{1032,1}, this.r.value(heapIs)
\theta_{funcstart\_1032,1}.p2, \theta_{funcstart\_1032,1
\rightarrow [expand definition of constant 'a2' at prang.cpp (35,26)]
[18.4] \text{ div2} == \text{div}(\mathbf{heapIs} \$ \mathbf{heap}_{funcstart\_1032,1}, \mathbf{this.\$r.value}(\mathbf{heapIs}))
\theta_{funcstart\_1032,1}.p2, \theta_{funcstart\_1032,1}.p2, \theta_{funcstart\_1032,1}.p2, \theta_{funcstart\_1032,1}.p2
\rightarrow [simplify]
[18.6] \text{ div2} == \text{div}(\mathbf{heapIs} \$ \mathbf{heap}_{funcstart\_1032,1}, \mathbf{this.\$r.value}(\mathbf{heapIs}))
heap_{funcstart_{-1032,1}}.p2, 176
```

```
[Take goal term]
[1.0] (\mathbf{asType} < \mathbf{integer} > (\mathbf{operator}^*(\mathbf{heapIs} \ \$ \mathbf{heap}_{funcstart\_1032,1}, \ \mathbf{this}).p2)
< asType<integer>($heap<sub>funcstart_1032,1</sub>.a2)) =>
(asType<integer>(div2.rem) == asType<integer>(operator*(heapIs
heap_{funcstart\_1032.1}, this).p2)
→ [expand definition of operator '*' in class 'pointer' at built in declaration]
[1.1] \ (\mathbf{asType} < \mathbf{integer} > (\mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs} \ \$ \mathbf{heap}_{funcstart\_1032,1}).\mathbf{p2}) < \mathbf{p2}) < \mathbf{p3}
asType < integer > (\$heap_{funcstart\_1032,1}.a2)) = >
(asType<integer>(div2.rem) == asType<integer>(operator*(heapIs
heap_{funcstart\_1032,1}, this).p2)
\rightarrow [simplify]
[1.2] (this.$r.value(heapIs $heap_{funcstart\_1032,1}).p2 <
asType < integer > (\$heap_{funcstart\_1032,1}.a2)) = >
(asType<integer>(div2.rem) == asType<integer>(operator*(heapIs
heap_{funcstart\_1032,1}, this).p2)
\rightarrow [const static or extern object]
[1.3] (this.$r.value(heapIs \rho_{funcstart\_1032,1}).p2 <
asType<integer>($heap_{init}.a2)) => (asType<integer>(div2.rem) ==
asType<integer>(operator*(heapIs $heap_{funcstart\_1032.1}, this).p2))
\rightarrow [expand definition of constant 'a2' at prang.cpp (35,26)]
[1.4] (this.$r.value(heap
Is \rho_{uncstart\_1032,1}).p2 <
asType<integer>((int)176)) => (asType<integer>(div2.rem) ==
asType < integer > (operator*(heapIs $heap_{funcstart\_1032,1}, this).p2))
\rightarrow [simplify]
[1.9] (-176 < -this.$r.value(heapIs $heap_{funcstart\_1032,1}).p2) =>
(asType<integer>(div2.rem) == asType<integer>(operator*(heapIs
heap_{funcstart\_1032,1}, this).p2)
\rightarrow [from term 18.6, div2 is equal to div(heapIs $heap_{funcstart\_1032,1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p2, 176)]
[1.10] (-176 < -this.$r.value(heapIs heapIs = f_{uncstart\_1032,1}).p2) =>
(asType<integer>(div(heapIs $heap_{funcstart\_1032,1}, this.$r.value(heapIs)
heap_{funcstart\_1032,1}.p2, 176).rem = 
asType<integer>(operator*(heapIs $heap_{funcstart\_1032.1}, this).p2))
\rightarrow [simplify]
[1.11] (-176 < -this.$r.value(heapIs $heap_{funcstart\_1032,1}).p2) =>
(\text{div}(\mathbf{heapIs} \$ \text{heap}_{funcstart\_1032,1}, \mathbf{this}.\$ \text{r.value}(\mathbf{heapIs}))
heap_{funcstart\_1032,1}.p2, 176).rem ==
\mathbf{asType} {<} \mathbf{integer} {>} (\mathbf{operator}^*(\mathbf{heapIs}\ \$ \mathbf{heap}_{funcstart\_1032,1},\ \mathbf{this}).\mathtt{p2}))
→ [expand definition of operator '*' in class 'pointer' at built in declaration]
```

```
[1.12] (-176 < -this.$r.value(heapIs $heap_{funcstart_1032.1}).p2) =>
(\text{div}(\mathbf{heapIs} \$ \text{heap}_{funcstart\_1032,1}, \mathbf{this}.\$ \text{r.value}(\mathbf{heapIs}))
heap_{funcstart_1032,1}.p2, 176).rem ==
\mathbf{asType} < \mathbf{integer} > (\mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs} \$heap_{funcstart\_1032,1}).p2))
\rightarrow [simplify]
[1.18] (0 == (-\text{this.} \text{sr.value}(\text{heapIs} \text{sheap}_{funcstart\_1032,1}).\text{p2} + \text{div}(\text{heapIs})
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p2,
176).rem)) \vee (175 < this.$r.value(heapIs $heap_{funcstart\_1032,1}).p2)
\rightarrow [negate goal and search for contradiction]
[1.19] !(0 == (-this.$r.value(heapIs $heap_{funcstart\_1032,1}).p2 + div(heapIs
\rho_{tuncstart_1032.1}, this.r.value(heapIs \rho_{tuncstart_1032.1}).p2,
176).rem)) \land!(175 < this.$r.value(heapIs $heap_{tuncstart\_1032.1}).p2)
\rightarrow [simplify]
[1.21]!(0 == (-this.\$r.value(heapIs \$heap_{funcstart\_1032,1}).p2 + div(heapIs)
\rho_{funcstart\_1032,1}, this.\r.value(heapIs \rho_{funcstart\_1032,1}).p2,
176).rem)) \land (-176 < -this.$r.value(heapIs $heap_{funcstart\_1032,1}).p2)
\rightarrow [separate conjunction and work on first sub-term]
[1.22] -176 < -this.$r.value(heapIs \theta_{funcstart\_1032,1}).p2
[Assume known post-assertion, class invariant or type constraint for term 18.6]
[23.0] (0 < asType<integer>(this.$r.value(heapIs
\label{eq:continuous} $\operatorname{heap}_{funcstart\_1032,1}.p2)) \&\& (asType < integer > (this.\$r.value(heapIs)) \\
\label{eq:class} \$ heap_{funcstart\_1032,1}).p2) < \mathbf{asType} < \mathbf{integer} > (\$ heap.\mathbf{class} \ WHPrang \in \texttt{Constant} = \texttt{Consta
M2))
\rightarrow [simplify]
[23.2] (0 < this.$r.value(heap
Is \rho_{uncstart\_1032,1}).p2) &&
(this.r.value(heapIs $heap_{funcstart\_1032,1}).p2 <
asType < integer > (\$heap.class WHPrang \in M2))
\rightarrow [const static or extern object]
[23.3] (0 < this.$r.value(heap
Is \rho_{uncstart\_1032,1}).p2) &&
(this.r.value(heapIs $heap_{funcstart\_1032,1}).p2 <
asType < integer > (\$heap_{init}.class WHPrang \in M2))
\rightarrow [expand definition of constant 'M2' at prang.cpp (33,26)]
[23.4] (0 < this.$r.value(heapIs \theta_{tuncstart\_1032.1}).p2) &&
(this.$r.value(heapIs \theta_{funcstart\_1032,1}).p2 <
asType < integer > ((int)30307))
\rightarrow [simplify]
[23.10] (-30307 < -this.$r.value(heapIs $heap_{funcstart\_1032,1}).p2) \land (0 <
this.r.value(heapIs $heap_{funcstart\_1032,1}).p2)
```

```
[Work on sub-term 2 of conjunction in term 23.10]
[24.0] 0 < this.$r.value(heapIs \rho_{funcstart\_1032,1}).p2
[Assume known post-assertion, class invariant or type constraint for term 18.6]
[26.0] (as
Type<integer>(this.$r.value(heap
Is \rho_{uncstart\_1032,1}).p2) \%
asType<integer>(176)) == asType<integer>(div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p2,
176).rem)
\rightarrow [simplify]
[26.2] (this.$r.value(heapIs $heap_{funcstart\_1032,1}).p2 % 176) ==
\mathbf{asType}{<}\mathbf{integer}{>}(\text{div}(\mathbf{heapIs}\ \$\text{heap}_{funcstart\_1032,1},\ \mathbf{this.}\$r.\mathbf{value}(\mathbf{heapIs}
heap_{funcstart\_1032,1}.p2, 176).rem
→ [expand definition of operator '.%' in class 'int' at built in declaration]
[26.3] ([asType<integer>(this.$r.value(heapIs $heap_{funcstart\_1032.1}).p2) <
0]: -(-asType < integer > (this. r.value(heapIs  heap_{funcstart\_1032.1}).p2) %
176), ||: asType<integer>(this.$r.value(heapIs $heap_{funcstart\_1032,1}).p2)
\% 176) == asType<integer>(div(heapIs $heap_{funcstart\_1032,1},
this.r.value(heapIs $heap_{funcstart\_1032,1}).p2, 176).rem)
→ [explicitly assert falsehood of skipped guards in subsequent guards]
[26.4] \; ([\mathbf{asType} < \mathbf{integer} > (\mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs} \; \$ \mathbf{heap}_{funcstart\_1032,1}).\mathbf{p2}) < \mathbf{p2}) 
0]: -(-asType < integer > (this.\$r.value(heapIs \$heap_{funcstart\_1032,1}).p2) \%
176), [!(asType<integer>(this.$r.value(heapIs \rho_{tancstart\_1032,1}).p2) <
0)]: asType<integer>(this.r.value(heapIs $heap_{funcstart\_1032,1}).p2) %
176) == asType<integer>(div(heapIs $heap_{funcstart\_1032,1},)
this.r.value(heapIs $heap_{funcstart\_1032,1}).p2, 176).rem)
\rightarrow [simplify]
[26.7] ([0 < -this.$r.value(heapIs $heap_{funcstart\_1032,1}).p2]:
-(-asType < integer > (this. r.value(heapIs  heap_{funcstart\_1032,1}).p2) \%
176), [!(asType<integer>(this.$r.value(heapIs \rho_{tancetart\_1032,1}).p2) <
0)]: asType<integer>(this.$r.value(heapIs \rho_{tuncstart\_1032,1}).p2) %
176) == asType<integer>(div(heapIs heap_{funcstart\_1032,1},
this.r.value(heapIs $heap_{funcstart\_1032,1}).p2, 176).rem)
\rightarrow [from term 24.0, literala < -this.$r.value(heapIs $heap_{funcstart\_1032,1}).p2
is false whenever -2 < (0 + literala)
   Proof of rule precondition:
   [26.7.0] - 2 < (0 + 0)
   \rightarrow [simplify]
   [26.7.2] true
[26.8] ([false]: -(-asType<integer>(this.$r.value(heapIs
```

```
\label{eq:funcstart_1032,1} $$ \operatorname{heap}_{funcstart_1032,1}.$p2) \% 176), [!(asType < integer > (this.\$r.value(heapIs))] $$
\label{eq:funcstart_1032,1} $$ \operatorname{heap}_{funcstart_1032,1}).p2) < 0)$ ]: $$ \operatorname{asType}< \operatorname{integer}> ( \operatorname{this}. r.value( \operatorname{heapIs}) ).p2) < 0)$ ]: $$ \operatorname{heap}_{funcstart_1032,1}).p2) < 0.$ ] ]: $$ \operatorname{heap}_{funcstart_1032,1}).p3) < 0.$ ] ] ] ] ] 
\theta_{normalize} = \theta_{normalize
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p2,
176).rem)
\rightarrow [simplify]
[26.11] ([false]: -(-asType<integer>(this.$r.value(heapIs
\theta_{funcstart\_1032,1}.p2)% 176), [!(0 < -this.$r.value(heapIs
\rho_{uncstart\_1032.1}.p2): asType<integer>(this.$r.value(heapIs)
\theta_{funcstart\_1032,1}.p2) \% 176 = asType < integer > (div(heapIs))
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p2,
176).rem)
\rightarrow [from term 24.0, literala < -this.$r.value(heapIs $heap_{funcstart\_1032.1}).p2
is false whenever -2 < (0 + literala)
            Proof of rule precondition:
            [26.11.0] - 2 < (0 + 0)
            \rightarrow [simplify]
            [26.11.2] true
[26.12] ([false]: -(-asType<integer>(this.$r.value(heapIs
heap_{funcstart\_1032,1}.p2) \% 176, [!false]:
asType<integer>(this.r.value(heapIs $heap_{funcstart\_1032,1}).p2) \% 176)
== asType<integer>(div(heapIs $heap_{tuncstart_1032.1},
this.r.value(heapIs $heap_{funcstart\_1032,1}).p2, 176).rem)
\rightarrow [simplify]
[26.17] 0 == (-\text{div}(\mathbf{heapIs} \$ \text{heap}_{funcstart\_1032,1}, \mathbf{this}.\$ r.\mathbf{value}(\mathbf{heapIs}))
\theta_{funcstart\_1032,1}.p2, 176).rem + (this.r.value(heapIs)
heap_{funcstart_{1032,1}}.p2 \% 176)
[Work on sub-term 2 of conjunction in term 1.21]
[31.0]!(0 == (-this.\$r.value(heapIs \$heap_{funcstart\_1032,1}).p2 + div(heapIs)
\rho_{funcstart\_1032,1}, this. r.value(heapIs \rho_{funcstart\_1032,1}).p2,
176).rem))
[Copy term 31.0]
[35.0] ! (0 == (-\mathbf{this.\$r.value}(\mathbf{heapIs} \ \$ \mathbf{heap}_{funcstart\_1032,1}).\mathbf{p}2 + \mathbf{div}(\mathbf{heapIs} \ \mathbf{heapIs})] 
\rho_{funcstart\_1032,1}, this. r.value(heapIs \rho_{funcstart\_1032,1}).p2,
176).rem))
\rightarrow [from term 26.17, div(heapIs $heap_{funcstart\_1032,1}$, this.$r.value(heapIs)
$heap<sub>funcstart_1032,1</sub>).p2, 176).rem is equal to this.$r.value(heapIs
heap_{funcstart\_1032,1}).p2 \% 176
\label{eq:constant_1} \textit{[35.1] !} (0 == (-\textbf{this.}\$r.\textbf{value}(\textbf{heapIs} \ \$heap_{funcstart\_1032,1}).p2 + \\
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```
(this.$r.value(heapIs heap_{funcstart\_1032,1}).p2 % 176)))
\rightarrow [remainder with larger divisor]
   Proof of rule precondition 1:
   [35.1.0.0] literald < -this.$r.value(heapIs $heap_{funcstart\_1032,1}).p2
   \rightarrow [unify with term 1.22]
   [35.1.0.1] true
   Proof of rule precondition 2:
   [35.1.1.0] literalc < this.$r.value(heapIs $heap_{funcstart\_1032,1}).p2
   \rightarrow [unify with term 24.0]
   [35.1.1.1] true
   Proof of rule precondition 3:
   [35.1.2.0] --176 \le 176
   \rightarrow [simplify]
   [35.1.2.2] true
   Proof of rule precondition 4:
   [35.1.3.0] - 2 < 0
   \rightarrow [simplify]
   [35.1.3.1] true
[35.2]!(0 == (-this.\$r.value(heapIs \$heap_{funcstart\_1032,1}).p2 +
\mathbf{this.\$r.value}(\mathbf{heapIs}~\$ \mathrm{heap}_{funcstart\_1032,1}).\mathrm{p2}))
\rightarrow [simplify]
[35.5] false
Proof of verification condition: Assertion valid
In the context of class: WHPrang, declared at:
C:\Escher\Customers\prang-cpp\prang.cpp (18,1)
Condition generated at: C:\Escher\Customers\prang-cpp\prang.cpp
(66,26)
To prove: !(0 == asType < integer > (div2.rem)) || !(0 ==
asType<integer>(div2.quot))
Given:
heap_{init}.LIMIT == (int)80
heap_{init}.class WHPrang \in M1 == (int)30269
heap_{init}.class WHPrang \in r1 == (int)171
```

```
heap_{init}.class WHPrang \in a1 == (int)177
heap_{init}.class WHPrang \in b1 == (int)2
\text{$heap}_{init}.\mathbf{class} \text{ WHPrang} \in M2 == (\mathbf{int})30307
heap_{init}.class WHPrang \in r2 == (int)172
heap_{init}.class WHPrang \in a2 == (int)176
heap_{init}.class WHPrang \in b2 == (int)35
heap_{init}.class WHPrang \in M3 == (int)30323
heap_{init}.class WHPrang \in r3 == (int)170
heap_{init}.class WHPrang \in a3 == (int)178
heap_{init}.class WHPrang \in b3 == (int)63
div1 == div(\mathbf{heapIs} \$heap_{funcstart\_1032,1},
static\_cast < int > (operator*(heapIs $heap_{funcstart\_1032,1}, this).p1),
static\_cast < int > (\$heap_{funcstart\_1032,1}.a1))
(asType<integer>(static_cast<int>(operator*(heapIs
heap_{funcstart\_1032,1}, this).p1) /
\mathbf{asType} < \mathbf{integer} > (\mathbf{static\_cast} < \mathbf{int} > (\$ \operatorname{heap}_{funcstart\_1032,1}.a1))) = =
asType<integer>(div1.quot)
(\mathbf{asType} {<} \mathbf{integer} {>} (\mathbf{static\_cast} {<} \mathbf{int} {>} (\mathbf{operator}^* (\mathbf{heapIs}
heap_{funcstart\_1032,1}, this).p1) %
asType < integer > (static\_cast < int > (\$heap_{funcstart\_1032,1}.a1))) = =
asType<integer>(div1.rem)
(\mathbf{asType}{<}\mathbf{integer}{>}(\mathbf{operator}^*(\mathbf{heapIs}\ \$\mathbf{heap}_{funcstart\_1032,1},\ \mathbf{this}).\mathtt{p1}) <
asType < integer > (\$heap_{funcstart\_1032.1}.a1)) = >
(asType<integer>(div1.rem) == asType<integer>(operator*(heapIs
heap_{funcstart\_1032,1}, this).p1)
(\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathsf{heap}_{funcstart\_1032,1}.\mathsf{a1}) \leq
\mathbf{asType} < \mathbf{integer} > (\mathbf{operator}^*(\mathbf{heapIs} \ \$ \mathbf{heap}_{funcstart\_1032,1}, \ \mathbf{this}).\mathtt{p1})) = >
!(0 == asType < integer > (div1.quot))
!(0 == asType < integer > (div1.rem)) || !(0 ==
asType<integer>(div1.quot))
div2 == div(\mathbf{heapIs} \$heap_{funcstart\_1032,1},
\mathbf{static\_cast} {<} \mathbf{int} {>} (\mathbf{operator*}(\mathbf{heapIs}\ \$ \mathbf{heap}_{funcstart\_1032,1},\ \mathbf{this}).\mathbf{p2}),
\mathbf{static\_cast} < \mathbf{int} > (\$ \mathbf{heap}_{funcstart\_1032,1}.\mathbf{a2}))
(asType<integer>(static_cast<int>(operator*(heapIs
heap_{funcstart\_1032,1}, this).p2)
\mathbf{asType} \small{<} \mathbf{integer} \small{>} (\mathbf{static\_cast} \small{<} \mathbf{int} \small{>} (\$ \mathbf{heap}_{funcstart\_1032,1}.\mathbf{a2}))) = =
asType<integer>(div2.quot)
(asType<integer>(static_cast<int>(operator*(heapIs
```

```
\theta_{funcstart_{1032,1}}, this).p2))
asType < integer > (static\_cast < int > (\$heap_{funcstart\_1032,1}.a2))) = =
asType<integer>(div2.rem)
(\mathbf{asType}{<}\mathbf{integer}{>}(\mathbf{operator}^*(\mathbf{heapIs}\ \$\mathbf{heap}_{funcstart\_1032,1},\ \mathbf{this}).\mathtt{p2}) <
asType < integer > (\$heap_{funcstart\_1032,1}.a2)) = >
(asType<integer>(div2.rem) == asType<integer>(operator*(heapIs
heap_{funcstart\_1032,1}, this).p2)
(\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathsf{heap}_{funcstart\_1032,1}.\mathsf{a2}) \leq
\mathbf{asType} < \mathbf{integer} > (\mathbf{operator}^*(\mathbf{heapIs} \ \$ \mathbf{heap}_{funcstart\_1032,1}, \ \mathbf{this}).\mathtt{p2})) = >
!(0 == asType < integer > (div2.quot))
Proof:
[Take given term]
[18.0] \operatorname{div2} == \operatorname{div}(\mathbf{heapIs} \ \text{$heap}_{funcstart\_1032,1},
static\_cast < int > (operator*(heapIs $heap_{funcstart\_1032,1}, this).p2),
static\_cast < int > (\$heap_{funcstart\_1032,1}.a2))
→ [expand definition of operator '*' in class 'pointer' at built in declaration]
[18.1] \operatorname{div2} == \operatorname{div}(\mathbf{heapIs} \ \operatorname{heap}_{funcstart\_1032.1},
static\_cast < int > (this.\$r.value(heapIs \$heap_{funcstart\_1032,1}).p2),
static\_cast < int > (\$heap_{funcstart\_1032,1}.a2))
\rightarrow [simplify]
[18.2] \operatorname{div2} == \operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_1032,1}, \ \mathbf{this}. \text{\$r.value}(\mathbf{heapIs})
\theta_{funcstart\_1032,1}.p2, \theta_{funcstart\_1032,1}.p2, \theta_{funcstart\_1032,1}.a2))
\rightarrow [const static or extern object]
[18.3] div2 == div(heapIs \rho_{uncstart\_1032,1}, his.\r.value(heapIs
\theta_{funcstart\_1032,1}.p2, \theta_{funcstart\_1032,1
\rightarrow [expand definition of constant 'a2' at prang.cpp (35,26)]
[18.4] div2 == div(heapIs $heap<sub>funcstart_1032,1</sub>, this.$r.value(heapIs)
\theta_{funcstart\_1032,1}.p2, \theta_{funcstart\_1032,1
\rightarrow [simplify]
[18.6] div2 == div(heapIs heapIs heap_{funcstart\_1032,1}, this.r.value(heapIs)
heap_{funcstart_{-1032,1}}.p2, 176
[Take goal term]
[1.0]!(0 == asType < integer > (div2.rem)) || !(0 ==
asType<integer>(div2.quot))
\rightarrow [from term 18.6, div2 is equal to div(heapIs $heap_{funcstart\_1032,1},
this.r.value(heapIs $heap_{funcstart\_1032,1}).p2, 176)]
[1.1] !(0 == asType < integer > (div(heapIs $heap_{funcstart\_1032,1}, 
this.$r.value(heapIs heap_{funcstart\_1032,1}).p2, 176).rem)) || !(0 ==
```

```
asType<integer>(div2.quot))
\rightarrow [simplify]
[1.2]!(0 == \operatorname{div}(\mathbf{heapIs} \$ \mathbf{heap}_{funcstart\_1032,1}, \mathbf{this}.\$ \mathbf{r.value}(\mathbf{heapIs}))
\frac{\text{sheap}_{funcstart\_1032,1}.p2, 176).rem}{\parallel !(0 == asType < integer > (div2.quot))}
\rightarrow [from term 18.6, div2 is equal to div(heapIs $heap_{funcstart\_1032,1},
this.r.value(heapIs $heap_{funcstart\_1032,1}).p2, 176)
[1.3]!(0 == div(\mathbf{heapIs} \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}))
\rho_{tuncstart\_1032.1}.p2, 176).rem) || !(0 == asType < integer > (div(heapIs))
\rho_{tuncstart\_1032.1}, this.r.value(heapIs \rho_{tuncstart\_1032.1}).p2,
176).quot))
\rightarrow [simplify]
[1.5]!(0 == div(\mathbf{heapIs} \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}))
\text{Sheap}_{funcstart\_1032.1}.p2, 176).quot) \vee !(0 == \text{div}(\text{heapIs})
\rho_{tuncstart\_1032.1}, this.r.value(heapIs \rho_{tuncstart\_1032.1}).p2,
176).rem)
\rightarrow [negate goal and search for contradiction]
[1.6] (0 == \text{div}(\text{heapIs } \text{heap}_{funcstart\_1032,1}, \text{this.}\text{$\$r.value}(\text{heapIs}))
\text{Sheap}_{funcstart\_1032,1}.p2, 176).quot) \land (0 == div(heapIs \text{Sheap}_{funcstart\_1032,1},
this.r.value(heapIs $heap_{funcstart\_1032,1}).p2, 176).rem)
\rightarrow [separate conjunction and work on first sub-term]
[1.7] 0 == \operatorname{div}(\mathbf{heapIs} \ \mathbf{heap}_{funcstart\_1032,1}, \ \mathbf{this}.\mathbf{r.value}(\mathbf{heapIs})
heap_{funcstart\_1032,1}.p2, 176).quot
[Assume known post-assertion, class invariant or type constraint for term 18.6]
[23.0] (0 < asType<integer>(this.$r.value(heapIs
\verb§heap$_{funcstart\_1032,1}).p2)) \&\& (\mathbf{asType} < \mathbf{integer} > (\mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}))) \&\& (\mathbf{asType} < \mathbf{integer} > (\mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}))) \&\& (\mathbf{asType} < \mathbf{integer} > (\mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})))) \&\& (\mathbf{asType} < \mathbf{integer} > (\mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}))))) \&\& (\mathbf{asType} < \mathbf{integer} > (\mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}))))) \&\& (\mathbf{asType} < \mathbf{integer} > (\mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})))))
\rho_{tuncstart\_1032.1},p2) < asType<integer>(\rho_{tuncstart\_1032.1}).p2) < asType<integer>(\rho_{tuncstart\_1032.1}).p2)
M2))
\rightarrow [simplify]
[23.2] (0 < this.$r.value(heap
Is \rho_{uncstart\_1032,1}).p2) &&
(this.r.value(heapIs \ heap_{funcstart\_1032,1}).p2 <
asType < integer > (\text{$heap.class WHPrang} \in M2))
\rightarrow [const static or extern object]
[23.3] (0 < this.$r.value(heapIs $heap_{funcstart\_1032,1}).p2) &&
(this.$r.value(heapIs \rho_{funcstart\_1032,1}).p2 <
asType < integer > (\$heap_{init}.class WHPrang \in M2))
\rightarrow [expand definition of constant 'M2' at prang.cpp (33,26)]
[23.4] (0 < this.$r.value(heapIs heap_{funcstart\_1032,1}).p2) &&
(this.$r.value(heapIs \rho_{funcstart\_1032,1}).p2 <
```

```
asType < integer > ((int)30307))
\rightarrow [simplify]
this.r.value(heapIs $heap_{funcstart\_1032,1}).p2)
[Work on sub-term 2 of conjunction in term 23.10]
[24.0] 0 < this.$r.value(heapIs $heap_{funcstart\_1032,1}).p2
[Work on sub-term 2 of conjunction in term 1.6]
[33.0] 0 == div(heapIs heap_{funcstart\_1032,1}, this.$r.value(heapIs
heap_{funcstart_{1032,1}}.p2, 176).rem
[Take given term]
[31.0] (asType<integer>(operator*(heapIs heapIs heap_{funcstart\_1032,1}, this).p2)
<\mathbf{asType} < \mathbf{integer} > (\$ \mathrm{heap}_{funcstart\_1032,1}.\mathrm{a2})) = >
(asType<integer>(div2.rem) == asType<integer>(operator*(heapIs
heap_{funcstart\_1032,1}, this).p2)
→ [expand definition of operator '*' in class 'pointer' at built in declaration]
[31.1] \ (\mathbf{asType} < \mathbf{integer} > (\mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs} \ \$ \mathbf{heap}_{funcstart\_1032,1}).\mathbf{p2}) < \mathbf{p2}) < \mathbf{p31.1} 
asType < integer > (\$heap_{funcstart\_1032,1}.a2)) = >
(asType < integer > (div2.rem) == asType < integer > (operator*(heapIs))
heap_{funcstart\_1032,1}, this).p2)
\rightarrow [simplify]
[31.2] (this.$r.value(heapIs \theta_{funcstart\_1032,1}).p2 <
asType < integer > (\$heap_{funcstart\_1032,1}.a2)) = >
(asType<integer>(div2.rem) == asType<integer>(operator*(heapIs
heap_{funcstart_1032,1}, this.p2))
\rightarrow [const static or extern object]
[31.3] (this.$r.value(heap
Is \rho_{uncstart\_1032,1}).p2 <
asType < integer > (\$heap_{init}.a2)) = > (asType < integer > (div2.rem) = =
\mathbf{asType} < \mathbf{integer} > (\mathbf{operator}^*(\mathbf{heapIs} \ \$ \mathbf{heap}_{funcstart\_1032,1}, \ \mathbf{this}).\mathtt{p2}))
\rightarrow [expand definition of constant 'a2' at prang.cpp (35,26)]
[31.4] (this.$r.value(heapIs \theta_{funcstart\_1032,1}).p2 <
asType<integer>((int)176)) => (asType<integer>(div2.rem) ==
\mathbf{asType} \small{<} \mathbf{integer} \small{>} (\mathbf{operator}^*(\mathbf{heapIs} \ \$ \mathbf{heap}_{funcstart\_1032,1}, \ \mathbf{this}).\mathtt{p2}))
\rightarrow [simplify]
[31.9] (-176 < -this.$r.value(heapIs $heap<sub>funcstart_1032,1</sub>).p2) =>
(asType<integer>(div2.rem) == asType<integer>(operator*(heapIs
heap_{funcstart\_1032,1}, this).p2)
\rightarrow [from term 18.6, div2 is equal to div(heapIs $heap_{funcstart\_1032,1},
this.r.value(heapIs $heap_{funcstart\_1032,1}).p2, 176)
```

```
[31.10] (-176 < -this.$r.value(heapIs $heap_{funcstart\_1032,1}).p2) =>
(\mathbf{asType} < \mathbf{integer} > (\mathbf{div}(\mathbf{heapIs} \ \$ \mathbf{heap}_{funcstart\_1032,1}, \ \mathbf{this}.\$ \mathbf{r.value}(\mathbf{heapIs} \ \mathsf{heap}_{funcstart\_1032,1}, \ \mathbf{this}.\$ \mathbf{r.value}(\mathbf{heapIs} \ \mathsf{heap}_{funcstart\_1032,1}, \ \mathbf{this}.\$ \mathbf{r.value}(\mathbf{heapIs} \ \mathsf{heap}_{funcstart\_1032,1}, \ \mathbf{this}.\$ \mathbf{r.value}(\mathbf{heapIs}))
heap_{funcstart_1032,1}.p2, 176).rem = 
asType < integer > (operator*(heapIs $heap_{funcstart\_1032,1}, this).p2))
\rightarrow [simplify]
[31.11] (-176 < -this.$r.value(heapIs $heap_{funcstart_1032,1}).p2) =>
(\text{div}(\mathbf{heapIs} \$ \text{heap}_{funcstart\_1032,1}, \mathbf{this}.\$ \text{r.value}(\mathbf{heapIs}))
heap_{funcstart_1032,1}.p2, 176).rem ==
\mathbf{asType} < \mathbf{integer} > (\mathbf{operator}^*(\mathbf{heapIs} \ \$ \mathbf{heap}_{funcstart\_1032,1}, \ \mathbf{this}).\mathtt{p2}))
→ [expand definition of operator '*' in class 'pointer' at built in declaration]
[31.12] (-176 < -this.$r.value(heapIs $heap_{tuncstart\_1032.1}).p2) =>
(\text{div}(\mathbf{heapIs} \$ \text{heap}_{funcstart\_1032,1}, \mathbf{this}.\$ r. \mathbf{value}(\mathbf{heapIs}))
heap_{funcstart_1032,1}.p2, 176).rem ==
\mathbf{asType} < \mathbf{integer} > (\mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs} \$ heap_{funcstart\_1032,1}).p2))
\rightarrow [simplify]
[31.18] (0 == (-this.$r.value(heapIs heapIs $heap<sub>funcstart_1032,1</sub>).p2 + div(heapIs
\rho_{funcstart_1032,1}, this. r.value(heapIs \rho_{funcstart_1032,1}).p2,
176).rem)) \vee (175 < this.$r.value(heapIs $heap_{funcstart\_1032,1}).p2)
\rightarrow [from term 33.0, div(heapIs $heap_{funcstart\_1032,1}$, this.$r.value(heapIs)
heap_{funcstart_1032,1}.p2, 176).rem is equal to 0
[31.19] (0 == (-this.$r.value(heapIs $heap_{funcstart\_1032,1}).p2 + 0)) \vee (175
< this.r.value(heapIs $heap_{funcstart\_1032,1}).p2)
\rightarrow [simplify]
[31.20] (0 == -this.$r.value(heapIs $heap_{tuncstart\_1032.1}).p2) \vee (175 <
\mathbf{this.\$r.value}(\mathbf{heapIs}~\$\mathbf{heap}_{funcstart\_1032,1}).\mathbf{p2})
\rightarrow [from term 24.0, -this.$r.value(heapIs $heap_{funcstart\_1032,1}).p2 ==
literala is false whenever -1 < (0 + literala)
    Proof of rule precondition:
    [31.20.0] -1 < (0 + 0)
    \rightarrow [simplify]
    [31.20.2] true
[31.21] false \vee (175 < this.\$r.value(heapIs \$heap_{funcstart\_1032,1}).p2)
\rightarrow [simplify]
[31.22] 175 < this.\$r.value(heapIs \$heap_{funcstart_1032,1}).p2
[Take given term]
[32.0] (asType<integer>(heap_{funcstart\_1032,1}.a2) \leq
asType < integer > (operator^*(heapIs \$heap_{funcstart\_1032,1}, this).p2)) = >
```

```
!(0 == asType < integer > (div2.quot))
\rightarrow [const static or extern object]
[32.1] (asType<integer>($heap_{init}.a2) <
\mathbf{asType} < \mathbf{integer} > (\mathbf{operator}^*(\mathbf{heapIs} \ \$ \mathbf{heap}_{funcstart\_1032,1}, \ \mathbf{this}).\mathbf{p2})) = >
!(0 == asType < integer > (div2.quot))
\rightarrow [expand definition of constant 'a2' at prang.cpp (35,26)]
[32.2] (asType<integer>((int)176) \leq
asType < integer > (operator^*(heapIs \$heap_{funcstart\_1032,1}, this).p2)) = >
!(0 == asType < integer > (div2.quot))
\rightarrow [simplify]
[32.4] (176 \leq asType<integer>(operator*(heapIs $heap<sub>funcstart_1032,1</sub>,
this).p2)) => !(0 == asType < integer > (div2.quot))
→ [expand definition of operator '*' in class 'pointer' at built in declaration]
[32.5] (176 \le asType < integer > (this. r.value (heapIs))
heap_{funcstart\_1032,1}.p2) = !(0 = asType < integer > (div2.quot))
\rightarrow [simplify]
[32.8] (175 < this.$r.value(heapIs \rho_{funcstart\_1032,1}).p2) => !(0 ==
asType<integer>(div2.quot))
\rightarrow [from term 18.6, div2 is equal to div(heapIs $heap_{funcstart\_1032,1},
this.$r.value(heapIs $heap_{funcstart\_1032,1}).p2, 176)]
[32.9] (175 < this.$r.value(heapIs \rho_{funcstart\_1032,1}).p2) => !(0 ==
\mathbf{asType}{<}\mathbf{integer}{>}(\mathbf{div}(\mathbf{heapIs}\ \$\mathbf{heap}_{funcstart\_1032,1},\ \mathbf{this.}\$\mathbf{r.value}(\mathbf{heapIs}\ \mathbf{heapIs})
heap_{funcstart_1032,1}.p2, 176).quot)
\rightarrow [simplify]
[32.13]!(0 == div(\mathbf{heapIs} \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})]
\$heap_{funcstart\_1032,1}).p2,\ 176).quot) \lor (-176 < -\mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
heap_{funcstart\_1032,1}.p2
\rightarrow [from term 31.22, literala < -this.$r.value(heapIs
heap_{funcstart\_1032,1}.p2 is false whenever -2 < (175 + literala)
   Proof of rule precondition:
   [32.13.0] - 2 < (-176 + 175)
   \rightarrow [simplify]
   [32.13.2] true
[32.14] false \vee !(0 == div(heapIs \theta) $heap_{funcstart_1032,1}$, this.$r.value(heapIs)
heap_{funcstart_{1032,1}}.p2, 176).quot
\rightarrow [from term 1.7, div(heapIs $heap_{funcstart\_1032,1}$, this.$r.value(heapIs)
heap_{funcstart\_1032,1}.p2, 176).quot is equal to 0
```

```
[32.15] false \vee !(0 == 0)
\rightarrow [simplify]
[32.18] false
Proof of verification condition: Precondition of 'div' satisfied
In the context of class: WHPrang, declared at:
C:\Escher\Customers\prang-cpp\prang.cpp (18,1)
Condition generated at: C:\Escher\Customers\prang-cpp\prang.cpp
(68,18)
Condition defined at: C:\Escher\ecv\standard\stdlib.h (94,10)
To prove: 0 <
asType < integer > (static\_cast < int > (\$heap_{funcstart\_1032,1}.a3))
Given:
heap_{init}.LIMIT == (int)80
heap_{init}.class WHPrang \in M1 == (int)30269
heap_{init}.class WHPrang \in r1 == (int)171
\text{heap}_{init}.\mathbf{class} \text{ WHPrang } \in \text{a1} == (\mathbf{int})177
heap_{init}.class WHPrang \in b1 == (int)2
heap_{init}.class WHPrang \in M2 == (int)30307
heap_{init}.class WHPrang \in r2 == (int)172
heap_{init}.class WHPrang \in a2 == (int)176
heap_{init}.class WHPrang \in b2 == (int)35
heap_{init}.class WHPrang \in M3 == (int)30323
heap_{init}.class WHPrang \in r3 == (int)170
heap_{init}.class WHPrang \in a3 == (int)178
heap_{init}.class WHPrang \in b3 == (int)63
\operatorname{div1} == \operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_1032,1},
static_cast<int>(operator*(heapIs $heap_{funcstart\_1032.1}, this).p1),
\mathbf{static\_cast}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_1032,1}.\mathrm{a1}))
(asType < integer > (static\_cast < int > (operator^*(heapIs))) \\
heap_{funcstart\_1032,1}, this).p1) /
\mathbf{asType} < \mathbf{integer} > (\mathbf{static\_cast} < \mathbf{int} > (\$ \operatorname{heap}_{funcstart\_1032,1}.a1))) = =
asType<integer>(div1.quot)
(asType<integer>(static_cast<int>(operator*(heapIs
heap_{funcstart\_1032,1}, this).p1) %
asType < integer > (static\_cast < int > (\$heap_{funcstart\_1032.1}.a1))) = =
```

```
asType<integer>(div1.rem)
(asType<integer>(operator*(heapIs $heap_{funcstart\_1032,1}, this).p1) <
asType < integer > (\$heap_{funcstart\_1032,1}.a1)) = >
(asType<integer>(div1.rem) == asType<integer>(operator*(heapIs
heap_{funcstart\_1032.1}, this).p1)
(asType < integer > (\$heap_{funcstart\_1032,1}.a1) \le
asType < integer > (operator*(heapIs $heap_{funcstart\_1032,1}, this).p1)) = > funcstart\_1032,1, this)
!(0 == asType < integer > (div1.quot))
!(0 == \mathbf{asType} {<} \mathbf{integer} {>} (\mathrm{div1.rem})) \ || \ !(0 ==
asType<integer>(div1.quot))
div2 == div(\mathbf{heapIs} \$ heap_{funcstart\_1032.1},
\mathbf{static\_cast} < \mathbf{int} > (\mathbf{operator}^*(\mathbf{heapIs}\ \$ \mathbf{heap}_{funcstart\_1032,1},\ \mathbf{this}).\mathbf{p2}),
\mathbf{static\_cast} < \mathbf{int} > (\$ \mathbf{heap}_{funcstart\_1032,1}.\mathbf{a2}))
(asType<integer>(static_cast<int>(operator*(heapIs
heap_{funcstart\_1032.1}, this).p2)
asType < integer > (static\_cast < int > (\$heap_{funcstart\_1032.1}.a2))) = =
asType<integer>(div2.quot)
(asType<integer>(static_cast<int>(operator*(heapIs
heap_{funcstart\_1032,1}, this).p2) %
asType < integer > (static\_cast < int > (\$heap_{funcstart\_1032,1}.a2))) = =
asType<integer>(div2.rem)
(asType < integer > (operator*(heapIs $heap_{funcstart\_1032,1}, this).p2) < footnote{the content of the conte
asType < integer > (\$heap_{funcstart\_1032,1}.a2)) = >
(asType<integer>(div2.rem) == asType<integer>(operator*(heapIs
heap_{funcstart\_1032,1}, this).p2)
(\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathsf{heap}_{funcstart\_1032,1}.\mathsf{a2}) \leq
\mathbf{asType}{<}\mathbf{integer}{>}(\mathbf{operator*}(\mathbf{heapIs}\ \$\mathbf{heap}_{funcstart\_1032,1},\ \mathbf{this}).\mathtt{p2})) =>
!(0 == asType < integer > (div2.quot))
!(0 == asType < integer > (div2.rem)) || !(0 ==
asType<integer>(div2.quot))
Proof:
[Take goal term]
[1.0] 0 < asType < integer > (static\_cast < int > ($heap_{funcstart\_1032,1}.a3))
\rightarrow [const static or extern object]
[1.1] 0 < asType < integer > (static\_cast < int > (\$heap_{init}.a3))
\rightarrow [expand definition of constant 'a3' at prang.cpp (40,26)]
[1.2] 0 < asType<integer>(static_cast<int>((int)178))
\rightarrow [simplify]
```

[1.6] true

```
Proof of verification condition: Assertion valid
In the context of class: WHPrang, declared at:
C:\Escher\Customers\prang-cpp\prang.cpp (18,1)
Condition generated at: C:\Escher\Customers\prang-cpp\prang.cpp
(69,48)
To prove: (asType<integer>(heap_{funcstart\_1032.1}.a3) \leq
asType<integer>(operator*(heapIs $heap_{funcstart\_1032,1}, this).p3)) =>
!(0 == asType < integer > (div3.quot))
Given:
heap_{init}.LIMIT == (int)80
heap_{init}.class WHPrang \in M1 == (int)30269
heap_{init}.class WHPrang \in r1 == (int)171
heap_{init}.class WHPrang \in a1 == (int)177
heap_{init}.class WHPrang \in b1 == (int)2
heap_{init}.class WHPrang \in M2 == (int)30307
heap_{init}.class WHPrang \in r2 == (int)172
heap_{init}.class WHPrang \in a2 == (int)176
heap_{init}.class WHPrang \in b2 == (int)35
heap_{init}.class WHPrang \in M3 == (int)30323
heap_{init}.class WHPrang \in r3 == (int)170
heap_{init}.class WHPrang \in a3 == (int)178
heap_{init}.class WHPrang \in b3 == (int)63
\operatorname{div1} == \operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_1032,1},
\mathbf{static\_cast} {<} \mathbf{int} {>} (\mathbf{operator}^*(\mathbf{heapIs}\ \$ \mathbf{heap}_{funcstart\_1032,1},\ \mathbf{this}).\mathtt{p1}),
\mathbf{static\_cast}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_1032,1}.\mathrm{a1}))
(asType < integer > (static\_cast < int > (operator*(heapIs)))
heap_{funcstart\_1032.1}, this).p1) /
\mathbf{asType} < \mathbf{integer} > (\mathbf{static\_cast} < \mathbf{int} > (\$ \mathbf{heap}_{funcstart\_1032,1}.\mathbf{a1}))) = =
asType<integer>(div1.quot)
(asType < integer > (static\_cast < int > (operator*(heapIs)))
heap_{funcstart\_1032,1}, this).p1) %
asType<integer>(static_cast<int>($heap_{funcstart_1032.1}.a1))) ==
asType<integer>(div1.rem)
(\mathbf{asType}{<}\mathbf{integer}{>}(\mathbf{operator}^*(\mathbf{heapIs}\ \$\mathbf{heap}_{funcstart\_1032,1},\ \mathbf{this}).\mathtt{p1}) <
```

```
asType < integer > (\$heap_{funcstart\_1032,1}.a1)) = >
(asType<integer>(div1.rem) == asType<integer>(operator*(heapIs
heap_{funcstart\_1032,1}, this).p1)
(\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathsf{heap}_{funcstart\_1032,1}.\mathsf{a1}) \leq
asType<integer>(operator*(heapIs $heap_{tuncstart\_1032.1}, this).p1)) =>
!(0 == asType < integer > (div1.quot))
!(0 == asType < integer > (div1.rem)) || !(0 ==
asType<integer>(div1.quot))
div2 == div(\mathbf{heapIs} \$heap_{funcstart\_1032,1},
\mathbf{static\_cast} < \mathbf{int} > (\mathbf{operator}^*(\mathbf{heapIs}\ \$ \mathbf{heap}_{funcstart\_1032,1},\ \mathbf{this}).\mathtt{p2}),
\mathbf{static\_cast}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_1032,1}.\mathrm{a2}))
(asType<integer>(static_cast<int>(operator*(heapIs
heap_{funcstart\_1032,1}, this).p2) /
asType < integer > (static\_cast < int > (\$heap_{funcstart\_1032.1}.a2))) = =
asType<integer>(div2.quot)
(asType<integer>(static_cast<int>(operator*(heapIs
heap_{funcstart_{1032.1}}, this).p2)
asType < integer > (static\_cast < int > (\$heap_{funcstart\_1032.1}.a2))) = =
\mathbf{asType}{<}\mathbf{integer}{>}(\mathrm{div}2.\mathrm{rem})
(\mathbf{asType}{<}\mathbf{integer}{>}(\mathbf{operator}^*(\mathbf{heapIs}\ \$\mathbf{heap}_{funcstart\_1032,1},\ \mathbf{this}).\mathtt{p2}) <
asType < integer > (\$heap_{funcstart\_1032,1}.a2)) = >
(asType<integer>(div2.rem) == asType<integer>(operator*(heapIs
heap_{funcstart\_1032,1}, this).p2)
(\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathbf{heap}_{funcstart\_1032,1}.\mathbf{a2}) \leq
\mathbf{asType} < \mathbf{integer} > (\mathbf{operator}^*(\mathbf{heapIs} \ \$ \mathbf{heap}_{funcstart\_1032,1}, \ \mathbf{this}).\mathtt{p2})) = >
!(0 == asType < integer > (div2.quot))
!(0 == asType < integer > (div2.rem)) || !(0 ==
asType<integer>(div2.quot))
\label{eq:div3} \text{div3} == \text{div}(\mathbf{heapIs} \ \$ \text{heap}_{funcstart\_1032,1},
\mathbf{static\_cast} < \mathbf{int} > (\mathbf{operator}^*(\mathbf{heapIs}\ \$ \mathbf{heap}_{funcstart\_1032,1},\ \mathbf{this}).\mathbf{p3}),
static\_cast < int > (\$heap_{funcstart\_1032.1}.a3))
(asType < integer > (static\_cast < int > (operator*(heapIs
heap_{funcstart=1032.1}, this).p3) /
asType < integer > (static\_cast < int > (\$heap_{funcstart\_1032,1}.a3))) = =
asType<integer>(div3.quot)
(asType<integer>(static_cast<int>(operator*(heapIs
heap_{funcstart\_1032.1}, this).p3)
\mathbf{asType} < \mathbf{integer} > (\mathbf{static\_cast} < \mathbf{int} > (\$ \mathbf{heap}_{funcstart\_1032,1}.\mathbf{a3}))) = =
asType<integer>(div3.rem)
(\mathbf{asType}{<}\mathbf{integer}{>}(\mathbf{operator}^*(\mathbf{heapIs}\ \$\mathbf{heap}_{funcstart\_1032,1},\ \mathbf{this}).\mathrm{p3}) <
asType < integer > (\$heap_{funcstart\_1032,1}.a3)) = >
```

```
(asType<integer>(div3.rem) == asType<integer>(operator*(heapIs
heap_{funcstart\_1032,1}, this).p3)
Proof:
[Take given term]
[34.0] div3 == div(heapIs $heap_{funcstart\_1032.1},
static_cast<int>(operator*(heapIs $heap_{funcstart\_1032,1}, this).p3),
static\_cast < int > (\$heap_{funcstart\_1032,1}.a3))
→ [expand definition of operator '*' in class 'pointer' at built in declaration]
[34.1] \operatorname{div3} == \operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_1032,1},
\mathbf{static\_cast} < \mathbf{int} > (\mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs} \$ \mathbf{heap}_{funcstart\_1032,1}).p3),
\mathbf{static\_cast}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_1032,1}.\mathrm{a3}))
\rightarrow [simplify]
[34.2] \text{ div3} == \text{div(heapIs $heap}_{funcstart\_1032,1}, \text{ this.} \$r. \text{value(heapIs)}
\theta_{funcstart\_1032,1}.p3, \theta_{funcstart\_1032,1}.p3, \theta_{funcstart\_1032,1}.a3)
\rightarrow [const static or extern object]
[34.3] div3 == div(heapIs heapIs  heap_{funcstart\_1032,1}, this.r.value(heapIs)
\theta_{tuncstart\_1032,1}.p3, \theta_{tuncstart\_1032,1}.p4, \theta_{tuncstart\_1032,1}.p4, \theta_{tuncstart\_1032,1}.p4, \theta_{tuncstart\_1032,1
\rightarrow [expand definition of constant 'a3' at prang.cpp (40,26)]
[34.4] \text{ div3} == \text{div(heapIs $heap}_{funcstart\_1032,1}, \text{ this.} \text{$r.value(heapIs)}
\theta_{funcstart\_1032,1}, p3, \theta_{funcstart\_1032,1}, p3, \theta_{funcstart\_1032,1}
\rightarrow [simplify]
[34.6] div3 == div(heapIs $heap_{funcstart\_1032,1}, this.$r.value(heapIs)
heap_{funcstart\_1032,1}.p3, 178)
[Take goal term]
[1.0] (asType<integer>($heap_{funcstart\_1032.1}.a3) \leq
asType < integer > (operator^*(heapIs \$heap_{funcstart\_1032,1}, this).p3)) = >
!(0 == asType < integer > (div3.quot))
\rightarrow [const static or extern object]
[1.1] (asType<integer>(\theta) (\theta) (
asType < integer > (operator^*(heapIs \$heap_{funcstart\_1032,1}, this).p3)) = >
!(0 == asType < integer > (div3.quot))
\rightarrow [expand definition of constant 'a3' at prang.cpp (40,26)]
[1.2] (asType<integer>((int)178) \le asType<integer>(operator*(heapIs
heap_{funcstart\_1032,1}, this).p3) => !(0 == asType < integer > (div3.quot))
\rightarrow [simplify]
[1.4] (178 \le asType < integer > (operator*(heapIs $heap_{funcstart\_1032,1}, for all the start of the start 
this).p3)) => !(0 == asType < integer > (div3.quot))
```

```
→ [expand definition of operator '*' in class 'pointer' at built in declaration]
[1.5] (178 \le asType < integer > (this. r.value (heapIs))
heap_{funcstart\_1032,1}.p3) = 10 = asType < integer > (div3.quot)
\rightarrow [simplify]
[1.8] (177 < this.$r.value(heapIs $heap_{tuncstart\_1032,1}).p3) => !(0 ==
asType<integer>(div3.quot))
\rightarrow [from term 34.6, div3 is equal to div(heapIs $heap_{funcstart\_1032,1},
this.r.value(heapIs \ heap_{funcstart\_1032.1}).p3, 178)
[1.9] (177 < this.$r.value(heapIs $heap_{tuncstart\_1032,1}).p3) => !(0 ==
\mathbf{asType} < \mathbf{integer} > (\mathbf{div}(\mathbf{heapIs} \ \$\mathbf{heap}_{funcstart\_1032,1}, \ \mathbf{this}.\$\mathbf{r.value}(\mathbf{heapIs} \ \mathbf{heapIs}))
heap_{funcstart\_1032,1}.p3, 178.quot)
\rightarrow [simplify]
[1.13]!(0 == div(\mathbf{heapIs} \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}))
\$heap_{funcstart\_1032,1}).p3,\ 178).quot) \lor (-178 < -\mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
heap_{funcstart\_1032,1}.p3
\rightarrow [negate goal and search for contradiction]
[1.14] (0 == div(heapIs $heap<sub>funcstart_1032,1</sub>, this.$r.value(heapIs)
\theta_{funcstart\_1032,1}.p3, 178).quot) \wedge !(-178 < -this.r.value(heapIs)
heap_{funcstart_{1032,1}}.p3
\rightarrow [simplify]
[1.17] (0 == div(heapIs $heap<sub>funcstart_1032.1</sub>, this.$r.value(heapIs)
\theta_{funcstart\_1032,1}.p3, 178).quot \land (177 < this. r.value(heapIs)
heap_{funcstart_{1032,1}}.p3
\rightarrow [separate conjunction and work on first sub-term]
[1.18] 0 == \operatorname{div}(\mathbf{heapIs} \$ \mathbf{heap}_{funcstart\_1032,1}, \mathbf{this}.\$ \mathbf{r.value}(\mathbf{heapIs})
heap_{funcstart_{-1032,1}}.p3, 178).quot
[Assume known post-assertion, class invariant or type constraint for term 34.6]
[39.0] (0 < asType<integer>(this.$r.value(heapIs
\theta_{funcstart\_1032,1}.p3) && (asType<integer>(this.$r.value(heapIs)
\$heap_{funcstart\_1032,1}).p3) < \mathbf{asType} < \mathbf{integer} > (\$heap.\mathbf{class} \ WHPrang \in \texttt{Constart} = \texttt{Constart} =
M3))
\rightarrow [simplify]
[39.2] (0 < this.$r.value(heap
Is \rho_{uncstart\_1032,1}).p3) &&
(this.r.value(heapIs $heap_{funcstart\_1032,1}).p3 <
asType < integer > (\text{$heap.class WHPrang} \in M3))
\rightarrow [const static or extern object]
[39.3] (0 < this.$r.value(heapIs $heap_{funcstart\_1032,1}).p3) &&
(this.r.value(heapIs $heap_{funcstart\_1032,1}).p3 <
```

```
asType < integer > (\$heap_{init}.class WHPrang \in M3))
\rightarrow [expand definition of constant 'M3' at prang.cpp (38,26)]
[39.4] (0 < this.$r.value(heap
Is \rho_{uncstart\_1032,1}).p3) &&
(this.$r.value(heapIs heap_{funcstart\_1032,1}).p3 <
asType < integer > ((int)30323))
\rightarrow [simplify]
[39.10] (-30323 < -this.$r.value(heapIs heapIs = f_{uncstart_{1032,1}}).p3) \land (0 <
this.r.value(heapIs $heap_{funcstart\_1032.1}).p3)
[Work on sub-term 2 of conjunction in term 39.10]
[40.0] 0 < this.$r.value(heapIs $heap_{funcstart\_1032,1}).p3
[Assume known post-assertion, class invariant or type constraint for term 34.6]
[41.0] \ (\mathbf{asType} < \mathbf{integer} > (\mathbf{this.\$r.value} (\mathbf{heapIs} \ \$ \mathbf{heap}_{funcstart\_1032,1}).\mathbf{p3}) \ / \\
asType<integer>(178)) == asType<integer>(div(heapIs
\rho_{tuncstart\_1032.1}, this.r.value(heapIs \rho_{tuncstart\_1032.1}).p3,
178).quot)
\rightarrow [simplify]
[41.2] (this.$r.value(heapIs $heap_{funcstart\_1032,1}).p3 / 178) ==
asType < integer > (div(heapIs \$heap_{funcstart\_1032,1}, this.\$r.value(heapIs))
heap_{funcstart\_1032,1}.p3, 178).quot
→ [expand definition of operator './' in class 'int' at built in declaration]
[41.3] \; ([\mathbf{asType} < \mathbf{integer} > (\mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs} \; \$ \mathbf{heap}_{funcstart\_1032,1}).\mathbf{p3}) < \mathbf{page}) \\
0]: -(-asType < integer > (this.\$r.value(heapIs \$heap_{funcstart\_1032,1}).p3) /
178), \parallel: asType<integer>(this.$r.value(heapIs \theta_{funcstart\_1032,1}).p3) /
178) == asType<integer>(div(heapIs heap_{funcstart\_1032,1},
this.r.value(heapIs $heap_{funcstart\_1032,1}).p3, 178).quot)
→ [explicitly assert falsehood of skipped guards in subsequent guards]
[41.4] ([asType<integer>(this.$r.value(heapIs $heap_{funcstart\_1032.1}).p3) <
0]: -(-asType < integer > (this. r.value(heapIs <math>heap_{funcstart\_1032,1}).p3) /
178), [!(asType<integer>(this.$r.value(heapIs $heap_{funcstart\_1032,1}).p3) <
0)]: asType<integer>(this.$r.value(heapIs $heap_{funcstart\_1032,1}).p3) /
178) == asType < integer > (div(heapIs \$heap_{funcstart\_1032,1},
this.r.value(heapIs $heap_{funcstart\_1032,1}).p3, 178).quot)
\rightarrow [simplify]
[41.7] ([0 < -this.$r.value(heapIs $heap_{funcstart\_1032.1}).p3]:
-(-asType < integer > (this. r.value(heapIs $heap_{funcstart\_1032,1}).p3) / 
178), [!(asType<integer>(this.$r.value(heapIs $heap_{funcstart\_1032.1}).p3) <
0): asType<integer>(this.$r.value(heapIs $heap_{tuncstart\_1032.1}).p3) /
178) == asType < integer > (div(heapIs \$heap_{funcstart\_1032,1},
this.r.value(heapIs $heap_{funcstart\_1032,1}).p3, 178).quot)
```

```
is false whenever -2 < (0 + literala)
         Proof of rule precondition:
         [41.7.0] - 2 < (0 + 0)
         \rightarrow [simplify]
         [41.7.2] true
[41.8] ([false]: -(-asType<integer>(this.$r.value(heapIs
$heap_funcstart_1032,1).p3) / 178), [!(asType<integer>(this.$r.value(heapIs
\{\text{heap}_{funcstart\_1032,1}\}, p3) < 0)]: asType<integer>(this.\r.value(heapIs)
\label{eq:heapfuncstart_1032,1} \$ heap_{funcstart\_1032,1}).p3) \ / \ 178) == \mathbf{asType} < \mathbf{integer} > (\mathrm{div}(\mathbf{heapIs}) < \mathrm{div}(\mathbf{heapIs}) < \mathrm
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p3,
178).quot)
\rightarrow [simplify]
[41.11] ([false]: -(-asType<integer>(this.$r.value(heapIs
\theta_{funcstart\_1032,1}.p3 / 178), [!\theta_{funcstart\_1032,1}.p3 / 178), [!\theta_{funcstart\_1032,1}.p3
\rho_{funcstart_{1032,1}}.p3): asType<integer>(this.$r.value(heapIs
\theta_{funcstart\_1032,1}.p3 / 178) == asType<integer>(div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p3,
178).quot)
\rightarrow [from term 40.0, literala < -this.$r.value(heapIs $heap_{funcstart\_1032,1}).p3
is false whenever -2 < (0 + literala)
         Proof of rule precondition:
         [41.11.0] - 2 < (0 + 0)
         \rightarrow [simplify]
         [41.11.2] true
[41.12] ([false]: -(-asType<integer>(this.$r.value(heapIs
heap_{funcstart_{1032.1}}.p3) / 178, [!false]:
asType < integer > (this. r.value(heapIs $heap_{funcstart\_1032,1}).p3) / 178)
== asType<integer>(div(heapIs $heap_{tuncstart\_1032,1},
this.r.value(heapIs $heap_{funcstart\_1032,1}).p3, 178).quot)
\rightarrow [simplify]
[41.17] 0 == (-\text{div}(\mathbf{heapIs} \$ \text{heap}_{funcstart\_1032,1}, \mathbf{this}.\$ \mathbf{r.value}(\mathbf{heapIs}))
\theta_{funcstart\_1032,1}.p3, 178).quot + (this.\frac{1}{2}r.value(heapIs)
heap_{funcstart_{1032,1}}.p3 / 178)
\rightarrow [from term 1.18, div(heapIs $heap_{funcstart\_1032,1}$, this.$r.value(heapIs)
heap_{funcstart\_1032.1}.p3, 178).quot is equal to 0
[41.18] \ 0 == (-0 + (\mathbf{this.\$r.value}(\mathbf{heapIs} \ \$ \mathbf{heap}_{funcstart\_1032,1}).\mathbf{p3} \ / \ 178))
```

 \rightarrow [from term 40.0, literala < -this.\$r.value(heapIs \$heap_{funcstart_1032.1}).p3

 \rightarrow [simplify]

```
[41.20] 0 == (this.$r.value(heapIs \theta_{funcstart\_1032,1}).p3 / 178)
[Work on sub-term 2 of conjunction in term 1.17]
[48.0] 177 < this.r.value(heapIs \ensuremath{\$}heap_{funcstart\_1032,1}).p3
[Create new term from term 41.20 using rule: condition for equality of division]
[55.0] ((0 * 178) < (1 + this.$r.value(heap
Is \rho_{uncstart\_1032,1}.p3)) \land
(this.$r.value(heapIs heap_{funcstart\_1032,1}).p3 < (178 * (0 + 1)))
\rightarrow [simplify]
[55.3] (-1 < this.$r.value(heap
Is $heap_{funcstart\_1032,1}).p3) \land
(this.$r.value(heapIs heap_{funcstart\_1032,1}).p3 < (178 * (0 + 1)))
\rightarrow [from term 48.0, literala < this.$r.value(heapIs $heap_{tuncstart\_1032.1}).p3
is true whenever (-1 + literala) < 177
   Proof of rule precondition:
   [55.3.0](-1+-1)<177
   \rightarrow [simplify]
   [55.3.2] true
[55.4] true \land (this.$r.value(heapIs $heap_{funcstart\_1032,1}).p3 < (178 * (0 +
1)))
\rightarrow [simplify]
[55.9] true \land (-178 < -this.$r.value(heapIs $heap_{funcstart\_1032,1}).p3)
\rightarrow [from term 48.0, literala < -this.$r.value(heapIs $heap_{funcstart\_1032,1}).p3
is false whenever -2 < (177 + literala)
   Proof of rule precondition:
   [55.9.0] - 2 < (-178 + 177)
   \rightarrow [simplify]
   [55.9.2] true
[55.10] true \wedge false
\rightarrow [simplify]
[55.11] false
Proof of verification condition: Assertion valid
In the context of class: WHPrang, declared at:
C:\Escher\Customers\prang-cpp\prang.cpp (18,1)
Condition generated at: C:\Escher\Customers\prang-cpp\prang.cpp
(69,20)
To prove: (asType<integer>(operator*(heapIs \rho_{tuncstart\_1032,1})
```

```
this).p3) < asType<integer>($heap_{funcstart\_1032,1}.a3)) =>
(asType<integer>(div3.rem) == asType<integer>(operator*(heapIs
heap_{funcstart\_1032,1}, this).p3)
Given:
heap_{init}.LIMIT == (int)80
heap_{init}.class WHPrang \in M1 == (int)30269
heap_{init}.class WHPrang \in r1 == (int)171
heap_{init}.class WHPrang \in a1 == (int)177
heap_{init}.class WHPrang \in b1 == (int)2
\text{$heap}_{init}.\mathbf{class} \text{ WHPrang} \in M2 == (\mathbf{int})30307
heap_{init}.class WHPrang \in r2 == (int)172
heap_{init}.class WHPrang \in a2 == (int)176
heap_{init}.class WHPrang \in b2 == (int)35
\text{$heap}_{init}.\mathbf{class} \text{ WHPrang} \in M3 == (\mathbf{int})30323
heap_{init}.class WHPrang \in r3 == (int)170
heap_{init}.class WHPrang \in a3 == (int)178
heap_{init}.class WHPrang \in b3 == (int)63
\operatorname{div1} == \operatorname{div}(\mathbf{heapIs} \ \operatorname{\$heap}_{funcstart\_1032,1},
static\_cast < int > (operator*(heapIs $heap_{funcstart\_1032,1}, this).p1),
\mathbf{static\_cast} < \mathbf{int} > (\$ \mathbf{heap}_{funcstart\_1032,1}.\mathbf{a1}))
(asType < integer > (static\_cast < int > (operator*(heapIs)))
heap_{funcstart\_1032.1}, this).p1) /
\mathbf{asType} < \mathbf{integer} > (\mathbf{static\_cast} < \mathbf{int} > (\$ \mathbf{heap}_{funcstart\_1032,1}.\mathbf{a1}))) = =
asType<integer>(div1.quot)
(asType < integer > (static\_cast < int > (operator*(heapIs)))
heap_{funcstart\_1032,1}, this).p1)
asType < integer > (static\_cast < int > (\$heap_{funcstart\_1032,1}.a1))) = =
asType<integer>(div1.rem)
(\mathbf{asType}{<}\mathbf{integer}{>}(\mathbf{operator}^*(\mathbf{heapIs}\ \$\mathbf{heap}_{funcstart\_1032,1},\ \mathbf{this}).\mathtt{p1}) <
asType < integer > (\$heap_{funcstart\_1032,1}.a1)) = >
(asType<integer>(div1.rem) == asType<integer>(operator*(heapIs
heap_{funcstart\_1032,1}, this).p1)
(\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathsf{heap}_{funcstart\_1032,1}.\mathsf{a1}) \leq
\mathbf{asType}{<}\mathbf{integer}{>}(\mathbf{operator*}(\mathbf{heapIs}\ \$\mathbf{heap}_{funcstart\_1032,1},\ \mathbf{this}).\mathbf{p1})) =>
!(0 == asType < integer > (div1.quot))
!(0 == asType < integer > (div1.rem)) || !(0 ==
asType<integer>(div1.quot))
```

```
div2 == div(\mathbf{heapIs} \$heap_{funcstart\_1032,1},
\mathbf{static\_cast} {<} \mathbf{int} {>} (\mathbf{operator}^*(\mathbf{heapIs}\ \$ \mathbf{heap}_{funcstart\_1032,1},\ \mathbf{this}).\mathtt{p2}),
\mathbf{static\_cast}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_1032,1}.\mathrm{a2}))
(asType < integer > (static\_cast < int > (operator*(heapIs)))
heap_{funcstart\_1032,1}, this).p2) /
asType < integer > (static\_cast < int > (\$heap_{funcstart\_1032.1}.a2))) = =
asType<integer>(div2.quot)
(asType<integer>(static_cast<int>(operator*(heapIs
heap_{funcstart\_1032,1}, this).p2)
asType<integer>(static_cast<int>($heap_{funcstart_1032.1}.a2))) ==
asType<integer>(div2.rem)
(asType < integer > (operator*(heapIs $heap_{funcstart\_1032,1}, this).p2) < footnote{the content of the conte
asType < integer > ($heap_{funcstart\_1032,1}.a2)) =>
(asType<integer>(div2.rem) == asType<integer>(operator*(heapIs
heap_{funcstart\_1032,1}, this).p2)
(\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathsf{heap}_{funcstart\_1032,1}.\mathsf{a2}) \leq
asType < integer > (operator*(heapIs $heap_{funcstart\_1032,1}, this).p2)) =>
!(0 == asType < integer > (div2.quot))
!(0 == asType < integer > (div2.rem)) || !(0 ==
asType<integer>(div2.quot))
div3 == div(\mathbf{heapIs} \$ heap_{funcstart\_1032,1},
\mathbf{static\_cast} {<} \mathbf{int} {>} (\mathbf{operator*}(\mathbf{heapIs}\ \$\mathbf{heap}_{funcstart\_1032,1},\ \mathbf{this}).\mathbf{p3}),
\mathbf{static\_cast}{<}\mathbf{int}{>}(\$\mathsf{heap}_{funcstart\_1032,1}.\mathsf{a3}))
(asType < integer > (static\_cast < int > (operator*(heapIs)))
heap_{funcstart\_1032,1}, this).p3) /
\mathbf{asType} < \mathbf{integer} > (\mathbf{static\_cast} < \mathbf{int} > (\$ \mathbf{heap}_{funcstart\_1032,1}.\mathbf{a3}))) = =
asType<integer>(div3.quot)
(asType < integer > (static\_cast < int > (operator*(heapIs)))
\theta_{funcstart_{1032,1}}, this).p3)) \%
asType < integer > (static\_cast < int > (\$heap_{funcstart\_1032.1}.a3))) = =
asType<integer>(div3.rem)
Proof:
[Take given term]
[34.0] div3 == div(heapIs $heap_{funcstart\_1032,1},
static\_cast < int > (operator*(heapIs $heap_{funcstart\_1032,1}, this).p3),
\mathbf{static\_cast}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_1032,1}.\mathrm{a3}))
→ [expand definition of operator '*' in class 'pointer' at built in declaration]
[34.1] \text{ div3} == \text{div}(\mathbf{heapIs} \$ heap_{funcstart\_1032,1},
static\_cast < int > (this. r.value(heapIs  heap_{funcstart\_1032,1}).p3),
static\_cast < int > (\$heap_{funcstart\_1032.1}.a3))
```

```
\rightarrow [simplify]
[34.2] div3 == div(heapIs heapIs heapIs this.\r.value(heapIs
\rho_{tuncstart=1032,1}, p3, static_cast<int>(\rho_{tuncstart=1032,1})
\rightarrow [const static or extern object]
[34.3] \text{ div3} == \text{div(heapIs $heap}_{funcstart\_1032,1}, \text{ this.} \text{$r.value(heapIs)}
\theta_{funcstart\_1032,1}.p3, \theta_{funcstart\_1032,1}.p4, \theta_{funcstart\_1032,1}.p4, \theta_{funcstart\_1032,1}.p4, \theta_{funcstart\_1032,1}.p4, \theta_{funcstart\_1032,1}.p5, \theta_{funcstart\_1032,1}.p5, \theta_{funcstart\_1032,1}.p5, \theta_{funcstart\_1032,1}.p5, \theta_{funcstart\_1032,1}.p5, \theta_{funcstart\_1032,1}.p5, \theta_{funcstart\_1032,1}.p5, \theta_{funcstart\_1032,1
\rightarrow [expand definition of constant 'a3' at prang.cpp (40,26)]
[34.4] div3 == div(heapIs $heap_{funcstart\_1032,1}, this.$r.value(heapIs)
heap_{funcstart\_1032,1}.p3, static\_cast < int > ((int)178)
\rightarrow [simplify]
[34.6] div3 == div(heapIs heapIs  heap_{funcstart\_1032,1}, this.r.value(heapIs)
heap_{funcstart\_1032,1}.p3, 178)
[Take goal term]
[1.0] (asType<integer>(operator*(heapIs $heap_{funcstart\_1032,1}, this).p3)
< asType<integer>($heap<sub>funcstart_1032,1</sub>.a3)) =>
(asType<integer>(div3.rem) == asType<integer>(operator*(heapIs
heap_{funcstart\_1032,1}, this).p3)
→ [expand definition of operator '*' in class 'pointer' at built in declaration]
[1.1] (asType<integer>(this.$r.value(heapIs \rho_{funcstart\_1032,1}).p3) <
asType < integer > (\$heap_{funcstart\_1032,1}.a3)) = >
(asType<integer>(div3.rem) == asType<integer>(operator*(heapIs
heap_{funcstart\_1032,1}, this).p3)
\rightarrow [simplify]
[1.2] (this.$r.value(heap
Is \rho_{funcstart\_1032,1}).p3 <
asType < integer > (\$heap_{funcstart\_1032,1}.a3)) = >
(asType<integer>(div3.rem) == asType<integer>(operator*(heapIs
heap_{funcstart\_1032,1}, this).p3)
\rightarrow [const static or extern object]
[1.3] (this.r.value(heapIs $heap_{funcstart\_1032,1}).p3 <
asType<integer>($heap_{init}.a3)) => (asType<integer>(div3.rem) ==
\mathbf{asType}{<}\mathbf{integer}{>}(\mathbf{operator}^*(\mathbf{heapIs}\ \$\mathbf{heap}_{funcstart\_1032,1},\ \mathbf{this}).\mathbf{p3}))
\rightarrow [expand definition of constant 'a3' at prang.cpp (40,26)]
[1.4] (this.$r.value(heap
Is \rho_{funcstart\_1032,1}).p3 <
asType < integer > ((int)178)) => (asType < integer > (div3.rem) ==
asType<integer>(operator*(heapIs $heap_{tuncstart\_1032.1}, this).p3))
\rightarrow [simplify]
[1.9] (-178 < -this.$r.value(heapIs \theta_{funcstart\_1032,1}).p3) =>
(asType<integer>(div3.rem) == asType<integer>(operator*(heapIs
```

```
heap_{funcstart_1032,1}, this).p3)
\rightarrow [from term 34.6, div3 is equal to div(heapIs $heap_{funcstart\_1032,1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p3, 178)]
[1.10] (-178 < -this.$r.value(heapIs $heap_{funcstart\_1032,1}).p3) =>
(\mathbf{asType} < \mathbf{integer} > (\mathbf{div}(\mathbf{heapIs} \ \$ \mathbf{heap}_{funcstart\_1032,1}, \ \mathbf{this}.\$ \mathbf{r.value}(\mathbf{heapIs} \ \mathsf{heap}_{funcstart\_1032,1}, \ \mathbf{this}.\$ \mathbf{r.value}(\mathbf{heapIs}))
heap_{funcstart_{-1032,1}}.p3, 178).rem ==
\mathbf{asType} < \mathbf{integer} > (\mathbf{operator}^*(\mathbf{heapIs} \ \$ \mathbf{heap}_{funcstart\_1032,1}, \ \mathbf{this}).\mathbf{p3}))
\rightarrow [simplify]
[1.11] (-178 < -this.$r.value(heapIs \rho_{funcstart\_1032,1}).p3) =>
(\operatorname{div}(\mathbf{heapIs}\ \$ \operatorname{heap}_{funcstart\_1032,1},\ \mathbf{this}.\$ r. \mathbf{value}(\mathbf{heapIs}
heap_{funcstart_1032.1}.p3, 178).rem ==
\mathbf{asType} < \mathbf{integer} > (\mathbf{operator}^*(\mathbf{heapIs} \ \$ \mathbf{heap}_{funcstart\_1032,1}, \ \mathbf{this}).\mathbf{p3}))
→ [expand definition of operator '*' in class 'pointer' at built in declaration]
[1.12] (-178 < -this.$r.value(heapIs $heap<sub>funcstart_1032,1</sub>).p3) =>
(\text{div}(\mathbf{heapIs} \$ \text{heap}_{funcstart\_1032,1}, \mathbf{this}.\$ r. \mathbf{value}(\mathbf{heapIs}))
heap_{funcstart_1032,1}.p3, 178).rem ==
asType < integer > (this. r.value(heapIs  heap_{funcstart\_1032,1}).p3))
\rightarrow [simplify]
[1.18] (0 == (-this.\$r.value(heapIs \$heap_{funcstart\_1032,1}).p3 + div(heapIs)
\$heap_{funcstart\_1032,1},\, \textbf{this}.\$r.\textbf{value}(\textbf{heapIs}\,\,\$heap_{funcstart\_1032,1}).p3,
178).rem)) \vee (177 < this.$r.value(heapIs $heap<sub>funcstart_1032.1</sub>).p3)
\rightarrow [negate goal and search for contradiction]
[1.19] !(0 == (-this.$r.value(heapIs $heap_{funcstart\_1032,1}).p3 + div(heapIs
\rho_{tuncstart\_1032.1}, this.r.value(heapIs \rho_{tuncstart\_1032.1}).p3,
178).rem)) \land!(177 < this.$r.value(heapIs $heap_{tuncstart\_1032.1}).p3)
\rightarrow [simplify]
[1.21] !(0 == (-this.$r.value(heapIs heapIs heap_{funcstart\_1032,1}).p3 + div(heapIs
\rho_{funcstart\_1032,1}, this.\r.value(heapIs \rho_{funcstart\_1032,1}).p3,
178).rem)) \land (-178 < -this.$r.value(heapIs $heap_{funcstart\_1032,1}).p3)
\rightarrow [separate conjunction and work on first sub-term]
[1.22] -178 < -this.$r.value(heapIs \theta_{funcstart\_1032,1}).p3
[Assume known post-assertion, class invariant or type constraint for term 34.6]
[39.0]~(0 < \mathbf{asType} < \mathbf{integer} > (\mathbf{this.\$r.value}(\mathbf{heapIs}
\rho_{uncstart_{1032,1}.p3}) \& (asType < integer > (this. r.value(heapIs))
\rho_{funcstart\_1032,1}.p3 < asType<integer>(\rho_{funcstart\_1032,1}.p3) < asType<integer>(\rho_{funcstart\_1032,1}.p3)
M3))
\rightarrow [simplify]
[39.2] (0 < this.$r.value(heap
Is $heap_{funcstart\_1032,1}).p3) &&
```

```
(this.$r.value(heapIs \rho_{uncstart\_1032,1}).p3 <
asType < integer > (\text{$heap.class WHPrang} \in M3))
\rightarrow [const static or extern object]
[39.3] (0 < this.$r.value(heap
Is $heap_{tuncstart\_1032,1}).p3) &&
(this.r.value(heapIs $heap_{funcstart\_1032,1}).p3 <
asType < integer > (\$heap_{init}.class WHPrang \in M3))
\rightarrow [expand definition of constant 'M3' at prang.cpp (38,26)]
[39.4] (0 < this.\$r.value(heapIs \$heap_{funcstart_{-1032,1}}).p3) &&
(this.r.value(heapIs $heap_{funcstart\_1032,1}).p3 <
asType < integer > ((int)30323))
\rightarrow [simplify]
[39.10] (-30323 < -this.$r.value(heapIs $heap_{funcstart\_1032.1}).p3) \land (0 <
this.$r.value(heapIs $heap_{funcstart_1032.1}).p3)
[Work on sub-term 2 of conjunction in term 39.10]
[40.0] 0 < this.$r.value(heapIs $heap_{tuncstart\_1032.1}).p3
[Assume known post-assertion, class invariant or type constraint for term 34.6]
[42.0] (asType<integer>(this.r.value(heapIs \heap_{funcstart\_1032,1}).p3) \%
asType < integer > (178)) == asType < integer > (div(heapIs))
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p3,
178).rem)
\rightarrow [simplify]
[42.2] (this.$r.value(heapIs heap_{funcstart\_1032,1}).p3 % 178) ==
asType<integer>(div(heapIs $heap_funcstart_1032.1, this.$r.value(heapIs
heap_{funcstart_1032,1}.p3, 178.rem
\rightarrow [expand definition of operator '.%' in class 'int' at built in declaration]
[42.3] \; ([\mathbf{asType} < \mathbf{integer} > (\mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs} \; \$ \mathbf{heap}_{funcstart\_1032,1}).\mathbf{p3}) < \\
0]: -(-asType < integer > (this. r.value(heapIs  heap_{funcstart\_1032.1}).p3) %
178), []: asType<integer>(this.$r.value(heapIs $heap_{funcstart\_1032,1}).p3)
\% 178) == asType<integer>(div(heapIs $heap_{funcstart\_1032,1},
this.r.value(heapIs $heap_{funcstart\_1032,1}).p3, 178).rem)
→ [explicitly assert falsehood of skipped guards in subsequent guards]
[42.4] \; ([\mathbf{asType} < \mathbf{integer} > (\mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs} \; \$ \mathbf{heap}_{funcstart\_1032,1}).\mathbf{p3}) < \mathbf{page}) \\
0]: -(-asType < integer > (this.\$r.value(heapIs \$heap_{funcstart\_1032,1}).p3) \%
178), [!(asType<integer>(this.$r.value(heapIs \rho_{tart_1032,1}).p3] <
0)]: asType<integer>(this.$r.value(heapIs \rho_{tuncstart\_1032,1}).p3) %
178) == asType<integer>(div(heapIs $heap_{tuncstart\_1032.1},
this.r.value(heapIs $heap_{funcstart\_1032.1}).p3, 178).rem)
\rightarrow [simplify]
```

```
[42.7] ([0 < -this.$r.value(heapIs $heap<sub>funcstart_1032,1</sub>).p3]:
-(-\mathbf{asType} < \mathbf{integer} > (\mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}~\$\mathbf{heap}_{funcstart\_1032,1}).\mathbf{p3})~\%
178), [!(asType<integer>(this.$r.value(heapIs \rho_{tancstart\_1032,1}).p3] <
0)]: asType<integer>(this.$r.value(heapIs \rho_{uncstart\_1032,1}).p3) %
178) == asType < integer > (div(heapIs $heap_{funcstart\_1032.1},
this.r.value(heapIs $heap_{funcstart\_1032,1}).p3, 178).rem)
\rightarrow [from term 40.0, literala < -this.$r.value(heapIs $heap_{funcstart\_1032,1}).p3
is false whenever -2 < (0 + literala)
   Proof of rule precondition:
   [42.7.0] - 2 < (0 + 0)
   \rightarrow [simplify]
   [42.7.2] true
[42.8] ([false]: -(-asType < integer > (this. r.value(heapIs))
\rho_{funcstart\_1032,1}.p3) \% 178, [!(asType<integer>(this.$r.value(heapIs)
\label{eq:continuous} $\operatorname{heap}_{funcstart\_1032,1}).p3) < 0)]: \ \mathbf{asType} < \mathbf{integer} > (\mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})) < 0)] < 0) = 0.
\theta_{funcstart\_1032,1}.p3) \% 178 = asType < integer > (div(heapIs))
\rho_{funcstart_1032,1}, this.\r.value(heapIs \rho_{funcstart_1032,1}).p3,
178).rem)
\rightarrow [simplify]
[42.11] ([false]: -(-asType<integer>(this.$r.value(heapIs
heap_{funcstart_1032.1}.p3) \% 178, [!(0 < -this. r.value(heapIs)]
\rho_{tuncstart=1032.1}.p3: asType<integer>(this.$r.value(heapIs)
\text{Sheap}_{funcstart\_1032,1}.\text{p3}) \% 178) == asType < integer > (div(heapIs))
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p3,
178).rem)
\rightarrow [from term 40.0, literala < -this.$r.value(heapIs $heap_{funcstart\_1032,1}).p3
is false whenever -2 < (0 + literala)
   Proof of rule precondition:
   [42.11.0] - 2 < (0 + 0)
   \rightarrow [simplify]
   [42.11.2] true
[42.12] ([false]: -(-asType<integer>(this.$r.value(heapIs
heap_{funcstart\_1032,1}.p3) \% 178, [!false]:
asType<integer>(this.$r.value(heapIs $heap_{funcstart\_1032,1}).p3) % 178)
== asType<integer>(div(heapIs $heap_funcstart_1032.1,
this.r.value(heapIs $heap_{funcstart\_1032.1}).p3, 178).rem)
\rightarrow [simplify]
[42.17] 0 == (-\text{div}(\mathbf{heapIs} \ \$ \text{heap}_{funcstart\_1032,1}, \ \mathbf{this}.\$ r. \mathbf{value}(\mathbf{heapIs}))
\theta_{funcstart\_1032,1}.p3, 178).rem + (this.\$r.value(heapIs)
```

```
heap_{funcstart_{-1032,1}}.p3 \% 178)
[Work on sub-term 2 of conjunction in term 1.21]
[47.0] ! (0 == (-\mathbf{this.\$r.value}(\mathbf{heapIs} \$ heap_{funcstart\_1032,1}).p3 + div(\mathbf{heapIs} )] 
\$heap_{funcstart\_1032,1},\, \textbf{this}.\$r.\textbf{value}(\textbf{heapIs}\,\,\$heap_{funcstart\_1032,1}).p3,
178).rem))
[Copy term 47.0]
[54.0] ! (0 == (-\mathbf{this.\$r.value}(\mathbf{heapIs} \ \$ \mathbf{heap}_{funcstart\_1032,1}).\mathbf{p3} + \mathbf{div}(\mathbf{heapIs} \ \mathbf{heapIs}) ] 
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p3,
178).rem))
\rightarrow [from\ term\ 42.17,\ div(\textbf{heapIs}\ \$heap_{funcstart\_1032,1},\ \textbf{this}.\$r.\textbf{value}(\textbf{heapIs}
\rho_{uncstart\_1032,1}.p3,\ 178).rem is equal to this.
$r.value<br/>(heapIs
heap_{funcstart\_1032,1}.p3 % 178]
 [54.1] ! (0 == (-\mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs} \$heap_{funcstart\_1032,1}).p3 + \\
(this.$r.value(heapIs heap_{funcstart\_1032,1}).p3 % 178)))
\rightarrow [remainder with larger divisor]
    Proof of rule precondition 1:
    [54.1.0.0] \ \mathrm{literald} < -\mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}\ \$\mathrm{heap}_{funcstart\_1032,1}).\mathrm{p3}
    \rightarrow [unify with term 1.22]
    [54.1.0.1] true
    Proof of rule precondition 2:
    [54.1.1.0] literalc < this.$r.value(heapIs $heap_{funcstart\_1032,1}).p3
    \rightarrow [unify with term 40.0]
    [54.1.1.1] true
    Proof of rule precondition 3:
    [54.1.2.0] --178 \leq 178
    \rightarrow \textit{[simplify]}
    [54.1.2.2] true
    Proof of rule precondition 4:
    [54.1.3.0] - 2 < 0
    \rightarrow [simplify]
    [54.1.3.1] true
 [54.2] ! (0 == (-\mathbf{this.\$r.value}(\mathbf{heapIs} \ \$ heap_{funcstart\_1032,1}).p3 + \\
\mathbf{this.\$r.value}(\mathbf{heapIs}~\$ \mathrm{heap}_{funcstart\_1032,1}).\mathrm{p3}))
\rightarrow [simplify]
[54.5] false
```

```
Proof of verification condition: Assertion valid
In the context of class: WHPrang, declared at:
C:\Escher\Customers\prang-cpp\prang.cpp (18,1)
Condition generated at: C:\Escher\Customers\prang-cpp\prang.cpp
(70,26)
To prove: !(0 == asType < integer > (div3.rem)) || !(0 ==
asType<integer>(div3.quot))
Given:
heap_{init}.LIMIT == (int)80
heap_{init}.class WHPrang \in M1 == (int)30269
heap_{init}.class WHPrang \in r1 == (int)171
heap_{init}.class WHPrang \in a1 == (int)177
heap_{init}.class WHPrang \in b1 == (int)2
heap_{init}.class WHPrang \in M2 == (int)30307
heap_{init}.class WHPrang \in r2 == (int)172
heap_{init}.class WHPrang \in a2 == (int)176
heap_{init}.class WHPrang \in b2 == (int)35
heap_{init}.class WHPrang \in M3 == (int)30323
heap_{init}.class WHPrang \in r3 == (int)170
heap_{init}.class WHPrang \in a3 == (int)178
heap_{init}.class WHPrang \in b3 == (int)63
\operatorname{div1} == \operatorname{div}(\mathbf{heapIs} \ \operatorname{heap}_{funcstart\_1032,1},
static\_cast < int > (operator^*(heapIs \$heap_{funcstart\_1032,1}, this).p1),
static\_cast < int > (\$heap_{funcstart\_1032,1}.a1))
(asType<integer>(static_cast<int>(operator*(heapIs
heap_{funcstart\_1032,1}, this).p1) /
\mathbf{asType} {<} \mathbf{integer} {>} (\mathbf{static\_cast} {<} \mathbf{int} {>} (\$ \mathbf{heap}_{funcstart\_1032,1}.\mathbf{a1}))) = =
asType<integer>(div1.quot)
(asType<integer>(static_cast<int>(operator*(heapIs
heap_{funcstart\_1032,1}, this).p1) %
asType < integer > (static\_cast < int > (\$heap_{funcstart\_1032.1}.a1))) = =
asType<integer>(div1.rem)
(\mathbf{asType}{<}\mathbf{integer}{>}(\mathbf{operator}^*(\mathbf{heapIs}\ \$\mathbf{heap}_{funcstart\_1032,1},\ \mathbf{this}).\mathtt{p1}) <
asType < integer > (\$heap_{tuncstart=1032.1}.a1)) = >
(asType<integer>(div1.rem) == asType<integer>(operator*(heapIs
heap_{funcstart\_1032,1}, this).p1)
```

```
(\mathbf{asType} < \mathbf{integer} > (\$ \mathbf{heap}_{funcstart\_1032,1}.\mathbf{a1}) \le
asType < integer > (operator*(heapIs $heap_{funcstart\_1032,1}, this).p1)) = >
!(0 == asType < integer > (div1.quot))
!(0 == asType < integer > (div1.rem)) || !(0 ==
asType<integer>(div1.quot))
div2 == div(\mathbf{heapIs} \$ heap_{funcstart\_1032,1},
static\_cast < int > (operator*(heapIs $heap_{funcstart\_1032,1}, this).p2),
\mathbf{static\_cast}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_1032,1}.\mathrm{a2}))
(asType < integer > (static\_cast < int > (operator*(heapIs
heap_{funcstart\_1032,1}, this).p2)
asType < integer > (static\_cast < int > (\$heap_{funcstart\_1032.1}.a2))) = =
asType < integer > (div2.quot)
(asType<integer>(static_cast<int>(operator*(heapIs
heap_{funcstart\_1032,1}, this).p2)
asType < integer > (static\_cast < int > (\$heap_{funcstart\_1032.1}.a2))) = =
asType<integer>(div2.rem)
(asType<integer>(operator*(heapIs $heap_{tuncstart\_1032.1}, this).p2) <
asType < integer > (\$heap_{funcstart\_1032,1}.a2)) = >
(asType<integer>(div2.rem) == asType<integer>(operator*(heapIs
heap_{funcstart\_1032.1}, this).p2)
(asType < integer > (\$heap_{funcstart\_1032,1}.a2) \le
\mathbf{asType} < \mathbf{integer} > (\mathbf{operator}^*(\mathbf{heapIs} \ \$ \mathbf{heap}_{funcstart\_1032,1}, \ \mathbf{this}).\mathtt{p2})) = >
!(0 == asType < integer > (div2.quot))
!(0 == asType < integer > (div2.rem)) || !(0 ==
asType<integer>(div2.quot))
div3 == div(\mathbf{heapIs} \$ heap_{funcstart\_1032,1},
static\_cast < int > (operator*(heapIs $heap_{funcstart\_1032,1}, this).p3),
\mathbf{static\_cast} < \mathbf{int} > (\$ \mathbf{heap}_{funcstart\_1032,1}.\mathbf{a3}))
(asType<integer>(static_cast<int>(operator*(heapIs
heap_{funcstart\_1032,1}, this).p3)) /
asType < integer > (static\_cast < int > (\$heap_{funcstart\_1032.1}.a3))) = =
asType<integer>(div3.quot)
(asType<integer>(static_cast<int>(operator*(heapIs
heap_{funcstart\_1032,1}, this).p3)
\mathbf{asType} < \mathbf{integer} > (\mathbf{static\_cast} < \mathbf{int} > (\$ \mathbf{heap}_{funcstart\_1032,1}.\mathbf{a3}))) = =
asType<integer>(div3.rem)
(asType < integer > (operator*(heapIs $heap_{funcstart\_1032,1}, this).p3) < footnote{the content of the conte
asType < integer > (\$heap_{funcstart\_1032,1}.a3)) = >
(asType<integer>(div3.rem) == asType<integer>(operator*(heapIs
heap_{funcstart=1032.1}, this).p3)
(asType < integer > (\$heap_{funcstart\_1032,1}.a3) \le
```

```
asType < integer > (operator*(heapIs $heap_{funcstart\_1032.1}, this).p3)) = >
!(0 == asType < integer > (div3.quot))
Proof:
[Take given term]
[34.0] div3 == div(heapIs $heap_{funcstart\_1032,1},
static_cast<int>(operator*(heapIs $heap_{funcstart\_1032,1}, this).p3),
static\_cast < int > (\$heap_{funcstart\_1032,1}.a3))
→ [expand definition of operator '*' in class 'pointer' at built in declaration]
[34.1] \operatorname{div3} == \operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_1032,1},
static\_cast < int > (this. r.value(heapIs $heap_{funcstart\_1032,1}).p3),
\mathbf{static\_cast}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_1032,1}.\mathrm{a3}))
\rightarrow [simplify]
[34.2] \text{ div3} == \text{div(heapIs $heap}_{funcstart\_1032,1}, \text{ this.} \$r. \text{value(heapIs)}
\theta_{funcstart\_1032,1}.p3, \theta_{funcstart\_1032,1}.p3, \theta_{funcstart\_1032,1}.a3))
\rightarrow [const static or extern object]
[34.3] div3 == div(heapIs heapIs  heap_{funcstart\_1032,1}, this.r.value(heapIs)
\theta_{tuncstart\_1032,1}.p3, \theta_{tuncstart\_1032,1}.p4, \theta_{tuncstart\_1032,1}.p4, \theta_{tuncstart\_1032,1}.p4, \theta_{tuncstart\_1032,1
\rightarrow [expand definition of constant 'a3' at prang.cpp (40,26)]
[34.4] div3 == div(heapIs heapIs heapIs _{funcstart\_1032,1}, this.r.value(heapIs)
\theta_{funcstart\_1032,1}, p3, \theta_{funcstart\_1032,1}, p3, \theta_{funcstart\_1032,1}
\rightarrow [simplify]
[34.6] div3 == div(heapIs $heap_{funcstart\_1032,1}, this.$r.value(heapIs)
heap_{funcstart\_1032,1}.p3, 178)
[Take goal term]
[1.0]!(0 == asType < integer > (div3.rem)) || !(0 ==
asType<integer>(div3.quot))
\rightarrow [from term 34.6, div3 is equal to div(heapIs $heap_{funcstart\_1032,1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p3, 178)]
[1.1]!(0 == asType < integer) (div(heapIs $heap_{funcstart\_1032,1},
this.$r.value(heapIs heap_{funcstart\_1032,1}).p3, 178).rem)) || !(0 ==
asType<integer>(div3.quot))
\rightarrow [simplify]
[1.2]!(0 == div(\mathbf{heapIs} \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}))
\frac{\text{sheap}_{funcstart\_1032,1}.p3, 178.rem}{\text{l}} || !(0 == asType < integer > (div3.quot))
\rightarrow [from term 34.6, div3 is equal to div(heapIs $heap_{funcstart\_1032,1},
this.r.value(heapIs $heap_{funcstart\_1032,1}).p3, 178)
[1.3]!(0 == \text{div}(\text{heapIs } \text{heap}_{funcstart\_1032.1}, \text{this.}\text{$r.value}(\text{heapIs}))
```

```
\theta_{uncstart_1032,1}.p3, 178).rem) || !\theta = asType < integer > (div(heapIs))
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p3,
178).quot))
\rightarrow [simplify]
[1.5]!(0 == \text{div}(\text{heapIs } \text{heap}_{funcstart\_1032,1}, \text{this.}\text{$r.value}(\text{heapIs}))
\text{Sheap}_{funcstart\_1032,1}.p3, 178).quot) \vee !(0 == \text{div}(\text{heapIs})
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p3,
178).rem)
\rightarrow [negate goal and search for contradiction]
[1.6] (0 == \operatorname{div}(\mathbf{heapIs} \ \mathbf{heap}_{funcstart\_1032,1}, \ \mathbf{this}.\mathbf{r.value}(\mathbf{heapIs})
\text{Sheap}_{funcstart\_1032.1}.p3, 178).quot) \land (0 == div(heapIs \text{Sheap}_{funcstart\_1032.1},
this.r.value(heapIs $heap_{funcstart\_1032,1}).p3, 178).rem)
\rightarrow [separate conjunction and work on first sub-term]
[1.7] 0 == \operatorname{div}(\mathbf{heapIs} \ \mathbf{heap}_{funcstart\_1032,1}, \ \mathbf{this}.\mathbf{r.value}(\mathbf{heapIs})
heap_{funcstart_{1032,1}}.p3, 178.quot
[Assume known post-assertion, class invariant or type constraint for term 34.6]
[39.0] (0 < asType<integer>(this.$r.value(heapIs
\theta_{funcstart\_1032,1}.p3) && (asType<integer>(this.$r.value(heapIs)
\theta_{funcstart\_1032,1}.p3 < asType<integer>(\theta_{funcstart\_1032,1}.p3) < asType<integer>(\theta_{funcstart\_1032,1}.p3)
M3))
\rightarrow [simplify]
[39.2] (0 < this.$r.value(heap
Is $heap_{funcstart\_1032,1}).p3) &&
(this.$r.value(heapIs heap_{funcstart\_1032,1}).p3 <
asType < integer > (\text{$heap.class WHPrang} \in M3))
\rightarrow [const static or extern object]
[39.3] (0 < this.$r.value(heapIs \rho_{funcstart\_1032,1}).p3) &&
(this.r.value(heapIs $heap_{funcstart\_1032,1}).p3 <
asType < integer > (\$heap_{init}.class WHPrang \in M3))
\rightarrow [expand definition of constant 'M3' at prang.cpp (38,26)]
[39.4] (0 < this.$r.value(heapIs heap_{funcstart\_1032,1}).p3) &&
(this.$r.value(heapIs heap_{funcstart\_1032,1}).p3 <
asType < integer > ((int)30323))
\rightarrow [simplify]
[39.10] (-30323 < -this.$r.value(heapIs \rho_{tuncstart_{-1032,1}}).p3) \wedge (0 <
this.r.value(heapIs $heap_{funcstart\_1032,1}).p3)
[Work on sub-term 2 of conjunction in term 39.10]
[40.0] 0 < this.$r.value(heapIs \rho_{funcstart\_1032,1}).p3
[Work on sub-term 2 of conjunction in term 1.6]
```

```
[49.0] 0 == div(heapIs $heap<sub>funcstart_1032,1</sub>, this.$r.value(heapIs)
heap_{funcstart\_1032,1}.p3, 178).rem
[Take given term]
[47.0] (asType<integer>(operator*(heapIs $heap_{funcstart\_1032,1}, this).p3)
< asType<integer>($heap_{funcstart\_1032,1}.a3)) =>
(asType<integer>(div3.rem) == asType<integer>(operator*(heapIs
heap_{funcstart\_1032,1}, this).p3)
→ [expand definition of operator '*' in class 'pointer' at built in declaration]
[47.1] \ (\mathbf{asType} < \mathbf{integer} > (\mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs} \ \$ \mathbf{heap}_{funcstart\_1032,1}).\mathbf{p3}) < \mathbf{page}(\mathbf{page}) < \mathbf{page}(\mathbf{page})
asType < integer > (\$heap_{funcstart\_1032,1}.a3)) = >
(\mathbf{asType} < \mathbf{integer} > (\mathbf{div3.rem}) == \mathbf{asType} < \mathbf{integer} > (\mathbf{operator} * (\mathbf{heapIs}))
heap_{funcstart\_1032,1}, this).p3)
\rightarrow [simplify]
[47.2] (this.$r.value(heapIs $heap_{tuncstart\_1032.1}).p3 <
asType < integer > (\$heap_{funcstart\_1032,1}.a3)) = >
(asType<integer>(div3.rem) == asType<integer>(operator*(heapIs
heap_{funcstart\_1032,1}, this).p3)
\rightarrow [const static or extern object]
[47.3] (this.r.value(heapIs \ heap_{funcstart\_1032,1}).p3 <
asType < integer > ($heap_{init}.a3)) => (asType < integer > (div3.rem) ==
\mathbf{asType}{<}\mathbf{integer}{>}(\mathbf{operator}^*(\mathbf{heapIs}\ \$\mathbf{heap}_{funcstart\_1032,1},\ \mathbf{this}).\mathbf{p3}))
\rightarrow [expand definition of constant 'a3' at prang.cpp (40,26)]
[47.4] (this.$r.value(heap
Is \rho_{funcstart\_1032,1}).p3 <
asType < integer > ((int)178)) => (asType < integer > (div3.rem) ==
asType<integer>(operator*(heapIs $heap_{tuncstart\_1032.1}, this).p3))
[47.9] (-178 < -this.$r.value(heapIs $heap<sub>funcstart_1032.1</sub>).p3) =>
(\mathbf{asType} < \mathbf{integer} > (\mathbf{div3.rem}) == \mathbf{asType} < \mathbf{integer} > (\mathbf{operator} * (\mathbf{heapIs}))
heap_{funcstart\_1032,1}, this).p3)
\rightarrow [from term 34.6, div3 is equal to div(heapIs $heap_{funcstart\_1032,1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p3, 178)
[47.10] (-178 < -this.$r.value(heapIs $heap_{funcstart\_1032,1}).p3) =>
(\mathbf{asType} < \mathbf{integer} > (\mathbf{div}(\mathbf{heapIs} \ \$ \mathbf{heap}_{funcstart\_1032,1}, \ \mathbf{this}.\$ \mathbf{r.value}(\mathbf{heapIs} \ \mathsf{heap}_{funcstart\_1032,1}, \ \mathbf{this}.\$ \mathbf{r.value}(\mathbf{heapIs} \ \mathsf{heap}_{funcstart\_1032,1}, \ \mathbf{this}.\$ \mathbf{r.value}(\mathbf{heapIs} \ \mathsf{heap}_{funcstart\_1032,1}, \ \mathbf{this}.\$ \mathbf{r.value}(\mathbf{heapIs}))
heap_{funcstart\_1032,1}.p3, 178.rem = =
asType<integer>(operator*(heapIs $heap_{tuncstart\_1032.1}, this).p3))
\rightarrow [simplify]
[47.11] (-178 < -this.$r.value(heapIs $heap_{funcstart\_1032,1}).p3) =>
(\text{div}(\mathbf{heapIs} \$ \text{heap}_{funcstart\_1032.1}, \mathbf{this}.\$ \text{r.value}(\mathbf{heapIs}))
heap_{funcstart\_1032,1}.p3, 178).rem ==
```

```
\mathbf{asType}{<}\mathbf{integer}{>}(\mathbf{operator}^*(\mathbf{heapIs}\ \$\mathbf{heap}_{funcstart\_1032,1},\ \mathbf{this}).\mathbf{p3}))
→ [expand definition of operator '*' in class 'pointer' at built in declaration]
[47.12] \; (-178 < -\mathbf{this.}\$r.\mathbf{value}(\mathbf{heapIs} \; \$heap_{funcstart\_1032,1}).p3) = >
(\text{div}(\mathbf{heapIs} \$ \text{heap}_{funcstart\_1032,1}, \mathbf{this}.\$ \text{r.value}(\mathbf{heapIs}))
heap_{funcstart_1032,1}.p3, 178).rem ==
asType < integer > (this. r.value(heapIs  heap_{funcstart\_1032,1}).p3))
\rightarrow [simplify]
[47.18] (0 == (-this.$r.value(heapIs $heap_{funcstart\_1032,1}).p3 + div(heapIs)
\$heap_{funcstart\_1032,1}, \ \textbf{this}.\$r. \textbf{value} (\textbf{heapIs} \ \$heap_{funcstart\_1032,1}).p3,
178).rem)) \vee (177 < this.$r.value(heapIs $heap<sub>funcstart_1032.1</sub>).p3)
\rightarrow [from term 49.0, div(heapIs $heap_{funcstart\_1032,1}$, this.$r.value(heapIs)
heap_{funcstart\_1032,1}.p3, 178).rem is equal to 0
[47.19] (0 == (-this.$r.value(heapIs heap_{funcstart\_1032,1}).p3 + 0)) \vee (177)
< this.$r.value(heapIs $heap_{tuncstart\_1032.1}).p3)
\rightarrow [simplify]
[47.20] (0 == -this.$r.value(heapIs $heap_{funcstart\_1032,1}).p3) \vee (177 <
this.r.value(heapIs $heap_{funcstart\_1032,1}).p3)
\rightarrow [from term 40.0, -this.$r.value(heapIs $heap_{funcstart\_1032,1}).p3 ==
literala is false whenever -1 < (0 + literala)
    Proof of rule precondition:
    [47.20.0] -1 < (0 + 0)
    \rightarrow [simplify]
    [47.20.2] true
[47.21] false \lor (177 < this.$r.value(heapIs $heap_{funcstart\_1032,1}).p3)
\rightarrow [simplify]
[47.22] 177 < this.r.value(heapIs $heap_{funcstart\_1032,1}).p3
[Take given term]
[48.0] (asType<integer>($heap_{funcstart\_1032,1}.a3) \leq
\mathbf{asType} < \mathbf{integer} > (\mathbf{operator}^*(\mathbf{heapIs} \ \$ \mathbf{heap}_{funcstart\_1032,1}, \ \mathbf{this}).\mathrm{p3})) = >
!(0 == asType < integer > (div3.quot))
\rightarrow [const static or extern object]
[48.1] (asType<integer>($heap_{init}.a3) \leq
\mathbf{asType} < \mathbf{integer} > (\mathbf{operator}^*(\mathbf{heapIs} \ \$ \mathbf{heap}_{funcstart\_1032,1}, \ \mathbf{this}).\mathrm{p3})) = >
!(0 == asType < integer > (div3.quot))
\rightarrow [expand definition of constant 'a3' at prang.cpp (40,26)]
[48.2] (asType<integer>((int)178) \leq
```

```
asType < integer > (operator*(heapIs $heap_{funcstart\_1032.1}, this).p3)) = >
!(0 == asType < integer > (div3.quot))
\rightarrow [simplify]
[48.4] (178 \leq asType<integer>(operator*(heapIs $heap_{funcstart\_1032,1},
this).p3)) => !(0 == asType < integer > (div3.quot))
→ [expand definition of operator '*' in class 'pointer' at built in declaration]
[48.5] (178 \leq asType<integer>(this.r.value(heapIs)
\verb§heap$_{funcstart\_1032,1}).p3)) => !(0 == \mathbf{asType} < \mathbf{integer} > (\mathbf{div3}.\mathbf{quot}))
\rightarrow [simplify]
[48.8] (177 < this.$r.value(heapIs $heap_{funcstart\_1032,1}).p3) => !(0 ==
asType<integer>(div3.quot))
\rightarrow [from term 34.6, div3 is equal to div(heapIs $heap_{funcstart\_1032,1},
this.$r.value(heapIs $heap_{funcstart\_1032,1}).p3, 178)]
[48.9] (177 < this.$r.value(heapIs $heap_{funcstart\_1032,1}).p3) => !(0 ==
asType<integer>(div(heapIs $heap_{tuncstart\_1032.1}, this.$r.value(heapIs
heap_{funcstart_{1032,1}}.p3, 178).quot)
\rightarrow [simplify]
[48.13]!(0 == div(\mathbf{heapIs} \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})]
\$heap_{funcstart\_1032,1}).p3,\ 178).quot) \lor (-178 < -\mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
heap_{funcstart\_1032,1}.p3
\rightarrow [from term 47.22, literala < -this.$r.value(heapIs
heap_{funcstart\_1032,1}.p3 is false whenever -2 < (177 + literala)
   Proof of rule precondition:
   [48.13.0] - 2 < (-178 + 177)
   \rightarrow [simplify]
   [48.13.2] true
[48.14] false \vee !(0 == div(heapIs \theta) \theta = function for this .$\frac{1}{2}, \text{this.}$\frac{1}{2}, \text{this.}$\frac{1}{2}, \text{this.}$\text{$\text{calue}(heapIs)}$
heap_{funcstart\_1032,1}.p3, 178).quot
\rightarrow [from term 1.7, div(heapIs $heap_{funcstart\_1032,1}$, this.$r.value(heapIs)
$heap_{funcstart\_1032,1}.p3, 178).quot is equal to 0]
[48.15] false \vee !(0 == 0)
\rightarrow [simplify]
[48.18] false
```

Proof of verification condition: Arithmetic result of operator '*' is within limit of type 'signed int'

```
In the context of class: WHPrang, declared at:
C:\Escher\Customers\prang-cpp\prang.cpp (18,1)
Condition generated at: C:\Escher\Customers\prang-cpp\prang.cpp
(74,30)
Condition defined at:
To prove: minof(signed int) \leq ($heap<sub>funcstart_1032,1</sub>.r1 *
static_cast<signed int>(div1.rem))
Given:
heap_{init}.LIMIT == (int)80
heap_{init}.class WHPrang \in M1 == (int)30269
heap_{init}.class WHPrang \in r1 == (int)171
heap_{init}.class WHPrang \in a1 == (int)177
heap_{init}.class WHPrang \in b1 == (int)2
heap_{init}.class WHPrang \in M2 == (int)30307
heap_{init}.class WHPrang \in r2 == (int)172
heap_{init}.class WHPrang \in a2 == (int)176
heap_{init}.class WHPrang \in b2 == (int)35
heap_{init}.class WHPrang \in M3 == (int)30323
heap_{init}.class WHPrang \in r3 == (int)170
heap_{init}.class WHPrang \in a3 == (int)178
heap_{init}.class WHPrang \in b3 == (int)63
\operatorname{div1} == \operatorname{div}(\mathbf{heapIs} \ \operatorname{heap}_{funcstart\_1032,1},
static\_cast < int > (operator^*(heapIs \$heap_{funcstart\_1032,1}, this).p1),
static\_cast < int > (\$heap_{funcstart\_1032,1}.a1))
(asType<integer>(static_cast<int>(operator*(heapIs
heap_{funcstart\_1032,1}, this).p1) /
\mathbf{asType} {<} \mathbf{integer} {>} (\mathbf{static\_cast} {<} \mathbf{int} {>} (\$ \mathbf{heap}_{funcstart\_1032,1}.\mathbf{a1}))) = =
asType<integer>(div1.quot)
(asType<integer>(static_cast<int>(operator*(heapIs
heap_{funcstart\_1032,1}, this).p1) %
asType < integer > (static\_cast < int > (\$heap_{funcstart\_1032.1}.a1))) = =
asType<integer>(div1.rem)
(\mathbf{asType}{<}\mathbf{integer}{>}(\mathbf{operator}^*(\mathbf{heapIs}\ \$\mathbf{heap}_{funcstart\_1032,1},\ \mathbf{this}).\mathtt{p1}) <
asType < integer > (\$heap_{tuncstart=1032.1}.a1)) = >
(asType<integer>(div1.rem) == asType<integer>(operator*(heapIs
heap_{funcstart\_1032,1}, this).p1)
```

```
(\mathbf{asType} < \mathbf{integer} > (\$ \mathbf{heap}_{funcstart\_1032,1}.\mathbf{a1}) \le
asType < integer > (operator*(heapIs $heap_{funcstart\_1032,1}, this).p1)) = >
!(0 == asType < integer > (div1.quot))
!(0 == asType < integer > (div1.rem)) || !(0 ==
asType<integer>(div1.quot))
div2 == div(\mathbf{heapIs} \$ heap_{funcstart\_1032,1},
static\_cast < int > (operator*(heapIs $heap_{funcstart\_1032,1}, this).p2),
\mathbf{static\_cast}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_1032,1}.\mathrm{a2}))
(asType < integer > (static\_cast < int > (operator*(heapIs
heap_{funcstart\_1032,1}, this).p2)
asType < integer > (static\_cast < int > (\$heap_{funcstart\_1032.1}.a2))) = =
asType<integer>(div2.quot)
(asType<integer>(static_cast<int>(operator*(heapIs
heap_{funcstart\_1032,1}, this).p2)
asType < integer > (static\_cast < int > (\$heap_{funcstart\_1032.1}.a2))) = =
asType<integer>(div2.rem)
(asType<integer>(operator*(heapIs $heap_{tuncstart\_1032.1}, this).p2) <
asType < integer > (\$heap_{funcstart\_1032,1}.a2)) = >
(asType<integer>(div2.rem) == asType<integer>(operator*(heapIs
heap_{funcstart\_1032.1}, this).p2)
(asType < integer > (\$heap_{funcstart\_1032,1}.a2) \le
\mathbf{asType} < \mathbf{integer} > (\mathbf{operator}^*(\mathbf{heapIs} \ \$ \mathbf{heap}_{funcstart\_1032,1}, \ \mathbf{this}).\mathtt{p2})) = >
!(0 == asType < integer > (div2.quot))
!(0 == asType < integer > (div2.rem)) || !(0 ==
asType<integer>(div2.quot))
div3 == div(\mathbf{heapIs} \$ heap_{funcstart\_1032,1},
static\_cast < int > (operator*(heapIs $heap_{funcstart\_1032,1}, this).p3),
\mathbf{static\_cast} < \mathbf{int} > (\$ \mathbf{heap}_{funcstart\_1032,1}.\mathbf{a3}))
(asType<integer>(static_cast<int>(operator*(heapIs
heap_{funcstart\_1032,1}, this).p3) /
asType < integer > (static\_cast < int > (\$heap_{funcstart\_1032.1}.a3))) = =
asType<integer>(div3.quot)
(asType<integer>(static_cast<int>(operator*(heapIs
heap_{funcstart\_1032,1}, this).p3)
\mathbf{asType} < \mathbf{integer} > (\mathbf{static\_cast} < \mathbf{int} > (\$ \mathbf{heap}_{funcstart\_1032,1}.\mathbf{a3}))) = =
asType<integer>(div3.rem)
(asType < integer > (operator*(heapIs $heap_{funcstart\_1032,1}, this).p3) < footnote{the content of the conte
asType < integer > (\$heap_{funcstart\_1032,1}.a3)) = >
(asType<integer>(div3.rem) == asType<integer>(operator*(heapIs
heap_{funcstart=1032.1}, this).p3)
(asType < integer > (\$heap_{funcstart\_1032,1}.a3) \le
```

```
asType < integer > (operator*(heapIs $heap_{funcstart\_1032.1}, this).p3)) = >
!(0 == asType < integer > (div3.quot))
!(0 == asType < integer > (div3.rem)) || !(0 ==
asType<integer>(div3.quot))
Proof:
[Take given term]
[2.0] \operatorname{div1} == \operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_1032,1},
static_cast<int>(operator*(heapIs $heap_{funcstart\_1032.1}, this).p1),
\mathbf{static\_cast}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_1032,1}.\mathrm{a1}))
→ [expand definition of operator '*' in class 'pointer' at built in declaration]
[2.1] \text{ div1} == \text{div}(\mathbf{heapIs} \$ heap_{funcstart\_1032,1},
static_cast<int>(this.$r.value(heapIs $heap_{tuncstart\_1032.1}).p1),
static\_cast < int > (\$heap_{funcstart\_1032.1}.a1))
\rightarrow [simplify]
[2.2] \operatorname{div1} == \operatorname{div}(\mathbf{heapIs} \$ \mathbf{heap}_{funcstart\_1032,1}, \mathbf{this}.\$ \mathbf{r.value}(\mathbf{heapIs})
\theta_{funcstart\_1032,1}.p1, \theta_{funcstart\_1032,1}.p1, \theta_{funcstart\_1032,1}.a1))
\rightarrow [const static or extern object]
[2.3] \operatorname{div1} == \operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_1032,1}, \mathbf{this}.\$ r. \mathbf{value}(\mathbf{heapIs})
\theta_{funcstart\_1032,1}.p1, \theta_{funcstart\_1032,1}.p1, \theta_{funcstart\_1032,1}.p1, \theta_{funcstart\_1032,1}.p1
\rightarrow [expand definition of constant 'a1' at prang.cpp (30,26)]
[2.4] \operatorname{div1} == \operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_1032,1}, \mathbf{this}.\$ r. \mathbf{value}(\mathbf{heapIs})
\theta_{uncstart\_1032,1}.p1, \theta_{uncstart\_1032,1}.p1, \theta_{uncstart\_1032,1}.p1
\rightarrow [simplify]
[2.6] \operatorname{div1} == \operatorname{div}(\mathbf{heapIs} \ \mathbf{\$heap}_{funcstart\_1032,1}, \ \mathbf{this}.\mathbf{\$r.value}(\mathbf{heapIs})
heap_{funcstart\_1032,1}.p1, 177)
[Take goal term]
[1.0] minof(signed int) \leq ($heap_{tuncstart\_1032,1}.r1 * static_cast < signed
int>(div1.rem))
\rightarrow [simplify]
[1.1] -32768 \leq ($heap<sub>funcstart_1032,1</sub>.r1 * static_cast<signed int>(div1.rem))
\rightarrow [const static or extern object]
[1.2] -32768 \leq ($heap<sub>init</sub>.r1 * static_cast<signed int>(div1.rem))
→ [expand definition of constant 'r1' at prang.cpp (29,26)]
[1.3] -32768 \leq ((int)171 * static_cast\leqsigned int\geq(div1.rem))
\rightarrow [simplify]
[1.4] -32768 \leq (171 * static_cast < signed int > (div1.rem))
```

```
\rightarrow [from term 2.6, div1 is equal to div(heapIs $heap_{funcstart\_1032,1},
this.r.value(heapIs \ \$heap_{funcstart\_1032,1}).p1, \ 177)]
[1.5] -32768 \leq (171 * static_cast<signed int>(div(heapIs)
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).rem))
\rightarrow [simplify]
[1.8] -32769 < (171 * div(\mathbf{heapIs} \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}))
heap_{funcstart_{-1032,1}}.p1, 177).rem
\rightarrow [literal comparison of product]
[1.9] ([171 < 0]: (-32769 / -171) < -\text{div}(\mathbf{heapIs} \$heap_{funcstart\_1032,1},
this.$r.value(heapIs heap_{funcstart\_1032,1}).p1, 177).rem, [0 < 171]: (-32769 /
171) < div(heapIs $heap<sub>funcstart_1032,1</sub>, this.$r.value(heapIs)
\text{Sheap}_{funcstart\_1032,1}).p1, 177).rem, [0 == 171]: -32769 < 0)
→ [explicitly assert falsehood of skipped guards in subsequent guards]
[1.10] ([171 < 0]: (-32769 / -171) < -\text{div}(\mathbf{heapIs} \$ heap_{funcstart\_1032,1},
this.$r.value(heapIs heap_{funcstart\_1032,1}).p1, 177).rem, [(0 < 171) \land!(171 <
0)]: (-32769 / 171) < \text{div}(\text{heapIs } \text{heap}_{funcstart\_1032,1}, \text{this.}\text{$r.value}(\text{heapIs}))
\text{Sheap}_{funcstart\_1032,1}).p1, 177).rem, [(0 == 171) \land !(0 < 171) \land !(171 < 0)]:
-32769 < 0
\rightarrow [simplify]
[1.18] -192 < div(heapIs heap_{funcstart\_1032,1}, this.r.value(heapIs)
heap_{funcstart_{-1032,1}}.p1, 177).rem
\rightarrow [negate goal and search for contradiction]
[1.19]!(-192 < div(heapIs heap_{funcstart\_1032,1}, this.r.value(heapIs)
heap_{funcstart\_1032,1}.p1, 177).rem
\rightarrow [simplify]
[1.21] 191 < -\text{div}(\mathbf{heapIs} \$ \mathbf{heap}_{funcstart\_1032,1}, \mathbf{this}.\$ \mathbf{r.value}(\mathbf{heapIs})
heap_{funcstart\_1032,1}.p1, 177).rem
[Assume known post-assertion, class invariant or type constraint for term 2.6]
[7.0] (0 < asType<integer>(this.\r.value(heapIs
\theta_{funcstart_1032.1}.p1) && (asType<integer>(this.$r.value(heapIs)
\verb§heap$_{funcstart\_1032,1}).p1) < \mathbf{asType} < \mathbf{integer} > (\$ heap.\mathbf{class} \ WHPrang \in \texttt{Prang}) = \texttt{Prang} + \texttt{Prang}
M1))
\rightarrow [simplify]
[7.2] (0 < this.$r.value(heap
Is \rho_{funcstart\_1032,1}).p1) &&
(this.r.value(heapIs $heap_{funcstart\_1032,1}).p1 <
asType < integer > (\text{$heap.class WHPrang} \in M1))
```

 \rightarrow [const static or extern object]

```
[7.3] (0 < this.$r.value(heapIs $heap_{funcstart\_1032,1}).p1) &&
(this.$r.value(heapIs \theta_{funcstart\_1032,1}).p1 <
asType < integer > (\$heap_{init}.class WHPrang \in M1))
\rightarrow [expand definition of constant 'M1' at prang.cpp (28,26)]
[7.4] (0 < this.$r.value(heap
Is $heap_{funcstart\_1032,1}).p1) &&
(this.r.value(heapIs $heap_{funcstart\_1032,1}).p1 <
asType < integer > ((int)30269))
\rightarrow [simplify]
[7.10] (-30269 < -this.$r.value(heapIs heap_{funcstart\_1032,1}).p1) \land (0 <
this.r.value(heapIs $heap_{funcstart\_1032,1}).p1)
[Work on sub-term 2 of conjunction in term 7.10]
[8.0] 0 < this.$r.value(heapIs $heap_{tuncstart\_1032.1}).p1
[Assume known post-assertion, class invariant or type constraint for term 2.6]
[10.0] (asType<integer>(this.$r.value(heapIs \rho_{tuncstart\_1032.1}).p1) %
asType<integer>(177)) == asType<integer>(div(heapIs
\rho_{tuncstart\_1032.1}, this.r.value(heapIs \rho_{tuncstart\_1032.1}).p1,
177).rem)
\rightarrow [simplify]
asType<integer>(div(heapIs $heap_{funcstart\_1032,1}, this.$r.value(heapIs
heap_{funcstart\_1032,1}.p1, 177).rem
→ [expand definition of operator '.%' in class 'int' at built in declaration]
{\it [10.3]}~([{\bf asType}{<}{\bf integer}{>}({\bf this.\$r.value}({\bf heapIs}~\${\bf heap}_{funcstart\_1032,1}).{\bf p1})<
0]: -(-asType < integer > (this.\$r.value(heapIs \$heap_{funcstart\_1032,1}).p1) \%
177), \parallel: asType<integer>(this.$r.value(heapIs \theta_{funcstart\_1032,1}).p1)
\% 177) == asType<integer>(div(heapIs $heap_{tuncstart\_1032,1},
this.r.value(heapIs $heap_{funcstart\_1032,1}).p1, 177).rem)
→ [explicitly assert falsehood of skipped guards in subsequent guards]
[10.4] ([asType<integer>(this.$r.value(heapIs $heap_{funcstart\_1032.1}).p1) <
0]: -(-asType < integer > (this. r.value(heapIs  heap_{funcstart\_1032,1}).p1) \%
177), [!(asType < integer > (this. r.value(heapIs <math>heapIs heap_{funcstart\_1032,1}).p1) < ]
0)]: asType<integer>(this.r.value(heapIs \heap_{funcstart\_1032,1}).p1) %
177) == asType<integer>(div(heapIs heap_{funcstart\_1032,1},
this.r.value(heapIs $heap_{funcstart\_1032,1}).p1, 177).rem)
\rightarrow [simplify]
[10.7] ([0 < -this.$r.value(heapIs $heap_{tuncstart\_1032.1}).p1]:
-(-asType < integer > (this. r.value(heapIs  heap_{funcstart\_1032,1}).p1) \%
177), [!(asType<integer>(this.$r.value(heapIs $heap_{tuncstart\_1032.1}).p1) <
0)]: asType<integer>(this.$r.value(heapIs \theta_{funcstart\_1032,1}).p1) %
```

```
177) == asType < integer > (div(heapIs $heap_{funcstart\_1032,1},
\mathbf{this.\$r.value}(\mathbf{heapIs}~\$\mathrm{heap}_{funcstart\_1032,1}).\mathrm{p1},~177).\mathrm{rem})
\rightarrow [from term 8.0, literala < -this.$r.value(heapIs $heap_{funcstart\_1032,1}).p1
is false whenever -2 < (0 + literala)
       Proof of rule precondition:
       [10.7.0] - 2 < (0 + 0)
       \rightarrow [simplify]
       [10.7.2] true
[10.8] ([false]: -(-asType<integer>(this.$r.value(heapIs
\rho_{funcstart\_1032,1}.p1) \% 177, [!(asType<integer>(this.$r.value(heapIs)
\verb§heap$_{funcstart\_1032,1}).p1) < 0)]: \textbf{ asType} < \textbf{integer} > (\textbf{this}.\$r.\textbf{value}(\textbf{heapIs})))
\theta_{funcstart\_1032.1}.p1) % 177) == asType<integer>(div(heapIs)
\rho_{tuncstart\_1032.1}, this.r.value(heapIs \rho_{tuncstart\_1032.1}).p1,
177).rem)
\rightarrow [simplify]
[10.11] ([false]: -(-asType < integer > (this. r.value(heapIs))
\rho_{funcstart\_1032,1}.p1) \%177), [!(0 < -this.$r.value(heapIs
\rho_{uncstart\_1032,1}.p1): asType<integer>(this.$r.value(heapIs)
\theta_{funcstart\_1032,1}.p1) \% 177 == asType < integer > (div(heapIs)) % 1
\theta_{funcstart\_1032,1}, this.r.value(heapIs \theta_{funcstart\_1032,1}).p1,
177).rem)
\rightarrow [from term 8.0, literala < -this.$r.value(heapIs $heap_{funcstart\_1032,1}).p1
is false whenever -2 < (0 + literala)
       Proof of rule precondition:
       [10.11.0] - 2 < (0 + 0)
       \rightarrow [simplify]
       [10.11.2] true
[10.12] ([false]: -(-asType<integer>(this.$r.value(heapIs
heap_{funcstart_{1032,1}}.p1) \% 177, [!false]:
asType<integer>(this.$r.value(heapIs $heap_{funcstart\_1032,1}).p1) % 177)
== asType < integer > (div(heapIs $heap_{funcstart\_1032,1},
this.r.value(heapIs $heap_{funcstart\_1032,1}).p1, 177).rem)
\rightarrow [simplify]
[10.17] 0 == (-\text{div}(\mathbf{heapIs} \$ \text{heap}_{funcstart\_1032,1}, \mathbf{this}.\$ r.\mathbf{value}(\mathbf{heapIs}))
\theta_{tuncstart_1032,1}.p1, 177).rem + (this.r.value(heapIs)
heap_{funcstart_{1032,1}}.p1 \% 177)
[Create new term from terms 1.21, 10.17 using rule: transitivity 15]
[60.0] (0 + 191) < -(this.$r.value(heapIs $heap_{funcstart\_1032,1}).p1 % 177)
```

```
[60.2] false
Proof of verification condition: Arithmetic result of operator '*' is within
limit of type 'signed int'
In the context of class: WHPrang, declared at:
C:\Escher\Customers\prang-cpp\prang.cpp (18,1)
Condition generated at: C:\Escher\Customers\prang-cpp\prang.cpp
(74,30)
Condition defined at:
To prove: ($heap_{tuncstart\_1032.1}.r1 * static_cast<signed int>(div1.rem)) \le \text{...}
maxof(signed int)
Given:
heap_{init}.LIMIT == (int)80
heap_{init}.class WHPrang \in M1 == (int)30269
heap_{init}.class WHPrang \in r1 == (int)171
heap_{init}.class WHPrang \in a1 == (int)177
heap_{init}.class WHPrang \in b1 == (int)2
heap_{init}.class WHPrang \in M2 == (int)30307
heap_{init}.class WHPrang \in r2 == (int)172
heap_{init}.class WHPrang \in a2 == (int)176
heap_{init}.class WHPrang \in b2 == (int)35
heap_{init}.class WHPrang \in M3 == (int)30323
heap_{init}.class WHPrang \in r3 == (int)170
heap_{init}.class WHPrang \in a3 == (int)178
heap_{init}.class WHPrang \in b3 == (int)63
\operatorname{div1} == \operatorname{div}(\mathbf{heapIs} \ \text{$heap}_{funcstart\_1032,1},
\mathbf{static\_cast} {<} \mathbf{int} {>} (\mathbf{operator}^*(\mathbf{heapIs}\ \$ \mathbf{heap}_{funcstart\_1032,1},\ \mathbf{this}).\mathtt{p1}),
static\_cast < int > (\$heap_{funcstart\_1032,1}.a1))
(asType<integer>(static_cast<int>(operator*(heapIs
heap_{funcstart\_1032,1}, this).p1) /
\mathbf{asType} {<} \mathbf{integer} {>} (\mathbf{static\_cast} {<} \mathbf{int} {>} (\$ \mathbf{heap}_{funcstart\_1032,1}.\mathbf{a1}))) = =
asType<integer>(div1.quot)
(asType < integer > (static\_cast < int > (operator*(heapIs)))
heap_{funcstart_1032.1}, this).p1)
\mathbf{asType} {<} \mathbf{integer} {>} (\mathbf{static\_cast} {<} \mathbf{int} {>} (\$ \mathbf{heap}_{funcstart\_1032,1}.\mathbf{a1}))) = =
```

 \rightarrow [simplify]

```
asType<integer>(div1.rem)
(asType<integer>(operator*(heapIs $heap_{funcstart\_1032,1}, this).p1) <
asType < integer > (\$heap_{funcstart\_1032,1}.a1)) = >
(asType<integer>(div1.rem) == asType<integer>(operator*(heapIs
heap_{funcstart\_1032.1}, this).p1)
(asType < integer > (\$heap_{funcstart\_1032,1}.a1) \le
asType < integer > (operator*(heapIs $heap_{funcstart\_1032,1}, this).p1)) = >
!(0 == asType < integer > (div1.quot))
!(0 == asType < integer > (div1.rem)) || !(0 ==
asType<integer>(div1.quot))
div2 == div(\mathbf{heapIs} \$ heap_{funcstart\_1032.1},
static_cast<int>(operator*(heapIs $heap_{funcstart_1032.1}, this).p2),
\mathbf{static\_cast}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_1032,1}.\mathrm{a2}))
(asType < integer > (static\_cast < int > (operator*(heapIs
heap_{funcstart\_1032.1}, this).p2)
\mathbf{asType} < \mathbf{integer} > (\mathbf{static\_cast} < \mathbf{int} > (\$ \mathbf{heap}_{funcstart\_1032,1}.\mathbf{a2}))) = =
asType<integer>(div2.quot)
(asType<integer>(static_cast<int>(operator*(heapIs
heap_{funcstart\_1032,1}, this).p2) %
asType < integer > (static\_cast < int > (\$heap_{funcstart\_1032,1}.a2))) = =
asType<integer>(div2.rem)
(asType < integer > (operator*(heapIs $heap_{funcstart\_1032,1}, this).p2) < footnote{the content of the conte
asType < integer > (\$heap_{funcstart\_1032,1}.a2)) = >
(asType<integer>(div2.rem) == asType<integer>(operator*(heapIs
heap_{funcstart\_1032,1}, this).p2)
(asType < integer > (\$heap_{funcstart\_1032,1}.a2) \le
asType < integer > (operator*(heapIs $heap_{funcstart\_1032,1}, this).p2)) =>
!(0 == asType < integer > (div2.quot))
!(0 == asType < integer > (div2.rem)) || !(0 ==
asType<integer>(div2.quot))
div3 == div(\mathbf{heapIs} \$ heap_{funcstart\_1032,1},
static_cast<int>(operator*(heapIs $heap_{funcstart\_1032.1}, this).p3),
static\_cast < int > (\$heap_{funcstart\_1032,1}.a3))
(asType<integer>(static_cast<int>(operator*(heapIs
heap_{funcstart\_1032,1}, this).p3)
\mathbf{asType} {<} \mathbf{integer} {>} (\mathbf{static\_cast} {<} \mathbf{int} {>} (\$ \mathbf{heap}_{funcstart\_1032,1}.\mathbf{a3}))) = =
asType<integer>(div3.quot)
(asType<integer>(static_cast<int>(operator*(heapIs
heap_{funcstart\_1032,1}, this).p3)
asType < integer > (static\_cast < int > (\$heap_{funcstart\_1032.1}.a3))) = =
asType<integer>(div3.rem)
```

```
(\mathbf{asType}{<}\mathbf{integer}{>}(\mathbf{operator}^*(\mathbf{heapIs}\ \$\mathbf{heap}_{funcstart\_1032,1},\ \mathbf{this}).\mathrm{p3}) <
asType < integer > (\$heap_{funcstart\_1032,1}.a3)) = >
(asType<integer>(div3.rem) == asType<integer>(operator*(heapIs
heap_{funcstart\_1032,1}, this).p3)
(asType < integer > (\$heap_{funcstart\_1032.1}.a3) \le
\mathbf{asType}{<}\mathbf{integer}{>}(\mathbf{operator*}(\mathbf{heapIs}\ \$\mathbf{heap}_{funcstart\_1032,1},\ \mathbf{this}).\mathrm{p3})) =>
!(0 == asType < integer > (div3.quot))
!(0 == asType < integer > (div3.rem)) || !(0 ==
asType<integer>(div3.quot))
Proof:
[Take given term]
[2.0] div1 == div(heapIs $heap_{funcstart\_1032,1},
static\_cast < int > (operator*(heapIs $heap_{funcstart\_1032,1}, this).p1),
\mathbf{static\_cast}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_1032,1}.\mathrm{a1}))
→ [expand definition of operator '*' in class 'pointer' at built in declaration]
[2.1] \operatorname{div1} == \operatorname{div}(\mathbf{heapIs} \ \text{$heap}_{funcstart\_1032,1},
\mathbf{static\_cast} < \mathbf{int} > (\mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs} \$ \mathbf{heap}_{funcstart\_1032,1}).p1),
static\_cast < int > (\$heap_{funcstart\_1032,1}.a1))
\rightarrow [simplify]
[2.2] \operatorname{div1} == \operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_1032,1}, \mathbf{this}.\$ r. \mathbf{value}(\mathbf{heapIs}))
\theta_{funcstart\_1032,1}.p1, \theta_{funcstart\_1032,1}.a1)
\rightarrow [const static or extern object]
[2.3] \operatorname{div1} == \operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_1032,1}, \mathbf{this}.\$ r. \mathbf{value}(\mathbf{heapIs})
\$ heap_{funcstart\_1032,1}).p1, \ \mathbf{static\_cast} < \mathbf{int} > (\$ heap_{init}.a1))
\rightarrow [expand definition of constant 'a1' at prang.cpp (30,26)]
[2.4] \text{ div1} == \text{div}(\text{heapIs } \text{heap}_{funcstart\_1032,1}, \text{this.}\text{\$r.value}(\text{heapIs})
\theta_{funcstart\_1032,1}.p1, \theta_{funcstart\_1032,1}.p1, \theta_{funcstart\_1032,1}.p1, \theta_{funcstart\_1032,1}.p1, \theta_{funcstart\_1032,1}.p1, \theta_{funcstart\_1032,1}.p1, \theta_{funcstart\_1032,1}.p2, \theta_{funcstart\_1032,1}.p2, \theta_{funcstart\_1032,1}.p2, \theta_{funcstart\_1032,1}.p2, \theta_{funcstart\_1032,1}.p2, \theta_{funcstart\_1032,1}.p3, \theta_{funcstart\_1032,1}.p4, \theta_{funcstart\_1032,1}.p4, \theta_{funcstart\_1032,1}.p4, \theta_{funcstart\_1032,1}.p4, \theta_{funcstart\_1032,1}.p5, \theta_{funcstart\_1032,1}.p5, \theta_{funcstart\_1032,1}.p5, \theta_{funcstart\_1032,1}.p5, \theta_{funcstart\_1032,1}.p5, \theta_{funcstart\_1032,1}.p5, \theta_{funcstart\_1032,1}.p5, \theta_{funcstart\_1032,1}.p5, \theta_{funcstart\_1032,1}.p5, \theta_{funcstart\_1032,1
\rightarrow [simplify]
[2.6] div1 == div(heapIs $heap_{funcstart\_1032,1}, this.$r.value(heapIs)
heap_{funcstart_{1032,1}}.p1, 177)
[Take goal term]
[1.0] (\theta_{1.0}) (\theta_{1.0}) (\theta_{1.0}) (\theta_{1.0}) (\theta_{1.0}) (\theta_{1.0}) (\theta_{1.0}) (\theta_{1.0})
maxof(signed int)
\rightarrow [const static or extern object]
[1.1] \; (\$ heap_{init}.r1 \; * \; \textbf{static\_cast} < \textbf{signed int} > (div1.rem)) \leq \textbf{maxof}(\textbf{signed})
\rightarrow [expand definition of constant 'r1' at prang.cpp (29,26)]
```

```
[1.2] ((int)171 * static_cast<signed int>(div1.rem)) < maxof(signed int)
\rightarrow [simplify]
[1.3] (171 * static_cast<signed int>(div1.rem)) < maxof(signed int)
\rightarrow [from term 2.6, div1 is equal to div(heapIs $heap_{funcstart\_1032,1},
\mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}~\$heap_{funcstart\_1032,1}).p1,~177)]
[1.4] (171 * static_cast<signed int>(div(heapIs $heap_funcstart_1032,1,
this.$r.value(heapIs \theta_{funcstart\_1032,1}).p1, 177).rem)) \leq \max f(signed)
\rightarrow [simplify]
[1.15] -32768 < (-171 * div(heapIs $heap_{funcstart\_1032,1}, this.$r.value(heapIs)
heap_{funcstart\_1032,1}.p1, 177).rem
\rightarrow [literal comparison of product]
[1.16] ([-171 < 0]: (-32768 / 171) < -\text{div}(\mathbf{heapIs} \ \$ heap_{funcstart\_1032.1},
this.$r.value(heapIs \rho_{tart_1032,1}).p1, 177).rem, [0 < -171]: (-32768 /
-171) < div(heapIs $heap_{tuncstart\_1032.1}, this.$r.value(heapIs)
\text{Sheap}_{funcstart\_1032,1}.p1, 177).rem, [-171 == 0]: -32768 < 0)
\rightarrow [explicitly assert falsehood of skipped guards in subsequent guards]
[1.17] ([-171 < 0]: (-32768 / 171) < -\text{div}(\mathbf{heapIs} \$ heap_{funcstart\_1032,1},
this.$r.value(heapIs $heap_{funcstart\_1032,1}).p1, 177).rem, [(0 < -171) \land !(-171
< 0)]: (-32768 / -171) < div(heapIs $heap_{funcstart\_1032,1},
this.$r.value(heapIs heap_{funcstart\_1032,1}).p1, 177).rem, [(-171 == 0) \land
!(-171 < 0) \land !(0 < -171)]: -32768 < 0)
\rightarrow [simplify]
[1.21]-192<-{\rm div}({\bf heap Is}\ {\bf \$heap}_{funcstart\_1032,1},\ {\bf this.\$r.value}({\bf heap Is}
heap_{funcstart\_1032,1}.p1, 177).rem
\rightarrow [negate goal and search for contradiction]
[1.22] ! (-192 < -\text{div}(\textbf{heapIs} \$ \text{heap}_{funcstart\_1032,1}, \, \textbf{this}.\$ r. \textbf{value}(\textbf{heapIs})) 
heap_{funcstart_{-1032,1}}.p1, 177).rem
\rightarrow [simplify]
[1.25] 191 < div(heapIs heapIs heap_{funcstart\_1032,1}, this.r.value(heapIs
heap_{funcstart\_1032,1}.p1, 177).rem
[Assume known post-assertion, class invariant or type constraint for term 2.6]
[7.0] (0 < asType<integer>(this.$r.value(heapIs
\label{eq:continuous} $\operatorname{heap}_{funcstart\_1032,1}).p1)) \&\& (\mathbf{asType} < \mathbf{integer} > (\mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}))) \&\& (\mathbf{asType} < \mathbf{integer} > (\mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})))) \&\& (\mathbf{asType} < \mathbf{integer} > (\mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}))))) \&\& (\mathbf{asType} < \mathbf{integer} > (\mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}))))
\theta_{funcstart\_1032,1}.p1 < asType<integer>(\theta_{funcstart\_1032,1}).p1) < asType<integer>(\theta_{funcstart\_1032,1}).p1)
M1))
\rightarrow [simplify]
```

```
[7.2] (0 < this.$r.value(heapIs $heap_{funcstart\_1032,1}).p1) &&
(this.$r.value(heapIs heap_{funcstart\_1032,1}).p1 <
asType < integer > (\$heap.class WHPrang \in M1))
\rightarrow [const static or extern object]
[7.3] (0 < this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1) \&\&
(this.r.value(heapIs $heap_{funcstart\_1032.1}).p1 <
asType < integer > (\text{$heap}_{init}.class WHPrang \in M1))
\rightarrow [expand definition of constant 'M1' at prang.cpp (28,26)]
[7.4] (0 < this.$r.value(heap
Is $heap_{funcstart\_1032,1}).p1) &&
(this.$r.value(heapIs heap_{funcstart\_1032,1}).p1 <
asType<integer>((int)30269))
\rightarrow [simplify]
[7.10] (-30269 < -this.$r.value(heapIs $heap_{funcstart\_1032.1}).p1) \land (0 <
this.$r.value(heapIs $heap_{funcstart\_1032.1}).p1)
[Work on sub-term 2 of conjunction in term 7.10]
[8.0] 0 < this.$r.value(heap
Is \rho_{funcstart\_1032,1}).p1
[Assume known post-assertion, class invariant or type constraint for term 2.6]
[10.0] (asType<integer>(this.$r.value(heapIs heapIs heap_{funcstart\_1032,1}).p1) %
asType<integer>(177)) == asType<integer>(div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).rem)
\rightarrow [simplify]
[10.2] (this.$r.value(heapIs heap_{funcstart\_1032,1}).p1 % 177) ==
asType<integer>(div(heapIs $heap_{tuncstart\_1032,1}, this.$r.value(heapIs
heap_{funcstart\_1032,1}.p1, 177).rem
→ [expand definition of operator '.%' in class 'int' at built in declaration]
{\it [10.3]}~([{\bf asType}{<}{\bf integer}{>}({\bf this.\$r.value}({\bf heapIs}~\${\bf heap}_{funcstart\_1032,1}).{\bf p1})<
0]: -(-asType < integer > (this. r.value(heapIs  heap_{funcstart\_1032,1}).p1) %
177), []: asType<integer>(this.$r.value(heapIs $heap_{funcstart\_1032,1}).p1)
\% 177) == asType<integer>(div(heapIs $heap_{funcstart\_1032,1},
\mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}~\$\mathrm{heap}_{funcstart\_1032,1}).\mathrm{p1},~177).\mathrm{rem})
→ [explicitly assert falsehood of skipped guards in subsequent guards]
[10.4] \; ([\mathbf{asType} < \mathbf{integer} > (\mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs} \; \$ \mathbf{heap}_{funcstart\_1032,1}).\mathbf{p1}) < \mathbf{p1}) 
177), [!(asType<integer>(this.$r.value(heapIs \rho_{tart_{-1032,1}}.p1) < 0.000
0)]: asType<integer>(this.$r.value(heapIs $heap_{tuncstart\_1032.1}).p1) %
177) == asType<integer>(div(heapIs heap_{funcstart\_1032.1}),
this.r.value(heapIs $heap_{funcstart\_1032.1}).p1, 177).rem)
```

```
\rightarrow [simplify]
[10.7] ([0 < -this.$r.value(heapIs $heap<sub>funcstart_1032,1</sub>).p1]:
-(-asType < integer > (this. r.value(heapIs  heap_{funcstart\_1032,1}).p1) \%
177), [!(asType<integer>(this.$r.value(heapIs $heap_{funcstart\_1032,1}).p1) <
0): asType<integer>(this.$r.value(heapIs $heap_{funcstart\_1032.1}).p1) %
177) == asType < integer > (div(heapIs $heap_{funcstart\_1032,1},
this.r.value(heapIs $heap_{funcstart\_1032,1}).p1, 177).rem)
\rightarrow [from term 8.0, literala < -this.$r.value(heapIs $heap_{funcstart\_1032,1}).p1
is false whenever -2 < (0 + literala)
        Proof of rule precondition:
        [10.7.0] - 2 < (0 + 0)
        \rightarrow [simplify]
        [10.7.2] true
[10.8] ([false]: -(-asType<integer>(this.$r.value(heapIs
\rho_{funcstart\_1032,1}.p1) \% 177, [!(asType<integer>(this.$r.value(heapIs)
\theta_{tuncstart_{1032,1}}.p1 < 0: asType<integer>(this.\r.value(heapIs)
\theta_{normalize} = \theta_{normalize
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).rem)
\rightarrow [simplify]
[10.11] ([false]: -(-asType<integer>(this.$r.value(heapIs
heap_{funcstart\_1032,1}.p1) \% 177, [!(0 < -this.$r.value(heapIs)
\rho_{funcstart_{1032,1}}.p1): asType<integer>(this.$r.value(heapIs)
\theta_{funcstart\_1032,1}.p1) % 177) == asType<integer>(div(heapIs)
\rho_{funcstart_1032,1}, this.r.value(heapIs \rho_{funcstart_1032,1}).p1,
177).rem)
\rightarrow [from term 8.0, literala < -this.$r.value(heapIs $heap_{funcstart\_1032.1}).p1
is false whenever -2 < (0 + literala)
        Proof of rule precondition:
        [10.11.0] - 2 < (0 + 0)
        \rightarrow [simplify]
        [10.11.2] true
[10.12] ([false]: -(-asType<integer>(this.$r.value(heapIs
\rho_{funcstart\_1032,1}).p1)~\%~177), [!false]:
asType<integer>(this.$r.value(heapIs $heap_{funcstart\_1032,1}).p1) % 177)
== asType<integer>(div(heapIs $heap_{funcstart_1032,1},
this.r.value(heapIs $heap_{funcstart\_1032,1}).p1, 177).rem)
\rightarrow [simplify]
```

```
[10.17] 0 == (-\text{div}(\mathbf{heapIs} \$ \text{heap}_{funcstart\_1032,1}, \mathbf{this}.\$ \mathbf{r.value}(\mathbf{heapIs}))
\theta_{funcstart\_1032,1}.p1, 177).rem + (this.r.value(heapIs)
heap_{funcstart_{1032,1}}.p1 \% 177)
\rightarrow [remainder is less than divisor]
    Proof of rule precondition:
    [10.17.0] (177 + -\text{div}(\mathbf{heapIs} \ \text{$heap}_{funcstart\_1032,1}, \ \mathbf{this}.\text{$r.value}(\mathbf{heapIs})
    heap_{funcstart\_1032,1}.p1, 177.rem) \le 0
    \rightarrow [simplify]
    [10.17.11] 176 < div(heapIs heap_{funcstart\_1032,1}, this.r.value(heapIs)
    heap_{funcstart\_1032,1}.p1, 177).rem
    \rightarrow [from term 1.25, literala < div(heapIs $heap_{funcstart\_1032,1},
    this.$r.value(heapIs $heap_{funcstart\_1032,1}).p1, 177).rem is true whenever
    (-1 + literala) < 191
        Proof of rule precondition:
        [10.17.11.0](-1 + 176) < 191
        \rightarrow [simplify]
        [10.17.11.2] true
    [10.17.12] true
[10.18] false
limit of type 'signed int'
```

Proof of verification condition: Arithmetic result of operator '*' is within

In the context of class: WHPrang, declared at: C:\Escher\Customers\prang-cpp\prang.cpp (18,1)

Condition generated at: C:\Escher\Customers\prang-cpp\prang.cpp (74,57)

Condition defined at:

To prove: minof(signed int) \leq (\$heap_{funcstart_1032,1}.b1 * static_cast<signed int>(div1.quot))

Given:

```
heap_{init}.LIMIT == (int)80
heap_{init}.class WHPrang \in M1 == (int)30269
heap_{init}.class WHPrang \in r1 == (int)171
heap_{init}.class WHPrang \in a1 == (int)177
heap_{init}.class WHPrang \in b1 == (int)2
heap_{init}.class WHPrang \in M2 == (int)30307
```

```
heap_{init}.class WHPrang \in r2 == (int)172
heap_{init}.class WHPrang \in a2 == (int)176
heap_{init}.class WHPrang \in b2 == (int)35
heap_{init}.class WHPrang \in M3 == (int)30323
heap_{init}.class WHPrang \in r3 == (int)170
heap_{init}.class WHPrang \in a3 == (int)178
heap_{init}.class WHPrang \in b3 == (int)63
\operatorname{div1} == \operatorname{div}(\mathbf{heapIs} \ \operatorname{\$heap}_{funcstart\_1032,1},
\mathbf{static\_cast} {<} \mathbf{int} {>} (\mathbf{operator^*(heapIs}\ \$heap_{funcstart\_1032,1},\ \mathbf{this}).p1),
static\_cast < int > (\$heap_{funcstart\_1032,1}.a1))
(asType<integer>(static_cast<int>(operator*(heapIs
heap_{funcstart\_1032,1}, this).p1) /
asType < integer > (static\_cast < int > (\$heap_{funcstart\_1032,1}.a1))) = =
asType<integer>(div1.quot)
(asType < integer > (static\_cast < int > (operator*(heapIs)))
heap_{funcstart\_1032,1}, this).p1) %
asType<integer>(static_cast<int>($heap_{funcstart_1032.1}.a1))) ==
asType<integer>(div1.rem)
(\mathbf{asType}{<}\mathbf{integer}{>}(\mathbf{operator}^*(\mathbf{heapIs}\ \$\mathbf{heap}_{funcstart\_1032,1},\ \mathbf{this}).\mathtt{p1}) <
asType < integer > (\$heap_{funcstart\_1032,1}.a1)) = >
(asType<integer>(div1.rem) == asType<integer>(operator*(heapIs
heap_{funcstart_{1032,1}}, this).p1)
(\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathsf{heap}_{funcstart\_1032,1}.\mathsf{a1}) \leq
\mathbf{asType}{<}\mathbf{integer}{>}(\mathbf{operator*}(\mathbf{heapIs}\ \$\mathbf{heap}_{funcstart\_1032,1},\ \mathbf{this}).\mathbf{p1})) =>
!(0 == asType < integer > (div1.quot))
!(0 == asType < integer > (div1.rem)) || !(0 ==
asType<integer>(div1.quot))
div2 == div(\mathbf{heapIs} \$ heap_{funcstart\_1032,1},
static\_cast < int > (operator*(heapIs $heap_{funcstart\_1032,1}, this).p2),
\mathbf{static\_cast}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_1032,1}.\mathrm{a2}))
(asType<integer>(static_cast<int>(operator*(heapIs
heap_{funcstart\_1032.1}, this).p2)
\mathbf{asType} < \mathbf{integer} > (\mathbf{static\_cast} < \mathbf{int} > (\$ \mathbf{heap}_{funcstart\_1032,1}.\mathbf{a2}))) = =
asType<integer>(div2.quot)
(asType < integer > (static\_cast < int > (operator*(heapIs)))
heap_{funcstart\_1032,1}, this).p2)
asType < integer > (static\_cast < int > (\$heap_{funcstart\_1032,1}.a2))) = =
asType<integer>(div2.rem)
(\mathbf{asType}{<}\mathbf{integer}{>}(\mathbf{operator}^*(\mathbf{heapIs}\ \$\mathbf{heap}_{funcstart\_1032,1},\ \mathbf{this}).\mathbf{p2})<
```

```
asType < integer > ($heap_{funcstart\_1032,1}.a2)) =>
(asType<integer>(div2.rem) == asType<integer>(operator*(heapIs
heap_{funcstart\_1032,1}, this).p2)
(\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathbf{heap}_{funcstart\_1032,1}.\mathbf{a2}) \leq
asType<integer>(operator*(heapIs $heap_{tuncstart\_1032.1}, this).p2)) =>
!(0 == asType < integer > (div2.quot))
!(0 == asType < integer > (div2.rem)) || !(0 ==
asType<integer>(div2.quot))
div3 == div(\mathbf{heapIs} \$heap_{funcstart\_1032,1},
\mathbf{static\_cast} < \mathbf{int} > (\mathbf{operator}^*(\mathbf{heapIs}\ \$ \mathbf{heap}_{funcstart\_1032,1},\ \mathbf{this}).\mathbf{p3}),
\mathbf{static\_cast}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_1032,1}.\mathrm{a3}))
(asType<integer>(static_cast<int>(operator*(heapIs
heap_{funcstart\_1032,1}, this).p3)) /
asType < integer > (static\_cast < int > (\$heap_{funcstart\_1032.1}.a3))) = =
asType<integer>(div3.quot)
(asType<integer>(static_cast<int>(operator*(heapIs
heap_{funcstart\_1032.1}, this).p3)
asType < integer > (static\_cast < int > (\$heap_{funcstart\_1032.1}.a3))) = =
\mathbf{asType}{<}\mathbf{integer}{>}(\mathbf{div3.rem})
(\mathbf{asType}{<}\mathbf{integer}{>}(\mathbf{operator}^*(\mathbf{heapIs}\ \$\mathbf{heap}_{funcstart\_1032,1},\ \mathbf{this}).\mathrm{p3}) <
asType < integer > (\$heap_{funcstart\_1032,1}.a3)) = >
(asType<integer>(div3.rem) == asType<integer>(operator*(heapIs
heap_{funcstart\_1032,1}, this).p3)
(\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathbf{heap}_{funcstart\_1032,1}.\mathbf{a3}) \leq
asType < integer > (operator*(heapIs $heap_{funcstart\_1032,1}, this).p3)) =>
!(0 == asType < integer > (div3.quot))
!(0 == asType < integer > (div3.rem)) || !(0 ==
asType<integer>(div3.quot))
Proof:
[Take given term]
[2.0] \operatorname{div1} == \operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_1032,1},
\mathbf{static\_cast} < \mathbf{int} > (\mathbf{operator^*(heapIs} \ \$ heap_{funcstart\_1032,1}, \ \mathbf{this}).p1),
\mathbf{static\_cast}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_1032,1}.\mathrm{a1}))
→ [expand definition of operator '*' in class 'pointer' at built in declaration]
[2.1] div1 == div(heapIs $heap_{funcstart\_1032,1},
\mathbf{static\_cast} < \mathbf{int} > (\mathbf{this.\$r.value}(\mathbf{heapIs} \ \$ \mathbf{heap}_{funcstart\_1032,1}).\mathbf{p1}),
\mathbf{static\_cast}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_1032,1}.\mathrm{a1}))
\rightarrow [simplify]
[2.2] \operatorname{div1} == \operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_1032,1}, \mathbf{this.}\$ r. \mathbf{value}(\mathbf{heapIs})
```

```
\theta_{funcstart\_1032,1}.p1, \theta_{funcstart\_1032,1}.a1)
\rightarrow [const static or extern object]
[2.3] div1 == div(heapIs heap_{funcstart\_1032,1}, this.r.value(heapIs)
\theta_{uncstart\_1032,1}.p1, \theta_{uncstart\_1032,1}.p2, \theta_{uncstart\_1032,1}.p3, \theta_{uncstart\_1032,1}.p4, \theta_{uncstart\_1032,1}.p4, \theta_{uncstart\_1032,1}.p4, \theta_{uncstart\_1032
\rightarrow [expand definition of constant 'a1' at prang.cpp (30,26)]
[2.4] \text{ div1} == \text{div}(\text{heapIs } \text{heap}_{funcstart\_1032,1}, \text{this.}\text{\$r.value}(\text{heapIs})
\theta_{funcstart\_1032,1}.p1, \theta_{funcstart\_1032,1}.p1, \theta_{funcstart\_1032,1}.p1, \theta_{funcstart\_1032,1}.p1, \theta_{funcstart\_1032,1}.p1, \theta_{funcstart\_1032,1}.p1, \theta_{funcstart\_1032,1}.p2, \theta_{funcstart\_1032,1}.p2, \theta_{funcstart\_1032,1}.p2, \theta_{funcstart\_1032,1}.p2, \theta_{funcstart\_1032,1}.p2, \theta_{funcstart\_1032,1}.p3, \theta_{funcstart\_1032,1}.p4, \theta_{funcstart\_1032,1}.p4, \theta_{funcstart\_1032,1}.p4, \theta_{funcstart\_1032,1}.p5, \theta_{funcstart\_1032,1
\rightarrow [simplify]
[2.6] \operatorname{div1} == \operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_1032,1}, \mathbf{this.}\$ r. \mathbf{value}(\mathbf{heapIs})
heap_{funcstart_{-1032.1}}.p1, 177
[Take goal term]
[1.0] minof(signed int) \leq ($heap_{funcstart\_1032,1}.b1 * static_cast < signed
int>(div1.quot))
\rightarrow [simplify]
[1.1] -32768 \leq ($heap<sub>funcstart_1032,1</sub>.b1 * static_cast<signed
int>(div1.quot))
\rightarrow [const static or extern object]
\textit{[1.2] -32768} \leq (\$heap_{init}.b1 * \textbf{static\_cast} < \textbf{signed int} > (div1.quot))
\rightarrow [expand definition of constant 'b1' at prang.cpp (31,26)]
[1.3] -32768 \leq ((int)2 * static_cast \leq signed int\geq(div1.quot))
\rightarrow [simplify]
[1.4] -32768 \leq (2 * static_cast\leqsigned int\geq(div1.quot))
\rightarrow [from term 2.6, div1 is equal to div(heapIs $heap_{funcstart\_1032,1},
this.r.value(heapIs $heap_{funcstart\_1032,1}).p1, 177)
[1.5] -32768 \leq (2 * static_cast<signed int>(div(heapIs
\rho_{tuncstart\_1032.1}, this.r.value(heapIs \rho_{tuncstart\_1032.1}).p1,
177).quot))
\rightarrow [simplify]
[1.8] -32769 < (2 * div(heapIs $heap<sub>funcstart_1032,1</sub>, this.$r.value(heapIs)
heap_{funcstart_{1032,1}}.p1, 177).quot
\rightarrow [literal comparison of product]
[1.9] ([2 < 0]: (-32769 / -2) < -\text{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_1032,1},
this.$r.value(heapIs heap_{funcstart\_1032,1}).p1, 177).quot, [0 < 2]: (-32769 /
(2) < \text{div}(\text{heapIs } \text{heap}_{funcstart\_1032,1}, \text{this.} \text{sr.value}(\text{heapIs}))
\text{Sheap}_{funcstart\_1032,1}.p1, 177).quot, [0 == 2]: -32769 < 0)
→ [explicitly assert falsehood of skipped guards in subsequent guards]
```

```
[1.10] ([2 < 0]: (-32769 / -2) < -\text{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_1032,1},
this.$r.value(heapIs heap_{funcstart\_1032,1}).p1, 177).quot, [(0 < 2) \land !(2 < 0)]:
(-32769 / 2) < \text{div}(\text{heapIs } \text{$heap}_{funcstart\_1032,1}, \text{this.}\text{$r.value}(\text{heapIs})
\text{Sheap}_{funcstart\_1032,1}.p1, 177).quot, [(0 == 2) \land !(0 < 2) \land !(2 < 0)]: -32769
< 0)
\rightarrow [simplify]
[1.18] -16385 < div(heapIs $heap<sub>funcstart_1032,1</sub>, this.$r.value(heapIs)
heap_{funcstart_1032,1}.p1, 177).quot
\rightarrow [negate goal and search for contradiction]
\textit{[1.19] !} (-16385 < \operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_1032,1}, \ \mathbf{this.\$r.value}(\mathbf{heapIs}
heap_{funcstart_{-1032.1}}.p1, 177).quot
\rightarrow [simplify]
[1.21] 16384 < -\text{div}(\text{heapIs }\text{\$heap}_{funcstart\_1032.1}, \text{this.}\text{\$r.value}(\text{heapIs})
heap_{funcstart_{1032,1}}.p1, 177).quot
[Assume known post-assertion, class invariant or type constraint for term 2.6]
[7.0] (0 < asType<integer>(this.\$r.value(heapIs
\theta_{funcstart\_1032,1}.p1) && (asType<integer>(this.$r.value(heapIs)
\$ heap_{funcstart\_1032,1}).p1) < \mathbf{asType} < \mathbf{integer} > (\$ heap.\mathbf{class} \ WHPrang \in \texttt{Constart} = \texttt{Constart}
M1))
\rightarrow [simplify]
[7.2] (0 < this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1) \&\&
(this.$r.value(heapIs heap_{funcstart\_1032,1}).p1 <
asType < integer > (\text{heap.class WHPrang} \in M1))
\rightarrow [const static or extern object]
[7.3] (0 < this.$r.value(heap
Is $heap_{funcstart\_1032,1}).p1) &&
(this.r.value(heapIs $heap_{funcstart\_1032.1}).p1 <
asType < integer > (\$heap_{init}.class WHPrang \in M1))
\rightarrow [expand definition of constant 'M1' at prang.cpp (28,26)]
[7.4] (0 < this.$r.value(heap
Is \rho_{funcstart\_1032,1}).p1) &&
(this.$r.value(heapIs \rho_{funcstart\_1032,1}).p1 <
asType < integer > ((int)30269))
\rightarrow [simplify]
[7.10] (-30269 < -this.$r.value(heapIs $heap_{funcstart\_1032,1}).p1) \land (0 <
this.r.value(heapIs $heap_{funcstart\_1032,1}).p1)
[Work on sub-term 2 of conjunction in term 7.10]
[8.0] 0 < this.$r.value(heap
Is $heap_{funcstart\_1032,1}).p1
[Assume known post-assertion, class invariant or type constraint for term 2.6]
```

```
[9.0] (asType<integer>(this.$r.value(heapIs $heap_{tuncstart\_1032,1}).p1) /
asType<integer>(177)) == asType<integer>(div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot)
\rightarrow [simplify]
[9.2] (this.$r.value(heapIs $heap_{funcstart\_1032,1}).p1 / 177) ==
asType < integer > (div(heapIs \$heap_{funcstart\_1032,1}, this.\$r.value(heapIs))
heap_{funcstart_1032,1}.p1, 177).quot
\rightarrow [expand definition of operator './' in class 'int' at built in declaration]
[9.3] ([asType<integer>(this.$r.value(heapIs $heap_{tuncstart\_1032.1}).p1) <
0]: -(-asType < integer > (this. r.value(heapIs <math>heap_{funcstart\_1032,1}).p1) /
177), \parallel: asType<integer>(this.$r.value(heapIs $heap_{funcstart\_1032,1}).p1) /
177) == asType<integer>(div(heapIs heap_{funcstart\_1032,1}),
\mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}~\$\mathrm{heap}_{funcstart\_1032,1}).\mathrm{p1},~177).\mathrm{quot})
→ [explicitly assert falsehood of skipped guards in subsequent guards]
\textit{[9.4]} \; ([\textbf{asType} < \textbf{integer} > (\textbf{this}.\$r.\textbf{value}(\textbf{heapIs} \; \$heap_{funcstart\_1032,1}).p1) < \\
0]: -(-asType < integer > (this. r.value(heapIs <math>heap_{funcstart\_1032,1}).p1) /
177), [!(asType < integer > (this.\$r.value(heapIs \$heap_{funcstart\_1032,1}).p1) < ]
0)]: asType < integer > (this. r.value(heapIs  heap_{funcstart\_1032,1}).p1) / 
177) == asType<integer>(div(heapIs heap_{funcstart\_1032,1},
this.$r.value(heapIs $heap_{tuncstart 1032.1}).p1, 177).quot)
\rightarrow [simplify]
[9.7] ([0 < -this.$r.value(heapIs $heap_{funcstart\_1032,1}).p1]:
-(-\mathbf{asType} < \mathbf{integer} > (\mathbf{this.\$r.value} (\mathbf{heapIs}\ \$ \mathbf{heap}_{funcstart\_1032,1}).\mathbf{p1})\ /
177), [!(asType<integer>(this.$r.value(heapIs $heap_{funcstart\_1032.1}).p1) <
0)]: asType<integer>(this.$r.value(heapIs $heap_{tuncstart\_1032,1}).p1) /
177) == asType<integer>(div(heapIs heap_{funcstart\_1032,1})
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177).quot)
\rightarrow [from term 8.0, literala < -this.$r.value(heapIs $heap_{funcstart\_1032,1}).p1
is false whenever -2 < (0 + literala)
        Proof of rule precondition:
        [9.7.0] - 2 < (0 + 0)
        \rightarrow [simplify]
        [9.7.2] true
[9.8] ([false]: -(-asType < integer > (this. r.value(heapIs))
\theta_{uncstart\_1032,1}.p1) / 177, [!(asType<integer>(this.$r.value(heapIs)
\rho_{funcstart\_1032,1}.p1 < 0: asType<integer>(this.$r.value(heapIs)
\label{eq:heapfuncstart_1032,1} \$ heap_{funcstart\_1032,1}).p1) \ / \ 177) == \mathbf{asType} < \mathbf{integer} > (\mathrm{div}(\mathbf{heapIs})) < \mathbf{fine} > (\mathrm{div}(\mathbf{heapIs})) < 
\rho_{tuncstart_1032.1}, this.r.value(heapIs \rho_{tuncstart_1032.1}).p1,
177).quot)
```

```
\rightarrow [simplify]
[9.11] ([false]: -(-asType<integer>(this.$r.value(heapIs
\rho_{funcstart_{-1032,1}}.p1) / 177, [!(0 < -this.\r.value(heapIs)
\verb§heap$ funcstart\_1032,1).p1)]: \textbf{ asType} < \textbf{integer} > (\textbf{this}.\$r.\textbf{value}(\textbf{heapIs})) + \textbf{funcstart} = \textbf
\label{eq:heapfuncstart_1032,1} \$ heap_{funcstart\_1032,1}).p1) \ / \ 177) == \mathbf{asType} < \mathbf{integer} > (\mathrm{div}(\mathbf{heapIs})) < \mathbf{fine} > (\mathrm{div}(\mathbf{heapIs})) < 
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot)
\rightarrow [from term 8.0, literala < -this.$r.value(heapIs $heap_{funcstart\_1032,1}).p1
is false whenever -2 < (0 + literala)
                Proof of rule precondition:
                [9.11.0] - 2 < (0 + 0)
                \rightarrow [simplify]
                [9.11.2] true
[9.12] ([false]: -(-asType < integer > (this. r.value(heapIs))
heap_{funcstart\_1032,1}.p1) / 177, [!false]:
asType<integer>(this.$r.value(heapIs $heap_{tuncstart\_1032,1}).p1) / 177)
== asType<integer>(div(heapIs $heap_{funcstart\_1032,1},
this.r.value(heapIs $heap_{funcstart\_1032,1}).p1, 177).quot)
\rightarrow [simplify]
[9.17] 0 == (-\text{div}(\mathbf{heapIs} \$ \mathbf{heap}_{funcstart\_1032,1}, \mathbf{this}.\$ \mathbf{r.value}(\mathbf{heapIs}))
\label{eq:heapIs} \$ heap_{funcstart\_1032,1}).p1,\,177).quot + (\textbf{this}.\$r.\textbf{value}(\textbf{heapIs})).p1,\,p1,\,p2).p2
heap_{funcstart\_1032,1}.p1 / 177)
[Create new term from terms 1.21, 9.17 using rule: transitivity 15]
[59.0] (0 + 16384) < -(this.$r.value(heapIs $heap_{funcstart\_1032,1}).p1 / 177)
\rightarrow [simplify]
[59.7] 2899968 < -this.$r.value(heapIs \rho_{funcstart\_1032,1}).p1
\rightarrow [from term 8.0, literala < -this.$r.value(heapIs $heap_{funcstart\_1032,1}).p1
is false whenever -2 < (0 + literala)
                Proof of rule precondition:
                [59.7.0] - 2 < (0 + 2899968)
                \rightarrow [simplify]
                [59.7.2] true
[59.8] false
```

Proof of verification condition: Arithmetic result of operator '*' is within limit of type 'signed int'

In the context of class: WHPrang, declared at:

```
C:\Escher\Customers\prang-cpp\prang.cpp (18,1)
Condition generated at: C:\Escher\Customers\prang-cpp\prang.cpp
(74,57)
Condition defined at:
To prove: ($heap_funcstart_1032,1.b1 * static_cast<signed int>(div1.quot))
\leq \max of(signed\ int)
Given:
heap_{init}.LIMIT == (int)80
heap_{init}.class WHPrang \in M1 == (int)30269
heap_{init}.class WHPrang \in r1 == (int)171
heap_{init}.class WHPrang \in a1 == (int)177
heap_{init}.class WHPrang \in b1 == (int)2
heap_{init}.class WHPrang \in M2 == (int)30307
heap_{init}.class WHPrang \in r2 == (int)172
heap_{init}.class WHPrang \in a2 == (int)176
heap_{init}.class WHPrang \in b2 == (int)35
heap_{init}.class WHPrang \in M3 == (int)30323
heap_{init}.class WHPrang \in r3 == (int)170
heap_{init}.class WHPrang \in a3 == (int)178
heap_{init}.class WHPrang \in b3 == (int)63
\operatorname{div1} == \operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_1032,1},
\mathbf{static\_cast} {<} \mathbf{int} {>} (\mathbf{operator^*(heapIs}\ \$heap_{funcstart\_1032,1},\ \mathbf{this}).p1),
static\_cast < int > (\$heap_{funcstart\_1032,1}.a1))
(asType<integer>(static_cast<int>(operator*(heapIs
heap_{funcstart\_1032,1}, this).p1) /
\mathbf{asType} {<} \mathbf{integer} {>} (\mathbf{static\_cast} {<} \mathbf{int} {>} (\$ \mathbf{heap}_{funcstart\_1032,1}.\mathbf{a1}))) = =
asType<integer>(div1.quot)
(asType < integer > (static\_cast < int > (operator*(heapIs)))
heap_{funcstart\_1032.1}, this).p1)
asType < integer > (static\_cast < int > (\$heap_{funcstart\_1032.1}.a1))) = =
asType<integer>(div1.rem)
(\mathbf{asType}{<}\mathbf{integer}{>}(\mathbf{operator}^*(\mathbf{heapIs}\ \$\mathbf{heap}_{funcstart\_1032,1},\ \mathbf{this}).\mathtt{p1}) <
asType < integer > ($heap_{funcstart\_1032,1}.a1)) = >
(asType<integer>(div1.rem) == asType<integer>(operator*(heapIs
heap_{funcstart_{-1032,1}}, this).p1)
(\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathrm{heap}_{funcstart\_1032,1}.\mathrm{a1}) \leq
```

```
asType<integer>(operator*(heapIs $heap_{tuncstart\_1032,1}, this).p1)) =>
!(0 == asType < integer > (div1.quot))
!(0 == asTvpe < integer > (div1.rem)) || !(0 ==
asType<integer>(div1.quot))
div2 == div(\mathbf{heapIs} \$ heap_{funcstart\_1032,1},
static_cast<int>(operator*(heapIs $heap_{funcstart\_1032,1}, this).p2),
static\_cast < int > (\$heap_{funcstart\_1032,1}.a2))
(asType<integer>(static_cast<int>(operator*(heapIs
heap_{funcstart_1032,1}, this).p2) /
asType < integer > (static\_cast < int > (\$heap_{funcstart\_1032,1}.a2))) = =
asType<integer>(div2.quot)
(asType<integer>(static_cast<int>(operator*(heapIs
heap_{funcstart\ 1032.1}, this).p2)
asType < integer > (static\_cast < int > (\$heap_{funcstart\_1032.1}.a2))) = =
asType<integer>(div2.rem)
(asType<integer>(operator*(heapIs $heap_{funcstart\_1032.1}, this).p2) <
asType < integer > (\$heap_{funcstart\_1032,1}.a2)) = >
(asType<integer>(div2.rem) == asType<integer>(operator*(heapIs
heap_{funcstart_1032,1}, this).p2)
(asType < integer > (\$heap_{funcstart\_1032,1}.a2) \le
asType < integer > (operator^*(heapIs \$heap_{funcstart\_1032,1}, this).p2)) = >
!(0 == asType < integer > (div2.quot))
!(0 == asType < integer > (div2.rem)) || !(0 ==
asType<integer>(div2.quot))
div3 == div(\mathbf{heapIs} \$heap_{funcstart\_1032,1},
static\_cast < int > (operator*(heapIs $heap_{funcstart\_1032,1}, this).p3),
static\_cast < int > (\$heap_{funcstart\_1032,1}.a3))
(asType<integer>(static_cast<int>(operator*(heapIs
heap_{funcstart\_1032,1}, this).p3)) /
asType < integer > (static\_cast < int > (\$heap_{funcstart\_1032.1}.a3))) = =
asType<integer>(div3.quot)
(asType < integer > (static\_cast < int > (operator^*(heapIs))) \\
heap_{funcstart\_1032,1}, this).p3)
asType < integer > (static\_cast < int > (\$heap_{funcstart\_1032.1}.a3))) = =
asType<integer>(div3.rem)
(asType < integer > (operator*(heapIs $heap_{funcstart\_1032,1}, this).p3) < footnote{the content of the conte
asType < integer > (\$heap_{funcstart\_1032,1}.a3)) = >
(asType<integer>(div3.rem) == asType<integer>(operator*(heapIs
heap_{funcstart\_1032.1}, this).p3)
(\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathsf{heap}_{funcstart\_1032,1}.\mathsf{a3}) \leq
asType < integer > (operator*(heapIs $heap_{funcstart\_1032,1}, this).p3)) = >
```

```
!(0 == asType < integer > (div3.quot))
!(0 == asType < integer > (div3.rem)) || !(0 ==
asType<integer>(div3.quot))
Proof:
[Take given term]
[2.0] div1 == div(heapIs $heap<sub>funcstart_1032,1</sub>,
static_cast<int>(operator*(heapIs $heap_{funcstart\_1032,1}, this).p1),
\mathbf{static\_cast}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_1032,1}.\mathrm{a1}))
→ [expand definition of operator '*' in class 'pointer' at built in declaration]
[2.1] \operatorname{div1} == \operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_1032,1},
static\_cast < int > (this. r.value(heapIs $heap_{funcstart\_1032,1}).p1),
static_cast<int>($heap_{tuncstart_1032.1}.a1))
\rightarrow [simplify]
[2.2] \text{ div1} == \text{div(heapIs } \text{$heap}_{funcstart\_1032,1}, \text{this.} \text{$r.value(heapIs)}
\theta_{funcstart\_1032,1}.p1, \theta_{funcstart\_1032,1}.p1, \theta_{funcstart\_1032,1}.a1))
\rightarrow [const static or extern object]
[2.3] \text{ div1} == \text{div(heapIs } \text{$heap}_{funcstart\_1032,1}, \text{ this.} \text{$r.value(heapIs)}
\theta_{nit}.a1).p1, \theta_{nit}.a1
\rightarrow [expand definition of constant 'a1' at prang.cpp (30,26)]
[2.4]~{\rm div1} == {\rm div}(\mathbf{heapIs}~\$ \mathrm{heap}_{funcstart\_1032,1},~\mathbf{this}.\$ \mathrm{r.value}(\mathbf{heapIs}
\theta_{funcstart\_1032,1}.p1, \theta_{funcstart\_1032,1}.p2, \theta_{funcstart\_1032,1}.p2, \theta_{funcstart\_1032,1}.p2, \theta_{funcstart\_1032,1}.p2, \theta_{funcstart\_1032,1}.p2, \theta_{funcstart\_1032,1}.p2, \theta_{funcstart\_1032,1}.p3, \theta_{funcstart\_1032,1}.p2, \theta_{funcstart\_1032,1}.p3, \theta_{funcstart\_1032,1}.p4, \theta_{funcstart\_1032,1}.p4, \theta_{funcstart\_1032,1}.p4, \theta_{funcstart\_1032,1
\rightarrow [simplify]
[2.6] \operatorname{div1} == \operatorname{div}(\mathbf{heapIs} \ \mathbf{\$heap}_{funcstart\_1032,1}, \ \mathbf{this}.\mathbf{\$r.value}(\mathbf{heapIs})
heap_{funcstart_{-1032,1}}.p1, 177
[Take goal term]
[1.0] (\theta_{1.0}) (\theta_{1.0}) (\theta_{1.0}) (\theta_{1.0}) (\theta_{1.0}) (\theta_{1.0}) (\theta_{1.0}) (\theta_{1.0})
maxof(signed int)
\rightarrow [const static or extern object]
[1.1] (\theta static_cast<signed int>(div1.quot)) \theta maxof(signed)
int)
\rightarrow [expand definition of constant 'b1' at prang.cpp (31,26)]
[1.2] ((int)2 * static_cast<signed int>(div1.quot)) \leq maxof(signed int)
\rightarrow [simplify]
[1.3] (2 * static_cast<signed int>(div1.quot)) \leq maxof(signed int)
\rightarrow [from term 2.6, div1 is equal to div(heapIs $heap_{funcstart\_1032.1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177)
```

```
[1.4] (2 * static_cast<signed int>(div(heapIs $heap_{funcstart_1032,1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177).quot)) \le maxof(signed)
int)
\rightarrow [simplify]
[1.15]-32768 < (-2 * div(heapIs $heap_{funcstart\_1032,1}, this.$r.value(heapIs  
heap_{funcstart_{-1032,1}}.p1, 177).quot
\rightarrow [literal comparison of product]
[1.16] ([-2 < 0]: (-32768 / 2) < -\text{div}(\text{heapIs } \text{$heap}_{funcstart\_1032.1},
this.$r.value(heapIs \theta_{funcstart\_1032,1}).p1, 177).quot, [0 < -2]: (-32768 /
-2) < div(heapIs heap_{funcstart\_1032,1}, this.r.value(heapIs)
\theta_{funcstart_1032,1}.p1, 177).quot, [-2 == 0]: -32768 < 0
→ [explicitly assert falsehood of skipped guards in subsequent guards]
[1.17] ([-2 < 0]: (-32768 / 2) < -\text{div}(\text{heapIs } \text{$heap}_{tuncstart\_1032.1},
this.$r.value(heapIs heap_{funcstart\_1032,1}).p1, 177).quot, [(0 < -2) \land !(-2 <
0)]: (-32768 / -2) < \text{div}(\text{heapIs } \text{heap}_{funcstart\_1032,1}, \text{this.} \text{r.value}(\text{heapIs})
\text{Sheap}_{funcstart\_1032,1}.p1, 177).quot, [(-2 == 0) \land!(-2 < 0) \land!(0 < -2)]: -32768
< 0)
\rightarrow [simplify]
[1.21] -16384 < -\text{div}(\text{heapIs }\text{\$heap}_{funcstart\_1032,1}, \text{this.}\text{\$r.value}(\text{heapIs})
\theta_{funcstart_1032,1}.p1, 177).quot
\rightarrow [negate goal and search for contradiction]
[1.22]!(-16384 < -\text{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_1032,1}, \ \mathbf{this}.\text{\$r.value}(\mathbf{heapIs})
heap_{funcstart_{1032,1}}.p1, 177).quot
\rightarrow [simplify]
[1.25] 16383 < div(heapIs $heap<sub>funcstart_1032,1</sub>, this.$r.value(heapIs)
heap_{funcstart_{1032,1}}.p1, 177).quot
[Assume known post-assertion, class invariant or type constraint for term 2.6]
[7.0] (0 < asType<integer>(this.$r.value(heapIs)
\label{eq:continuous} $\operatorname{heap}_{funcstart\_1032,1}).p1)) \&\& (\mathbf{asType} < \mathbf{integer} > (\mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}))) \&\& (\mathbf{asType} < \mathbf{integer} > (\mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})))) \&\& (\mathbf{asType} < \mathbf{integer} > (\mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}))))) \&\& (\mathbf{asType} < \mathbf{integer} > (\mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}))))
\theta_{uncstart\_1032,1}.p1 < asType<integer>(\theta_{uncstart\_1032,1}.p1) < asType<integer>(\theta_{uncstart\_1032,1}.p1)
M1))
\rightarrow [simplify]
[7.2] (0 < this.$r.value(heapIs heap_{funcstart\_1032,1}).p1) &&
(this.r.value(heapIs $heap_{funcstart\_1032,1}).p1 <
asType < integer > (\$heap.class WHPrang \in M1))
\rightarrow [const static or extern object]
[7.3] (0 < this.$r.value(heap
Is \rho_{funcstart\_1032,1}).p1) &&
(this.$r.value(heap
Is \rho_{funcstart\_1032,1}).p1 <
```

```
asType < integer > (\$heap_{init}.class WHPrang \in M1))
\rightarrow [expand definition of constant 'M1' at prang.cpp (28,26)]
[7.4] (0 < this.\$r.value(heapIs \$heap_{funcstart\_1032,1}).p1) &&
(this.r.value(heapIs $heap_{funcstart\_1032,1}).p1 <
asType < integer > ((int)30269))
\rightarrow [simplify]
[7.10] (-30269 < -this.$r.value(heapIs heap_{funcstart\_1032,1}).p1) \land (0 <
this.r.value(heapIs $heap_{funcstart\_1032.1}).p1)
\rightarrow [separate conjunction and work on first sub-term]
[7.11] -30269 < -this.$r.value(heapIs $heap_{funcstart\_1032,1}).p1
[Work on sub-term 2 of conjunction in term 7.10]
[8.0] 0 < this.$r.value(heapIs \rho_{funcstart\_1032,1}).p1
[Assume known post-assertion, class invariant or type constraint for term 2.6]
 [9.0] \ (\mathbf{asType} < \mathbf{integer} > (\mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}\ \$ \mathbf{heap}_{funcstart\_1032,1}).\mathbf{p1}) \ / \\ 
asType<integer>(177)) == asType<integer>(div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot)
\rightarrow [simplify]
[9.2] (this.$r.value(heapIs $heap_{funcstart\_1032,1}).p1 / 177) ==
asType < integer > (div(heapIs \$heap_{funcstart\_1032,1}, this.\$r.value(heapIs))
heap_{funcstart\_1032,1}.p1, 177).quot
→ [expand definition of operator './' in class 'int' at built in declaration]
\textit{[9.3]} \; ([\textbf{asType} < \textbf{integer} > (\textbf{this}.\$r.\textbf{value}(\textbf{heapIs} \; \$ heap_{funcstart\_1032,1}).p1) < \\
0]: -(-asType < integer > (this. r.value(heapIs  heap_{funcstart\_1032,1}).p1) /
177), \parallel: asType<integer>(this.$r.value(heapIs $heap_{funcstart\_1032,1}).p1) /
177) == asType<integer>(div(heapIs heap_{funcstart\_1032,1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177).quot)
→ [explicitly assert falsehood of skipped guards in subsequent guards]
\textit{[9.4]} \; ([\textbf{asType} < \textbf{integer} > (\textbf{this}.\$r.\textbf{value}(\textbf{heapIs} \; \$ heap_{funcstart\_1032,1}).p1) < \\
0]: -(-asType < integer > (this. r.value(heapIs $heap_{funcstart\_1032,1}).p1) /
177), [!(asType<integer>(this.$r.value(heapIs $heap_{funcstart\_1032,1}).p1) <  
0)]: asType<integer>(this.$r.value(heapIs $heap_{tuncstart\_1032.1}).p1) /
177) == asType<integer>(div(heapIs heap_{funcstart\_1032,1}),
this.r.value(heapIs $heap_{funcstart\_1032,1}).p1, 177).quot)
\rightarrow [simplify]
[9.7] ([0 < -this.$r.value(heapIs $heap<sub>funcstart_1032,1</sub>).p1]:
-(-asType<integer>(this.$r.value(heapIs $heap_{funcstart\_1032.1}).p1) /
177), [!(asType<integer>(this.$r.value(heapIs \rho_{tart_1032,1}).p1] <
```

```
0)]: as
Type<integer>(this.$r.value(heapIs \rho_{funcstart\_1032,1}).p1) / 
177) == asType < integer > (div(heapIs $heap_{funcstart\_1032,1},
\mathbf{this.\$r.value}(\mathbf{heapIs}\ \$\mathbf{heap}_{funcstart\_1032,1}).\mathbf{p1},\ 177).\mathbf{quot})
\rightarrow [from term 8.0, literala < -this.$r.value(heapIs $heap_{funcstart\_1032,1}).p1
is false whenever -2 < (0 + literala)
            Proof of rule precondition:
            [9.7.0] - 2 < (0 + 0)
            \rightarrow [simplify]
            [9.7.2] true
[9.8] ([false]: -(-asType<integer>(this.$r.value(heapIs
\label{eq:funcstart_1032,1} $$ \operatorname{heap}_{funcstart_1032,1}.p1) \ / \ 177), \ [!(asType < integer > (this.\$r.value(heapIs))] $$ \ / \ 177), \ [!(asType < integer) < (this.\$r.value(heapIs))] $$ \ / \ 1770, \ [!(asType < integer) < (this.\$r.value(heapIs))] $$ \ / \ 1770, \ [!(asType < integer) < (this.\$r.value(heapIs))] $$ \ / \ 1770, \ [!(asType < integer) < (this.\$r.value(heapIs))] $$ \ / \ 1770, \ [!(asType < integer) < (this.\$r.value(heapIs))] $$ \ / \ 1770, \ [!(asType < integer) < (this.\$r.value(heapIs))] $$ \ / \ 1770, \ [!(asType < integer) < (this.\$r.value(heapIs))] $$ \ / \ 1770, \ [!(asType < integer) < (this.\$r.value(heapIs))] $$ \ / \ 1770, \ [!(asType < integer) < (this.\$r.value(heapIs))] $$ \ / \ 1770, \ [!(asType < integer) < (this.\$r.value(heapIs))] $$ \ / \ 1770, \ [!(asType < integer) < (this.\$r.value(heapIs))] $$ \ / \ 1770, \ [!(asType < integer) < (this.\$r.value(heapIs))] $$ \ / \ 1770, \ [!(asType < integer) < (this.\$r.value(heapIs))] $$ \ / \ 1770, \ [!(asType < integer) < (this.\$r.value(heapIs))] $$ \ / \ 1770, \ [!(asType < integer) < (this.\$r.value(heapIs))] $$ \ / \ 1770, \ [!(asType < integer) < (this.\$r.value(heapIs))] $$ \ / \ 1770, \ [!(asType < integer) < (this.\$r.value(heapIs))] $$ \ / \ 1770, \ [!(asType < integer) < (this.\$r.value(heapIs))] $$ \ / \ 1770, \ [!(asType < integer) < (this.\$r.value(heapIs))] $$ \ / \ 1770, \ [!(asType < integer) < (this.\$r.value(heapIs))] $$ \ / \ 1770, \ [!(asType < integer) < (this.\$r.value(heapIs))] $$ \ / \ 1770, \ [!(asType < integer) < (this.\$r.value(heapIs))] $$ \ / \ 1770, \ [!(asType < integer) < (this.\$r.value(heapIs))] $$ \ / \ 1770, \ [!(asType < integer) < (this.\$r.value(heapIs))] $$ \ / \ 1770, \ [!(asType < integer) < (this.\$r.value(heapIs))] $$ \ / \ 1770, \ [!(asType < integer) < (this.\$r.value(heapIs))] $$ \ / \ 1770, \ [!(asType < integer) < (this.\$r.value(heapIs))] $$ \ / \ 1770, \ [!(asType < integer) < (this.\$r.value(heapIs))] $$ \ / \ 1770, \ [!(asType < integer) < (this.\$r.value(heapIs))] $$ \ / \ 1770, \ [!(asType < integer
\theta_{funcstart\_1032.1}.p1) / 177) == asType<integer>(div(heapIs)
\rho_{tuncstart\_1032.1}, this.r.value(heapIs \rho_{tuncstart\_1032.1}).p1,
177).quot)
\rightarrow [simplify]
[9.11] ([false]: -(-asType<integer>(this.$r.value(heapIs
\rho_{funcstart\_1032,1}.p1) / 177, [!\rho_{funcstart\_1032,1}.p1] / 177, [!\rho_{funcstart\_1032,1}.p1]
\rho_{funcstart_{1032,1}}.p1): asType<integer>(this.$r.value(heapIs)
\label{eq:loss_function} \$ heap_{funcstart\_1032,1}).p1) \ / \ 177) == \mathbf{asType} < \mathbf{integer} > (\mathrm{div}(\mathbf{heapIs})).p1) \ / \ 177) == \mathbf{asType} < \mathbf{integer} > (\mathrm{div}(\mathbf{heapIs})).p1) \ / \ 177) == \mathbf{asType} < \mathbf{integer} > (\mathrm{div}(\mathbf{heapIs})).p1) \ / \ 177) == \mathbf{asType} < \mathbf{integer} > (\mathrm{div}(\mathbf{heapIs})).p1) \ / \ 177) == \mathbf{asType} < \mathbf{integer} > (\mathrm{div}(\mathbf{heapIs})).p1) \ / \ 177) == \mathbf{asType} < \mathbf{integer} > (\mathrm{div}(\mathbf{heapIs})).p1) \ / \ 177) == \mathbf{asType} < \mathbf{integer} > (\mathrm{div}(\mathbf{heapIs})).p1) \ / \ 177) == \mathbf{asType} < \mathbf{integer} > (\mathrm{div}(\mathbf{heapIs})).p1) \ / \ 177) == \mathbf{asType} < \mathbf{integer} > (\mathrm{div}(\mathbf{heapIs})).p1) \ / \ 177) == \mathbf{asType} < \mathbf{integer} > (\mathrm{div}(\mathbf{heapIs})).p1) \ / \ 177) == \mathbf{asType} < \mathbf{integer} > (\mathrm{div}(\mathbf{heapIs})).p1) \ / \ 177) == \mathbf{asType} < \mathbf{integer} > (\mathrm{div}(\mathbf{heapIs})).p1) \ / \ 177) == \mathbf{asType} < \mathbf{integer} > (\mathrm{div}(\mathbf{heapIs})).p1) \ / \ 177) == \mathbf{asType} < \mathbf{integer} > (\mathrm{div}(\mathbf{heapIs})).p1) \ / \ 177) == \mathbf{asType} < \mathbf{integer} > (\mathrm{div}(\mathbf{heapIs})).p2) \ / \ 177) == \mathbf{asType} < \mathbf{integer} > (\mathrm{div}(\mathbf{heapIs})).p2) \ / \ 177) == \mathbf{asType} < \mathbf{integer} > (\mathrm{div}(\mathbf{heapIs})).p2) \ / \ 177) == \mathbf{asType} < \mathbf{integer} > (\mathrm{div}(\mathbf{heapIs})).p2) \ / \ 177) == \mathbf{asType} < \mathbf{integer} > (\mathrm{div}(\mathbf{heapIs})).p2) \ / \ 177) == \mathbf{asType} < \mathbf{integer} > (\mathrm{div}(\mathbf{heapIs})).p2) \ / \ 177) == \mathbf{asType} < \mathbf{integer} > (\mathrm{div}(\mathbf{heapIs})).p3) \ / \ 177) == \mathbf{asType} < \mathbf{integer} > (\mathrm{div}(\mathbf{heapIs})).p3) \ / \ 177) == \mathbf{asType} < \mathbf{integer} > (\mathrm{div}(\mathbf{heapIs})).p3) \ / \ 177) == \mathbf{asType} < \mathbf{integer} > (\mathrm{div}(\mathbf{heapIs})).p3) \ / \ 177) == \mathbf{asType} < \mathbf{integer} > (\mathrm{div}(\mathbf{heapIs})).p3) \ / \ 177) == \mathbf{asType} < \mathbf{integer} > (\mathrm{div}(\mathbf{heapIs})).p4) \ / \ 177) == \mathbf{asType} < \mathbf{integer} > (\mathrm{div}(\mathbf{heapIs})).p4) \ / \ 177) == \mathbf{asType} < \mathbf{integer} > (\mathrm{div}(\mathbf{heapIs})).p4) \ / \ 177) == \mathbf{asType} < \mathbf{integer} > (\mathrm{div}(\mathbf{heapIs})).p4) \ / \ 177) == \mathbf{asType} < \mathbf{integer} > (\mathrm{div}(\mathbf{heapIs})).p4) \ / \ 177) == \mathbf{asType} < \mathbf{integer} > (\mathrm{div}(\mathbf{heapIs})).p4) \ / \ 177) == \mathbf{asType} < \mathbf{integer
\rho_{tuncstart_1032.1}, this.r.value(heapIs \rho_{tuncstart_1032.1}).p1,
177).quot)
\rightarrow [from term 8.0, literala < -this.$r.value(heapIs $heap_{funcstart\_1032,1}).p1
is false whenever -2 < (0 + literala)
            Proof of rule precondition:
            [9.11.0] - 2 < (0 + 0)
            \rightarrow [simplify]
            [9.11.2] true
[9.12] ([false]: -(-asType<integer>(this.$r.value(heapIs
heap_{funcstart\_1032,1}.p1) / 177, [!false]:
\mathbf{asType} < \mathbf{integer} > (\mathbf{this.\$r.value}(\mathbf{heapIs}\ \$\mathbf{heap}_{funcstart\_1032,1}).\mathbf{p1})\ /\ 177)
== asType < integer > (div(heapIs $heap_{funcstart\_1032,1},
this.r.value(heapIs $heap_{funcstart\_1032,1}).p1, 177).quot)
\rightarrow [simplify]
[9.17]~0 == (-\text{div}(\textbf{heapIs}~\$\text{heap}_{funcstart\_1032,1},~\textbf{this}.\$\text{r.value}(\textbf{heapIs}~
\theta_{funcstart\_1032,1}.p1, 177.quot + (this.r.value(heapIs)
heap_{funcstart_{1032.1}}.p1 / 177)
[Create new term from terms 1.25, 9.17 using rule: transitivity 16]
```

```
[59.0] (0 + 16383) < (this.$r.value(heapIs $heap_{funcstart\_1032,1}).p1 / 177)
\rightarrow [simplify]
[59.8] \ 2899967 < this. r.value(heapIs \ heap_{funcstart\_1032,1}).p1
[Assume known post-assertion, class invariant or type constraint for term 2.6]
\label{eq:continuous} \mbox{[7.11] -30269} < -\mbox{this.\$r.value(heapIs \$heap}_{funcstart\_1032,1}).p1
\rightarrow [from term 59.8, literala < -this.$r.value(heapIs $heap_{funcstart\_1032,1}).p1
is false whenever -2 < (2899967 + literala)
   Proof of rule precondition:
   [7.11.0] - 2 < (-30269 + 2899967)
   \rightarrow [simplify]
   [7.11.2] true
[7.12] false
Proof of verification condition: Arithmetic result of operator '-' is within
limit of type 'signed int'
In the context of class: WHPrang, declared at:
C:\Escher\Customers\prang-cpp\prang.cpp (18,1)
Condition generated at: C:\Escher\Customers\prang-cpp\prang.cpp
(74,52)
Condition defined at:
To prove: minof(signed int) \leq (($heap_{funcstart\_1032,1}.r1 *
static_cast<signed int>(div1.rem)) - ($heap_funcstart_1032,1.b1 *
static_cast<signed int>(div1.quot)))
Given:
heap_{init}.LIMIT == (int)80
heap_{init}.class WHPrang \in M1 == (int)30269
heap_{init}.class WHPrang \in r1 == (int)171
heap_{init}.class WHPrang \in a1 == (int)177
heap_{init}.class WHPrang \in b1 == (int)2
heap_{init}.class WHPrang \in M2 == (int)30307
heap_{init}.class WHPrang \in r2 == (int)172
heap_{init}.class WHPrang \in a2 == (int)176
heap_{init}.class WHPrang \in b2 == (int)35
heap_{init}.class WHPrang \in M3 == (int)30323
```

```
heap_{init}.class WHPrang \in r3 == (int)170
heap_{init}.class WHPrang \in a3 == (int)178
heap_{init}.class WHPrang \in b3 == (int)63
\operatorname{div1} == \operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_1032,1},
static_cast<int>(operator*(heapIs $heap_{funcstart\_1032.1}, this).p1),
\mathbf{static\_cast}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_1032,1}.\mathrm{a1}))
(asType < integer > (static\_cast < int > (operator*(heapIs)))
heap_{funcstart\_1032.1}, this).p1)
asType < integer > (static\_cast < int > (\$heap_{funcstart\_1032.1}.a1))) = =
asType<integer>(div1.quot)
(asType < integer > (static\_cast < int > (operator*(heapIs)))
heap_{funcstart\_1032,1}, this).p1) %
asType < integer > (static\_cast < int > (\$heap_{funcstart\_1032.1}.a1))) = =
asType<integer>(div1.rem)
(asType < integer > (operator^*(heapIs \$heap_{funcstart\_1032,1}, this).p1) < (operator^*(heapIs \$heap_{funcstart\_1032,1}, this).p1)
asType < integer > (\$heap_{funcstart\_1032,1}.a1)) = >
(asType<integer>(div1.rem) == asType<integer>(operator*(heapIs
heap_{funcstart\_1032,1}, this).p1)
(\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathsf{heap}_{funcstart\_1032,1}.\mathsf{a1}) \leq
\mathbf{asType}{<}\mathbf{integer}{>}(\mathbf{operator*}(\mathbf{heapIs}\ \$\mathbf{heap}_{funcstart\_1032,1},\ \mathbf{this}).\mathbf{p1})) =>
!(0 == asType < integer > (div1.quot))
!(0 == asType < integer > (div1.rem)) || !(0 ==
asType<integer>(div1.quot))
div2 == div(\mathbf{heapIs} \$ heap_{funcstart\_1032,1},
\mathbf{static\_cast} {<} \mathbf{int} {>} (\mathbf{operator^*(heapIs}\ \$heap_{funcstart\_1032,1},\ \mathbf{this}).p2),
\mathbf{static\_cast}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_1032,1}.\mathrm{a2}))
(asType < integer > (static\_cast < int > (operator*(heapIs)))
heap_{funcstart=1032.1}, this).p2)
asType < integer > (static\_cast < int > (\$heap_{funcstart\_1032,1}.a2))) = =
asType<integer>(div2.quot)
(asType<integer>(static_cast<int>(operator*(heapIs
heap_{funcstart\_1032,1}, this).p2)
asType < integer > (static\_cast < int > (\$heap_{funcstart\_1032.1}.a2))) = =
asType<integer>(div2.rem)
(\mathbf{asType}{<}\mathbf{integer}{>}(\mathbf{operator}^*(\mathbf{heapIs}\ \$\mathbf{heap}_{funcstart\_1032,1},\ \mathbf{this}).\mathtt{p2}) <
asType < integer > (\$heap_{funcstart\_1032,1}.a2)) = >
(asType<integer>(div2.rem) == asType<integer>(operator*(heapIs
heap_{funcstart\_1032,1}, this).p2)
(asType < integer > (\$heap_{funcstart\_1032,1}.a2) \le
asType<integer>(operator*(heapIs $heap_{tuncstart\_1032.1}, this).p2)) =>
```

```
!(0 == asType < integer > (div2.quot))
!(0 == asType < integer > (div2.rem)) || !(0 ==
asType<integer>(div2.quot))
\label{eq:div3} \text{div3} == \text{div}(\mathbf{heapIs} \ \$ \text{heap}_{funcstart\_1032,1},
\mathbf{static\_cast} < \mathbf{int} > (\mathbf{operator}^*(\mathbf{heapIs}\ \$ \mathbf{heap}_{funcstart\_1032,1},\ \mathbf{this}).\mathbf{p3}),
static\_cast < int > (\$heap_{funcstart\_1032,1}.a3))
(asType<integer>(static_cast<int>(operator*(heapIs
heap_{funcstart\_1032,1}, this).p3)) /
asType < integer > (static\_cast < int > (\$heap_{funcstart\_1032.1}.a3))) = =
asType<integer>(div3.quot)
(asType<integer>(static_cast<int>(operator*(heapIs
heap_{funcstart_{-1032.1}}, this).p3)
asType < integer > (static\_cast < int > (\$heap_{funcstart\_1032.1}.a3))) = =
asType<integer>(div3.rem)
(asType<integer>(operator*(heapIs $heap_{funcstart\_1032.1}, this).p3) <
asType < integer > (\$heap_{tuncstart\_1032.1}.a3)) = >
(asType<integer>(div3.rem) == asType<integer>(operator*(heapIs
heap_{funcstart\_1032,1}, this).p3)
(\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathsf{heap}_{funcstart\_1032,1}.\mathbf{a3}) \leq
asType < integer > (operator^*(heapIs \$heap_{funcstart\_1032,1}, this).p3)) = >
!(0 == asType < integer > (div3.quot))
!(0 == asType < integer > (div3.rem)) || !(0 ==
asType<integer>(div3.quot))
Proof:
[Take given term]
[2.0] div1 == div(heapIs heap_{funcstart\_1032,1},
static\_cast < int > (operator*(heapIs $heap_{funcstart\_1032,1}, this).p1),
\mathbf{static\_cast}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_1032,1}.\mathrm{a1}))
→ [expand definition of operator '*' in class 'pointer' at built in declaration]
[2.1] \operatorname{div1} == \operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_1032,1},
\mathbf{static\_cast} < \mathbf{int} > (\mathbf{this.\$r.value}(\mathbf{heapIs} \ \$ \mathbf{heap}_{funcstart\_1032,1}).\mathbf{p1}),
\mathbf{static\_cast}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_1032,1}.\mathrm{a1}))
\rightarrow [simplify]
[2.2] \text{ div1} == \text{div(heapIs } \text{$heap}_{funcstart\_1032,1}, \text{ this.} \text{$r.value(heapIs)}
\rho_{tuncstart\_1032.1}, p1, static_cast<int>(\rho_{tuncstart\_1032.1})
\rightarrow [const static or extern object]
[2.3] \operatorname{div1} == \operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_1032,1}, \mathbf{this}.\$ r. \mathbf{value}(\mathbf{heapIs}))
\theta_{uncstart\_1032.1}.p1, static_cast<int>(\theta_{unit}.a1))
```

```
\rightarrow [expand definition of constant 'a1' at prang.cpp (30,26)]
[2.4] \text{ div1} == \text{div}(\text{heapIs } \text{heap}_{funcstart\_1032,1}, \text{this.}\text{\$r.value}(\text{heapIs})
\theta_{funcstart\_1032,1}.p1, \theta_{funcstart\_1032,1}.p1, \theta_{funcstart\_1032,1}.p1, \theta_{funcstart\_1032,1}.p1, \theta_{funcstart\_1032,1}.p1, \theta_{funcstart\_1032,1}.p1, \theta_{funcstart\_1032,1}.p2, \theta_{funcstart\_1032,1}.p2, \theta_{funcstart\_1032,1}.p2, \theta_{funcstart\_1032,1}.p2, \theta_{funcstart\_1032,1}.p2, \theta_{funcstart\_1032,1}.p3, \theta_{funcstart\_1032,1}.p4, \theta_{funcstart\_1032,1}.p4, \theta_{funcstart\_1032,1}.p4, \theta_{funcstart\_1032,1}.p5, \theta_{funcstart\_1032,1
\rightarrow [simplify]
[2.6] div1 == div(heapIs $heap_{funcstart\_1032,1}, this.$r.value(heapIs)
heap_{funcstart_{-1032,1}}.p1, 177
[Take goal term]
[1.0] minof(signed int) \leq (($heap_{funcstart\_1032,1}.r1 * static_cast < signed)
int>(div1.rem)) - (\$heap_{funcstart\_1032,1}.b1 * static\_cast < signed)
int>(div1.quot)))
\rightarrow [simplify]
[1.1] -32768 \leq (($heap_{funcstart\_1032,1}.r1 * static_cast < signed)
int>(div1.rem)) - (\$heap_{funcstart\_1032,1}.b1 * static\_cast < signed)
int > (div1.quot)))
\rightarrow [const static or extern object]
[1.2] -32768 \leq (($heap_{init}.r1 * static_cast<signed int>(div1.rem)) -
($heap_funcstart_1032,1.b1 * static_cast<signed int>(div1.quot)))
\rightarrow [expand definition of constant 'r1' at prang.cpp (29,26)]
[1.3] -32768 < (((int)171 * static_cast<signed int>(div1.rem)) -
(\$heap_{funcstart\_1032,1}.b1 * \textbf{static\_cast} < \textbf{signed int} > (\text{div1.quot})))
\rightarrow [simplify]
[1.4] -32768 \leq ((171 * static_cast < signed int > (div1.rem)) -
($heap_funcstart_1032.1.b1 * static_cast<signed int>(div1.quot)))
\rightarrow [from term 2.6, div1 is equal to div(heapIs $heap_{funcstart\_1032,1},
this.r.value(heapIs $heap_{funcstart\_1032,1}).p1, 177)]
[1.5] -32768 \leq ((171 * static_cast<signed int>(div(heapIs))
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
(177).rem) - (\$heap_{funcstart\_1032,1}.b1 * static\_cast < signed)
int > (div1.quot)))
\rightarrow [simplify]
[1.6] -32768 \leq ((171 * div(heapIs $heap_{funcstart\_1032,1}, this.$r.value(heapIs)
\text{Sheap}_{funcstart\_1032.1}.p1, 177).rem) - (\text{Sheap}_{funcstart\_1032.1}.b1 *
static_cast<signed int>(div1.quot)))
\rightarrow [const static or extern object]
[1.7] -32768 \leq ((171 * div(heapIs $heap<sub>funcstart_1032,1</sub>, this.$r.value(heapIs)
\rho_{uncstart\_1032.1}.p1, 177).rem - (\rho_{uncstart\_1032.1}).p1, 177).rem - (\rho_{uncstar
int>(div1.quot)))
```

```
\rightarrow [expand definition of constant 'b1' at prang.cpp (31,26)]
[1.8] -32768 \leq ((171 * div(heapIs $heap_{funcstart\_1032,1}, this.$r.value(heapIs)
\theta_{funcstart\_1032,1}.p1, 177).rem) - ((int)2 * static_cast<signed)
int > (div1.quot)))
\rightarrow [simplify]
\textit{[1.9] -32768} \leq ((171 * \text{div}(\textbf{heapIs} \$ \text{heap}_{funcstart\_1032,1}, \textbf{this.}\$ r. \textbf{value}(\textbf{heapIs} + \textbf{heapIs}))
\theta_{funcstart\_1032,1}.p1, 177).rem - (2 * static\_cast < signed)
int>(div1.quot)))
\rightarrow [from term 2.6, div1 is equal to div(heapIs $heap_{funcstart\_1032,1},
this.r.value(heapIs $heap_{funcstart\_1032,1}).p1, 177)]
[1.10] -32768 \leq ((171 * div(heapIs $heap_{funcstart\_1032,1},)
this.r.value(heapIs \$heap_{funcstart\_1032,1}).p1, 177).rem) - (2 *
static\_cast < signed int > (div(heapIs $heap_{funcstart\_1032,1},
\mathbf{this.\$r.value}(\mathbf{heapIs}~\$ \mathrm{heap}_{funcstart\_1032,1}).\mathrm{p1},~177).\mathrm{quot})))
\rightarrow [simplify]
[1.15]-32769 < ((-2 * div(heapIs $heap_{funcstart\_1032,1}, this.$r.value(heapIs funcstart)
\text{Sheap}_{funcstart\_1032.1}.p1, 177).quot) + (171 * div(heapIs \text{Sheap}_{funcstart\_1032.1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177).rem))
\rightarrow [negate goal and search for contradiction]
[1.16] \ !(-32769 < ((-2 * \mathrm{div}(\mathbf{heapIs} \ \$ \mathrm{heap}_{funcstart\_1032,1}, \ \mathbf{this}.\$ r. \mathbf{value}(\mathbf{heapIs} \ \$ \mathrm{heap}_{funcstart\_1032,1}, \ \mathbf{this}.\$ r. \mathbf{value}(\mathbf{heapIs} \ \$ \mathrm{heap}_{funcstart\_1032,1}, \ \mathbf{this}.\$ r. \mathbf{value}(\mathbf{heapIs} \ \$ \mathrm{heap}_{funcstart\_1032,1}, \ \mathbf{this}.\$ r. \mathbf{value}(\mathbf{heapIs}))
\text{Sheap}_{funcstart\_1032,1}.p1, 177).quot) + (171 * div(heapIs \text{Sheap}_{funcstart\_1032,1},
this.r.value(heapIs $heap_{funcstart\_1032,1}).p1, 177).rem)))
\rightarrow [simplify]
[1.21]~32768 < ((2*\operatorname{div}(\mathbf{heapIs}~\$\operatorname{heap}_{funcstart\_1032,1},~\mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}
heap_{funcstart\_1032,1}.p1, 177).quot + (-171 * div(heapIs)
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).rem))
[Assume known post-assertion, class invariant or type constraint for term 2.6]
[7.0] (0 < asType<integer>(this.$r.value(heapIs
\label{eq:continuous} $\operatorname{heap}_{funcstart\_1032,1}).p1)) \&\& (\mathbf{asType} < \mathbf{integer} > (\mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}))) \&\& (\mathbf{asType} < \mathbf{integer} > (\mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})))) \&\& (\mathbf{asType} < \mathbf{integer} > (\mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}))))) \&\& (\mathbf{asType} < \mathbf{integer} > (\mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}))))
\text{Sheap}_{funcstart\_1032,1}).\text{p1} < \text{asType} < \text{integer} > (\text{Sheap.class WHPrang} \in
M1))
\rightarrow [simplify]
[7.2] (0 < this.$r.value(heap
Is $heap_{funcstart\_1032,1}).p1) &&
(this.$r.value(heapIs heap_{funcstart\_1032,1}).p1 <
asType < integer > (\$heap.class WHPrang \in M1))
\rightarrow [const static or extern object]
[7.3] (0 < this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1) \&\&
```

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(this.$r.value(heapIs \rho_{uncstart\_1032,1}).p1 <
asType < integer > (\$heap_{init}.class WHPrang \in M1))
\rightarrow [expand definition of constant 'M1' at prang.cpp (28,26)]
[7.4] (0 < this.$r.value(heap
Is $heap_{funcstart\_1032,1}).p1) &&
(this.$r.value(heapIs heap_{funcstart\_1032,1}).p1 <
asType < integer > ((int)30269))
\rightarrow [simplify]
[7.10] (-30269 < -this.$r.value(heapIs $heap_{funcstart\_1032.1}).p1) \land (0 <
this.$r.value(heapIs $heap_{tuncstart_1032.1}).p1)
\rightarrow [separate conjunction and work on first sub-term]
[7.11] -30269 < -this.$r.value(heapIs $heap_{tuncstart\_1032,1}).p1
[Work on sub-term 2 of conjunction in term 7.10]
[8.0] 0 < this.$r.value(heapIs $heap_{tuncstart\_1032,1}).p1
[Assume known post-assertion, class invariant or type constraint for term 2.6]
[9.0] (asType<integer>(this.$r.value(heapIs $heap_{tuncstart\_1032,1}).p1) /
asType<integer>(177)) == asType<integer>(div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot)
\rightarrow [simplify]
[9.2] (this.$r.value(heapIs $heap_{funcstart\_1032,1}).p1 / 177) ==
asType < integer > (div(heapIs \$heap_{funcstart\_1032,1}, this.\$r.value(heapIs))
heap_{funcstart_{-1032,1}}.p1, 177).quot
→ [expand definition of operator './' in class 'int' at built in declaration]
{\it [9.3]}~([{\bf asType}{<}{\bf integer}{>}({\bf this.\$r.value}({\bf heapIs}~\${\bf heap}_{funcstart\_1032,1}).{\bf p1})<
0]: -(-asType < integer > (this. r.value(heapIs <math>heapIs heap_{funcstart\_1032,1}).p1) /
177), \parallel: asType<integer>(this.$r.value(heapIs $heap_{funcstart\_1032,1}).p1) /
177) == asType<integer>(div(heapIs heap_{funcstart\_1032,1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177).quot)
→ [explicitly assert falsehood of skipped guards in subsequent guards]
{\it [9.4] ([asType < integer > (this.\$r.value(heapIs \$heap_{funcstart\_1032,1}).p1) < }
0]: -(-asType < integer > (this. r.value(heapIs $heap_{tuncstart\_1032,1}).p1) / (this. r.value(heapIs $heap_{tuncstart\_1032,1}).p1)
177), [!(asType<integer>(this.$r.value(heapIs \rho_{tuncstart\_1032,1}).p1] <
0): asType<integer>(this.$r.value(heapIs $heap_{tuncstart\_1032,1}).p1) /
177) == asType < integer > (div(heapIs $heap_{funcstart\_1032.1},
this.r.value(heapIs $heap_{funcstart\_1032,1}).p1, 177).quot)
\rightarrow [simplify]
\textit{[9.7] ([0<-this.\$r.value(heapIs \$heap_{funcstart\_1032,1}).p1]:}
-(-\mathbf{asType} < \mathbf{integer} > (\mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}~\$\mathbf{heap}_{funcstart\_1032,1}).\mathbf{p1})~/
```

```
0)]: as
Type<integer>(this.$r.value(heap
Is \rho_{funcstart\_1032,1}).p1) / 
177) == asType<integer>(div(heapIs heap_{funcstart\_1032,1},
\mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}~\$\mathrm{heap}_{funcstart\_1032,1}).\mathrm{p1},~177).\mathrm{quot})
\rightarrow [from term 8.0, literala < -this.$r.value(heapIs $heap_{funcstart\_1032,1}).p1
is false whenever -2 < (0 + literala)
       Proof of rule precondition:
       [9.7.0] - 2 < (0 + 0)
       \rightarrow [simplify]
       [9.7.2] true
[9.8] ([false]: -(-asType<integer>(this.$r.value(heapIs
\label{eq:funcstart_1032,1} $$ \operatorname{heap}_{funcstart_1032,1}.p1) \ / \ 177), \ [!(asType < integer > (this.\$r.value(heapIs))] $$ \ / \ 177), \ [!(asType < integer) < (this.\$r.value(heapIs))] $$ \ / \ 1770, \ [!(asType < integer) < (this.\$r.value(heapIs))] $$ \ / \ 1770, \ [!(asType < integer) < (this.\$r.value(heapIs))] $$ \ / \ 1770, \ [!(asType < integer) < (this.\$r.value(heapIs))] $$ \ / \ 1770, \ [!(asType < integer) < (this.\$r.value(heapIs))] $$ \ / \ 1770, \ [!(asType < integer) < (this.\$r.value(heapIs))] $$ \ / \ 1770, \ [!(asType < integer) < (this.\$r.value(heapIs))] $$ \ / \ 1770, \ [!(asType < integer) < (this.\$r.value(heapIs))] $$ \ / \ 1770, \ [!(asType < integer) < (this.\$r.value(heapIs))] $$ \ / \ 1770, \ [!(asType < integer) < (this.\$r.value(heapIs))] $$ \ / \ 1770, \ [!(asType < integer) < (this.\$r.value(heapIs))] $$ \ / \ 1770, \ [!(asType < integer) < (this.\$r.value(heapIs))] $$ \ / \ 1770, \ [!(asType < integer) < (this.\$r.value(heapIs))] $$ \ / \ 1770, \ [!(asType < integer) < (this.\$r.value(heapIs))] $$ \ / \ 1770, \ [!(asType < integer) < (this.\$r.value(heapIs))] $$ \ / \ 1770, \ [!(asType < integer) < (this.\$r.value(heapIs))] $$ \ / \ 1770, \ [!(asType < integer) < (this.\$r.value(heapIs))] $$ \ / \ 1770, \ [!(asType < integer) < (this.\$r.value(heapIs))] $$ \ / \ 1770, \ [!(asType < integer) < (this.\$r.value(heapIs))] $$ \ / \ 1770, \ [!(asType < integer) < (this.\$r.value(heapIs))] $$ \ / \ 1770, \ [!(asType < integer) < (this.\$r.value(heapIs))] $$ \ / \ 1770, \ [!(asType < integer) < (this.\$r.value(heapIs))] $$ \ / \ 1770, \ [!(asType < integer) < (this.\$r.value(heapIs))] $$ \ / \ 1770, \ [!(asType < integer) < (this.\$r.value(heapIs))] $$ \ / \ 1770, \ [!(asType < integer) < (this.\$r.value(heapIs))] $$ \ / \ 1770, \ [!(asType < integer) < (this.\$r.value(heapIs))] $$ \ / \ 1770, \ [!(asType < integer) < (this.\$r.value(heapIs))] $$ \ / \ 1770, \ [!(asType < integer) < (this.\$r.value(heapIs))] $$ \ / \ 1770, \ [!(asType < integer) < (this.\$r.value(heapIs))] $$ \ / \ 1770, \ [!(asType < integer
\rho_{tuncstart_1032.1}.p1 < 0: asType<integer>(this.$r.value(heapIs)
\theta_{funcstart\_1032.1}.p1) / 177) == asType<integer>(div(heapIs)
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot)
\rightarrow [simplify]
[9.11] ([false]: -(-asType<integer>(this.$r.value(heapIs
\theta_{funcstart_{1032,1}}.p1) / 177, [!\theta_{funcstart_{1032,1}}.p1] / 177), [!\theta_{funcstart_{1032,1}}.p1]
\theta_{funcstart\_1032,1}.p1): asType<integer>(this.$r.value(heapIs)
\label{eq:heapfuncstart_1032,1} \$ heap_{funcstart\_1032,1}).p1) \ / \ 177) == \mathbf{asType} < \mathbf{integer} > (\mathrm{div}(\mathbf{heapIs}
\rho_{tuncstart_1032.1}, this.r.value(heapIs \rho_{tuncstart_1032.1}).p1,
177).quot)
\rightarrow [from term 8.0, literala < -this.$r.value(heapIs $heap_{funcstart\_1032,1}).p1
is false whenever -2 < (0 + literala)
       Proof of rule precondition:
       [9.11.0] - 2 < (0 + 0)
       \rightarrow [simplify]
       [9.11.2] true
[9.12] ([false]: -(-asType<integer>(this.$r.value(heapIs
heap_{funcstart\_1032,1}.p1) / 177, [!false]:
asType<integer>(this.r.value(heapIs \heap_{funcstart\_1032,1}).p1) / 177)
== asType < integer > (div(heapIs $heap_{funcstart\_1032,1},
this.r.value(heapIs $heap_{funcstart\_1032,1}).p1, 177).quot)
\rightarrow [simplify]
[9.17] 0 == (-\text{div}(\mathbf{heapIs} \$ \text{heap}_{funcstart\_1032,1}, \mathbf{this}.\$ r.\mathbf{value}(\mathbf{heapIs}))
\theta_{funcstart\_1032.1}.p1, 177).quot + (this.r.value(heapIs)
heap_{funcstart_{-1032.1}}.p1 / 177)
```

```
[Assume known post-assertion, class invariant or type constraint for term 2.6]
[10.0] (asType<integer>(this.$r.value(heapIs \rho_{uncstart\_1032,1}).p1) \%
asType<integer>(177)) == asType<integer>(div(heapIs
$heap_tuncstart_1032.1, this.$r.value(heapIs $heap_tuncstart_1032.1).p1,
177).rem)
\rightarrow [simplify]
[10.2] (this.$r.value(heap
Is $heap_{funcstart\_1032,1}).p1 % 177) ==
\mathbf{asType} {<} \mathbf{integer} {>} ( \mathbf{div} (\mathbf{heapIs} \ \$ \mathbf{heap}_{funcstart\_1032,1}, \ \mathbf{this}.\$ \mathbf{r.value} (\mathbf{heapIs} \ \mathbf{heapIs}) )
heap_{funcstart_{-1032,1}}.p1, 177).rem
→ [expand definition of operator '.%' in class 'int' at built in declaration]
[10.3] ([asType<integer>(this.$r.value(heapIs $heap_{funcstart\_1032,1}).p1) <
0]: -(-asType < integer > (this. r.value(heapIs  heap_{funcstart\_1032,1}).p1) %
177), ||: asType<integer>(this.r.value(heapIs \\heap_{funcstart\_1032,1}).p1)
\% 177) == asType<integer>(div(heapIs $heap_{funcstart\_1032,1},
\mathbf{this.\$r.value(heapIs}~\$heap_{funcstart\_1032,1}).p1,~177).rem)
→ [explicitly assert falsehood of skipped guards in subsequent guards]
[10.4] \; ([\mathbf{asType} < \mathbf{integer} > (\mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs} \; \$ \mathbf{heap}_{funcstart\_1032,1}).\mathbf{p1}) < \mathbf{p1}) 
0]: -(-asType < integer > (this. r.value(heapIs <math>heapIs heap_{funcstart\_1032,1}).p1) \%
177), [!(asType<integer>(this.$r.value(heapIs \rho_{tart_{-1032,1}}.p1) < 0.000
0)]: asType<integer>(this.r.value(heapIs $heap_{funcstart\_1032,1}).p1) %
177) == asType<integer>(div(heapIs heap_{funcstart\_1032,1},
this.r.value(heapIs \ heap_{funcstart\_1032.1}).p1, 177).rem)
\rightarrow [simplify]
[10.7] ([0 < -this.$r.value(heapIs $heap_{funcstart\_1032,1}).p1]:
-(-\mathbf{asType} < \mathbf{integer} > (\mathbf{this.\$r.value} (\mathbf{heapIs} \ \$ \mathbf{heap}_{funcstart\_1032,1}).\mathbf{p1}) \ \%
177), [!(asType<integer>(this.$r.value(heapIs $heap_{funcstart\_1032,1}).p1) <
0)]: asType<integer>(this.$r.value(heapIs \theta_{funcstart\_1032,1}).p1) %
177) == asType<integer>(div(heapIs heap_{funcstart\_1032,1},
this.r.value(heapIs $heap_{funcstart\_1032,1}).p1, 177).rem)
\rightarrow [from term 8.0, literala < -this.$r.value(heapIs $heap_{funcstart\_1032.1}).p1
is false whenever -2 < (0 + literala)
       Proof of rule precondition:
       [10.7.0] - 2 < (0 + 0)
       \rightarrow [simplify]
       [10.7.2] true
[10.8] ([false]: -(-asType < integer > (this. r.value(heapIs))
\rho_{tuncstart\_1032,1}.p1) \% 177, [!(asType<integer>(this.$r.value(heapIs)
\{\text{heap}_{funcstart\_1032,1}\}.p1) < 0): asType<integer>(this.r.value(\text{heapIs})
\theta_{normalize} = \theta_{normalize
```

```
\rho_{tuncstart=1032.1}, this.r.value(heapIs \rho_{tuncstart=1032.1}).p1,
177).rem)
\rightarrow [simplify]
[10.11] ([false]: -(-asType<integer>(this.$r.value(heapIs
\theta_{funcstart\_1032,1}.p1) \% 177, [!\theta_{funcstart\_1032,1}.p1] % 177), [!\theta_{funcstart\_1032,1}.p1]
\theta_{funcstart=1032,1}.p1): asType<integer>(this.$r.value(heapIs)
\theta_{funcstart\_1032,1}.p1) % 177) == asType<integer>(div(heapIs)
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).rem)
\rightarrow [from term 8.0, literala < -this.$r.value(heapIs $heap_{funcstart\_1032,1}).p1
is false whenever -2 < (0 + literala)
      Proof of rule precondition:
      [10.11.0] - 2 < (0 + 0)
      \rightarrow [simplify]
      [10.11.2] true
[10.12] ([false]: -(-asType<integer>(this.$r.value(heapIs
heap_{funcstart\_1032,1}.p1) \% 177, [!false]:
asType<integer>(this.r.value(heapIs $heap_{funcstart\_1032,1}).p1) \% 177)
== asType < integer > (div(heapIs $heap_{funcstart\_1032,1},
this.r.value(heapIs $heap_{funcstart\_1032,1}).p1, 177).rem)
\rightarrow [simplify]
[10.17] 0 == (-div(heapIs \rho_{funcstart\_1032,1}, this.r.value(heapIs)
\theta_{tuncstart\_1032.1}.p1, 177).rem + (this.r.value(heapIs)
heap_{funcstart_{1032,1}}.p1 \% 177)
[Copy term 1.21]
[66.0] \ 32768 < ((-171 \ ^* \ \mathrm{div}(\mathbf{heapIs} \ \$ \mathrm{heap}_{funcstart\_1032,1}, \ \mathbf{this}.\$ r. \mathbf{value}(\mathbf{heapIs} \ \$))
\theta_{funcstart\_1032,1}.p1, 177).rem) + (2 * div(heapIs \theta_{funcstart\_1032,1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177).quot))
\rightarrow [from term 10.17, div(heapIs $heap_{funcstart\_1032,1}$, this.$r.value(heapIs)
heap_{funcstart\_1032,1}.p1, 177.rem is equal to this.r.value(heapIs)
heap_{funcstart\_1032,1}.p1 % 177]
\textit{[66.1]}32768< ((-171 * (this.$r.value(heapIs \theta_{funcstart\_1032,1}).p1 \%
177)) + (2 * \text{div}(\textbf{heapIs} \$ \text{heap}_{funcstart\_1032,1}, \textbf{this}.\$ \text{r.value}(\textbf{heapIs}
heap_{funcstart\_1032,1}.p1, 177).quot)
[Create new term from term 9.17 using rule: condition for equality of division]
[69.0] ((177 * (0 + -(-div(heapIs $heap_{funcstart\_1032,1}, this.$r.value(heapIs)]
\theta_{tuncstart\_1032.1}.p1, 177).quot))) < (1 + this.\r.value(heapIs)
\{\text{heap}_{funcstart\_1032.1}\}.p1) \land (this.\{\text{r.value}(\text{heapIs}\}\}
```

 $(177 * (0 + 1 + -(-\text{div}(\textbf{heapIs} \$\text{heap}_{funcstart_1032,1}, \textbf{this}.\$r.\textbf{value}(\textbf{heapIs}))$

```
heap_{funcstart_1032,1}.p1, 177).quot))))
\rightarrow [simplify]
[69.15] (-1 < ((-177 * div(heapIs $heap_{funcstart\_1032,1}, this.$r.value(heapIs)]
\theta_{funcstart\_1032,1}.p1, 177).quot) + this.r.value(heapIs)
\$heap_{funcstart\_1032,1}).p1)) \land (-177 < (-\mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}
\text{Sheap}_{funcstart\_1032,1}.p1 + (177 * div(heapIs \text{Sheap}_{funcstart\_1032,1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177).quot)))
[Work on sub-term 2 of conjunction in term 69.15]
[70.0] -1 < ((-177 * div(heapIs $heap_{funcstart\_1032,1}, this.$r.value(heapIs)
\$heap_{funcstart\_1032,1}).p1,\ 177).quot) + \textbf{this}.\$r.\textbf{value}(\textbf{heapIs}
heap_{funcstart_1032.1}.p1
[Create new term from terms 70.0, 7.11 using rule: transitivity 2]
[109.0] (-30269 + -1 + 1) < (-177 * div(heapIs $heap_{funcstart\_1032.1},
this.r.value(heapIs \ heap_{funcstart\_1032.1}).p1, 177).quot)
\rightarrow [simplify]
[109.1] -30269 < (-177 * div(heapIs $heap_{funcstart\_1032,1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177).quot)
\rightarrow [literal comparison of product]
[109.2] ([-177 < 0]: (-30269 / 177) < -\text{div}(\mathbf{heapIs} \ \text{$heap}_{funcstart\_1032,1},
this.$r.value(heapIs $heap_{funcstart\_1032,1}).p1, 177).quot, [0 < -177]: (-30269)
/ -177) < div(heapIs heap_{funcstart\_1032,1}, this.r.value(heapIs)
\text{Sheap}_{funcstart\_1032.1}.p1, 177).quot, [-177 == 0]: -30269 < 0)
→ [explicitly assert falsehood of skipped guards in subsequent guards]
[109.3] ([-177 < 0]: (-30269 / 177) < -\text{div}(\mathbf{heapIs} \$ \text{heap}_{funcstart\_1032,1},
this.$r.value(heapIs heap_{funcstart\_1032,1}).p1, 177).quot, [(0 < -177) \land !(-177)
< 0)]: (-30269 / -177) < div(heapIs $heap_{funcstart\_1032,1},
this.$r.value(heapIs heap_{funcstart\_1032,1}).p1, 177).quot, [(-177 == 0) \land
!(-177 < 0) \land !(0 < -177)]: -30269 < 0)
\rightarrow [simplify]
[109.7] -172 < -\text{div}(\text{heapIs }\text{\$heap}_{funcstart\_1032,1}, \text{this.}\text{\$r.value}(\text{heapIs})
heap_{funcstart\_1032,1}.p1, 177).quot
[Create new term from terms 109.7, 66.1 using rule: transitivity 5]
[131.0] 32768 < ((-171 * (this.$r.value(heapIs heap_{funcstart\_1032,1}).p1 \%
(177)) + (2 * -(-172 + 1))
\rightarrow [simplify]
[131.5] 32426 < (-171 * (this.$r.value(heap
Is \rho_{funcstart\_1032,1}).p1 \%
177))
\rightarrow [literal comparison of product]
```

```
 \begin{array}{l} [131.6] \ ([-171<0]:\ (32426\ /\ 171) < -(\mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs} \$ \mathbf{heap}_{funcstart\_1032,1}).\mathbf{p}1\ \%\ 177),\ [0<-171]:\ (32426\ /\ -171) < \\ (\mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}\ \$ \mathbf{heap}_{funcstart\_1032,1}).\mathbf{p}1\ \%\ 177),\ [-171==0]:\ 32426 < 0) \\ \rightarrow [explicitly\ assert\ falsehood\ of\ skipped\ guards\ in\ subsequent\ guards] \\ [131.7] \ ([-171<0]:\ (32426\ /\ 171) < -(\mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs} \$ \mathbf{heap}_{funcstart\_1032,1}).\mathbf{p}1\ \%\ 177),\ [(0<-171)<\ (1-171<0)]:\ (32426\ /\ -171) < \\ (\mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}\ \$ \mathbf{heap}_{funcstart\_1032,1}).\mathbf{p}1\ \%\ 177),\ [(-171==0)\ \land\ !(-171<<0)\ \land\ !(0<-171)]:\ 32426<0) \\ \rightarrow [simplify] \\ [131.12] \ \mathbf{false} \end{array}
```

Proof of verification condition: Arithmetic result of operator '-' is within limit of type 'signed int'

In the context of class: WHPrang, declared at: C:\Escher\Customers\prang-cpp\prang.cpp (18,1)

Condition generated at: C:\Escher\Customers\prang-cpp\prang.cpp (74,52)

Condition defined at:

```
To prove: ((\text{\$heap}_{funcstart\_1032,1}.r1 * \textbf{static\_cast} < \textbf{signed int} > (\text{div}1.rem)) - (\text{\$heap}_{funcstart\_1032,1}.b1 * \textbf{static\_cast} < \textbf{signed int} > (\text{div}1.quot))) \leq \max of(\textbf{signed int})
```

Given:

```
Sheap<sub>init</sub>.LIMIT == (int)80

Sheap<sub>init</sub>.class WHPrang \in M1 == (int)30269

Sheap<sub>init</sub>.class WHPrang \in r1 == (int)171

Sheap<sub>init</sub>.class WHPrang \in a1 == (int)177

Sheap<sub>init</sub>.class WHPrang \in b1 == (int)2

Sheap<sub>init</sub>.class WHPrang \in M2 == (int)30307

Sheap<sub>init</sub>.class WHPrang \in r2 == (int)172

Sheap<sub>init</sub>.class WHPrang \in a2 == (int)176

Sheap<sub>init</sub>.class WHPrang \in b2 == (int)35

Sheap<sub>init</sub>.class WHPrang \in M3 == (int)30323

Sheap<sub>init</sub>.class WHPrang \in r3 == (int)170

Sheap<sub>init</sub>.class WHPrang \in a3 == (int)178

Sheap<sub>init</sub>.class WHPrang \in b3 == (int)63
```

```
\operatorname{div1} == \operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_1032,1},
\mathbf{static\_cast} {<} \mathbf{int} {>} (\mathbf{operator^*(heapIs}\ \$heap_{funcstart\_1032,1},\ \mathbf{this}).p1),
\mathbf{static\_cast}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_1032,1}.\mathrm{a1}))
(asType<integer>(static_cast<int>(operator*(heapIs
heap_{funcstart\_1032,1}, this).p1) /
asType < integer > (static\_cast < int > (\$heap_{funcstart\_1032,1}.a1))) = =
asType<integer>(div1.quot)
(\mathbf{asType} {<} \mathbf{integer} {>} (\mathbf{static\_cast} {<} \mathbf{int} {>} (\mathbf{operator^*} (\mathbf{heapIs}
\theta_{funcstart\_1032,1},\, \mathbf{this}).p1)) \%
asType<integer>(static_cast<int>($heap_{funcstart_1032.1}.a1))) ==
asType<integer>(div1.rem)
(\mathbf{asType}{<}\mathbf{integer}{>}(\mathbf{operator}^*(\mathbf{heapIs}\ \$\mathbf{heap}_{funcstart\_1032,1},\ \mathbf{this}).\mathtt{p1}) <
asType < integer > ($heap_{funcstart\_1032,1}.a1)) = >
(asType<integer>(div1.rem) == asType<integer>(operator*(heapIs
heap_{funcstart\_1032,1}, this).p1)
(\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathsf{heap}_{funcstart\_1032,1}.\mathsf{a1}) \leq
\mathbf{asType} < \mathbf{integer} > (\mathbf{operator}^*(\mathbf{heapIs} \ \$ \mathbf{heap}_{funcstart\_1032,1}, \ \mathbf{this}).\mathtt{p1})) = >
!(0 == asType < integer > (div1.quot))
!(0 == asType < integer > (div1.rem)) || !(0 ==
asType<integer>(div1.quot))
div2 == div(\mathbf{heapIs} \$ heap_{funcstart\_1032,1},
\mathbf{static\_cast} {<} \mathbf{int} {>} (\mathbf{operator*}(\mathbf{heapIs}\ \$ \mathbf{heap}_{funcstart\_1032,1},\ \mathbf{this}).\mathbf{p2}),
\mathbf{static\_cast}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_1032,1}.\mathrm{a2}))
(asType < integer > (static\_cast < int > (operator*(heapIs)))
heap_{funcstart\_1032,1}, this).p2) /
\mathbf{asType} < \mathbf{integer} > (\mathbf{static\_cast} < \mathbf{int} > (\$ \mathbf{heap}_{funcstart\_1032,1}.\mathbf{a2}))) = =
asType<integer>(div2.quot)
(asType < integer > (static\_cast < int > (operator*(heapIs)))
\theta_{funcstart_{1032,1}}, this).p2))
asType < integer > (static\_cast < int > (\$heap_{funcstart\_1032.1}.a2))) = =
asType<integer>(div2.rem)
(\mathbf{asType}{<}\mathbf{integer}{>}(\mathbf{operator}^*(\mathbf{heapIs}\ \$\mathbf{heap}_{funcstart\_1032,1},\ \mathbf{this}).\mathtt{p2}) <
asType < integer > (\$heap_{funcstart\_1032,1}.a2)) = >
(asType<integer>(div2.rem) == asType<integer>(operator*(heapIs
heap_{funcstart_1032.1}, this).p2)
(asType < integer > (\$heap_{funcstart\_1032,1}.a2) \le
\mathbf{asType}{<}\mathbf{integer}{>}(\mathbf{operator*}(\mathbf{heapIs}\ \$\mathbf{heap}_{funcstart\_1032,1},\ \mathbf{this}).\mathtt{p2})) =>
!(0 == asType < integer > (div2.quot))
!(0 == asType < integer > (div2.rem)) || !(0 ==
asType<integer>(div2.quot))
div3 == div(\mathbf{heapIs} \$ heap_{funcstart\_1032,1},
```

```
\mathbf{static\_cast} < \mathbf{int} > (\mathbf{operator}^*(\mathbf{heapIs}\ \$ \mathbf{heap}_{funcstart\_1032,1},\ \mathbf{this}).\mathbf{p3}),
static\_cast < int > (\$heap_{funcstart\_1032,1}.a3))
(asType < integer > (static\_cast < int > (operator*(heapIs
heap_{funcstart\_1032.1}, this).p3) /
asType < integer > (static\_cast < int > (\$heap_{funcstart\_1032.1}.a3))) = =
asType<integer>(div3.quot)
(asType<integer>(static_cast<int>(operator*(heapIs
heap_{funcstart\_1032,1}, this).p3)
\mathbf{asType} {<} \mathbf{integer} {>} (\mathbf{static\_cast} {<} \mathbf{int} {>} (\$ \mathbf{heap}_{funcstart\_1032,1}.\mathbf{a3}))) = =
asType<integer>(div3.rem)
(\mathbf{asType}{<}\mathbf{integer}{>}(\mathbf{operator}^*(\mathbf{heapIs}\ \$\mathbf{heap}_{funcstart\_1032,1},\ \mathbf{this}).\mathbf{p3}) <
asType < integer > (\$heap_{funcstart\_1032,1}.a3)) = >
(asType<integer>(div3.rem) == asType<integer>(operator*(heapIs
heap_{funcstart\_1032.1}, this).p3)
(asType < integer > (\$heap_{funcstart\_1032,1}.a3) \le
\mathbf{asType}{<}\mathbf{integer}{>}(\mathbf{operator*}(\mathbf{heapIs}\ \$\mathbf{heap}_{funcstart\_1032,1},\ \mathbf{this}).\mathrm{p3})) =>
!(0 == asType < integer > (div3.quot))
!(0 == asType < integer > (div3.rem)) || !(0 ==
asType<integer>(div3.quot))
Proof:
[Take given term]
[2.0] \operatorname{div1} == \operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_1032.1},
static_cast<int>(operator*(heapIs $heap_funcstart_1032,1, this).p1),
\mathbf{static\_cast}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_1032,1}.\mathrm{a1}))
→ [expand definition of operator '*' in class 'pointer' at built in declaration]
[2.1] \ \mathrm{div1} == \mathrm{div}(\mathbf{heapIs} \ \$ \mathrm{heap}_{funcstart\_1032,1},
\mathbf{static\_cast} {<} \mathbf{int} {>} (\mathbf{this.\$r.value} (\mathbf{heapIs} \ \$ \mathbf{heap}_{funcstart\_1032,1}).\mathbf{p1}),
\mathbf{static\_cast} {<} \mathbf{int} {>} (\$ \mathbf{heap}_{funcstart\_1032,1}.\mathbf{a1}))
\rightarrow [simplify]
[2.2] \text{ div1} == \text{div(heapIs } \text{$heap}_{funcstart\_1032,1}, \text{this.} \text{$r.value(heapIs)}
\label{eq:cast_int} $$ $ p_{funcstart\_1032,1}.p1, \ \mathbf{static\_cast} < \mathbf{int} > (\$ p_{funcstart\_1032,1}.a1) ) $$
\rightarrow [const static or extern object]
[2.3] \text{ div1} == \text{div(heapIs } \text{$heap}_{funcstart\_1032,1}, \text{this.} \text{$r.value(heapIs)}
\verb|\heap| funcstart\_1032,1|.p1, \ \textbf{static\_cast} < \textbf{int} > (\verb|\heap| funit\_a1|)|
\rightarrow [expand definition of constant 'a1' at prang.cpp (30,26)]
[2.4] \operatorname{div1} == \operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_1032,1}, \mathbf{this}.\$ r. \mathbf{value}(\mathbf{heapIs})
\theta_{tuncstart\_1032.1}.p1, \theta_{tuncstart\_1032.1}.p1, \theta_{tuncstart\_1032.1}.p1, \theta_{tuncstart\_1032.1}.p1, \theta_{tuncstart\_1032.1}.p1, \theta_{tuncstart\_1032.1}.p1, \theta_{tuncstart\_1032.1}.p2, \theta_{tuncstart\_1032.1}.p2, \theta_{tuncstart\_1032.1}.p2, \theta_{tuncstart\_1032.1}.p2, \theta_{tuncstart\_1032.1}.p2, \theta_{tuncstart\_1032.1}.p3, \theta_{tuncstart\_1032.1}.p2, \theta_{tuncstart\_1032.1}.p3, \theta_{tuncstart\_1032.1}.p4, \theta_{tuncstart\_1032.1}.p3, \theta_{tuncstart\_1032.1}.p4, \theta_{tuncstart\_1032.1}.p5, \theta_{tuncstart\_1032.1}.p5, \theta_{tuncstart\_1032.1}.p5, \theta_{tuncstart\_1032.1}.p6, \theta_{tuncstart\_1032.1}.p7, \theta_{tuncstart\_1032.1
\rightarrow [simplify]
```

```
[2.6] \operatorname{div1} == \operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_1032,1}, \mathbf{this.}\$ r.\mathbf{value}(\mathbf{heapIs})
heap_{funcstart\_1032,1}.p1, 177)
[Take goal term]
[1.0] (($heap<sub>funcstart_1032,1</sub>.r1 * static_cast<signed int>(div1.rem)) -
(\text{\$heap}_{funcstart\_1032,1}.\text{b1} * \text{static\_cast} < \text{signed int} > (\text{div1.quot}))) \le
maxof(signed int)
\rightarrow [const static or extern object]
[1.1] (($heap<sub>init</sub>.r1 * static_cast<signed int>(div1.rem)) -
(\text{sheap}_{funcstart\_1032.1}.\text{b1 * static\_cast} < \text{signed int} > (\text{div1.quot}))) \le
maxof(signed int)
\rightarrow [expand definition of constant 'r1' at prang.cpp (29,26)]
[1.2] (((int)171 * static_cast<signed int>(div1.rem)) -
(\text{sheap}_{funcstart\_1032.1}.\text{b1 * static\_cast} < \text{signed int} > (\text{div1.quot}))) \le
maxof(signed int)
\rightarrow [simplify]
[1.3] ((171 * static_cast<signed int>(div1.rem)) - ($heap_{funcstart\_1032,1}.b1)
* static_cast<signed int>(div1.quot))) < maxof(signed int)
\rightarrow [from term 2.6, div1 is equal to div(heapIs $heap_{funcstart\_1032,1},
\mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}~\$heap_{funcstart\_1032,1}).p1,~177)]
[1.4] ((171 * static_cast<signed int>(div(heapIs $heap_{funcstart\_1032,1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177).rem)) -
(\text{sheap}_{funcstart\_1032.1}.\text{b1 * static\_cast} < \text{signed int} > (\text{div1.quot}))) \le
maxof(signed int)
\rightarrow [simplify]
[1.5] ((171 * div(heapIs heap_{funcstart\_1032,1}, this.r.value(heapIs
\text{Sheap}_{funcstart\_1032.1}.\text{p1}, 177).\text{rem} - (\text{Sheap}_{funcstart\_1032.1}.\text{b1} *
static\_cast < signed int > (div1.quot))) \le maxof(signed int)
\rightarrow [const static or extern object]
[1.6] ((171 * div(heapIs heapIs  heap_{funcstart\_1032,1}, this.r.value(heapIs 
\theta_{funcstart\_1032,1}.p1, 177.rem – (\theta_{funcstart\_1032,1}.p1, 177.rem) – (\theta_{funcstart\_1032,1}.p1, 177.rem) – (\theta_{funcstart\_1032,1}.p1, 177.rem)
int > (div1.quot))) \le maxof(signed int)
\rightarrow [expand definition of constant 'b1' at prang.cpp (31,26)]
[1.7] ((171 * div(heapIs \$heap_{funcstart\_1032.1}, this.\$r.value(heapIs
\theta_{funcstart\_1032,1}.p1, 177).rem) - ((int)2 * static_cast<signed)
int > (div1.quot))) \le maxof(signed int)
\rightarrow [simplify]
[1.8] ((171 * div(heapIs $heap_{funcstart\_1032,1}, this.$r.value(heapIs
\theta_{funcstart\_1032,1}.p1, 177).rem – (2 * static_cast<signed)
```

```
int > (div1.quot)) < maxof(signed int)
 \rightarrow [from term 2.6, div1 is equal to div(heapIs $heap_{funcstart\_1032,1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177)]
 [1.9] ((171 * div(heapIs \$heap_{funcstart\_1032,1}, this.\$r.value(heapIs)
\theta_{funcstart\_1032,1}.p1, 177).rem - (2 * static\_cast < signed)
int>(div(heapIs $heap_{tuncstart\_1032.1}, this.$r.value(heapIs
\text{Sheap}_{funcstart\_1032.1}.p1, 177).quot))) \leq \max f(\text{signed int})
 \rightarrow [simplify]
 \lceil 1.26 \rceil -32768 < ((-171 * div(heapIs $heap_{funcstart\_1032,1},)
this.r.value(heapIs \$heap_{funcstart\_1032,1}).p1, 177).rem) + (2 * div(heapIs)
\rho_{tuncstart_1032.1}, this.r.value(heapIs \rho_{tuncstart_1032.1}).p1,
 177).quot))
 \rightarrow [negate goal and search for contradiction]
[1.27]!(-32768 < ((-171 * div(heapIs $heap_{funcstart\_1032.1},
this.$r.value(heapIs \theta_{funcstart\_1032,1}).p1, 177).rem) + (2 * div(heapIs
\rho_{funcstart\_1032,1}, this. r.value(heapIs \rho_{funcstart\_1032,1}).p1,
 177).quot)))
 \rightarrow [simplify]
 \begin{array}{l} [1.32] \ 32767 < ((171 \ ^* \ \mathrm{div}(\mathbf{heapIs} \ \$ \mathrm{heap}_{funcstart\_1032,1}, \ \mathbf{this}.\$ r. \mathbf{value}(\mathbf{heapIs} \ \$ \mathrm{heap}_{funcstart\_1032,1}). p1, \ 177). rem) \ + \ (-2 \ ^* \ \mathrm{div}(\mathbf{heapIs} \ \$ \mathrm{heap}_{funcstart\_1032,1}, \ \mathbf{this}.\$ r. \mathbf{value}(\mathbf{heapIs}) \ \mathbf{value}(\mathbf{heapIs}) \ \mathbf{this}.\$ r. \mathbf{value}(\mathbf{heapIs}) \ 
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177).quot))
 [Assume known post-assertion, class invariant or type constraint for term 2.6]
 [7.0] (0 < asType<integer>(this.$r.value(heapIs
\$heap_{funcstart\_1032,1}).p1)) \ \&\& \ (\textbf{asType} < \textbf{integer} > (\textbf{this}.\$r.\textbf{value}(\textbf{heapIs}))) \ \&\& \ (\textbf{asType} < \textbf{integer} > (\textbf{this}.\$r.\textbf{value}))
\rho_{tuncstart_{1032.1}, p1} < asType < integer > (\rho_{tuncstart_{1032.1}, p1}) < asType < intege
M1))
 \rightarrow [simplify]
[7.2] (0 < this.$r.value(heap
Is $heap_{funcstart\_1032,1}).p1) &&
(this.$r.value(heapIs heap_{funcstart\_1032,1}).p1 <
asType < integer > (\text{$heap.class WHPrang} \in M1))
 \rightarrow [const static or extern object]
 [7.3] (0 < this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1) \&\&
 (this.r.value(heapIs $heap_{funcstart\_1032,1}).p1 <
asType < integer > (\$heap_{init}.class WHPrang \in M1))
 \rightarrow [expand definition of constant 'M1' at prang.cpp (28,26)]
 [7.4] (0 < this.$r.value(heapIs \theta_{funcstart\_1032,1}).p1) &&
 (this.r.value(heapIs $heap_{funcstart\_1032.1}).p1 <
asType<integer>((int)30269))
```

```
\rightarrow [simplify]
[7.10] (-30269 < -this.$r.value(heapIs $heap_{tuncstart_1032.1}).p1) \land (0 <
\textbf{this.\$r.value}(\textbf{heapIs}~\$\text{heap}_{funcstart\_1032,1}).\text{p1})
[Work on sub-term 2 of conjunction in term 7.10]
[8.0] 0 < this.$r.value(heap
Is \rho_{funcstart\_1032,1}).p1
[Assume known post-assertion, class invariant or type constraint for term 2.6]
[9.0] (asType<integer>(this.$r.value(heapIs $heap_{tuncstart\_1032,1}).p1) /
asType<integer>(177)) == asType<integer>(div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot)
\rightarrow [simplify]
[9.2] (this.$r.value(heapIs $heap_{funcstart\_1032,1}).p1 / 177) ==
\mathbf{asType}{<}\mathbf{integer}{>}(\text{div}(\mathbf{heapIs}\ \$\text{heap}_{funcstart\_1032,1},\ \mathbf{this.}\$r.\mathbf{value}(\mathbf{heapIs}
heap_{funcstart\_1032,1}.p1, 177).quot
→ [expand definition of operator './' in class 'int' at built in declaration]
\textit{[9.3] ([asType<integer>(this.\$r.value(heapIs~\$heap_{funcstart\_1032,1}).p1)} < \textit{[asType=integer>(this.\$r.value(heapIs~\$heap_{funcstart\_1032,1}).p1)} < \textit{[asType=integer>(this.\$r.value(heapIs~\$heap_{funcstart\_1032,1}).p1)]} 
0]: -(-asType < integer > (this. r.value(heapIs <math>heapIs heap_{funcstart\_1032,1}).p1) /
177), \parallel: asType<integer>(this.$r.value(heapIs $heap_{funcstart\_1032,1}).p1) /
177) == asType<integer>(div(heapIs heap_{funcstart\_1032,1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177).quot)
→ [explicitly assert falsehood of skipped guards in subsequent guards]
[9.4] ([asType<integer>(this.$r.value(heapIs $heap_{funcstart\_1032,1}).p1) <
0]: -(-asType < integer > (this. r.value(heapIs $heap_{tuncstart\_1032,1}).p1) / (this. r.value(heapIs $heap_{tuncstart\_1032,1}).p1)
177), [!(asType<integer>(this.$r.value(heapIs $heap_{funcstart\_1032.1}).p1) <
0): asType<integer>(this.$r.value(heapIs $heap_{tuncstart\_1032,1}).p1) /
177) == asType<integer>(div(heapIs heap_{funcstart\_1032,1},
this.r.value(heapIs $heap_{funcstart\_1032,1}).p1, 177).quot)
\rightarrow [simplify]
[9.7] ([0 < -this.$r.value(heapIs $heap_{funcstart\_1032,1}).p1]:
-(-\mathbf{asType} < \mathbf{integer} > (\mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}~\$\mathbf{heap}_{funcstart\_1032,1}).\mathbf{p1})~/
177), [!(asType<integer>(this.$r.value(heapIs \rho_{tancstart\_1032,1}).p1] <
0)]: as
Type<integer>(this.$r.value(heap
Is \rho_{funcstart\_1032,1}).p1) / 
177) == asType<integer>(div(heapIs heap_{funcstart\_1032,1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177).quot)
\rightarrow [from term 8.0, literala < -this.$r.value(heapIs $heap_{funcstart\_1032,1}).p1
is false whenever -2 < (0 + literala)
    Proof of rule precondition:
    [9.7.0] - 2 < (0 + 0)
```

```
\rightarrow [simplify]
        [9.7.2] true
[9.8] ([false]: -(-asType<integer>(this.$r.value(heapIs
\rho_{funcstart\_1032,1}.p1) / 177, [!(asType<integer>(this.$r.value(heapIs)
\hat{p}_{uncstart_{1032,1}}.p1 < 0): asType<integer>(this.$r.value(heapIs)
\theta_{funcstart=1032,1}.p1) / 177 = asType < integer > (div(heapIs))
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot)
\rightarrow [simplify]
[9.11] ([false]: -(-asType<integer>(this.$r.value(heapIs
\text{heap}_{funcstart\_1032.1}.p1) / 177), [!(0 < -this.\$r.value(heapIs)]
\verb§heap$ funcstart\_1032,1).p1)]: \textbf{ asType} < \textbf{integer} > (\textbf{this}.\$r.\textbf{value}(\textbf{heapIs}))
\label{eq:heapfuncstart_1032,1} \$ heap_{funcstart\_1032,1}).p1) \ / \ 177) == \mathbf{asType} < \mathbf{integer} > (\mathrm{div}(\mathbf{heapIs})) < \mathbf{fine} > (\mathrm{div}(\mathbf{heapIs})) < 
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot)
\rightarrow [from term 8.0, literala < -this.$r.value(heapIs $heap_{funcstart\_1032,1}).p1
is false whenever -2 < (0 + literala)
        Proof of rule precondition:
        [9.11.0] - 2 < (0 + 0)
        \rightarrow [simplify]
        [9.11.2] true
[9.12] ([false]: -(-asType<integer>(this.$r.value(heapIs
\theta_{funcstart\_1032,1}.p1) / 177, [false]:
asType<integer>(this.$r.value(heapIs $heap_{funcstart\_1032.1}).p1) / 177)
== asType < integer > (div(heapIs $heap_{funcstart\_1032,1},
this.r.value(heapIs $heap_{funcstart\_1032,1}).p1, 177).quot)
\rightarrow [simplify]
[9.17] 0 == (-\text{div}(\mathbf{heapIs} \$ \text{heap}_{funcstart\_1032,1}, \mathbf{this}.\$ r.\mathbf{value}(\mathbf{heapIs}))
\theta_{funcstart\_1032,1}.p1, 177.quot + (this.r.value(heapIs)
heap_{funcstart_{1032,1}}.p1 / 177)
[Assume known post-assertion, class invariant or type constraint for term 2.6]
[10.0] (asType<integer>(this.r.value(heapIs $heap_{funcstart\_1032,1}).p1) %
asType<integer>(177)) == asType<integer>(div(heapIs
\rho_{funcstart\_1032,1}, this.\r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).rem)
\rightarrow [simplify]
[10.2] (this.$r.value(heapIs $heap_{funcstart\_1032,1}).p1 % 177) ==
asType<integer>(div(heapIs $heap_funcstart_1032.1, this.$r.value(heapIs
heap_{funcstart\_1032,1}.p1, 177).rem
```

```
→ [expand definition of operator '.%' in class 'int' at built in declaration]
[10.3] ([asType<integer>(this.$r.value(heapIs $heap_{tuncstart_1032.1}).p1) <
0]: -(-asType < integer > (this.\$r.value(heapIs \$heap_{funcstart\_1032,1}).p1) \%
177), \parallel: asType<integer>(this.$r.value(heapIs \theta_{funcstart\_1032,1}).p1)
\% 177) == asType<integer>(div(heapIs $heap_{tuncstart\_1032.1},
\mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}~\$\mathrm{heap}_{funcstart\_1032,1}).\mathrm{p1},~177).\mathrm{rem})
→ [explicitly assert falsehood of skipped guards in subsequent guards]
[10.4] ([asType<integer>(this.$r.value(heapIs $heap_{tuncstart\_1032.1}).p1) <
0]: -(-asType < integer > (this.\$r.value(heapIs \$heap_{funcstart\_1032,1}).p1) \%
177), [!(asType < integer > (this. r.value(heapIs <math>heapIs heap_{funcstart\_1032,1}).p1) < ]
0)]: asType<integer>(this.r.value(heapIs \heap_{funcstart\_1032,1}).p1) %
177) == asType<integer>(div(heapIs heap_{funcstart\_1032,1},
this.r.value(heapIs $heap_{funcstart\_1032.1}).p1, 177).rem)
\rightarrow [simplify]
[10.7] ([0 < -this.$r.value(heapIs $heap_{tuncstart\_1032.1}).p1]:
-(-asType < integer > (this. r.value(heapIs  heap_{funcstart\_1032.1}).p1) \%
177), [!(asType<integer>(this.$r.value(heapIs $heap_{tuncstart\_1032.1}).p1) <
0): asType<integer>(this.$r.value(heapIs $heap_{funcstart\_1032.1}).p1) %
177) == asType<integer>(div(heapIs heap_{funcstart\_1032,1},
this.r.value(heapIs \ heap_{funcstart\_1032.1}).p1, 177).rem)
\rightarrow [from term 8.0, literala < -this.$r.value(heapIs $heap_{funcstart\_1032,1}).p1
is false whenever -2 < (0 + literala)
      Proof of rule precondition:
      [10.7.0] - 2 < (0 + 0)
      \rightarrow [simplify]
      [10.7.2] true
[10.8] ([false]: -(-asType<integer>(this.$r.value(heapIs
$heap_funcstart_1032,1).p1) % 177), [!(asType<integer>(this.$r.value(heapIs
\theta_{uncstart_1032,1}.p1 (1): asType<integer>(this.$r.value(heapIs)
\theta_{funcstart\_1032,1}.p1) \% 177 == asType < integer > (div(heapIs)) % 1
\rho_{funcstart=1032,1}, this.r.value(heapIs \rho_{funcstart=1032,1}).p1,
177).rem)
\rightarrow [simplify]
[10.11] ([false]: -(-asType < integer > (this. r.value(heapIs))
heap_{funcstart\_1032,1}.p1) \% 177, [!(0 < -this.\$r.value(heapIs)
\rho_{uncstart_{-1032,1}}.p1): asType<integer>(this.\fr.value(heapIs)
\theta_{funcstart\_1032,1}.p1) % 177) == asType<integer>(div(heapIs)
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).rem)
\rightarrow [from term 8.0, literala < -this.$r.value(heapIs $heap_{funcstart\_1032.1}).p1
```

```
is false whenever -2 < (0 + literala)
   Proof of rule precondition:
   [10.11.0] - 2 < (0 + 0)
   \rightarrow [simplify]
   [10.11.2] true
[10.12] ([false]: -(-asType<integer>(this.$r.value(heapIs
heap_{funcstart_{1032,1}}.p1) \% 177, [!false]:
asType<integer>(this.$r.value(heapIs $heap_{funcstart\_1032,1}).p1) % 177)
== asType < integer > (div(heapIs $heap_{funcstart\_1032,1},
this.r.value(heapIs $heap_{funcstart\_1032,1}).p1, 177).rem)
\rightarrow [simplify]
[10.17]~0 == (-\text{div}(\textbf{heapIs}~\$\text{heap}_{funcstart\_1032,1},\,\textbf{this}.\$\text{r.value}(\textbf{heapIs}
\label{eq:loss_function} \$ heap_{funcstart\_1032,1}).p1,\ 177).rem + (\textbf{this}.\$r.\textbf{value}(\textbf{heapIs}
heap_{funcstart\_1032,1}.p1 \% 177)
[Take given term]
[15.0] (asType<integer>(operator*(heapIs $heap_{tuncstart\_1032.1}, this).p1)
< asType<integer>($heap<sub>funcstart_1032,1</sub>.a1)) =>
(asType<integer>(div1.rem) == asType<integer>(operator*(heapIs
heap_{funcstart\_1032,1}, this).p1)
→ [expand definition of operator '*' in class 'pointer' at built in declaration]
[15.1] (asType<integer>(this.$r.value(heapIs $heap_{tuncstart\_1032.1}).p1) <
asType < integer > (\$heap_{funcstart\_1032,1}.a1)) = >
(asType<integer>(div1.rem) == asType<integer>(operator*(heapIs
heap_{funcstart\_1032,1}, this).p1)
\rightarrow [simplify]
[15.2] (this.r.value(heapIs $heap_{funcstart\_1032,1}).p1 <
asType < integer > (\$heap_{funcstart\_1032,1}.a1)) = >
(asType<integer>(div1.rem) == asType<integer>(operator*(heapIs
heap_{funcstart\_1032,1}, this).p1)
\rightarrow [const static or extern object]
[15.3] (this.$r.value(heap
Is \rho_{funcstart\_1032,1}).p1 <
asType < integer > (\$heap_{init}.a1)) = > (asType < integer > (div1.rem) = =
\mathbf{asType}{<}\mathbf{integer}{>}(\mathbf{operator}^*(\mathbf{heapIs}\ \$\mathbf{heap}_{funcstart\_1032,1},\ \mathbf{this}).\mathtt{p1}))
\rightarrow [expand definition of constant 'a1' at prang.cpp (30,26)]
[15.4] (this.$r.value(heapIs \rho_{funcstart\_1032,1}).p1 <
\mathbf{asType} < \mathbf{integer} > ((\mathbf{int})177)) => (\mathbf{asType} < \mathbf{integer} > (\mathbf{div1.rem}) ==
asType < integer > (operator^*(heapIs \$heap_{funcstart\_1032,1}, this).p1))
\rightarrow [simplify]
```

```
[15.9] (-177 < -this.$r.value(heapIs $heap_{funcstart_1032.1}).p1) =>
(asType<integer>(div1.rem) == asType<integer>(operator*(heapIs
heap_{funcstart\_1032,1}, this).p1)
\rightarrow [from term 2.6, div1 is equal to div(heapIs $heap_{funcstart\_1032,1},
this.r.value(heapIs $heap_{funcstart\_1032,1}).p1, 177)]
[15.10] (-177 < -this.$r.value(heapIs $heap_{funcstart\_1032,1}).p1) =>
(asType<integer>(div(heapIs $heap_{funcstart\_1032,1}, this.$r.value(heapIs
heap_{funcstart\_1032,1}.p1, 177).rem = =
\mathbf{asType} < \mathbf{integer} > (\mathbf{operator}^*(\mathbf{heapIs} \ \$ \mathbf{heap}_{funcstart\_1032,1}, \ \mathbf{this}).\mathtt{p1}))
\rightarrow [simplify]
[15.11] (-177 < -this.$r.value(heapIs $heap_{tuncstart\_1032.1}).p1) =>
(\text{div}(\mathbf{heapIs} \$ \text{heap}_{funcstart\_1032.1}, \mathbf{this}.\$ \text{r.value}(\mathbf{heapIs}))
heap_{funcstart\_1032,1}.p1, 177).rem ==
\mathbf{asType}{<}\mathbf{integer}{>}(\mathbf{operator}^*(\mathbf{heapIs}\ \$\mathbf{heap}_{funcstart\_1032,1},\ \mathbf{this}).\mathtt{p1}))
→ [expand definition of operator '*' in class 'pointer' at built in declaration]
[15.12] (-177 < -this.$r.value(heapIs heap_{funcstart\_1032,1}).p1) =>
(\text{div}(\mathbf{heapIs} \$ \text{heap}_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}))
heap_{funcstart\_1032,1}.p1, 177).rem ==
\mathbf{asType} < \mathbf{integer} > (\mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}~\$\mathbf{heap}_{funcstart\_1032,1}).\mathbf{p1}))
\rightarrow [simplify]
[15.18] (0 == (-this.$r.value(heapIs heapIs $heap<sub>funcstart_1032,1</sub>).p1 + div(heapIs
\rho_{tuncstart_{-1032.1}}, this.r.value(heapIs \rho_{tuncstart_{-1032.1}}).p1,
177).rem)) \vee (176 < this.$r.value(heapIs $heap<sub>funcstart_1032,1</sub>).p1)
[Branch on disjunction or conditional in term 15.18]
[50.0] (0 == (-\text{this.} \text{sr.value}(\text{heapIs} \text{sheap}_{funcstart\_1032,1}).\text{p1} + \text{div}(\text{heapIs})
\rho_{funcstart\_1032,1}, this. r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).rem)) \vee (176 < this.$r.value(heapIs $heap_{tuncstart\_1032.1}).p1) \vee !(0 ==
(-this.\$r.value(heapIs \$heap_{funcstart\_1032.1}).p1 + div(heapIs
\theta_{funcstart\_1032,1}, this.r.value(heapIs \theta_{funcstart\_1032,1}).p1,
177).rem))
[Copy term 1.32]
[51.0] (32767 < ((-2 * div(heapIs $heap_{funcstart\_1032,1}, this.$r.value(heapIs 
\text{Sheap}_{funcstart\_1032.1}.p1, 177).quot) + (171 * div(heapIs \text{Sheap}_{funcstart\_1032.1},
this.$r.value(heapIs heap_{funcstart\_1032,1}).p1, 177).rem))) \vee (176 <
this.$r.value(heapIs heap_{funcstart\_1032,1}).p1) \lor !(0 ==
(-this.\$r.value(heapIs \$heap_{funcstart\_1032,1}).p1 + div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).rem))
\rightarrow [from term 50.0, div(heapIs $heap_{funcstart\_1032,1}$, this.$r.value(heapIs)
heap_{funcstart\_1032,1}.p1, 177).rem is equal to this.r.value(heapIs)
```

```
$heap_{funcstart\_1032,1}).p1]
[51.1] (32767 < ((-2 * div(heapIs $heap_{funcstart\_1032,1}, this.$r.value(heapIs funcstart_1032,1)
\theta_{funcstart\_1032,1}.p1, 177).quot + (171 * this.r.value(heapIs)
heap_{funcstart\_1032,1}.p1)) \lor ...
[Copy term 10.17]
[52.0] (0 == (-\text{div}(\mathbf{heapIs} \$ \text{heap}_{funcstart\_1032,1}, \mathbf{this}.\$ \mathbf{r.value}(\mathbf{heapIs}))
\theta_{funcstart\_1032,1}.p1, 177).rem + (this.r.value(heapIs)
\theta_{funcstart\_1032.1}.p1 % 177))) \vee (176 < this.\frac{this.\frac{t}{r.value}}{heapIs}
\theta_{tuncstart_1032,1}.p1 \vee !(0 == (-this.\$r.value(heapIs))
\text{Sheap}_{funcstart\_1032,1}.p1 + div(heapIs \text{Sheap}_{funcstart\_1032,1},
this.r.value(heapIs $heap_{funcstart\_1032,1}).p1, 177).rem)
\rightarrow [from term 50.0, div(heapIs $heap_{funcstart\_1032,1}$, this.$r.value(heapIs)
heap_{funcstart\_1032,1}.p1, 177).rem is equal to this.r.value(heapIs)
heap_{funcstart\_1032,1}.p1
[52.1] (0 == (-this.$r.value(heapIs \rho_{funcstart\_1032,1}).p1 +
(this.$r.value(heapIs heap_{funcstart\_1032,1}).p1 % 177))) \vee ...
[Assume known post-assertion, class invariant or type constraint for term 52.1]
[53.0] (this.$r.value(heapIs heap_{funcstart\_1032,1}).p1 < 177) \vee (176 <
this.$r.value(heapIs \theta_{funcstart\_1032,1}).p1) \vee !(0 ==
(-this.\$r.value(heapIs \$heap_{funcstart\_1032,1}).p1 + div(heapIs
\rho_{funcstart\_1032,1}, this. r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).rem))
\rightarrow [simplify]
[53.3] (-177 < -this.$r.value(heapIs $heap<sub>funcstart_1032,1</sub>).p1) \vee ...
[Create new term from terms 51.1, 53.3 using rule: transitivity 5r]
[60.0]~(32767 < ((-2~* {\rm div}(\mathbf{heapIs}~\$ \mathrm{heap}_{funcstart\_1032,1},~\mathbf{this}.\$ \mathrm{r.value}(\mathbf{heapIs}~
heap_{funcstart\_1032,1}.p1, 177).quot + (171 * -(-177 + 1))) \lor (176 < -(-177 + 1))) \lor (176 < -(-177 + 1)))
this.$r.value(heapIs heap_{funcstart\_1032,1}).p1) \lor !(0 ==
(-this.\$r.value(heapIs \$heap_{funcstart\_1032,1}).p1 + div(heapIs
\rho_{funcstart_{-1032,1}}, this.r.value(heapIs \rho_{funcstart_{-1032,1}}).p1,
177).rem))
\rightarrow [simplify]
[60.5]~(2671<(-2~{\rm ^*div(heap Is}~{\rm \$heap}_{funcstart\_1032,1},\,{\rm this.\$r.value(heap Is}
heap_{funcstart\_1032,1}.p1, 177).quot) \lor ...
\rightarrow [literal comparison of product]
[60.6] ([-2 < 0]: (2671 / 2) < -\text{div}(\text{heapIs } \text{$heap}_{funcstart\_1032,1},
this.$r.value(heapIs heap_{funcstart\_1032,1}).p1, 177).quot, [0 < -2]: (2671 / -2)
< \text{div}(\mathbf{heapIs} \$ \text{heap}_{funcstart\_1032,1}, \mathbf{this}.\$ \text{r.value}(\mathbf{heapIs})
\$ heap_{funcstart\_1032,1}).p1,\ 177).quot,\ [-2 == 0]:\ 2671 < 0) \ \lor \ \dots
```

```
→ [explicitly assert falsehood of skipped guards in subsequent guards]
[60.7] ([-2 < 0]: (2671 / 2) < -\text{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_1032,1},
this.$r.value(heapIs heap_{funcstart_{-1032,1}}).p1, 177).quot, [(0 < -2) \land!(-2 <
0)]: (2671 / -2) < \text{div}(\text{heapIs } \text{$heap}_{funcstart\_1032,1}, \text{this.} \text{$r.value}(\text{heapIs})
\text{Sheap}_{funcstart\_1032.1}).p1, 177).quot, [(-2 == 0) \land !(-2 < 0) \land !(0 < -2)]: 2671
< 0) \vee ...
\rightarrow [simplify]
[60.11] \; (1335 < -{\rm div}(\mathbf{heapIs} \; \$ \mathrm{heap}_{funcstart\_1032,1}, \; \mathbf{this}.\$ \mathrm{r.value}(\mathbf{heapIs} \;
heap_{funcstart_{-1032,1}}.p1, 177).quot) \vee ...
[Create new term from terms 60.11, 9.17 using rule: transitivity 15]
[62.0] ((0 + 1335) < -(this.$r.value(heapIs $heap_{funcstart\_1032,1}).p1 / 177))
\lor (176 < this.$r.value(heapIs $heap_{funcstart\_1032,1}).p1) \lor !(0 ==
(-this.\$r.value(heapIs \$heap_{funcstart\_1032,1}).p1 + div(heapIs
\rho_{funcstart_{1032,1}}, this.r.value(heapIs \rho_{funcstart_{1032,1}}).p1,
177).rem))
\rightarrow [simplify]
[62.1] (1335 < -(this.$r.value(heap
Is \rho_{funcstart\_1032,1}).p1 / 177)) <math display="inline">\vee \dots
\rightarrow [division by larger divisor]
    Proof of rule precondition 1:
    [62.1.0.0] literald < -this.$r.value(heapIs $heap_{funcstart\_1032,1}).p1
    \rightarrow [unify with term 53.3]
    [62.1.0.1] true
    Proof of rule precondition 2:
    [62.1.1.0] literalc < this.$r.value(heapIs \theta_{funcstart\_1032,1}).p1
    \rightarrow [unify with term 8.0]
    [62.1.1.1] true
    Proof of rule precondition 3:
    [62.1.2.0] --177 < 177
    \rightarrow [simplify]
    [62.1.2.2] true
    Proof of rule precondition 4:
    [62.1.3.0] - 2 < 0
    \rightarrow [simplify]
    [62.1.3.1] true
[62.2] (1335 < -this.$r.value(heapIs $heap_{tuncstart\_1032.1}).p1) \lor ...
```

```
Proof of rule precondition:
    [62.2.0] - 2 < (0 + 1335)
    \rightarrow [simplify]
    [62.2.2] true
[62.3] false \vee \dots
[Remove 'false' term 62.3 and fetch new term from containing clause]
| [63.0] 176 < this.$r.value(heapIs $heap_{funcstart\_1032,1}).p1
[Copy term 1.32]
\textit{[66.0] }32767 < ((-2 * \text{div}(\textbf{heapIs} \$ \text{heap}_{funcstart\_1032,1}, \textbf{this.}\$ r. \textbf{value}(\textbf{heapIs} + \textbf{heap}_{funcstart\_1032,1}))
\rho_{uncstart_{1032,1}}, p1, 177).quot) + (171 * div(heapIs \rho_{uncstart_{1032,1}}
\mathbf{this.\$r.value}(\mathbf{heapIs}\ \$\mathbf{heap}_{funcstart\_1032,1}).\mathbf{p1},\ 177).\mathbf{rem}))
\rightarrow [from term 10.17, div(heapIs $heap_{funcstart\_1032,1}$, this.$r.value(heapIs)
heap_{funcstart\_1032,1}.p1, 177.rem is equal to this.r.value(heapIs)
heap_{funcstart\_1032,1}.p1 % 177]
\textit{[66.1] } 32767 < ((-2 * \text{div}(\textbf{heapIs} \$ \text{heap}_{funcstart\_1032,1}, \textbf{this}.\$ r. \textbf{value}(\textbf{heapIs} + \textbf{heap}_{funcstart\_1032,1}))
\theta_{funcstart\_1032.1}.p1, 177).quot) + (171 * (this.\r.value(heapIs)
heap_{funcstart\_1032,1}.p1 \% 177)
[Create new term from term 9.17 using rule: condition for equality of division]
[69.0] ((177 * (0 + -(-div(heapIs $heap_{funcstart\_1032,1}, this.$r.value(heapIs)]
\theta_{funcstart\_1032.1}.p1, 177).quot))) < (1 + this.\r.value(heapIs
\rho_{tuncstart\_1032.1}.p1) \land (this.\$r.value(heapIs \$heap_{tuncstart\_1032.1}).p1 < 0
(177 * (0 + 1 + -(-\text{div}(\textbf{heapIs} \$\text{heap}_{funcstart\_1032,1}, \textbf{this}.\$r.\textbf{value}(\textbf{heapIs}))
\$ \operatorname{heap}_{funcstart\_1032,1}).\operatorname{p1},\ 177).\operatorname{quot}))))
\rightarrow [simplify]
\textit{[69.15]} \ (-1 < ((-177 \ ^* \ \mathrm{div}(\mathbf{heapIs} \ \$ \mathrm{heap}_{funcstart\_1032,1}, \ \mathbf{this}.\$ r. \mathbf{value}(\mathbf{heapIs} \ \$))
\theta_{funcstart\_1032,1}.p1, 177).quot + this. r.value(heapIs)
heap_{funcstart\_1032,1}.p1) \land (-177 < (-this.r.value(heapIs))
\theta_{funcstart\_1032,1}.p1 + (177 * div(heapIs \theta_{funcstart\_1032,1}),
\mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}~\$\mathrm{heap}_{funcstart\_1032,1}).\mathrm{p1},~177).\mathrm{quot})))
\rightarrow [separate conjunction and work on first sub-term]
\textit{[69.16]}-177< (-this.$r.value(heapIs \rho_{funcstart\_1032,1}).p1 + (177 *
div(\mathbf{heapIs} \$ heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
heap_{funcstart_{1032,1}}.p1, 177).quot)
[Create new term from terms 63.0, 69.16 using rule: transitivity 3]
[71.0] (-177 + 1 + 176) < (177 * div(heapIs $heap_{funcstart\_1032,1},
this.r.value(heapIs $heap_{funcstart\_1032,1}).p1, 177).quot)
```

 \rightarrow [from term 8.0, literala < -this.\$r.value(heapIs \$heap_{funcstart_1032.1}).p1

is false whenever -2 < (0 + literala)

```
\rightarrow [simplify]
[71.1] 0 < (177 * div(heapIs $heap_{funcstart\_1032,1}, this.$r.value(heapIs)]
heap_{funcstart_{-1032,1}}.p1, 177).quot
\rightarrow [product is positive]
[71.2] ((0 < 177) \land (0 < \text{div}(\mathbf{heapIs} \$ heap_{funcstart\_1032,1},
this.$r.value(heapIs $heap_{tuncstart\_1032,1}).p1, 177).quot)) \lor ((177 < 0) \land
(\text{div}(\mathbf{heapIs} \$ \text{heap}_{funcstart\_1032,1}, \mathbf{this}.\$ \text{r.value}(\mathbf{heapIs}))
heap_{funcstart\_1032,1}.p1, 177).quot < 0
\rightarrow [simplify]
[71.7] 0 < div(heapIs $heap_{funcstart\_1032,1}, this.$r.value(heapIs
heap_{funcstart\_1032,1}.p1, 177).quot
[Create new term from terms 71.7, 66.1 using rule: transitivity 11]
[76.0] (1 + 32767 + (0 * 2)) < (171 * (this.$r.value(heapIs)
heap_{funcstart_{1032,1}}.p1 \% 177)
\rightarrow [simplify]
[76.2] 32768 < (171 * (this.\$r.value(heapIs \$heap_{funcstart\_1032,1}).p1 \% 177))
\rightarrow [literal comparison of product]
[76.3] ([171 < 0]: (32768 / -171) < -(this.\$r.value(heapIs)
\rho_{funcstart\_1032,1}.p1~\%~177), [0 < 171]: (32768 / 171) < 1710
(this.$r.value(heapIs heap_{funcstart\_1032,1}).p1 % 177), [0 == 171]: 32768 <
0)
\rightarrow [explicitly assert falsehood of skipped guards in subsequent guards]
[76.4] ([171 < 0]: (32768 / -171) < -(this.\$r.value(heapIs)
\text{Sheap}_{funcstart\_1032.1}).p1 % 177), [(0 < 171) \land !(171 < 0)]: (32768 / 171) < 0
(this.$r.value(heapIs $heap_{funcstart\_1032,1}).p1 % 177), [(0 == 171) \land !(0 <
171) \land !(171 < 0)]: 32768 < 0
\rightarrow [simplify]
[76.13] false
Proof of verification condition: Type constraint satisfied in explicit
```

Proof of verification condition: Type constraint satisfied in explicit conversion from 'integer' to 'int'

In the context of class: WHPrang, declared at: C:\Escher\Customers\prang-cpp\prang.cpp (18,1)

Condition generated at: C:\Escher\Customers\prang-cpp\prang.cpp (75,18)

Condition defined at:

To prove: $minof(int) \le static_cast < integer > (static_cast < signed)$

```
int>(operator^*(heapIs $heap_{funcstart=1032.1}, this).p1) < (int)0)
Given:
heap_{init}.LIMIT == (int)80
heap_{init}.class WHPrang \in M1 == (int)30269
heap_{init}.class WHPrang \in r1 == (int)171
heap_{init}.class WHPrang \in a1 == (int)177
heap_{init}.class WHPrang \in b1 == (int)2
heap_{init}.class WHPrang \in M2 == (int)30307
heap_{init}.class WHPrang \in r2 == (int)172
heap_{init}.class WHPrang \in a2 == (int)176
heap_{init}.class WHPrang \in b2 == (int)35
heap_{init}.class WHPrang \in M3 == (int)30323
heap_{init}.class WHPrang \in r3 == (int)170
heap_{init}.class WHPrang \in a3 == (int)178
heap_{init}.class WHPrang \in b3 == (int)63
\operatorname{div1} == \operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_1032,1},
static\_cast < int > (operator*(heapIs $heap_{funcstart\_1032,1}, this).p1),
\mathbf{static\_cast}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_1032,1}.\mathrm{a1}))
(asType<integer>(static_cast<int>(operator*(heapIs
heap_{funcstart\_1032,1}, this).p1) /
\mathbf{asType} {<} \mathbf{integer} {>} (\mathbf{static\_cast} {<} \mathbf{int} {>} (\$ \mathbf{heap}_{funcstart\_1032,1}.\mathbf{a1}))) = =
asType<integer>(div1.quot)
(asType<integer>(static_cast<int>(operator*(heapIs
heap_{funcstart\_1032,1}, this).p1) %
asType < integer > (static\_cast < int > (\$heap_{funcstart\_1032.1}.a1))) = =
asType<integer>(div1.rem)
(asType < integer > (operator*(heapIs $heap_{funcstart\_1032,1}, this).p1) < footnote{the content of the conte
asType < integer > (\$heap_{funcstart\_1032,1}.a1)) = >
(\mathbf{asType} < \mathbf{integer} > (\mathbf{div1.rem}) == \mathbf{asType} < \mathbf{integer} > (\mathbf{operator} * (\mathbf{heapIs}))
heap_{funcstart\_1032,1}, this).p1)
(asType < integer > (\$heap_{funcstart\_1032,1}.a1) \le
asType < integer > (operator^*(heapIs \$heap_{funcstart\_1032,1}, this).p1)) = >
!(0 == asType < integer > (div1.quot))
!(0 == asType < integer > (div1.rem)) || !(0 ==
asType<integer>(div1.quot))
\operatorname{div2} == \operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_1032,1},
static_cast<int>(operator*(heapIs $heap_{funcstart\_1032.1}, this).p2),
```

```
\mathbf{static\_cast} {<} \mathbf{int} {>} (\$ \mathbf{heap}_{funcstart\_1032,1}.\mathbf{a2}))
(asType<integer>(static_cast<int>(operator*(heapIs
heap_{funcstart_1032,1}, this).p2)
asType < integer > (static\_cast < int > (\$heap_{funcstart\_1032.1}.a2))) = =
asType<integer>(div2.quot)
(asType < integer > (static\_cast < int > (operator*(heapIs)))
heap_{funcstart\_1032,1}, this).p2)
\mathbf{asType} {<} \mathbf{integer} {>} (\mathbf{static\_cast} {<} \mathbf{int} {>} (\$ \mathbf{heap}_{funcstart\_1032,1}.\mathbf{a2}))) = =
asType<integer>(div2.rem)
(\mathbf{asType}{<}\mathbf{integer}{>}(\mathbf{operator}^*(\mathbf{heapIs}\ \$\mathbf{heap}_{funcstart\_1032,1},\ \mathbf{this}).\mathtt{p2}) <
asType < integer > (\$heap_{funcstart\_1032,1}.a2)) = >
(asType<integer>(div2.rem) == asType<integer>(operator*(heapIs
heap_{funcstart\_1032.1}, this).p2)
(\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathsf{heap}_{funcstart\_1032,1}.\mathsf{a2}) \leq
asType<integer>(operator*(heapIs $heap_{tuncstart\_1032,1}, this).p2)) =>
!(0 == asType < integer > (div2.quot))
!(0 == asType < integer > (div2.rem)) || !(0 ==
asType<integer>(div2.quot))
div3 == div(\mathbf{heapIs} \$heap_{funcstart\_1032,1},
static\_cast < int > (operator*(heapIs $heap_{funcstart\_1032,1}, this).p3),
static\_cast < int > (\$heap_{funcstart\_1032,1}.a3))
(asType<integer>(static_cast<int>(operator*(heapIs
heap_{funcstart\_1032.1}, this).p3) /
asType < integer > (static\_cast < int > (\$heap_{funcstart\_1032,1}.a3))) = =
asType<integer>(div3.quot)
(asType<integer>(static_cast<int>(operator*(heapIs
heap_{funcstart\ 1032.1}, this).p3)
asType < integer > (static\_cast < int > (\$heap_{funcstart\_1032.1}.a3))) = =
asType<integer>(div3.rem)
(\mathbf{asType}{<}\mathbf{integer}{>}(\mathbf{operator}^*(\mathbf{heapIs}\ \$\mathbf{heap}_{funcstart\_1032,1},\ \mathbf{this}).\mathrm{p3}) <
asType < integer > (\$heap_{funcstart\_1032.1}.a3)) = >
(asType<integer>(div3.rem) == asType<integer>(operator*(heapIs
heap_{funcstart\_1032,1}, this).p3)
(\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathbf{heap}_{funcstart\_1032,1}.\mathbf{a3}) \leq
asType < integer > (operator*(heapIs $heap_{funcstart\_1032,1}, this).p3)) = >
!(0 == asType < integer > (div3.quot))
!(0 == asType < integer > (div3.rem)) || !(0 ==
asType<integer>(div3.quot))
temp1 == (\$heap_{funcstart\_1032,1}.r1 * static\_cast < signed int > (div1.rem)) -
(\text{sheap}_{funcstart\_1032.1}.\text{b1} * \text{static\_cast} < \text{signed int} > (\text{div1.quot}))
```

```
minof(signed int) < temp1
temp1 \le maxof(signed int)
Proof:
[Take given term]
[2.0] div1 == div(heapIs $heap_{funcstart\_1032,1},
static_cast<int>(operator*(heapIs $heap_{funcstart\_1032,1}, this).p1),
\mathbf{static\_cast}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_1032,1}.\mathrm{a1}))
→ [expand definition of operator '*' in class 'pointer' at built in declaration]
[2.1] \operatorname{div1} == \operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_1032,1},
static\_cast < int > (this. r.value(heapIs  heap_{funcstart\_1032,1}).p1),
static\_cast < int > (\$heap_{funcstart\_1032,1}.a1))
\rightarrow [simplify]
[2.2]~{\rm div1} == {\rm div}(\mathbf{heapIs}~\$ \mathrm{heap}_{funcstart\_1032,1},~\mathbf{this}.\$ \mathrm{r.value}(\mathbf{heapIs}
\theta_{funcstart\_1032,1}.p1, \theta_{funcstart\_1032,1}.a1)
\rightarrow [const static or extern object]
[2.3] \text{ div1} == \text{div(heapIs } \text{$heap}_{funcstart\_1032,1}, \text{ this.} \text{$r.value(heapIs)}
\$ heap_{funcstart\_1032,1}).p1, \ \mathbf{static\_cast} < \mathbf{int} > (\$ heap_{init}.a1))
\rightarrow [expand definition of constant 'a1' at prang.cpp (30,26)]
[2.4] \operatorname{div1} == \operatorname{div}(\mathbf{heapIs} \ \hat{\mathbf{s}}_{heap}_{funcstart\_1032,1}, \ \mathbf{this.\$r.value}(\mathbf{heapIs})
\theta_{funcstart\_1032,1}.p1, \theta_{funcstart\_1032,1}.p1, \theta_{funcstart\_1032,1}.p1, \theta_{funcstart\_1032,1}.p1, \theta_{funcstart\_1032,1}.p1, \theta_{funcstart\_1032,1}.p2, \theta_{funcstart\_1032,1}.p2, \theta_{funcstart\_1032,1}.p2, \theta_{funcstart\_1032,1}.p2, \theta_{funcstart\_1032,1}.p2, \theta_{funcstart\_1032,1}.p3, \theta_{funcstart\_1032,1}.p4, \theta_{funcstart\_1032,1}.p4, \theta_{funcstart\_1032,1}.p4, \theta_{funcstart\_1032,1}.p4, \theta_{funcstart\_1032,1}.p4, \theta_{funcstart\_1032,1}.p5, \theta_{funcstart\_1032,1
\rightarrow [simplify]
[2.6] \operatorname{div1} == \operatorname{div}(\mathbf{heapIs} \ \mathbf{\$heap}_{funcstart\_1032,1}, \ \mathbf{this}.\mathbf{\$r.value}(\mathbf{heapIs})
heap_{funcstart_{1032,1}}.p1, 177
[Assume known post-assertion, class invariant or type constraint for term 2.6]
[7.0] (0 < asType<integer>(this.$r.value(heapIs
\theta_{uncstart\_1032,1}.p1) && (asType<integer>(this.$r.value(heapIs)
\$ heap_{funcstart\_1032,1}).p1) < \mathbf{asType} < \mathbf{integer} > (\$ heap.\mathbf{class} \ WHPrang \in \texttt{Constart} = \texttt{Constart}
M1))
\rightarrow [simplify]
[7.2] (0 < this.$r.value(heapIs $heap_{funcstart\_1032,1}).p1) &&
(this.r.value(heapIs $heap_{funcstart\_1032.1}).p1 <
asType < integer > (\$heap.class WHPrang \in M1))
\rightarrow [const static or extern object]
[7.3] (0 < this.$r.value(heap
Is \rho_{funcstart\_1032,1}.p1) \ \&\&
(this.$r.value(heapIs heap_{funcstart\_1032,1}).p1 <
asType < integer > (\$heap_{init}.class WHPrang \in M1))
\rightarrow [expand definition of constant 'M1' at prang.cpp (28,26)]
```

```
[7.4] (0 < this.$r.value(heap
Is $heap_{funcstart\_1032,1}).p1) &&
(this.$r.value(heapIs \theta_{funcstart\_1032,1}).p1 <
asType < integer > ((int)30269))
\rightarrow [simplify]
[7.10] (-30269 < -this.$r.value(heapIs heap_{funcstart\_1032,1}).p1) <math>\land (0 < 
\mathbf{this.\$r.value}(\mathbf{heapIs}~\$\mathbf{heap}_{funcstart\_1032,1}).\mathbf{p1})
[Work on sub-term 2 of conjunction in term 7.10]
[8.0] 0 < this.$r.value(heapIs \theta_{funcstart\_1032,1}).p1
[Take goal term]
[1.0] minof(int) < static_cast<integer>(static_cast<signed)
\mathbf{int} > (\mathbf{operator}^*(\mathbf{heapIs} \ \$ \mathbf{heap}_{funcstart\_1032,1}, \ \mathbf{this}).\mathbf{p1}) < (\mathbf{int})0)
\rightarrow [simplify]
[1.1] -32768 \leq static_cast<integer>(static_cast<signed
int>(operator^*(heapIs \$heap_{funcstart\_1032,1}, this).p1) < (int)0)
→ [expand definition of operator '*' in class 'pointer' at built in declaration]
[1.2] -32768 \leq static_cast<integer>(static_cast<signed
int>(this.\$r.value(heapIs \$heap_{funcstart\_1032,1}).p1) < (int)0)
\rightarrow [simplify]
[1.6] -32768 \leq static_cast<integer>(0 < -this.r.value(heapIs
heap_{funcstart\_1032,1}.p1
\rightarrow [from term 8.0, literala < -this.$r.value(heapIs $heap_{funcstart\_1032,1}).p1
is false whenever -2 < (0 + literala)
   Proof of rule precondition:
   [1.6.0] - 2 < (0 + 0)
   \rightarrow [simplify]
   [1.6.2] true
[1.7] -32768 \leq static_cast<integer>(false)
\rightarrow [simplify]
[1.8] -32768 \le ([false]: 1, []: 0)
→ [explicitly assert falsehood of skipped guards in subsequent guards]
[1.9] - 32768 \le ([false]: 1, [true]: 0)
\rightarrow [simplify]
[1.11] true
```

Proof of verification condition: Type constraint satisfied in explicit

```
conversion from 'integer' to 'int'
In the context of class: WHPrang, declared at:
C:\Escher\Customers\prang-cpp\prang.cpp (18,1)
Condition generated at: C:\Escher\Customers\prang-cpp\prang.cpp
(75,18)
Condition defined at:
To prove: static_cast<integer>(static_cast<signed
int>(operator^*(heapIs $heap_{funcstart\_1032.1}, this).p1) < (int)0) \le
maxof(int)
Given:
heap_{init}.LIMIT == (int)80
heap_{init}.class WHPrang \in M1 == (int)30269
heap_{init}.class WHPrang \in r1 == (int)171
heap_{init}.class WHPrang \in a1 == (int)177
heap_{init}.class WHPrang \in b1 == (int)2
heap_{init}.class WHPrang \in M2 == (int)30307
heap_{init}.class WHPrang \in r2 == (int)172
heap_{init}.class WHPrang \in a2 == (int)176
heap_{init}.class WHPrang \in b2 == (int)35
heap_{init}.class WHPrang \in M3 == (int)30323
heap_{init}.class WHPrang \in r3 == (int)170
heap_{init}.class WHPrang \in a3 == (int)178
heap_{init}.class WHPrang \in b3 == (int)63
\operatorname{div1} == \operatorname{div}(\mathbf{heapIs} \ \operatorname{heap}_{funcstart\_1032.1},
\mathbf{static\_cast} {<} \mathbf{int} {>} (\mathbf{operator*}(\mathbf{heapIs}\ \$ \mathbf{heap}_{funcstart\_1032,1},\ \mathbf{this}).\mathtt{p1}),
\mathbf{static\_cast}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_1032,1}.\mathrm{a1}))
(asType<integer>(static_cast<int>(operator*(heapIs
heap_{funcstart\_1032,1}, this).p1)) /
asType < integer > (static\_cast < int > (\$heap_{funcstart\_1032.1}.a1))) = =
asType<integer>(div1.quot)
(asType<integer>(static_cast<int>(operator*(heapIs
heap_{funcstart\_1032,1}, this).p1) %
\mathbf{asType} {<} \mathbf{integer} {>} (\mathbf{static\_cast} {<} \mathbf{int} {>} (\$ \mathbf{heap}_{funcstart\_1032,1}.\mathbf{a1}))) = =
asType<integer>(div1.rem)
(asType<integer>(operator*(heapIs $heap_{funcstart\_1032,1}, this).p1) <
asType < integer > (\$heap_{funcstart\_1032,1}.a1)) = >
```

```
(asType<integer>(div1.rem) == asType<integer>(operator*(heapIs
heap_{funcstart\_1032,1}, this).p1)
(asType < integer > (\$heap_{funcstart\_1032,1}.a1) \le
\mathbf{asType} < \mathbf{integer} > (\mathbf{operator}^*(\mathbf{heapIs} \ \$ \mathbf{heap}_{funcstart\_1032,1}, \ \mathbf{this}).\mathtt{p1})) = >
!(0 == asType < integer > (div1.quot))
!(0 == asType < integer > (div1.rem)) || !(0 ==
asType<integer>(div1.quot))
div2 == div(\mathbf{heapIs} \$heap_{funcstart\_1032,1},
\mathbf{static\_cast} < \mathbf{int} > (\mathbf{operator}^*(\mathbf{heapIs}\ \$ \mathbf{heap}_{funcstart\_1032,1},\ \mathbf{this}).\mathbf{p2}),
\mathbf{static\_cast}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_1032,1}.\mathrm{a2}))
(\mathbf{asType} {<} \mathbf{integer} {>} (\mathbf{static\_cast} {<} \mathbf{int} {>} (\mathbf{operator}^* (\mathbf{heapIs}
heap_{funcstart_1032,1}, this).p2) /
asType < integer > (static\_cast < int > (\$heap_{funcstart\_1032,1}.a2))) = =
asType<integer>(div2.quot)
(asType < integer > (static\_cast < int > (operator*(heapIs)))
heap_{funcstart\_1032.1}, this).p2)
asType < integer > (static\_cast < int > (\$heap_{funcstart\_1032.1}.a2))) = =
asType<integer>(div2.rem)
(\mathbf{asType}{<}\mathbf{integer}{>}(\mathbf{operator}^*(\mathbf{heapIs}\ \$\mathbf{heap}_{funcstart\_1032,1},\ \mathbf{this}).\mathtt{p2}) <
asType < integer > ($heap_{funcstart\_1032,1}.a2)) = >
(asType<integer>(div2.rem) == asType<integer>(operator*(heapIs
heap_{funcstart\_1032,1}, this).p2)
(asType < integer > (\$heap_{funcstart\_1032,1}.a2) \le
\mathbf{asType} < \mathbf{integer} > (\mathbf{operator}^*(\mathbf{heapIs} \ \$ \mathbf{heap}_{funcstart\_1032,1}, \ \mathbf{this}).\mathtt{p2})) = >
!(0 == asType < integer > (div2.quot))
!(0 == asType < integer > (div2.rem)) || !(0 ==
asType<integer>(div2.quot))
div3 == div(\mathbf{heapIs} \$ heap_{funcstart\_1032,1},
\mathbf{static\_cast} < \mathbf{int} > (\mathbf{operator}^*(\mathbf{heapIs}\ \$ \mathbf{heap}_{funcstart\_1032,1},\ \mathbf{this}).\mathbf{p3}),
\mathbf{static\_cast}{<}\mathbf{int}{>}(\$\mathsf{heap}_{funcstart\_1032,1}.\mathsf{a3}))
(asType < integer > (static\_cast < int > (operator*(heapIs)))
heap_{funcstart\_1032,1}, this).p3)
asType<integer>(static_cast<int>($heap_{funcstart_1032.1}.a3))) ==
asType<integer>(div3.quot)
(asType < integer > (static\_cast < int > (operator*(heapIs)))
heap_{funcstart\_1032,1}, this).p3)
asType < integer > (static\_cast < int > (\$heap_{funcstart\_1032.1}.a3))) = =
asType<integer>(div3.rem)
(\mathbf{asType}{<}\mathbf{integer}{>}(\mathbf{operator}^*(\mathbf{heapIs}\ \$\mathbf{heap}_{funcstart\_1032,1},\ \mathbf{this}).\mathbf{p3}) <
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathrm{heap}_{funcstart\_1032,1}.\mathrm{a3})) =>
(asType<integer>(div3.rem) == asType<integer>(operator*(heapIs
```

```
heap_{funcstart_1032,1}, this).p3)
(asType < integer > (\$heap_{funcstart\_1032,1}.a3) \le
asType < integer > (operator*(heapIs $heap_{funcstart\_1032,1}, this).p3)) = >
!(0 == asType < integer > (div3.quot))
!(0 == asType < integer > (div3.rem)) || !(0 ==
asType<integer>(div3.quot))
temp1 == (\$heap_{funcstart\_1032,1}.r1 * \textbf{static\_cast} < \textbf{signed int} > (div1.rem)) - (div1.rem) + (div1.r
(\text{sheap}_{funcstart\_1032,1}.\text{b1 * static\_cast} < \text{signed int} > (\text{div1.quot}))
minof(signed int) < temp1
temp1 \le maxof(signed int)
Proof:
[Take given term]
[2.0] \operatorname{div}1 == \operatorname{div}(\mathbf{heapIs} \ \operatorname{\$heap}_{funcstart\_1032,1},
\mathbf{static\_cast} < \mathbf{int} > (\mathbf{operator^*(heapIs} \ \$ heap_{funcstart\_1032,1}, \ \mathbf{this}).p1),
static\_cast < int > (\$heap_{funcstart\_1032.1}.a1))
→ [expand definition of operator '*' in class 'pointer' at built in declaration]
[2.1] \operatorname{div}1 == \operatorname{div}(\mathbf{heapIs} \ \operatorname{\$heap}_{funcstart\_1032,1},
\mathbf{static\_cast} < \mathbf{int} > (\mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs} \$ \mathbf{heap}_{funcstart\_1032,1}).p1),
\mathbf{static\_cast}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_1032,1}.\mathrm{a1}))
\rightarrow [simplify]
[2.2] \operatorname{div1} == \operatorname{div}(\mathbf{heapIs} \ \mathbf{\$heap}_{funcstart\_1032,1}, \ \mathbf{this}.\mathbf{\$r.value}(\mathbf{heapIs})
\rho_{tuncstart\_1032,1}, p1, static_cast<int>(\rho_{tuncstart\_1032,1})
\rightarrow [const static or extern object]
[2.3] \text{ div1} == \text{div(heapIs } \text{$heap}_{funcstart\_1032,1}, \text{ this.} \text{$r.value(heapIs)}
\$ heap_{funcstart\_1032,1}).p1, \ \mathbf{static\_cast} < \mathbf{int} > (\$ heap_{init}.a1))
\rightarrow [expand definition of constant 'a1' at prang.cpp (30,26)]
[2.4] \operatorname{div1} == \operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_1032,1}, \mathbf{this}.\$ r. \mathbf{value}(\mathbf{heapIs})
\$ heap_{funcstart\_1032,1}).p1, \ \mathbf{static\_cast} < \mathbf{int} > ((\mathbf{int})177))
\rightarrow [simplify]
[2.6] \operatorname{div1} == \operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_1032,1}, \mathbf{this.}\$ r.\mathbf{value}(\mathbf{heapIs})
heap_{funcstart_{-1032,1}}.p1, 177
[Assume known post-assertion, class invariant or type constraint for term 2.6]
[7.0] (0 < asType<integer>(this.$r.value(heapIs
\label{eq:continuous} $\operatorname{heap}_{funcstart\_1032,1}).p1)) \&\& (\mathbf{asType} < \mathbf{integer} > (\mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})) \&\& (\mathbf{asType} < \mathbf{integer} > (\mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}))) \&\& (\mathbf{asType} < \mathbf{integer} > (\mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})))) \&\& (\mathbf{asType} < \mathbf{integer} > (\mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}))) \&\& (\mathbf{asType} < \mathbf{integer} > (\mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})))) \&\& (\mathbf{asType} < \mathbf{integer} > (\mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}))))) \&\& (\mathbf{asType} < \mathbf{integer} > (\mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})))) \&\& (\mathbf{asType} < \mathbf{integer} > (\mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}))))) \&\& (\mathbf{asType} < \mathbf{integer} > (\mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}))))) \&\& (\mathbf{asType} < \mathbf{integer} > (\mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})))) \&\& (\mathbf{asType} < \mathbf{integer} > (\mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}))))) \&\& (\mathbf{asType} < \mathbf{integer} > (\mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}))))) \&\& (\mathbf{asType} < \mathbf{integer} > (\mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})))))) \&\& (\mathbf{asType} < \mathbf{integer} > (\mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}))))))) \&\& (\mathbf{asType} < \mathbf{integer} > (\mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}))))))))))
\theta_{funcstart\_1032,1}.p1 < asType<integer>(\theta_{funcstart\_1032,1}).p1) < asType<integer>(\theta_{funcstart\_1032,1}).p1)
M1))
\rightarrow [simplify]
```

```
[7.2] (0 < this.$r.value(heap
Is $heap_{funcstart\_1032,1}).p1) &&
(this.$r.value(heapIs heap_{funcstart\_1032,1}).p1 <
asType < integer > (\$heap.class WHPrang \in M1))
\rightarrow [const static or extern object]
[7.3] (0 < this.$r.value(heapIs \theta_{funcstart\_1032,1}).p1) &&
(this.r.value(heapIs $heap_{funcstart\_1032.1}).p1 <
asType < integer > (\$heap_{init}.class WHPrang \in M1))
\rightarrow [expand definition of constant 'M1' at prang.cpp (28,26)]
[7.4] (0 < this.$r.value(heap
Is $heap_{funcstart\_1032,1}).p1) &&
(this.$r.value(heapIs heap_{funcstart\_1032,1}).p1 <
asType < integer > ((int)30269))
\rightarrow [simplify]
[7.10] (-30269 < -this.$r.value(heapIs $heap_{tuncstart\_1032.1}).p1) \land (0 <
this.$r.value(heapIs $heap_{funcstart\_1032.1}).p1)
[Work on sub-term 2 of conjunction in term 7.10]
[8.0] 0 < this.$r.value(heapIs $heap<sub>funcstart_1032,1</sub>).p1
[Take goal term]
[1.0] static_cast<integer>(static_cast<signed int>(operator*(heapIs
\text{$heap}_{funcstart\_1032,1}, \text{ this}).p1) < (\text{int})0) \leq \text{maxof}(\text{int})
→ [expand definition of operator '*' in class 'pointer' at built in declaration]
[1.1] static_cast<integer>(static_cast<signed int>(this.$r.value(heapIs
\text{Sheap}_{funcstart\_1032,1}.\text{p1}) < (\text{int})0) \leq \text{maxof}(\text{int})
\rightarrow [simplify]
[1.5] static_cast<integer>(0 < -this.$r.value(heapIs
\text{$heap}_{funcstart\_1032,1}).p1) \leq \mathbf{maxof(int)}
\rightarrow [from term 8.0, literala < -this.$r.value(heapIs $heap_{funcstart\_1032.1}).p1
is false whenever -2 < (0 + literala)
   Proof of rule precondition:
   [1.5.0] - 2 < (0 + 0)
   \rightarrow [simplify]
   [1.5.2] true
[1.6] static_cast<integer>(false) \leq maxof(int)
\rightarrow [simplify]
[1.7] ([false]: 1, []: 0) \leq maxof(int)
→ [explicitly assert falsehood of skipped guards in subsequent guards]
[1.8] ([false]: 1, [true]: 0) \leq maxof(int)
```

```
[1.11] true
Proof of verification condition: Arithmetic result of operator '*' is within
limit of type 'signed int'
In the context of class: WHPrang, declared at:
C:\Escher\Customers\prang-cpp\prang.cpp (18,1)
Condition generated at: C:\Escher\Customers\prang-cpp\prang.cpp
(75,32)
Condition defined at:
To prove: minof(signed int) \leq ($heap<sub>funcstart_1032,1</sub>.M1 *
asType < int > (static\_cast < integer > (static\_cast < signed
int>(operator^*(heapIs $heap_{funcstart\_1032.1}, this).p1) < (int)0)))
Given:
heap_{init}.LIMIT == (int)80
heap_{init}.class WHPrang \in M1 == (int)30269
heap_{init}.class WHPrang \in r1 == (int)171
heap_{init}.class WHPrang \in a1 == (int)177
heap_{init}.class WHPrang \in b1 == (int)2
heap_{init}.class WHPrang \in M2 == (int)30307
heap_{init}.class WHPrang \in r2 == (int)172
heap_{init}.class WHPrang \in a2 == (int)176
heap_{init}.class WHPrang \in b2 == (int)35
heap_{init}.class WHPrang \in M3 == (int)30323
heap_{init}.class WHPrang \in r3 == (int)170
heap_{init}.class WHPrang \in a3 == (int)178
heap_{init}.class WHPrang \in b3 == (int)63
\operatorname{div1} == \operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_1032,1},
static\_cast < int > (operator^*(heapIs \$heap_{funcstart\_1032,1}, this).p1),
static\_cast < int > (\$heap_{funcstart\_1032,1}.a1))
(asType<integer>(static_cast<int>(operator*(heapIs
heap_{funcstart\_1032,1}, this).p1) /
\mathbf{asType} {<} \mathbf{integer} {>} (\mathbf{static\_cast} {<} \mathbf{int} {>} (\$ \mathbf{heap}_{funcstart\_1032,1}.\mathbf{a1}))) = =
asType<integer>(div1.quot)
(asType < integer > (static\_cast < int > (operator*(heapIs)))
heap_{funcstart\_1032,1}, this).p1) %
```

 \rightarrow [simplify]

```
asType < integer > (static\_cast < int > (\$heap_{funcstart\_1032.1}.a1))) = =
asType<integer>(div1.rem)
(\mathbf{asType}{<}\mathbf{integer}{>}(\mathbf{operator}^*(\mathbf{heapIs}\ \$\mathbf{heap}_{funcstart\_1032,1},\ \mathbf{this}).\mathtt{p1}) <
asType < integer > (\$heap_{funcstart\_1032,1}.a1)) = >
(asType<integer>(div1.rem) == asType<integer>(operator*(heapIs
heap_{funcstart\_1032,1}, this).p1)
(\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathsf{heap}_{funcstart\_1032,1}.\mathsf{a1}) \leq
\mathbf{asType}{<}\mathbf{integer}{>}(\mathbf{operator*}(\mathbf{heapIs}\ \$\mathbf{heap}_{funcstart\_1032,1},\ \mathbf{this}).\mathtt{p1})) =>
!(0 == asType < integer > (div1.quot))
!(0 == asType < integer > (div1.rem)) || !(0 ==
asType<integer>(div1.quot))
\operatorname{div2} == \operatorname{div}(\mathbf{heapIs} \ \operatorname{\$heap}_{funcstart\_1032,1},
static_cast<int>(operator*(heapIs $heap_{tuncstart\_1032.1}, this).p2),
\mathbf{static\_cast}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_1032,1}.\mathrm{a2}))
(asType < integer > (static\_cast < int > (operator*(heapIs)))
heap_{funcstart\_1032.1}, this).p2)
asType < integer > (static\_cast < int > (\$heap_{funcstart\_1032.1}.a2))) = =
asType<integer>(div2.quot)
(asType < integer > (static\_cast < int > (operator*(heapIs
heap_{funcstart\_1032,1}, this).p2) %
asType<integer>(static_cast<int>($heap_{funcstart_1032.1}.a2))) ==
asType<integer>(div2.rem)
(\mathbf{asType}{<}\mathbf{integer}{>}(\mathbf{operator}^*(\mathbf{heapIs}\ \$\mathbf{heap}_{funcstart\_1032,1},\ \mathbf{this}).\mathtt{p2})<
asType < integer > (\$heap_{funcstart\_1032,1}.a2)) = >
(asType<integer>(div2.rem) == asType<integer>(operator*(heapIs
heap_{funcstart\_1032.1}, this).p2)
(\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathsf{heap}_{funcstart\_1032,1}.\mathsf{a2}) \leq
\mathbf{asType} < \mathbf{integer} > (\mathbf{operator}^*(\mathbf{heapIs} \ \$ \mathbf{heap}_{funcstart\_1032,1}, \ \mathbf{this}).\mathtt{p2})) = >
!(0 == asType < integer > (div2.quot))
!(0 == asType < integer > (div2.rem)) || !(0 ==
asType<integer>(div2.quot))
div3 == div(\mathbf{heapIs} \$ heap_{funcstart\_1032,1},
static_cast<int>(operator*(heapIs $heap_{funcstart\_1032.1}, this).p3),
\mathbf{static\_cast}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_1032,1}.\mathrm{a3}))
(asType<integer>(static_cast<int>(operator*(heapIs
heap_{funcstart\_1032,1}, this).p3)
asType < integer > (static\_cast < int > (\$heap_{funcstart\_1032,1}.a3))) = =
asType<integer>(div3.quot)
(asType<integer>(static_cast<int>(operator*(heapIs
heap_{funcstart\_1032,1}, this).p3)
asType < integer > (static\_cast < int > (\$heap_{funcstart\_1032.1}.a3))) = =
```

```
asType<integer>(div3.rem)
(asType<integer>(operator*(heapIs $heap_{funcstart\_1032,1}, this).p3) <
asType < integer > (\$heap_{funcstart\_1032,1}.a3)) = >
(asType<integer>(div3.rem) == asType<integer>(operator*(heapIs
heap_{funcstart\_1032.1}, this).p3)
(asType < integer > (\$heap_{funcstart\_1032,1}.a3) \le
asType<integer>(operator*(heapIs $heap_{funcstart\_1032,1}, this).p3)) =>
!(0 == asType < integer > (div3.quot))
!(0 == asType < integer > (div3.rem)) || !(0 ==
asType<integer>(div3.quot))
temp1 == (\$heap_{funcstart\_1032.1}.r1 * static\_cast < signed int > (div1.rem)) -
(\text{\$heap}_{funcstart\_1032.1}.\text{b1 * static\_cast} < \text{signed int} > (\text{div1.quot}))
minof(signed\ int) \le temp1
temp1 < maxof(signed int)
Proof:
[Take given term]
[2.0] div1 == div(heapIs $heap_{funcstart\_1032,1},
static_cast<int>(operator*(heapIs $heap_{funcstart\_1032.1}, this).p1),
\mathbf{static\_cast}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_1032,1}.\mathrm{a1}))
→ [expand definition of operator '*' in class 'pointer' at built in declaration]
[2.1] \operatorname{div1} == \operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_1032,1},
static\_cast < int > (this. r.value(heapIs  heap_{funcstart\_1032,1}).p1),
static\_cast < int > (\$heap_{funcstart\_1032,1}.a1))
\rightarrow [simplify]
[2.2] \operatorname{div1} == \operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_1032,1}, \mathbf{this}.\$ r. \mathbf{value}(\mathbf{heapIs}))
\theta_{funcstart\_1032,1}.p1, \theta_{funcstart\_1032,1}.p1, \theta_{funcstart\_1032,1}.a1))
\rightarrow [const static or extern object]
[2.3] \text{ div1} == \text{div}(\text{heapIs } \text{heap}_{funcstart\_1032,1}, \text{this.}\text{\$r.value}(\text{heapIs})
\theta_{uncstart\_1032,1}.p1, \theta_{uncstart\_1032,1}.p2, \theta_{uncstart\_1032,1}.p3, \theta_{uncstart\_1032,1}.p4, \theta_{uncstart\_1032,1}.p4, \theta_{uncstart\_1032,1}.p4, \theta_{uncstart\_1032
\rightarrow [expand definition of constant 'a1' at prang.cpp (30,26)]
[2.4] \text{ div1} == \text{div(heapIs } \text{$heap}_{funcstart\_1032,1}, \text{this.} \text{$r.value(heapIs)}
\theta_{tuncstart\_1032.1}.p1, \theta_{tuncstart\_1032.1}.p1, \theta_{tuncstart\_1032.1}.p1, \theta_{tuncstart\_1032.1}.p1, \theta_{tuncstart\_1032.1}.p1, \theta_{tuncstart\_1032.1}.p1, \theta_{tuncstart\_1032.1}.p2, \theta_{tuncstart\_1032.1}.p2, \theta_{tuncstart\_1032.1}.p2, \theta_{tuncstart\_1032.1}.p2, \theta_{tuncstart\_1032.1}.p2, \theta_{tuncstart\_1032.1}.p3, \theta_{tuncstart\_1032.1}.p2, \theta_{tuncstart\_1032.1}.p3, \theta_{tuncstart\_1032.1}.p4, \theta_{tuncstart\_1032.1}.p3, \theta_{tuncstart\_1032.1}.p4, \theta_{tuncstart\_1032.1}.p5, \theta_{tuncstart\_1032.1}.p5, \theta_{tuncstart\_1032.1}.p5, \theta_{tuncstart\_1032.1}.p6, \theta_{tuncstart\_1032.1}.p7, \theta_{tuncstart\_1032.1
\rightarrow [simplify]
[2.6] \operatorname{div1} == \operatorname{div}(\mathbf{heapIs} \ \mathbf{\$heap}_{funcstart\_1032,1}, \ \mathbf{this}.\mathbf{\$r.value}(\mathbf{heapIs})
heap_{funcstart\_1032,1}.p1, 177
[Assume known post-assertion, class invariant or type constraint for term 2.6]
[7.0] (0 < asType<integer>(this.$r.value(heapIs
```

```
\label{eq:linear_funcstart} $$ \operatorname{heap}_{funcstart\_1032,1}.p1)) \&\& (asType < integer > (this.\$r.value(heapIs)) \\
\verb§heap$_{funcstart\_1032,1}).p1) < \mathbf{asType} < \mathbf{integer} > (\$ heap.\mathbf{class} \ \text{WHPrang} \in \texttt{Partition})
M1))
\rightarrow [simplify]
[7.2] (0 < this.$r.value(heapIs \theta_{funcstart\_1032,1}).p1) &&
(this.r.value(heapIs $heap_{funcstart\_1032.1}).p1 <
asType < integer > (\$heap.class WHPrang \in M1))
\rightarrow [const static or extern object]
[7.3] (0 < this.$r.value(heap
Is \rho_{funcstart\_1032,1}).p1) &&
(this.$r.value(heapIs heap_{funcstart\_1032,1}).p1 <
asType < integer > (\$heap_{init}.class WHPrang \in M1))
\rightarrow [expand definition of constant 'M1' at prang.cpp (28,26)]
[7.4] (0 < this.\$r.value(heapIs \$heap_{funcstart_1032.1}).p1) &&
(this.r.value(heapIs $heap_{tuncstart\_1032.1}).p1 <
asType < integer > ((int)30269))
\rightarrow [simplify]
[7.10] (-30269 < -this.$r.value(heapIs heap_{funcstart\_1032,1}).p1) \land (0 <
this.r.value(heapIs $heap_{funcstart\_1032,1}).p1)
[Work on sub-term 2 of conjunction in term 7.10]
[8.0] 0 < this.$r.value(heapIs $heap<sub>funcstart_1032,1</sub>).p1
[Take goal term]
[1.0] minof(signed int) \leq ($heap<sub>funcstart_1032,1</sub>.M1 *
asType<int>(static_cast<integer>(static_cast<signed
int>(operator^*(heapIs $heap_{funcstart\_1032,1}, this).p1) < (int)0)))
\rightarrow [simplify]
[1.1] -32768 \leq ($heap_{funcstart\_1032,1}.M1 *
asType<int>(static_cast<integer>(static_cast<signed
int>(operator^*(heapIs $heap_{funcstart\_1032,1}, this).p1) < (int)0)))
\rightarrow [const static or extern object]
[1.2] -32768 \le (\$heap_{init}.M1 *
asType<int>(static_cast<integer>(static_cast<signed
\mathbf{int}{>}(\mathbf{operator}^*(\mathbf{heapIs}\ \$\mathbf{heap}_{funcstart\_1032,1},\ \mathbf{this}).\mathtt{p1})<(\mathbf{int})0)))
\rightarrow [expand definition of constant 'M1' at prang.cpp (28,26)]
[1.3] -32768 \le ((int)30269 *
as Type < int > (static\_cast < integer > (static\_cast < signed))
int>(operator^*(heapIs \$heap_{funcstart\_1032,1}, this).p1) < (int)0)))
\rightarrow [simplify]
```

```
[1.4] -32768 < (30269 *)
asType<int>(static_cast<integer>(static_cast<signed
\mathbf{int}{>}(\mathbf{operator}^*(\mathbf{heapIs}\ \$\mathbf{heap}_{funcstart\_1032,1},\ \mathbf{this}).\mathbf{p1})<(\mathbf{int})0)))
→ [expand definition of operator '*' in class 'pointer' at built in declaration]
[1.5] -32768 \le (30269 *
asType < int > (static\_cast < integer > (static\_cast < signed)
int>(this.\$r.value(heapIs \$heap_{funcstart\_1032,1}).p1) < (int)0)))
\rightarrow [simplify]
\textit{[1.9] -32768} \leq \textit{(30269 * asType} < \textbf{int} > \textit{(static\_cast} < \textbf{integer} > \textit{(0} < \texttt{(0)})
-this.$r.value(heapIs \theta_{funcstart\_1032,1}).p1)))
\rightarrow [from term 8.0, literala < -this.$r.value(heapIs $heap_{funcstart\_1032,1}).p1
is false whenever -2 < (0 + literala)
   Proof of rule precondition:
   [1.9.0] - 2 < (0 + 0)
   \rightarrow [simplify]
   [1.9.2] true
[1.10] -32768 \leq (30269 * asType<int>(static_cast<integer>(false)))
\rightarrow [simplify]
[1.11] -32768 \leq (30269 * asType<int>(([false]: 1, []: 0)))
→ [explicitly assert falsehood of skipped guards in subsequent guards]
[1.12] -32768 \leq (30269 * asType<int>(([false]: 1, [true]: 0)))
\rightarrow [simplify]
[1.16] true
Proof of verification condition: Arithmetic result of operator '*' is within
limit of type 'signed int'
In the context of class: WHPrang, declared at:
C:\Escher\Customers\prang-cpp\prang.cpp (18,1)
Condition generated at: C:\Escher\Customers\prang-cpp\prang.cpp
(75,32)
Condition defined at:
To prove: (heap_{funcstart\_1032,1}.M1 *
asType<int>(static_cast<integer>(static_cast<signed
int>(operator^*(heapIs \$heap_{funcstart\_1032,1}, this).p1) < (int)0))) \le
maxof(signed int)
Given:
```

```
heap_{init}.LIMIT == (int)80
heap_{init}.class WHPrang \in M1 == (int)30269
heap_{init}.class WHPrang \in r1 == (int)171
heap_{init}.class WHPrang \in a1 == (int)177
heap_{init}.class WHPrang \in b1 == (int)2
heap_{init}.class WHPrang \in M2 == (int)30307
heap_{init}.class WHPrang \in r2 == (int)172
heap_{init}.class WHPrang \in a2 == (int)176
heap_{init}.class WHPrang \in b2 == (int)35
heap_{init}.class WHPrang \in M3 == (int)30323
\$ heap_{init}.\mathbf{class} \ WHPrang \in r3 == (\mathbf{int})170
heap_{init}.class WHPrang \in a3 == (int)178
heap_{init}.class WHPrang \in b3 == (int)63
\operatorname{div1} == \operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_1032,1},
static_cast<int>(operator*(heapIs $heap_{tuncstart\_1032.1}, this).p1),
\mathbf{static\_cast}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_1032,1}.\mathrm{a1}))
(asType<integer>(static_cast<int>(operator*(heapIs
heap_{funcstart\_1032,1}, this).p1) /
\mathbf{asType} {<} \mathbf{integer} {>} (\mathbf{static\_cast} {<} \mathbf{int} {>} (\$ \mathbf{heap}_{funcstart\_1032,1}.\mathbf{a1}))) = =
asType<integer>(div1.quot)
(asType<integer>(static_cast<int>(operator*(heapIs
heap_{funcstart\_1032,1}, this).p1) %
\mathbf{asType} {<} \mathbf{integer} {>} (\mathbf{static\_cast} {<} \mathbf{int} {>} (\$ \mathbf{heap}_{funcstart\_1032,1}.\mathbf{a1}))) = =
asType<integer>(div1.rem)
(asType<integer>(operator*(heapIs $heap_{funcstart\_1032.1}, this).p1) <
asType < integer > (\$heap_{funcstart\_1032,1}.a1)) = >
(asType<integer>(div1.rem) == asType<integer>(operator*(heapIs
heap_{funcstart\_1032,1}, this).p1)
(\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathsf{heap}_{funcstart\_1032,1}.\mathsf{a1}) \leq
asType<integer>(operator*(heapIs $heap_{funcstart\_1032,1}, this).p1)) =>
!(0 == asType < integer > (div1.quot))
!(0 == asType < integer > (div1.rem)) || !(0 ==
asType<integer>(div1.quot))
\operatorname{div2} == \operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_1032,1},
\mathbf{static\_cast} < \mathbf{int} > (\mathbf{operator}^*(\mathbf{heapIs}\ \$ \mathbf{heap}_{funcstart\_1032,1},\ \mathbf{this}).\mathtt{p2}),
\mathbf{static\_cast} < \mathbf{int} > (\$ \mathbf{heap}_{funcstart\_1032,1}.\mathbf{a2}))
(asType < integer > (static\_cast < int > (operator*(heapIs)))
```

```
\theta_{funcstart_{-1032,1}}, this).p2)) /
\mathbf{asType} < \mathbf{integer} > (\mathbf{static\_cast} < \mathbf{int} > (\$ \mathbf{heap}_{funcstart\_1032,1}.\mathbf{a2}))) = =
asType<integer>(div2.quot)
(asType < integer > (static\_cast < int > (operator*(heapIs)))
heap_{funcstart\_1032.1}, this).p2)
asType < integer > (static\_cast < int > (\$heap_{funcstart\_1032.1}.a2))) = =
asType<integer>(div2.rem)
(\mathbf{asType}{<}\mathbf{integer}{>}(\mathbf{operator}^*(\mathbf{heapIs}\ \$\mathbf{heap}_{funcstart\_1032,1},\ \mathbf{this}).\mathtt{p2}) <
asType < integer > ($heap_{funcstart\_1032,1}.a2)) = >
(asType<integer>(div2.rem) == asType<integer>(operator*(heapIs
heap_{funcstart_{1032,1}}, this).p2)
(\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathbf{heap}_{funcstart\_1032,1}.\mathbf{a2}) \leq
asType < integer > (operator*(heapIs $heap_{funcstart\_1032,1}, this).p2)) = >
!(0 == asType < integer > (div2.quot))
!(0 == asType < integer > (div2.rem)) || !(0 ==
asType<integer>(div2.quot))
\operatorname{div3} == \operatorname{div}(\mathbf{heapIs} \ \operatorname{\$heap}_{funcstart\_1032,1},
\mathbf{static\_cast}{<}\mathbf{int}{>}(\mathbf{operator^*(heapIs}\ \$heap_{funcstart\_1032,1},\ \mathbf{this}).p3),
\mathbf{static\_cast}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_1032,1}.\mathrm{a3}))
(asType < integer > (static\_cast < int > (operator*(heapIs
heap_{funcstart\ 1032.1}, this).p3) /
\mathbf{asType} < \mathbf{integer} > (\mathbf{static\_cast} < \mathbf{int} > (\$ \mathbf{heap}_{funcstart\_1032,1}.\mathbf{a3}))) = =
asType<integer>(div3.quot)
(asType<integer>(static_cast<int>(operator*(heapIs
heap_{funcstart\_1032,1}, this).p3)
asType < integer > (static\_cast < int > (\$heap_{funcstart\_1032.1}.a3))) = =
asType<integer>(div3.rem)
(\mathbf{asType}{<}\mathbf{integer}{>}(\mathbf{operator}^*(\mathbf{heapIs}\ \$\mathbf{heap}_{funcstart\_1032,1},\ \mathbf{this}).\mathrm{p3}) <
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathrm{heap}_{funcstart\_1032,1}.\mathrm{a3})) =>
(asType<integer>(div3.rem) == asType<integer>(operator*(heapIs
heap_{funcstart\_1032,1}, this).p3)
(asType < integer > (\$heap_{funcstart\_1032,1}.a3) \le
asType < integer > (operator^*(heapIs \$heap_{funcstart\_1032,1}, this).p3)) =>
!(0 == asType < integer > (div3.quot))
!(0 == asType < integer > (div3.rem)) || !(0 ==
asType<integer>(div3.quot))
temp1 == (\$heap_{funcstart\_1032,1}.r1 * static\_cast < signed int > (div1.rem)) -
(\text{sheap}_{funcstart\_1032,1}.\text{b1} * \text{static\_cast} < \text{signed int} > (\text{div1.quot}))
minof(signed int) \le temp1
temp1 < maxof(signed int)
```

Proof:

```
[Take given term]
[2.0] div1 == div(heapIs $heap<sub>funcstart_1032,1</sub>,
static_cast<int>(operator*(heapIs $heap_{funcstart\_1032,1}, this).p1),
\mathbf{static\_cast}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_1032,1}.\mathrm{a1}))
→ [expand definition of operator '*' in class 'pointer' at built in declaration]
[2.1] \operatorname{div1} == \operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_1032,1},
static\_cast < int > (this. r.value(heapIs  heap_{funcstart\_1032,1}).p1),
static\_cast < int > (\$heap_{funcstart\_1032.1}.a1))
\rightarrow [simplify]
[2.2] \text{ div1} == \text{div(heapIs } \text{$heap}_{funcstart\_1032,1}, \text{ this.} \text{$r.value(heapIs)}
\theta_{funcstart\_1032,1}, p1, static_cast<int>(\theta_{funcstart\_1032,1})
\rightarrow [const static or extern object]
[2.3] \text{ div1} == \text{div(heapIs } \text{$heap}_{funcstart\_1032,1}, \text{this.} \text{$r.value(heapIs)}
\theta_{uncstart\_1032.1}.p1, static_cast<int>(\theta_{unit}.a1))
\rightarrow [expand definition of constant 'a1' at prang.cpp (30,26)]
[2.4] \text{ div1} == \text{div}(\text{heapIs } \text{$heap}_{funcstart\_1032,1}, \text{this.}\text{$r.value}(\text{heapIs})
\theta_{funcstart\_1032,1}.p1, \theta_{funcstart\_1032,1}.p1, \theta_{funcstart\_1032,1}.p1, \theta_{funcstart\_1032,1}.p1, \theta_{funcstart\_1032,1}.p1, \theta_{funcstart\_1032,1}.p1, \theta_{funcstart\_1032,1}.p2, \theta_{funcstart\_1032,1}.p2, \theta_{funcstart\_1032,1}.p2, \theta_{funcstart\_1032,1}.p2, \theta_{funcstart\_1032,1}.p2, \theta_{funcstart\_1032,1}.p3, \theta_{funcstart\_1032,1}.p2, \theta_{funcstart\_1032,1}.p3, \theta_{funcstart\_1032,1}.p4, \theta_{funcstart\_1032,1}.p4, \theta_{funcstart\_1032,1}.p4, \theta_{funcstart\_1032,1}.p4, \theta_{funcstart\_1032,1}.p4, \theta_{funcstart\_1032,1}.p5, \theta_{funcstart\_1032,1
\rightarrow [simplify]
[2.6] \operatorname{div1} == \operatorname{div}(\mathbf{heapIs} \ \mathbf{\$heap}_{funcstart\_1032,1}, \ \mathbf{this}.\mathbf{\$r.value}(\mathbf{heapIs})
heap_{funcstart_{-1032,1}}.p1, 177
[Assume known post-assertion, class invariant or type constraint for term 2.6]
[7.0] (0 < asType<integer>(this.$r.value(heapIs
\label{eq:continuous} $\operatorname{heap}_{funcstart\_1032,1}).p1)) \&\& (\mathbf{asType} < \mathbf{integer} > (\mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}))) \&\& (\mathbf{asType} < \mathbf{integer} > (\mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})))) \&\& (\mathbf{asType} < \mathbf{integer} > (\mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}))))) \&\& (\mathbf{asType} < \mathbf{integer} > (\mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}))))
\$ heap_{funcstart\_1032,1}).p1) < \mathbf{asType} < \mathbf{integer} > (\$ heap.\mathbf{class} \ WHPrang \in \texttt{Constart} = \texttt{Constart}
M1))
\rightarrow [simplify]
[7.2] (0 < this.$r.value(heapIs \rho_{funcstart\_1032,1}).p1) &&
(this.$r.value(heapIs \theta_{funcstart\_1032,1}).p1 <
asType < integer > (\$heap.class WHPrang \in M1))
\rightarrow [const static or extern object]
[7.3] (0 < this.$r.value(heapIs heap_{funcstart\_1032,1}).p1) &&
(this.r.value(heapIs $heap_{funcstart\_1032,1}).p1 <
asType < integer > (\$heap_{init}.class WHPrang \in M1))
\rightarrow [expand definition of constant 'M1' at prang.cpp (28,26)]
[7.4] (0 < this.$r.value(heapIs \theta_{funcstart\_1032,1}).p1) &&
(this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1 <
```

```
asType < integer > ((int)30269))
\rightarrow [simplify]
[7.10] (-30269 < -this.$r.value(heapIs heap_{funcstart\_1032,1}).p1) <math>\land (0 < 
this.r.value(heapIs $heap_{funcstart\_1032,1}).p1)
[Work on sub-term 2 of conjunction in term 7.10]
[8.0] 0 < this.$r.value(heapIs $heap<sub>funcstart_1032,1</sub>).p1
[Take goal term]
[1.0] ($heap<sub>funcstart_1032,1</sub>.M1 *
asType{<}int{>}(static\_cast{<}integer{>}(static\_cast{<}signed
int>(operator^*(heapIs \$heap_{funcstart\_1032,1}, this).p1) < (int)0))) \le
maxof(signed int)
\rightarrow [const static or extern object]
[1.1] ($heap<sub>init</sub>.M1 *
asType < int > (static\_cast < integer > (static\_cast < signed
int>(operator^*(heapIs $heap_{funcstart\_1032.1}, this).p1) < (int)0))) \le
maxof(signed int)
\rightarrow [expand definition of constant 'M1' at prang.cpp (28,26)]
[1.2] ((int)30269 *
as Type < int > (static\_cast < integer > (static\_cast < signed))
\mathbf{int} > (\mathbf{operator}^*(\mathbf{heapIs}\ \$ \mathbf{heap}_{funcstart\_1032,1},\ \mathbf{this}).\mathbf{p1}) < (\mathbf{int})\mathbf{0}))) \leq
maxof(signed int)
\rightarrow [simplify]
[1.3] (30269 * asType<int>(static_cast<integer>(static_cast<signed)
int>(operator^*(heapIs \$heap_{funcstart\_1032,1}, this).p1) < (int)0))) \le
maxof(signed int)
→ [expand definition of operator '*' in class 'pointer' at built in declaration]
[1.4] (30269 * asType<int>(static_cast<integer>(static_cast<signed
int>(this.\$r.value(heapIs \$heap_{funcstart\_1032.1}).p1) < (int)0))) \le
maxof(signed int)
\rightarrow [simplify]
[1.8] (30269 * asType<int>(static_cast<integer>(0 <
-\mathbf{this.}\$r.\mathbf{value}(\mathbf{heapIs}~\$\mathrm{heap}_{funcstart\_1032,1}).\mathrm{p1}))) \leq \mathbf{maxof}(\mathbf{signed~int})
\rightarrow [from term 8.0, literala < -this.$r.value(heapIs $heap_{funcstart\_1032.1}).p1
is false whenever -2 < (0 + literala)
   Proof of rule precondition:
   [1.8.0] - 2 < (0 + 0)
   \rightarrow [simplify]
```

```
[1.8.2] true
[1.9] (30269 * asType<int>(static_cast<integer>(false))) \le \text{
maxof(signed int)
\rightarrow [simplify]
[1.10] (30269 * asType < int > (([false]: 1, []: 0))) \le maxof(signed int)
\rightarrow [explicitly assert falsehood of skipped guards in subsequent guards]
[1.11] (30269 * asType<int>(([false]: 1, [true]: 0))) \leq maxof(signed int)
\rightarrow [simplify]
[1.16] true
Proof of verification condition: Arithmetic result of operator '+' is within
limit of type 'signed int'
In the context of class: WHPrang, declared at:
C:\Escher\Customers\prang-cpp\prang.cpp (18,1)
Condition generated at: C:\Escher\Customers\prang-cpp\prang.cpp
(75,16)
Condition defined at:
To prove: minof(signed int) \leq (($heap_{funcstart\_1032,1}.M1 *
asType<int>(static_cast<integer>(static_cast<signed
int>(operator^*(heapIs \$heap_{funcstart\_1032,1}, this).p1) < (int)0))) + temp1)
Given:
heap_{init}.LIMIT == (int)80
heap_{init}.class WHPrang \in M1 == (int)30269
heap_{init}.class WHPrang \in r1 == (int)171
\text{heap}_{init}.\mathbf{class} \text{ WHPrang } \in \text{a1} == (\mathbf{int})177
heap_{init}.class WHPrang \in b1 == (int)2
heap_{init}.class WHPrang \in M2 == (int)30307
heap_{init}.class WHPrang \in r2 == (int)172
heap_{init}.class WHPrang \in a2 == (int)176
heap_{init}.class WHPrang \in b2 == (int)35
\text{$heap}_{init}.\mathbf{class} \text{ WHPrang} \in M3 == (\mathbf{int})30323
heap_{init}.class WHPrang \in r3 == (int)170
heap_{init}.class WHPrang \in a3 == (int)178
heap_{init}.class WHPrang \in b3 == (int)63
```

```
\operatorname{div1} == \operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_1032,1},
\mathbf{static\_cast} {<} \mathbf{int} {>} (\mathbf{operator^*(heapIs}\ \$heap_{funcstart\_1032,1},\ \mathbf{this}).p1),
\mathbf{static\_cast}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_1032,1}.\mathrm{a1}))
(\mathbf{asType} {<} \mathbf{integer} {>} (\mathbf{static\_cast} {<} \mathbf{int} {>} (\mathbf{operator}^* (\mathbf{heapIs}
heap_{funcstart\_1032,1}, this).p1) /
asType < integer > (static\_cast < int > (\$heap_{funcstart\_1032,1}.a1))) = =
asType<integer>(div1.quot)
(\mathbf{asType} {<} \mathbf{integer} {>} (\mathbf{static\_cast} {<} \mathbf{int} {>} (\mathbf{operator^*} (\mathbf{heapIs}
\theta_{funcstart\_1032,1},\, \mathbf{this}).p1)) \%
asType<integer>(static_cast<int>($heap_{funcstart_1032.1}.a1))) ==
asType<integer>(div1.rem)
(\mathbf{asType}{<}\mathbf{integer}{>}(\mathbf{operator}^*(\mathbf{heapIs}\ \$\mathbf{heap}_{funcstart\_1032,1},\ \mathbf{this}).\mathtt{p1}) <
asType < integer > ($heap_{funcstart\_1032,1}.a1)) = >
(asType<integer>(div1.rem) == asType<integer>(operator*(heapIs
heap_{funcstart\_1032,1}, this).p1)
(\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathsf{heap}_{funcstart\_1032,1}.\mathsf{a1}) \leq
\mathbf{asType} < \mathbf{integer} > (\mathbf{operator}^*(\mathbf{heapIs} \ \$ \mathbf{heap}_{funcstart\_1032,1}, \ \mathbf{this}).\mathtt{p1})) = >
!(0 == asType < integer > (div1.quot))
!(0 == asType < integer > (div1.rem)) || !(0 ==
asType<integer>(div1.quot))
div2 == div(\mathbf{heapIs} \$ heap_{funcstart\_1032,1},
\mathbf{static\_cast} {<} \mathbf{int} {>} (\mathbf{operator*}(\mathbf{heapIs}\ \$\mathbf{heap}_{funcstart\_1032,1},\ \mathbf{this}).\mathtt{p2}),
\mathbf{static\_cast}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_1032,1}.\mathrm{a2}))
(asType < integer > (static\_cast < int > (operator*(heapIs)))
heap_{funcstart\_1032,1}, this).p2) /
\mathbf{asType} < \mathbf{integer} > (\mathbf{static\_cast} < \mathbf{int} > (\$ \mathbf{heap}_{funcstart\_1032,1}.\mathbf{a2}))) = =
asType<integer>(div2.quot)
(asType < integer > (static\_cast < int > (operator*(heapIs)))
\theta_{funcstart_{1032,1}}, this).p2))
asType < integer > (static\_cast < int > (\$heap_{funcstart\_1032.1}.a2))) = =
asType<integer>(div2.rem)
(\mathbf{asType}{<}\mathbf{integer}{>}(\mathbf{operator}^*(\mathbf{heapIs}\ \$\mathbf{heap}_{funcstart\_1032,1},\ \mathbf{this}).\mathtt{p2}) <
asType < integer > (\$heap_{funcstart\_1032,1}.a2)) = >
(asType<integer>(div2.rem) == asType<integer>(operator*(heapIs
heap_{funcstart_1032.1}, this).p2)
(asType < integer > (\$heap_{funcstart\_1032,1}.a2) \le
\mathbf{asType}{<}\mathbf{integer}{>}(\mathbf{operator*}(\mathbf{heapIs}\ \$\mathbf{heap}_{funcstart\_1032,1},\ \mathbf{this}).\mathtt{p2})) =>
!(0 == asType < integer > (div2.quot))
!(0 == asType < integer > (div2.rem)) || !(0 ==
asType<integer>(div2.quot))
div3 == div(\mathbf{heapIs} \$ heap_{funcstart\_1032,1},
```

```
\mathbf{static\_cast} < \mathbf{int} > (\mathbf{operator}^*(\mathbf{heapIs}\ \$ \mathbf{heap}_{funcstart\_1032,1},\ \mathbf{this}).\mathbf{p3}),
\mathbf{static\_cast}{<}\mathbf{int}{>}(\$\mathsf{heap}_{funcstart\_1032,1}.\mathsf{a3}))
(asType < integer > (static\_cast < int > (operator*(heapIs
heap_{funcstart\_1032.1}, this).p3) /
asType < integer > (static\_cast < int > (\$heap_{funcstart\_1032.1}.a3))) = =
asType<integer>(div3.quot)
(asType<integer>(static_cast<int>(operator*(heapIs
heap_{funcstart\_1032,1}, this).p3)
\mathbf{asType} {<} \mathbf{integer} {>} (\mathbf{static\_cast} {<} \mathbf{int} {>} (\$ \mathbf{heap}_{funcstart\_1032,1}.\mathbf{a3}))) = =
asType<integer>(div3.rem)
(\mathbf{asType} < \mathbf{integer} > (\mathbf{operator}^*(\mathbf{heapIs} \ \$ \mathbf{heap}_{funcstart\_1032,1}, \ \mathbf{this}).\mathbf{p3}) <
asType < integer > ($heap_{funcstart\_1032,1}.a3)) = >
(asType<integer>(div3.rem) == asType<integer>(operator*(heapIs
heap_{funcstart\_1032.1}, this).p3)
(asType < integer > (\$heap_{funcstart\_1032,1}.a3) \le
\mathbf{asType} < \mathbf{integer} > (\mathbf{operator}^*(\mathbf{heapIs} \ \$ \mathbf{heap}_{funcstart\_1032,1}, \ \mathbf{this}).\mathbf{p3})) = >
!(0 == asType < integer > (div3.quot))
!(0 == asType < integer > (div3.rem)) || !(0 ==
asType<integer>(div3.quot))
temp1 == (\$heap_{funcstart\_1032,1}.r1 * \textbf{static\_cast} < \textbf{signed int} > (div1.rem)) -
($heap_tuncstart_1032.1.b1 * static_cast<signed int>(div1.quot))
minof(signed\ int) \le temp1
temp1 < maxof(signed int)
Proof:
[Take given term]
[2.0] \operatorname{div} 1 == \operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_1032,1},
\mathbf{static\_cast} < \mathbf{int} > (\mathbf{operator}^*(\mathbf{heapIs} \ \$ \mathbf{heap}_{funcstart\_1032,1}, \ \mathbf{this}).\mathtt{p1}),
\mathbf{static\_cast}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_1032,1}.\mathrm{a1}))
→ [expand definition of operator '*' in class 'pointer' at built in declaration]
[2.1] \operatorname{div1} == \operatorname{div}(\mathbf{heapIs} \ \text{$heap}_{funcstart\_1032,1},
static\_cast < int > (this. r.value(heapIs  heap_{funcstart\_1032,1}).p1),
static\_cast < int > (\$heap_{funcstart\_1032,1}.a1))
\rightarrow [simplify]
[2.2]~{\rm div1} == {\rm div}(\mathbf{heapIs}~\$ \mathrm{heap}_{funcstart\_1032,1},~\mathbf{this}.\$ \mathrm{r.value}(\mathbf{heapIs}
\theta_{funcstart\_1032,1}.p1, \theta_{funcstart\_1032,1}.p1, \theta_{funcstart\_1032,1}.a1))
\rightarrow [const static or extern object]
[2.3] \operatorname{div1} == \operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_1032,1}, \mathbf{this}.\$ \mathbf{r}.\mathbf{value}(\mathbf{heapIs})
\theta_{funcstart\_1032,1}.p1, \theta_{funcstart\_1032,1}.p1, \theta_{funcstart\_1032,1}.p1, \theta_{funcstart\_1032,1}.p1, \theta_{funcstart\_1032,1}.p1, \theta_{funcstart\_1032,1}.p1, \theta_{funcstart\_1032,1}.p2, \theta_{funcstart\_1032,1}.p2, \theta_{funcstart\_1032,1}.p2, \theta_{funcstart\_1032,1}.p2, \theta_{funcstart\_1032,1}.p2, \theta_{funcstart\_1032,1}.p3, \theta_{funcstart\_1032,1}.p4, \theta_{funcstart\_1032,1}.p4, \theta_{funcstart\_1032,1}.p4, \theta_{funcstart\_1032,1}.p4, \theta_{funcstart\_1032,1}.p4, \theta_{funcstart\_1032,1}.p5, \theta_{funcstart\_1032,1
```

```
\rightarrow [expand definition of constant 'a1' at prang.cpp (30,26)]
[2.4] \text{ div1} == \text{div}(\text{heapIs } \text{heap}_{funcstart\_1032,1}, \text{this.}\text{\$r.value}(\text{heapIs})
\theta_{funcstart\_1032,1}.p1, \theta_{funcstart\_1032,1}.p1, \theta_{funcstart\_1032,1}.p1, \theta_{funcstart\_1032,1}.p1, \theta_{funcstart\_1032,1}.p1, \theta_{funcstart\_1032,1}.p1, \theta_{funcstart\_1032,1}.p2, \theta_{funcstart\_1032,1}.p2, \theta_{funcstart\_1032,1}.p2, \theta_{funcstart\_1032,1}.p2, \theta_{funcstart\_1032,1}.p2, \theta_{funcstart\_1032,1}.p3, \theta_{funcstart\_1032,1}.p4, \theta_{funcstart\_1032,1}.p4, \theta_{funcstart\_1032,1}.p4, \theta_{funcstart\_1032,1}.p5, \theta_{funcstart\_1032,1
\rightarrow [simplify]
[2.6] div1 == div(heapIs $heap_{funcstart\_1032,1}, this.$r.value(heapIs)
heap_{funcstart\_1032,1}.p1, 177)
[Assume known post-assertion, class invariant or type constraint for term 2.6]
[7.0] (0 < asType<integer>(this.$r.value(heapIs
\theta_{funcstart\_1032,1}.p1) && (asType<integer>(this.$r.value(heapIs)
\$ heap_{funcstart\_1032,1}).p1) < \mathbf{asType} < \mathbf{integer} > (\$ heap.\mathbf{class} \ WHPrang \in \texttt{Constart} = \texttt{Constart}
M1))
\rightarrow [simplify]
[7.2] (0 < this.$r.value(heap
Is $heap_{funcstart\_1032,1}).p1) &&
(this.r.value(heapIs $heap_{funcstart\_1032,1}).p1 <
asType < integer > (\text{$heap.class WHPrang} \in M1))
\rightarrow [const static or extern object]
[7.3] (0 < this.\$r.value(heapIs \$heap_{funcstart\_1032.1}).p1) &&
(this.r.value(heapIs $heap_{funcstart\_1032,1}).p1 <
asType < integer > (\$heap_{init}.class WHPrang \in M1))
\rightarrow [expand definition of constant 'M1' at prang.cpp (28,26)]
[7.4] (0 < this.$r.value(heap
Is $heap_{funcstart\_1032,1}).p1) &&
(this.r.value(heapIs $heap_{funcstart\_1032,1}).p1 <
asType < integer > ((int)30269))
\rightarrow [simplify]
[7.10] (-30269 < -this.$r.value(heapIs heap_{funcstart\_1032,1}).p1) <math>\land (0 < 
this.r.value(heapIs $heap_{funcstart\_1032,1}).p1)
[Work on sub-term 2 of conjunction in term 7.10]
[8.0] 0 < this.$r.value(heapIs $heap<sub>funcstart_1032,1</sub>).p1
[Take given term]
[50.0] \; ((\$heap_{funcstart\_1032,1}.r1 * \textbf{static\_cast} < \textbf{signed int} > (\text{div1.rem})) \; - \\
(\text{sheap}_{funcstart\_1032,1}.\text{b1 * static\_cast} < \text{signed int} > (\text{div1.quot}))) = = \text{temp1}
\rightarrow [const static or extern object]
[50.1] (($heap<sub>init</sub>.r1 * static_cast<signed int>(div1.rem)) -
(\text{sheap}_{funcstart\_1032,1}.\text{b1 * static\_cast} < \text{signed int} > (\text{div1.quot}))) == \text{temp1}
\rightarrow [expand definition of constant 'r1' at prang.cpp (29,26)]
[50.2] (((int)171 * static_cast<signed int>(div1.rem)) -
(\text{sheap}_{funcstart\_1032,1}.\text{b1 * static\_cast} < \text{signed int} > (\text{div1.quot}))) == \text{temp1}
```

```
\rightarrow [simplify]
[50.3] ((171 * static_cast<signed int>(div1.rem)) - ($heap_tuncstart_1032.1.b1
* static_cast < signed int > (div1.quot))) == temp1
\rightarrow [from term 2.6, div1 is equal to div(heapIs $heap_{funcstart\_1032,1},
this.r.value(heapIs $heap_{funcstart\_1032,1}).p1, 177)]
[50.4] ((171 * static_cast<signed int>(div(heapIs \theta_{funcstart\_1032,1}),
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177).rem)) -
(\text{sheap}_{funcstart\_1032,1}.\text{b1} * \text{static\_cast} < \text{signed int} > (\text{div1.quot}))) == \text{temp1}
\rightarrow [simplify]
[50.5] ((171 * \mathrm{div}(\mathbf{heapIs}\ \$\mathrm{heap}_{funcstart\_1032,1},\ \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}\ 
\text{Sheap}_{funcstart\_1032,1}.p1, 177).rem) - (\text{Sheap}_{funcstart\_1032,1}.b1 *
static_cast<signed int>(div1.quot))) == temp1
\rightarrow [const static or extern object]
[50.6] ((171 * div(heapIs $heap<sub>funcstart_1032,1</sub>, this.$r.value(heapIs)
\rho_{uncstart\_1032,1}.p1, 177).rem – (\rho_{uncstart\_1032,1}.p1, 177).rem) – (\rho_{uncstart\_1032,1}.p1, 177).rem) – (\rho_{uncstart\_1032,1}.p1, 177).rem)
int>(div1.quot)) == temp1
\rightarrow [expand definition of constant 'b1' at prang.cpp (31,26)]
[50.7] ((171 * div(heapIs heap_{funcstart\_1032,1}, this.r.value(heapIs)
\theta_{uncstart\_1032,1}.p1, 177).rem - ((int)2 * static\_cast < signed)
int>(div1.quot)) == temp1
\rightarrow [simplify]
[50.8] ((171 * \operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_1032,1}, \ \mathbf{this}.\$ r. \mathbf{value}(\mathbf{heapIs})
\theta_{funcstart\_1032,1}.p1, 177).rem) - (2 * static_cast<signed)
int>(div1.quot))) == temp1
\rightarrow [from term 2.6, div1 is equal to div(heapIs $heap_{funcstart\_1032,1},
this.r.value(heapIs \ heap_{funcstart\_1032.1}).p1, 177)
[50.9] ((171 * div(heapIs $heap<sub>funcstart_1032,1</sub>, this.$r.value(heapIs)
\theta_{funcstart\_1032,1}.p1, 177).rem) - (2 * static_cast<signed)
int>(div(heapIs \$heap_{tuncstart\_1032.1}, this.\$r.value(heapIs
\text{Sheap}_{funcstart\_1032,1}).p1, 177).quot))) == temp1
\rightarrow [simplify]
[50.14] 0 == (-\text{temp1} + (-2 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177).quot) + (171 *
div(\mathbf{heapIs} \$ heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
heap_{funcstart\_1032,1}.p1, 177).rem)
[Take given term]
[51.0] minof(signed int) \leq temp1
\rightarrow [simplify]
```

```
[51.3] - 32769 < \text{temp1}
\rightarrow [from term 50.14, temp1 is equal to (-2 * div(heapIs $heap_{funcstart\_1032,1},
this.r.value(heapIs \ \ heap_{funcstart\_1032,1}).p1, \ 177).quot) + (171 \ \ *
div(\mathbf{heapIs} \ \$heap_{funcstart\_1032,1}, \ \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
heap_{funcstart_{1032,1}}.p1, 177).rem
[51.4]-32769 < ((-2 * div(heapIs \rho_{funcstart\_1032,1}, this.\r.value(heapIs
\text{Sheap}_{funcstart\_1032,1}.p1, 177).quot) + (171 * div(heapIs \text{Sheap}_{funcstart\_1032,1},
this.r.value(heapIs \ heap_{funcstart\_1032.1}).p1, 177).rem))
[Take goal term]
[1.0] minof(signed int) \leq (($heap_{funcstart\_1032,1}.M1 *
asType<int>(static_cast<integer>(static_cast<signed
int>(operator^*(heapIs \$heap_{funcstart\_1032,1}, this).p1) < (int)0))) + temp1)
\rightarrow [simplify]
[1.1] -32768 \leq (($heap_{funcstart\_1032,1}.M1 *
asType<int>(static_cast<integer>(static_cast<signed
\mathbf{int}{>}(\mathbf{operator}^*(\mathbf{heapIs}\ \$\mathbf{heap}_{funcstart\_1032,1},\ \mathbf{this}).\mathtt{p1})<(\mathbf{int})0)))+\mathtt{temp1})
\rightarrow [const static or extern object]
[1.2] - 32768 \le ((\$heap_{init}.M1 *
asType<int>(static_cast<integer>(static_cast<signed
int>(operator^*(heapIs \$heap_{funcstart\_1032,1}, this).p1) < (int)0))) + temp1)
\rightarrow [expand definition of constant 'M1' at prang.cpp (28,26)]
[1.3] -32768 \le (((int)30269 *
asType < int > (static\_cast < integer > (static\_cast < signed
int>(operator^*(heapIs \$heap_{tuncstart\_1032.1}, this).p1) < (int)0))) + temp1)
\rightarrow [simplify]
[1.4] - 32768 < ((30269 * 
asType<int>(static_cast<integer>(static_cast<signed
int>(operator^*(heapIs \$heap_{funcstart\_1032,1}, this).p1) < (int)0))) + temp1)
→ [expand definition of operator '*' in class 'pointer' at built in declaration]
[1.5] -32768 \le ((30269 *
asType<int>(static_cast<integer>(static_cast<signed
int>(this.\$r.value(heapIs \$heap_{funcstart\_1032,1}).p1) < (int)0))) + temp1)
\rightarrow [simplify]
[1.9] -32768 \leq ((30269 * asType<int>(static_cast<integer>(0 <
-this.$r.value(heapIs \theta_{funcstart\_1032,1}).p1))) + temp1)
\rightarrow [from term 8.0, literala < -this.$r.value(heapIs $heap_{funcstart\_1032,1}).p1
is false whenever -2 < (0 + literala)
```

Proof of rule precondition:

```
[1.9.0] - 2 < (0 + 0)
   \rightarrow [simplify]
   [1.9.2] true
[1.10] -32768 \leq ((30269 * asType<int>(static_cast<integer>(false))) +
temp1)
\rightarrow [simplify]
[1.11] -32768 \leq ((30269 * asType < int > (([false]: 1, []: 0))) + temp1)
\rightarrow [explicitly assert falsehood of skipped guards in subsequent guards]
[1.12] -32768 \leq ((30269 * asType<int>(([false]: 1, [true]: 0))) + temp1)
\rightarrow [simplify]
[1.15] -32768 \le (0 + \text{temp1})
\rightarrow [from term 50.14, temp1 is equal to (-2 * div(heapIs $heap_{funcstart\_1032,1},
this.r.value(heapIs \ \ heap_{funcstart\_1032.1}).p1, \ 177).quot) + (171)
div(heapIs $heap_{tuncstart\_1032.1}, this.$r.value(heapIs
heap_{funcstart\_1032,1}.p1, 177).rem
[1.16] -32768 \leq (0 + ((-2 * div(heapIs $heap_{funcstart\_1032,1},
this.r.value(heapIs \ heap_{funcstart\_1032.1}).p1, 177).quot) + (171 *
div(\mathbf{heapIs} \$ heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
heap_{funcstart\_1032,1}.p1, 177).rem)
\rightarrow [simplify]
[1.20]-32769 < ((-2 * div(heapIs \rho_{funcstart\_1032,1}, this.\r.value(heapIs
\rho_{funcstart\_1032,1}.p1, 177).quot + (171 * div(heapIs $heap_{funcstart\_1032,1})
\mathbf{this.\$r.value}(\mathbf{heapIs}\ \$\mathbf{heap}_{funcstart\_1032,1}).\mathbf{p1},\ 177).\mathbf{rem}))
\rightarrow [from term 51.4, literala < ((-2 * div(heapIs $heap_{funcstart\_1032,1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177).quot) + (171 * leapIs \ heap_{funcstart\_1032,1}).p1, 177).quot)
div(\mathbf{heapIs} \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
heap_{funcstart\_1032,1}.p1, 177).rem is true whenever (-1 + literala) < -32769
   Proof of rule precondition:
   [1.20.0](-32769 + -1) < -32769
   \rightarrow [simplify]
   [1.20.2] true
[1.21] true
```

Proof of verification condition: Arithmetic result of operator '+' is within limit of type 'signed int'

In the context of class: WHPrang, declared at: C:\Escher\Customers\prang-cpp\prang.cpp (18,1)

```
Condition generated at: C:\Escher\Customers\prang-cpp\prang.cpp
(75,16)
Condition defined at:
To prove: ((\$heap_{funcstart\_1032,1}.M1 *
asType<int>(static_cast<integer>(static_cast<signed
int>(operator^*(heapIs \$heap_{funcstart\_1032,1}, this).p1) < (int)0))) + temp1)
\leq maxof(signed\ int)
Given:
heap_{init}.LIMIT == (int)80
heap_{init}.class WHPrang \in M1 == (int)30269
heap_{init}.class WHPrang \in r1 == (int)171
\text{heap}_{init}.\mathbf{class} \text{ WHPrang } \in \text{a1} == (\mathbf{int})177
heap_{init}.class WHPrang \in b1 == (int)2
heap_{init}.class WHPrang \in M2 == (int)30307
heap_{init}.class WHPrang \in r2 == (int)172
heap_{init}.class WHPrang \in a2 == (int)176
heap_{init}.class WHPrang \in b2 == (int)35
heap_{init}.class WHPrang \in M3 == (int)30323
heap_{init}.class WHPrang \in r3 == (int)170
heap_{init}.class WHPrang \in a3 == (int)178
heap_{init}.class WHPrang \in b3 == (int)63
\operatorname{div1} == \operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_1032,1},
static\_cast < int > (operator*(heapIs $heap_{funcstart\_1032,1}, this).p1),
\mathbf{static\_cast}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_1032,1}.\mathrm{a1}))
(asType < integer > (static\_cast < int > (operator*(heapIs)))
heap_{funcstart\_1032.1}, this).p1) /
asType<integer>(static_cast<int>($heap_{tuncstart\_1032.1}.a1))) ==
asType<integer>(div1.quot)
(asType<integer>(static_cast<int>(operator*(heapIs
heap_{funcstart\_1032,1}, this).p1) %
\mathbf{asType} {<} \mathbf{integer} {>} (\mathbf{static\_cast} {<} \mathbf{int} {>} (\$ \mathbf{heap}_{funcstart\_1032,1}.\mathbf{a1}))) = =
asType<integer>(div1.rem)
(asType < integer > (operator*(heapIs $heap_{funcstart\_1032,1}, this).p1) < footnote{the content of the conte
asType < integer > (\$heap_{funcstart\_1032,1}.a1)) = >
(asType < integer > (div1.rem) == asType < integer > (operator*(heapIs))
heap_{funcstart\_1032,1}, this).p1)
(asType < integer > (\$heap_{funcstart\_1032,1}.a1) \le
```

```
asType<integer>(operator*(heapIs $heap_{tuncstart\_1032,1}, this).p1)) =>
!(0 == asType < integer > (div1.quot))
!(0 == asTvpe < integer > (div1.rem)) || !(0 ==
asType<integer>(div1.quot))
div2 == div(\mathbf{heapIs} \$ heap_{funcstart\_1032,1},
static_cast<int>(operator*(heapIs $heap_{funcstart_1032,1}, this).p2),
static\_cast < int > (\$heap_{funcstart\_1032,1}.a2))
(asType<integer>(static_cast<int>(operator*(heapIs
heap_{funcstart_1032,1}, this).p2) /
asType < integer > (static\_cast < int > (\$heap_{funcstart\_1032,1}.a2))) = =
asType<integer>(div2.quot)
(asType<integer>(static_cast<int>(operator*(heapIs
heap_{funcstart\ 1032.1}, this).p2)
asType < integer > (static\_cast < int > (\$heap_{funcstart\_1032.1}.a2))) = =
asType<integer>(div2.rem)
(asType<integer>(operator*(heapIs $heap_{funcstart\_1032.1}, this).p2) <
asType < integer > (\$heap_{funcstart\_1032,1}.a2)) = >
(asType<integer>(div2.rem) == asType<integer>(operator*(heapIs
heap_{funcstart_1032,1}, this).p2)
(asType < integer > (\$heap_{funcstart\_1032,1}.a2) \le
asType < integer > (operator^*(heapIs \$heap_{funcstart\_1032,1}, this).p2)) = >
!(0 == asTvpe < integer > (div2.quot))
!(0 == asType < integer > (div2.rem)) || !(0 ==
asType<integer>(div2.quot))
div3 == div(\mathbf{heapIs} \$heap_{funcstart\_1032,1},
static\_cast < int > (operator*(heapIs $heap_{funcstart\_1032,1}, this).p3),
static\_cast < int > (\$heap_{funcstart\_1032,1}.a3))
(asType<integer>(static_cast<int>(operator*(heapIs
heap_{funcstart\_1032,1}, this).p3)) /
asType < integer > (static\_cast < int > (\$heap_{funcstart\_1032.1}.a3))) = =
asType<integer>(div3.quot)
(asType < integer > (static\_cast < int > (operator*(heapIs)))
heap_{funcstart\_1032,1}, this).p3)
asType < integer > (static\_cast < int > (\$heap_{funcstart\_1032.1}.a3))) = =
asType<integer>(div3.rem)
(asType < integer > (operator*(heapIs $heap_{funcstart\_1032,1}, this).p3) < footnote{the content of the conte
asType < integer > (\$heap_{funcstart\_1032,1}.a3)) = >
(asType<integer>(div3.rem) == asType<integer>(operator*(heapIs
heap_{funcstart\_1032.1}, this).p3)
(\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathsf{heap}_{funcstart\_1032,1}.\mathsf{a3}) \leq
asType < integer > (operator*(heapIs $heap_{funcstart\_1032,1}, this).p3)) = >
```

```
!(0 == asType < integer > (div3.quot))
!(0 == asType < integer > (div3.rem)) || !(0 ==
asType<integer>(div3.quot))
temp1 == (\$heap_{funcstart\_1032,1}.r1 * \textbf{static\_cast} < \textbf{signed int} > (\text{div}1.rem)) - (\text{div}1.rem) + (\text
(\text{\$heap}_{funcstart\_1032,1}.\text{b1 * static\_cast} < \text{signed int} > (\text{div1.quot}))
minof(signed\ int) \le temp1
temp1 \le maxof(signed int)
Proof:
 [Take given term]
 [2.0] div1 == div(heapIs $heap_{funcstart\_1032,1},
static\_cast < int > (operator*(heapIs $heap_{funcstart\_1032,1}, this).p1),
\mathbf{static\_cast}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_1032,1}.\mathrm{a1}))
 → [expand definition of operator '*' in class 'pointer' at built in declaration]
 [2.1] \operatorname{div1} == \operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_1032,1},
static\_cast < int > (this. r.value(heapIs  heap_{funcstart\_1032,1}).p1),
static\_cast < int > (\$heap_{funcstart\_1032.1}.a1))
 \rightarrow [simplify]
 [2.2] \text{ div1} == \text{div(heapIs } \text{$heap}_{funcstart\_1032,1}, \text{this.} \text{$r.value(heapIs)}
\$heap_{funcstart\_1032,1}).p1, \ \mathbf{static\_cast} < \mathbf{int} > (\$heap_{funcstart\_1032,1}.a1))
 \rightarrow [const static or extern object]
 [2.3] \text{ div1} == \text{div(heapIs } \text{$heap}_{funcstart\_1032,1}, \text{this.} \text{$r.value(heapIs)$}
\theta_{uncstart\_1032,1}.p1, \theta_{uncstart\_1032,1}.p2, \theta_{uncstart\_1032,1}.p3, \theta_{uncstart\_1032,1}.p4, \theta_{uncstart\_1032,1}.p4, \theta_{uncstart\_1032,1}.p4, \theta_{uncstart\_1032
 \rightarrow [expand definition of constant 'a1' at prang.cpp (30,26)]
 [2.4] \text{ div1} == \text{div}(\text{heapIs } \text{heap}_{funcstart\_1032,1}, \text{this.}\text{\$r.value}(\text{heapIs})
\theta_{tuncstart\_1032.1}.p1, \theta_{tuncstart}.p1, \theta_{tuncstart\_1032.1}.p1, \theta_{tuncstart}.p1, \theta_{tuncstart\_1032.1}.p1, \theta_{tuncstart\_1032.1}.p1, \theta_{tuncstart\_1032.1}.p1, \theta_{tuncstart\_1032.1}.p1, \theta_{tuncstart\_1032.1}.p1, \theta_{tuncstart\_1032.1}.p2, \theta_{tuncstart\_1032.1}.p2, \theta_{tuncstart\_1032.1}.p2, \theta_{tuncstart\_1032.1}.p2, \theta_{tuncstart\_1032.1}.p2, \theta_{tuncstart\_1032.1}.p2, \theta_{tuncstart\_1032.1}.p3, \theta_{tuncstart\_1032.1}.p2, \theta_{tuncstart\_1032.1}.p3, \theta_{tuncstart\_1032.1}.p4, \theta_{tuncstart\_1032.1}.p3, \theta_{tuncstart\_1032.1}.p4, \theta_{tuncstart\_1032.1}.p4, \theta_{tuncstart\_1032.1}.p4, \theta_{tuncstart\_1032.1}.p4, \theta_{tuncstart\_1032.1}.p5, \theta_{tuncstart\_1032.1}.p5, \theta_{tuncstart\_1032.1}.p5, \theta_{tuncstart\_1032.1}.p6, \theta_{tuncstart\_1032.1}.p7, \theta_{tun
 \rightarrow [simplify]
 [2.6] \operatorname{div1} == \operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_1032,1}, \mathbf{this.}\$ r. \mathbf{value}(\mathbf{heapIs})
heap_{funcstart_{-1032,1}}.p1, 177
 [Assume known post-assertion, class invariant or type constraint for term 2.6]
 [7.0] (0 < asType<integer>(this.$r.value(heapIs
\label{eq:continuous} $\operatorname{heap}_{funcstart\_1032,1}).p1)) \&\& (\mathbf{asType} < \mathbf{integer} > (\mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}))) \&\& (\mathbf{asType} < \mathbf{integer} > (\mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})))) \&\& (\mathbf{asType} < \mathbf{integer} > (\mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}))))) \&\& (\mathbf{asType} < \mathbf{integer} > (\mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})))) \&\& (\mathbf{asType} < \mathbf{integer} > (\mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})))))
\theta_{funcstart\_1032,1}.p1) < asType<integer>(\theta_{funcstart\_1032,1}).p1)
M1))
 \rightarrow [simplify]
 [7.2] (0 < this.$r.value(heap
Is $heap_{funcstart\_1032,1}).p1) &&
 (this.$r.value(heapIs heap_{funcstart\_1032,1}).p1 <
asType < integer > (\$heap.class WHPrang \in M1))
```

```
\rightarrow [const static or extern object]
[7.3] (0 < this.\$r.value(heapIs \$heap_{funcstart\_1032.1}).p1) &&
(this.$r.value(heapIs heap_{funcstart\_1032,1}).p1 <
asType < integer > (\$heap_{init}.class WHPrang \in M1))
\rightarrow [expand definition of constant 'M1' at prang.cpp (28,26)]
[7.4] (0 < this.$r.value(heapIs $heap_{funcstart\_1032,1}).p1) &&
(this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1 <
asType < integer > ((int)30269))
\rightarrow [simplify]
[7.10] (-30269 < -this.$r.value(heap
Is \rho_{funcstart\_1032,1}).p1) <math display="inline">\land (0 <
this.r.value(heapIs $heap_{funcstart\_1032,1}).p1)
[Work on sub-term 2 of conjunction in term 7.10]
[8.0] 0 < this.$r.value(heapIs \theta_{funcstart\_1032,1}).p1
[Take given term]
[50.0] \; ((\$ heap_{funcstart\_1032,1}.r1 \; * \; \textbf{static\_cast} < \textbf{signed int} > (\text{div1.rem})) \; - \; \text{div1.rem})) \; - \; \text{div1.rem})) \; - \; \text{div1.rem}) \; - \; \text{di
(\text{sheap}_{funcstart\_1032,1}.\text{b1 * static\_cast} < \text{signed int} > (\text{div1.quot}))) = = \text{temp1}
\rightarrow [const static or extern object]
[50.1] (($heap<sub>init</sub>.r1 * static_cast<signed int>(div1.rem)) -
(\text{sheap}_{funcstart\_1032,1}.\text{b1 * static\_cast} < \text{signed int} > (\text{div1.quot}))) == \text{temp1}
\rightarrow [expand definition of constant 'r1' at prang.cpp (29,26)]
[50.2] (((int)171 * static_cast<signed int>(div1.rem)) -
($heap_tuncstart_1032.1.b1 * static_cast<signed int>(div1.quot))) == temp1
\rightarrow [simplify]
[50.3] ((171 * static_cast < signed int > (div1.rem)) - ($heap_{funcstart\_1032.1}.b1
* static_cast<signed int>(div1.quot))) == temp1
\rightarrow [from term 2.6, div1 is equal to div(heapIs $heap_{funcstart\_1032,1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177)]
[50.4] ((171 * static_cast < signed int > (div(heapIs heap_{funcstart\_1032,1},
this.r.value(heapIs $heap_{funcstart\_1032,1}).p1, 177).rem)) -
(\text{sheap}_{funcstart\_1032,1}.\text{b1 * static\_cast} < \text{signed int} > (\text{div1.quot}))) == \text{temp1}
\rightarrow [simplify]
[50.5] ((171 * div(heapIs $heap_{funcstart\_1032,1}, this.$r.value(heapIs)
\text{Sheap}_{funcstart\_1032,1}.p1, 177).rem) - (\text{Sheap}_{funcstart\_1032,1}.b1 *
static_cast<signed int>(div1.quot))) == temp1
\rightarrow [const static or extern object]
[50.6] ((171 * \mathrm{div}(\mathbf{heapIs}\ \$\mathrm{heap}_{funcstart\_1032,1},\ \mathbf{this}.\$\mathrm{r.value}(\mathbf{heapIs}
\theta_{funcstart\_1032,1}.p1, 177).rem) - (\theta_{funcstart\_1032,1}.p1, 177).rem) - (\theta_{funcstart\_1032,1}.p1, 177).rem)
```

```
int>(div1.quot)) == temp1
\rightarrow [expand definition of constant 'b1' at prang.cpp (31,26)]
[50.7] ((171 * \operatorname{div}(\mathbf{heapIs} \ \mathbf{sheap}_{funcstart\_1032,1}, \ \mathbf{this}.\mathbf{sr.value}(\mathbf{heapIs})
\theta_{funcstart\_1032,1}.p1, 177).rem) - ((int)2 * static_cast<signed)
int>(div1.quot)) == temp1
\rightarrow [simplify]
[50.8] ((171 * div(heapIs $heap<sub>funcstart_1032,1</sub>, this.$r.value(heapIs)
\theta_{funcstart\_1032,1}.p1, 177).rem - (2 * static\_cast < signed)
int>(div1.quot)) = temp1
\rightarrow [from term 2.6, div1 is equal to div(heapIs $heap_{funcstart\_1032,1},
this.r.value(heapIs $heap_{funcstart\_1032,1}).p1, 177)]
[50.9] ((171 * div(heapIs $heap<sub>funcstart_1032,1</sub>, this.$r.value(heapIs)
\theta_{funcstart\_1032.1}.p1, 177).rem) - (2 * static_cast<signed)
int>(div(heapIs \$heap_{funcstart\_1032,1}, this.\$r.value(heapIs
\text{Sheap}_{funcstart\_1032,1}).p1, 177).quot))) == temp1
\rightarrow [simplify]
[50.14] 0 == (-\text{temp1} + (-2 * \text{div}(\text{heapIs} \$\text{heap}_{funcstart\_1032,1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177).quot) + (171 *
div(\mathbf{heapIs} \$ heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
heap_{funcstart_{1032,1}}.p1, 177).rem
[Take given term]
[52.0] temp1 \leq maxof(signed int)
\rightarrow [simplify]
|52.9| -32768 < -\text{temp1}
\rightarrow [from term 50.14, temp1 is equal to (-2 * div(heapIs $heap_{funcstart\_1032,1},
this.$r.value(heapIs heap_{funcstart\_1032,1}).p1, 177).quot) + (171 *
div(\mathbf{heapIs} \ \$heap_{funcstart\_1032,1}, \ \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
heap_{funcstart\_1032,1}.p1, 177.rem
\label{eq:continuous} \mbox{$\lceil 52.10 \rceil$ -32768 < -((-2 * {\rm div}(\mathbf{heapIs} \ \${\rm heap}_{funcstart\_1032,1},
this.r.value(heapIs \ensuremath{\$}heap_{funcstart\_1032,1}).p1, 177).quot) + (171 *
div(\mathbf{heapIs} \$ heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
heap_{funcstart\_1032,1}.p1, 177).rem
\rightarrow [simplify]
[52.13] -32768 < ((2 * div(heapIs $heap_{funcstart\_1032,1}, this.$r.value(heapIs)]
heap_{funcstart_1032,1}.p1, 177).quot + (-171 * div(heapIs)
$\text{heap}_{funcstart_1032.1}$, this $\text{r.value}(\text{heapIs} $\text{heap}_{funcstart_1032.1}).p1$,
177).rem))
[Take goal term]
```

```
[1.0] (($heap<sub>funcstart_1032,1</sub>.M1 *
asType<int>(static_cast<integer>(static_cast<signed
int>(operator^*(heapIs \$heap_{funcstart\_1032,1}, this).p1) < (int)0))) + temp1)
\leq \max of(signed\ int)
\rightarrow [const static or extern object]
[1.1] (($heap_{init}.M1 *
asType<int>(static_cast<integer>(static_cast<signed
int>(operator*(heapIs $heap_{funcstart\_1032,1}, this).p1) < (int)0))) + temp1)
\leq \max of(signed int)
\rightarrow [expand definition of constant 'M1' at prang.cpp (28,26)]
[1.2] (((int)30269 *
asType<int>(static_cast<integer>(static_cast<signed
int>(operator^*(heapIs \$heap_{tuncstart\_1032,1}, this).p1) < (int)0))) + temp1)
\leq maxof(signed\ int)
\rightarrow [simplify]
[1.3] ((30269 * asType<int>(static_cast<integer>(static_cast<signed
int>(operator^*(heapIs \$heap_{funcstart\_1032,1}, this).p1) < (int)0))) + temp1)
\leq \max of(signed int)
→ [expand definition of operator '*' in class 'pointer' at built in declaration]
[1.4] ((30269 * asType<int>(static_cast<integer>(static_cast<signed
int>(this.\$r.value(heapIs \$heap_{funcstart\_1032,1}).p1) < (int)0))) + temp1) \le
maxof(signed int)
\rightarrow [simplify]
[1.8] ((30269 * asType<int>(static_cast<integer>(0 <
-this.$r.value(heapIs \rho_{tuncstart\_1032.1}).p1)) + temp1) \leq
maxof(signed int)
\rightarrow [from term 8.0, literala < -this.$r.value(heapIs $heap_{funcstart\_1032.1}).p1
is false whenever -2 < (0 + literala)
   Proof of rule precondition:
   [1.8.0] - 2 < (0 + 0)
   \rightarrow [simplify]
   [1.8.2] true
[1.9] ((30269 * asType<int>(static_cast<integer>(false))) + temp1) \leq
maxof(signed int)
\rightarrow [simplify]
[1.10] ((30269 * asType<int>(([false]: 1, []: 0))) + temp1) \leq maxof(signed)
int)
→ [explicitly assert falsehood of skipped guards in subsequent guards]
```

```
[1.11] ((30269 * asType<int>(([false]: 1, [true]: 0))) + temp1) <
maxof(signed int)
\rightarrow [simplify]
[1.14] (0 + \text{temp1}) \le \text{maxof(signed int)}
\rightarrow [from term 50.14, temp1 is equal to (-2 * div(heapIs $heap_{funcstart\_1032,1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177).quot) + (171 \ heap_{funcstart\_1032,1}).p1, 177).quot)
div(heapIs $heap_{tuncstart\_1032.1}, this.$r.value(heapIs
\$heap_{funcstart\_1032,1}).p1,\ 177).rem)]
[1.15] (0 + ((-2 * div(heap
Is $heap_{funcstart\_1032,1}, this.$r.value(heap
Is
\rho_{uncstart_{1032,1}}, p1, 177).quot) + (171 * div(heapIs \rho_{uncstart_{1032,1}}).
this.r.value(heapIs \ heap_{funcstart\_1032.1}).p1, 177).rem))) \le maxof(signed)
\rightarrow [simplify]
[1.31] -32768 < ((-171 * div(heapIs $heap_{funcstart\_1032.1})
this.r.value(heapIs \$heap_{funcstart\_1032,1}).p1, 177).rem) + (2 * div(heapIs)
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot))
\rightarrow [from term 52.13, literala < ((-171 * div(heapIs $heap_{funcstart\_1032.1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177).rem) + (2 * div(heapIs)
heap_{funcstart\_1032,1}, this.r.value(heapIs heap_{funcstart\_1032,1}).p1,
(-177).quot)) is true whenever (-1 + literala) < -32768
   Proof of rule precondition:
   [1.31.0](-32768 + -1) < -32768
   \rightarrow [simplify]
   [1.31.2] true
[1.32] true
Proof of verification condition: Type constraint satisfied in implicit
conversion from 'signed int' to 'P1Type'
In the context of class: WHPrang, declared at:
C:\Escher\Customers\prang-cpp\prang.cpp\ (18,1)
Condition generated at: C:\Escher\Customers\prang-cpp\prang.cpp
(75,16)
Condition defined at:
To prove: minof(signed int) \leq (($heap_{funcstart\_1032,1}.M1 *
asType < int > (static\_cast < integer > (static\_cast < signed
\mathbf{int} > (\mathbf{operator}^*(\mathbf{heapIs} \ \$ \mathbf{heap}_{funcstart\_1032,1}, \ \mathbf{this}).\mathtt{p1}) < (\mathbf{int})0))) + \mathtt{temp1})
Given:
```

```
heap_{init}.LIMIT == (int)80
heap_{init}.class WHPrang \in M1 == (int)30269
heap_{init}.class WHPrang \in r1 == (int)171
heap_{init}.class WHPrang \in a1 == (int)177
heap_{init}.class WHPrang \in b1 == (int)2
heap_{init}.class WHPrang \in M2 == (int)30307
heap_{init}.class WHPrang \in r2 == (int)172
heap_{init}.class WHPrang \in a2 == (int)176
heap_{init}.class WHPrang \in b2 == (int)35
heap_{init}.class WHPrang \in M3 == (int)30323
heap_{init}.class WHPrang \in r3 == (int)170
heap_{init}.class WHPrang \in a3 == (int)178
heap_{init}.class WHPrang \in b3 == (int)63
\operatorname{div1} == \operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_1032,1},
static_cast<int>(operator*(heapIs $heap_{tuncstart\_1032.1}, this).p1),
\mathbf{static\_cast}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_1032,1}.\mathrm{a1}))
(asType<integer>(static_cast<int>(operator*(heapIs
heap_{funcstart\_1032,1}, this).p1) /
\mathbf{asType} {<} \mathbf{integer} {>} (\mathbf{static\_cast} {<} \mathbf{int} {>} (\$ \mathbf{heap}_{funcstart\_1032,1}.\mathbf{a1}))) = =
asType<integer>(div1.quot)
(asType<integer>(static_cast<int>(operator*(heapIs
heap_{funcstart\_1032,1}, this).p1) %
\mathbf{asType} {<} \mathbf{integer} {>} (\mathbf{static\_cast} {<} \mathbf{int} {>} (\$ \mathbf{heap}_{funcstart\_1032,1}.\mathbf{a1}))) = =
asType<integer>(div1.rem)
(asType<integer>(operator*(heapIs $heap_{funcstart\_1032.1}, this).p1) <
asType < integer > (\$heap_{funcstart\_1032,1}.a1)) = >
(asType<integer>(div1.rem) == asType<integer>(operator*(heapIs
heap_{funcstart\_1032,1}, this).p1)
(\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathsf{heap}_{funcstart\_1032,1}.\mathsf{a1}) \leq
asType<integer>(operator*(heapIs $heap_{funcstart\_1032,1}, this).p1)) =>
!(0 == asType < integer > (div1.quot))
!(0 == asType < integer > (div1.rem)) || !(0 ==
asType<integer>(div1.quot))
div2 == div(\mathbf{heapIs} \$heap_{funcstart\_1032,1},
\mathbf{static\_cast} < \mathbf{int} > (\mathbf{operator}^*(\mathbf{heapIs}\ \$ \mathbf{heap}_{funcstart\_1032,1},\ \mathbf{this}).\mathtt{p2}),
\mathbf{static\_cast} < \mathbf{int} > (\$ \mathbf{heap}_{funcstart\_1032,1}.\mathbf{a2}))
(asType < integer > (static\_cast < int > (operator*(heapIs)))
```

```
\theta_{funcstart_{-1032,1}}, this).p2)) /
\mathbf{asType} < \mathbf{integer} > (\mathbf{static\_cast} < \mathbf{int} > (\$ \mathbf{heap}_{funcstart\_1032,1}.\mathbf{a2}))) = =
asType<integer>(div2.quot)
(asType < integer > (static\_cast < int > (operator*(heapIs)))
heap_{funcstart\_1032.1}, this).p2)
asType < integer > (static\_cast < int > (\$heap_{funcstart\_1032.1}.a2))) = =
asType<integer>(div2.rem)
(\mathbf{asType}{<}\mathbf{integer}{>}(\mathbf{operator}^*(\mathbf{heapIs}\ \$\mathbf{heap}_{funcstart\_1032,1},\ \mathbf{this}).\mathtt{p2}) <
asType < integer > ($heap_{funcstart\_1032,1}.a2)) =>
(asType<integer>(div2.rem) == asType<integer>(operator*(heapIs
heap_{funcstart\_1032,1}, this).p2)
(\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathbf{heap}_{funcstart\_1032,1}.\mathbf{a2}) \leq
asType < integer > (operator*(heapIs $heap_{funcstart\_1032,1}, this).p2)) = >
!(0 == asType < integer > (div2.quot))
!(0 == asType < integer > (div2.rem)) || !(0 ==
asType<integer>(div2.quot))
\operatorname{div3} == \operatorname{div}(\mathbf{heapIs} \ \operatorname{\$heap}_{funcstart\_1032,1},
\mathbf{static\_cast} < \mathbf{int} > (\mathbf{operator}^*(\mathbf{heapIs}\ \$ \mathbf{heap}_{funcstart\_1032,1},\ \mathbf{this}).\mathbf{p3}),
\mathbf{static\_cast}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_1032,1}.\mathrm{a3}))
(asType < integer > (static\_cast < int > (operator*(heapIs
heap_{funcstart\ 1032.1}, this).p3) /
\mathbf{asType} < \mathbf{integer} > (\mathbf{static\_cast} < \mathbf{int} > (\$ \mathbf{heap}_{funcstart\_1032,1}.\mathbf{a3}))) = =
asType<integer>(div3.quot)
(asType<integer>(static_cast<int>(operator*(heapIs
heap_{funcstart\_1032,1}, this).p3)
asType < integer > (static\_cast < int > (\$heap_{funcstart\_1032.1}.a3))) = =
asType<integer>(div3.rem)
(\mathbf{asType}{<}\mathbf{integer}{>}(\mathbf{operator}^*(\mathbf{heapIs}\ \$\mathbf{heap}_{funcstart\_1032,1},\ \mathbf{this}).\mathrm{p3}) <
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathrm{heap}_{funcstart\_1032,1}.\mathrm{a3})) =>
(asType<integer>(div3.rem) == asType<integer>(operator*(heapIs
heap_{funcstart\_1032,1}, this).p3)
(asType < integer > (\$heap_{funcstart\_1032,1}.a3) \le
asType < integer > (operator^*(heapIs \$heap_{funcstart\_1032,1}, this).p3)) =>
!(0 == asType < integer > (div3.quot))
!(0 == asType < integer > (div3.rem)) || !(0 ==
asType<integer>(div3.quot))
temp1 == (\$heap_{funcstart\_1032,1}.r1 * static\_cast < signed int > (div1.rem)) -
(\text{sheap}_{funcstart\_1032,1}.\text{b1} * \text{static\_cast} < \text{signed int} > (\text{div1.quot}))
minof(signed int) \le temp1
temp1 < maxof(signed int)
```

Proof:

```
[Take given term]
[2.0] div1 == div(heapIs $heap<sub>funcstart_1032,1</sub>,
static_cast<int>(operator*(heapIs $heap_{funcstart\_1032,1}, this).p1),
\mathbf{static\_cast}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_1032,1}.\mathrm{a1}))
→ [expand definition of operator '*' in class 'pointer' at built in declaration]
[2.1] \operatorname{div1} == \operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_1032,1},
static\_cast < int > (this. r.value(heapIs  heap_{funcstart\_1032,1}).p1),
static\_cast < int > (\$heap_{funcstart\_1032.1}.a1))
\rightarrow [simplify]
[2.2] \text{ div1} == \text{div(heapIs } \text{$heap}_{funcstart\_1032,1}, \text{this.} \text{$r.value(heapIs)}
\theta_{funcstart\_1032,1}, p1, static_cast<int>(\theta_{funcstart\_1032,1})
\rightarrow [const static or extern object]
[2.3] \text{ div1} == \text{div(heapIs } \text{$heap}_{funcstart\_1032,1}, \text{ this.} \text{$r.value(heapIs)}
\theta_{uncstart\_1032.1}.p1, static_cast<int>(\theta_{unit}.a1))
\rightarrow [expand definition of constant 'a1' at prang.cpp (30,26)]
[2.4] \text{ div1} == \text{div}(\text{heapIs } \text{$heap}_{funcstart\_1032,1}, \text{this.}\text{$r.value}(\text{heapIs})
\theta_{funcstart\_1032,1}.p1, \theta_{funcstart\_1032,1}.p1, \theta_{funcstart\_1032,1}.p1, \theta_{funcstart\_1032,1}.p1, \theta_{funcstart\_1032,1}.p1, \theta_{funcstart\_1032,1}.p2, \theta_{funcstart\_1032,1}.p2, \theta_{funcstart\_1032,1}.p2, \theta_{funcstart\_1032,1}.p2, \theta_{funcstart\_1032,1}.p2, \theta_{funcstart\_1032,1}.p3, \theta_{funcstart\_1032,1}.p2, \theta_{funcstart\_1032,1}.p3, \theta_{funcstart\_1032,1}.p4, \theta_{funcstart\_1032,1}.p4, \theta_{funcstart\_1032,1}.p4, \theta_{funcstart\_1032,1}.p4, \theta_{funcstart\_1032,1}.p4, \theta_{funcstart\_1032,1}.p5, \theta_{funcstart\_1032,1
\rightarrow [simplify]
[2.6] \operatorname{div1} == \operatorname{div}(\mathbf{heapIs} \ \mathbf{\$heap}_{funcstart\_1032,1}, \ \mathbf{this}.\mathbf{\$r.value}(\mathbf{heapIs})
heap_{funcstart_{-1032,1}}.p1, 177
[Assume known post-assertion, class invariant or type constraint for term 2.6]
[7.0] (0 < asType<integer>(this.$r.value(heapIs
\label{eq:continuous} $\operatorname{heap}_{funcstart\_1032,1}).p1)) \&\& (\mathbf{asType} < \mathbf{integer} > (\mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}))) \&\& (\mathbf{asType} < \mathbf{integer} > (\mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})))) \&\& (\mathbf{asType} < \mathbf{integer} > (\mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}))))) \&\& (\mathbf{asType} < \mathbf{integer} > (\mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})))) \&\& (\mathbf{asType} < \mathbf{integer} > (\mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})))))
\$ heap_{funcstart\_1032,1}).p1) < \mathbf{asType} < \mathbf{integer} > (\$ heap.\mathbf{class} \ WHPrang \in \texttt{Constart} = \texttt{Constart}
M1))
\rightarrow [simplify]
[7.2] (0 < this.$r.value(heapIs \rho_{funcstart\_1032,1}).p1) &&
(this.$r.value(heapIs \theta_{funcstart\_1032,1}).p1 <
asType < integer > (\$heap.class WHPrang \in M1))
\rightarrow [const static or extern object]
[7.3] (0 < this.$r.value(heapIs heap_{funcstart\_1032,1}).p1) &&
(this.r.value(heapIs $heap_{funcstart\_1032,1}).p1 <
asType < integer > (\$heap_{init}.class WHPrang \in M1))
\rightarrow [expand definition of constant 'M1' at prang.cpp (28,26)]
[7.4] (0 < this.$r.value(heapIs \theta_{funcstart\_1032,1}).p1) &&
(this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1 <
```

```
asType < integer > ((int)30269))
\rightarrow [simplify]
[7.10] (-30269 < -this.$r.value(heap
Is \rho_{funcstart\_1032,1}).p1) <math display="inline">\land (0 <
this.r.value(heapIs $heap_{funcstart\_1032,1}).p1)
[Work on sub-term 2 of conjunction in term 7.10]
[8.0] 0 < this.$r.value(heapIs $heap<sub>funcstart_1032,1</sub>).p1
[Take given term]
[50.0] \; ((\$ heap_{funcstart\_1032,1}.r1 * \textbf{static\_cast} < \textbf{signed int} > (div1.rem)) \; - \;
(\text{\$heap}_{funcstart\_1032,1}.\text{b1 * static\_cast} < \text{signed int} > (\text{div1.quot}))) = \text{temp1}
\rightarrow [const static or extern object]
[50.1] ((\theta_{init}.r1 * static_cast<signed int>(div1.rem)) -
(\$heap_{funcstart\_1032,1}.b1 * \textbf{static\_cast} < \textbf{signed int} > (div1.quot))) == temp1
\rightarrow [expand definition of constant 'r1' at prang.cpp (29,26)]
[50.2] (((int)171 * static_cast<signed int>(div1.rem)) -
(\$heap_{funcstart\_1032,1}.b1 * \textbf{static\_cast} < \textbf{signed int} > (div1.quot))) == temp1
\rightarrow [simplify]
[50.3] ((171 * static_cast < signed int > (div1.rem)) - ($heap_{funcstart\_1032,1}.b1
* static_cast<signed int>(div1.quot))) == temp1
\rightarrow [from term 2.6, div1 is equal to div(heapIs $heap_{funcstart\_1032,1},
this.r.value(heapIs \ heap_{funcstart\_1032.1}).p1, 177)
[50.4] ((171 * static_cast<signed int>(div(heapIs \theta_{funcstart\_1032,1}),
this.r.value(heapIs $heap_{funcstart\_1032,1}).p1, 177).rem)) -
(\text{sheap}_{funcstart\_1032,1}.\text{b1 * static\_cast} < \text{signed int} > (\text{div1.quot}))) == \text{temp1}
\rightarrow [simplify]
[50.5] ((171 * div(heapIs heapIs  heap_{funcstart\_1032,1}, this.r.value(heapIs)
\text{Sheap}_{funcstart\_1032,1}.\text{p1}, 177).\text{rem} - (\text{Sheap}_{funcstart\_1032,1}.\text{b1} *
static_cast<signed int>(div1.quot))) == temp1
\rightarrow [const static or extern object]
[50.6] ((171 * \mathrm{div}(\mathbf{heapIs}\ \$\mathrm{heap}_{funcstart\_1032,1},\ \mathbf{this}.\$\mathrm{r.value}(\mathbf{heapIs}
\rho_{uncstart\_1032,1}.p1,\ 177).rem) — ( \rho_{unit}.b1 * static\_cast < signed)
int>(div1.quot)) == temp1
\rightarrow [expand definition of constant 'b1' at prang.cpp (31,26)]
[50.7] ((171 * \operatorname{div}(\mathbf{heapIs} \ \mathbf{sheap}_{funcstart\_1032,1}, \ \mathbf{this}.\mathbf{sr.value}(\mathbf{heapIs})
\theta_{funcstart\_1032,1}.p1, 177).rem - ((int)2 * static\_cast < signed)
int>(div1.quot)) == temp1
\rightarrow [simplify]
```

```
[50.8] ((171 * div(heapIs $heap_{funcstart\_1032,1}, this.$r.value(heapIs)
\theta_{funcstart\_1032,1}.p1, 177).rem - (2 * static\_cast < signed)
int>(div1.quot))) == temp1
\rightarrow [from term 2.6, div1 is equal to div(heapIs $heap_{funcstart\_1032.1},
this.r.value(heapIs \ heap_{funcstart\_1032.1}).p1, 177)
[50.9] ((171 * div(heapIs $heap<sub>funcstart_1032,1</sub>, this.$r.value(heapIs)
\theta_{funcstart\_1032,1}.p1, 177).rem) - (2 * static_cast<signed
int>(div(heapIs \$heap_{tuncstart\_1032.1}, this.\$r.value(heapIs
\$ \operatorname{heap}_{funcstart\_1032,1}).\operatorname{p1},\ 177).\operatorname{quot}))) == \operatorname{temp1}
\rightarrow [simplify]
[50.14] 0 == (-\text{temp1} + (-2 * \text{div}(\text{heapIs } \text{$heap}_{funcstart\_1032.1},
this.$r.value(heapIs heap_{funcstart\_1032,1}).p1, 177).quot) + (171 *
\operatorname{div}(\mathbf{heapIs}\ \$ \mathrm{heap}_{funcstart\_1032,1},\ \mathbf{this}.\$ \mathbf{r.value}(\mathbf{heapIs}
heap_{funcstart\_1032,1}.p1, 177).rem
[Take given term]
[51.0] minof(signed int) \leq temp1
\rightarrow [simplify]
[51.3] - 32769 < \text{temp1}
\rightarrow [from term 50.14, temp1 is equal to (-2 * div(heapIs $heap_{tuncstart\_1032.1},
this.$r.value(heapIs $heap_{tuncstart | 1032,1}).p1, 177).quot) + (171 *
div(\mathbf{heapIs} \ \$heap_{funcstart\_1032,1}, \ \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
heap_{funcstart\_1032,1}.p1, 177.rem
[51.4]-32769 < ((-2 * div(heapIs $heap_{funcstart\_1032,1}, this.$r.value(heapIs + functions)]
\text{Sheap}_{funcstart\_1032.1}.p1, 177).quot) + (171 * div(heapIs \text{Sheap}_{funcstart\_1032.1},
this.r.value(heapIs \heap_{funcstart\_1032.1}).p1, 177).rem))
[Take goal term]
[1.0] minof(signed int) \leq (($heap_{funcstart\_1032,1}.M1 *
asType<int>(static_cast<integer>(static_cast<signed
int>(operator^*(heapIs \$heap_{funcstart\_1032,1}, this).p1) < (int)0))) + temp1)
\rightarrow [simplify]
[1.1] -32768 \leq (($heap_{funcstart\_1032,1}.M1 *
asType<int>(static_cast<integer>(static_cast<signed
int>(operator^*(heapIs \$heap_{funcstart\_1032,1}, this).p1) < (int)0))) + temp1)
\rightarrow [const static or extern object]
[1.2] -32768 \leq (($heap_{init}.M1 *
asType<int>(static_cast<integer>(static_cast<signed
int>(operator^*(heapIs \$heap_{funcstart\_1032.1}, this).p1) < (int)0))) + temp1)
\rightarrow [expand definition of constant 'M1' at prang.cpp (28,26)]
```

```
[1.3] -32768 < (((int)30269 *
as Type < int > (static\_cast < integer > (static\_cast < signed))
\mathbf{int} > (\mathbf{operator}^*(\mathbf{heapIs}\ \$ \mathbf{heap}_{funcstart\_1032,1},\ \mathbf{this}).\mathtt{p1}) < (\mathbf{int})0))) + \mathtt{temp1})
\rightarrow [simplify]
[1.4] -32768 \le ((30269 *
asType < int > (static\_cast < integer > (static\_cast < signed)
int>(operator^*(heapIs \$heap_{funcstart\_1032,1}, this).p1) < (int)0))) + temp1)
→ [expand definition of operator '*' in class 'pointer' at built in declaration]
[1.5] -32768 < ((30269 *
asType < int > (static\_cast < integer > (static\_cast < signed)
int>(this.\$r.value(heapIs \$heap_{funcstart\_1032.1}).p1) < (int)0))) + temp1)
\rightarrow [simplify]
[1.9] -32768 \leq ((30269 * asType<int>(static_cast<integer>(0 <
-\mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}~\$\mathrm{heap}_{funcstart\_1032,1}).\mathrm{p1}))) + \mathrm{temp1})
\rightarrow [from term 8.0, literala < -this.$r.value(heapIs $heap_{funcstart\_1032,1}).p1
is false whenever -2 < (0 + literala)
   Proof of rule precondition:
   [1.9.0] - 2 < (0 + 0)
   \rightarrow [simplify]
   [1.9.2] true
[1.10] -32768 \leq ((30269 * asType<int>(static_cast<integer>(false))) +
temp1)
\rightarrow [simplify]
[1.11] -32768 \leq ((30269 * asType<int>(([false]: 1, []: 0))) + temp1)
→ [explicitly assert falsehood of skipped guards in subsequent guards]
[1.12] -32768 \leq ((30269 * asType<int>(([false]: 1, [true]: 0))) + temp1)
\rightarrow [simplify]
[1.15] -32768 < (0 + \text{temp1})
\rightarrow [from term 50.14, temp1 is equal to (-2 * div(heapIs $heap_{funcstart\_1032,1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177).quot) + (171 * leapIs \ heap_{funcstart\_1032,1}).p1, 177).quot)
div(heapIs $heap_{funcstart\_1032.1}, this.$r.value(heapIs
heap_{funcstart\_1032,1}.p1, 177).rem
[1.16] -32768 \leq (0 + ((-2 * div(heapIs $heap_{funcstart\_1032,1},
this.r.value(heapIs \ensuremath{\$}heap_{funcstart\_1032,1}).p1, 177).quot) + (171 *
div(\mathbf{heapIs} \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
heap_{funcstart_{-1032,1}}.p1, 177).rem))
\rightarrow [simplify]
```

```
[1.20] -32769 < ((-2 * div(heapIs $heap_{funcstart\_1032,1}, this.$r.value(heapIs)]
\text{Sheap}_{funcstart\_1032,1}.p1, 177).quot) + (171 * div(heapIs \text{Sheap}_{funcstart\_1032,1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177).rem))
\rightarrow [from term 51.4, literala < ((-2 * div(heapIs $heap_{funcstart\_1032,1},
this.r.value(heapIs \ \ heap_{funcstart\_1032,1}).p1, \ 177).quot) + (171 \ \ *
div(\mathbf{heapIs} \ \$heap_{funcstart\_1032,1}, \ \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
heap_{funcstart\_1032,1}.p1, 177).rem is true whenever (-1 + literala) < -32769
   Proof of rule precondition:
   [1.20.0](-32769 + -1) < -32769
   \rightarrow [simplify]
   [1.20.2] true
[1.21] true
Proof of verification condition: Type constraint satisfied in implicit
conversion from 'signed int' to 'P1Type'
In the context of class: WHPrang, declared at:
C:\Escher\Customers\prang-cpp\prang.cpp (18,1)
Condition generated at: C:\Escher\Customers\prang-cpp\prang.cpp
(75,16)
Condition defined at:
To prove: ((\$heap_{funcstart\_1032.1}.M1 *
asType<int>(static_cast<integer>(static_cast<signed
\mathbf{int} > (\mathbf{operator}^*(\mathbf{heapIs} \ \$ \mathbf{heap}_{funcstart\_1032,1}, \ \mathbf{this}).\mathtt{p1}) < (\mathbf{int})0))) + \mathtt{temp1})
\leq \max of(signed int)
Given:
heap_{init}.LIMIT == (int)80
heap_{init}.class WHPrang \in M1 == (int)30269
heap_{init}.class WHPrang \in r1 == (int)171
heap_{init}.class WHPrang \in a1 == (int)177
heap_{init}.class WHPrang \in b1 == (int)2
heap_{init}.class WHPrang \in M2 == (int)30307
heap_{init}.class WHPrang \in r2 == (int)172
heap_{init}.class WHPrang \in a2 == (int)176
heap_{init}.class WHPrang \in b2 == (int)35
\text{$heap}_{init}.\mathbf{class} \text{ WHPrang} \in M3 == (\mathbf{int})30323
heap_{init}.class WHPrang \in r3 == (int)170
```

```
heap_{init}.class WHPrang \in a3 == (int)178
heap_{init}.class WHPrang \in b3 == (int)63
\mathrm{div1} == \mathrm{div}(\mathbf{heapIs} \ \$ \mathrm{heap}_{funcstart\_1032,1},
static\_cast < int > (operator^*(heapIs \$heap_{funcstart\_1032,1}, this).p1),
\mathbf{static\_cast}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_1032,1}.\mathrm{a1}))
(asType<integer>(static_cast<int>(operator*(heapIs
heap_{funcstart\_1032,1}, this).p1) /
\mathbf{asType}{<}\mathbf{integer}{>}(\mathbf{static\_cast}{<}\mathbf{int}{>}(\$\mathbf{heap}_{funcstart\_1032,1}.\mathbf{a1}))) = =
asType<integer>(div1.quot)
(asType < integer > (static\_cast < int > (operator*(heapIs)))
heap_{funcstart_1032.1}, this).p1)
asType < integer > (static\_cast < int > (\$heap_{funcstart\_1032.1}.a1))) = =
asType<integer>(div1.rem)
(asType<integer>(operator*(heapIs $heap_{funcstart\_1032,1}, this).p1) <
asType < integer > (\$heap_{funcstart\_1032,1}.a1)) = >
(asType<integer>(div1.rem) == asType<integer>(operator*(heapIs
heap_{funcstart\_1032,1}, this).p1)
(asType < integer > (\$heap_{funcstart\_1032,1}.a1) \le
\mathbf{asType} < \mathbf{integer} > (\mathbf{operator}^*(\mathbf{heapIs} \ \$ \mathbf{heap}_{funcstart\_1032,1}, \ \mathbf{this}).\mathtt{p1})) = >
!(0 == asType < integer > (div1.quot))
!(0 == asType < integer > (div1.rem)) || !(0 ==
asType<integer>(div1.quot))
div2 == div(\mathbf{heapIs} \$ heap_{funcstart\_1032,1},
\mathbf{static\_cast} {<} \mathbf{int} {>} (\mathbf{operator*}(\mathbf{heapIs}\ \$ \mathbf{heap}_{funcstart\_1032,1},\ \mathbf{this}).\mathbf{p2}),
\mathbf{static\_cast}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_1032,1}.\mathrm{a2}))
(asType < integer > (static\_cast < int > (operator*(heapIs
heap_{funcstart\_1032.1}, this).p2)
asType < integer > (static\_cast < int > (\$heap_{funcstart\_1032,1}.a2))) = =
asType<integer>(div2.quot)
(asType < integer > (static\_cast < int > (operator*(heapIs)))
\theta_{funcstart\_1032,1}, this).p2)) \%
asType < integer > (static\_cast < int > (\$heap_{funcstart\_1032.1}.a2))) = =
asType<integer>(div2.rem)
(asType < integer > (operator*(heapIs $heap_{funcstart\_1032,1}, this).p2) < footnote{this properties of the properties
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathrm{heap}_{funcstart\_1032,1}.\mathrm{a2})) =>
(asType<integer>(div2.rem) == asType<integer>(operator*(heapIs
heap_{funcstart\_1032,1}, this).p2)
(\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathsf{heap}_{funcstart\_1032,1}.\mathsf{a2}) \leq
\mathbf{asType} < \mathbf{integer} > (\mathbf{operator}^*(\mathbf{heapIs} \ \$ \mathbf{heap}_{funcstart\_1032,1}, \ \mathbf{this}).\mathtt{p2})) = >
!(0 == asType < integer > (div2.quot))
```

```
!(0 == asType < integer > (div2.rem)) || !(0 ==
asType<integer>(div2.quot))
div3 == div(\mathbf{heapIs} \$ heap_{funcstart\_1032,1},
\mathbf{static\_cast} < \mathbf{int} > (\mathbf{operator^*(heapIs}\ \$heap_{funcstart\_1032,1},\ \mathbf{this}).p3),
\mathbf{static\_cast} < \mathbf{int} > (\$ \mathbf{heap}_{funcstart\_1032,1}.\mathbf{a3}))
(asType < integer > (static\_cast < int > (operator*(heapIs)))
heap_{funcstart\_1032,1}, this).p3) /
asType < integer > (static\_cast < int > (\$heap_{funcstart\_1032,1}.a3))) = =
asType<integer>(div3.quot)
(asType<integer>(static_cast<int>(operator*(heapIs
heap_{funcstart\_1032.1}, this).p3)
\mathbf{asType} {<} \mathbf{integer} {>} (\mathbf{static\_cast} {<} \mathbf{int} {>} (\$ \mathbf{heap}_{funcstart\_1032,1}.\mathbf{a3}))) = =
asType<integer>(div3.rem)
(\mathbf{asType}{<}\mathbf{integer}{>}(\mathbf{operator}^*(\mathbf{heapIs}\ \$\mathbf{heap}_{funcstart\_1032,1},\ \mathbf{this}).\mathrm{p3}) <
asType < integer > (\$heap_{funcstart\_1032,1}.a3)) = >
(asType<integer>(div3.rem) == asType<integer>(operator*(heapIs
heap_{funcstart\_1032,1}, this).p3)
(\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathsf{heap}_{funcstart\_1032,1}.a3) \leq
\mathbf{asType} < \mathbf{integer} > (\mathbf{operator}^*(\mathbf{heapIs} \ \$ \mathbf{heap}_{funcstart\_1032,1}, \ \mathbf{this}).\mathrm{p3})) = >
!(0 == asType < integer > (div3.quot))
!(0 == asType < integer > (div3.rem)) || !(0 ==
asType<integer>(div3.quot))
temp1 == (\$heap_{funcstart\_1032,1}.r1 * static\_cast < signed int > (div1.rem)) -
(\text{sheap}_{funcstart\_1032,1}.\text{b1} * \text{static\_cast} < \text{signed int} > (\text{div1.quot}))
minof(signed int) \le temp1
temp1 \le maxof(signed int)
Proof:
[Take given term]
[2.0] div1 == div(heapIs $heap_{funcstart\_1032,1},
\mathbf{static\_cast} < \mathbf{int} > (\mathbf{operator*}(\mathbf{heapIs} \ \$ \mathbf{heap}_{funcstart\_1032,1}, \ \mathbf{this}).\mathtt{p1}),
\mathbf{static\_cast}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_1032,1}.\mathrm{a1}))
→ [expand definition of operator '*' in class 'pointer' at built in declaration]
[2.1] \operatorname{div1} == \operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_1032,1},
\mathbf{static\_cast} < \mathbf{int} > (\mathbf{this.\$r.value}(\mathbf{heapIs} \ \$ \mathbf{heap}_{funcstart\_1032,1}).\mathbf{p1}),
static\_cast < int > (\$heap_{funcstart\_1032.1}.a1))
\rightarrow [simplify]
[2.2] \operatorname{div1} == \operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_1032,1}, \mathbf{this}.\$ r. \mathbf{value}(\mathbf{heapIs}))
\rho_{tuncstart_{1032.1}}, p1, static_cast<int>(\rho_{tuncstart_{1032.1}})
```

```
\rightarrow [const static or extern object]
[2.3] \text{ div1} == \text{div(heapIs } \text{$heap}_{funcstart\_1032,1}, \text{ this.} \text{$r.value(heapIs)}
\theta_{tuncstart\_1032,1}.p1, \theta_{tuncstart\_1032,1}.p2, \theta_{tuncstart\_1032,1}.p2, \theta_{tuncstart\_1032,1}.p2, \theta_{tuncstart\_1032,1}.p1, \theta_{tuncstart\_1032,1}.p1, \theta_{tuncstart\_1032,1}.p2, \theta_{tuncstart\_1032,1}.p3, \theta_{tuncstart\_1032,1
\rightarrow [expand definition of constant 'a1' at prang.cpp (30,26)]
[2.4] \operatorname{div1} == \operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_1032,1}, \mathbf{this}.\$ r. \mathbf{value}(\mathbf{heapIs})
\theta_{funcstart\_1032,1}.p1, \theta_{funcstart} (int)177)
\rightarrow [simplify]
[2.6] \operatorname{div1} == \operatorname{div}(\mathbf{heapIs} \ \mathbf{\$heap}_{funcstart\_1032,1}, \ \mathbf{this}.\mathbf{\$r.value}(\mathbf{heapIs})
heap_{funcstart_{-1032,1}}.p1, 177
[Assume known post-assertion, class invariant or type constraint for term 2.6]
[7.0] (0 < asType<integer>(this.$r.value(heapIs
\verb§heap$_{funcstart\_1032,1}).p1)) \&\& (\textbf{asType} < \textbf{integer} > (\textbf{this}.\$r.\textbf{value}(\textbf{heapIs}))) \&\& (\textbf{asType} < \textbf{integer})) \\
\theta_{funcstart\_1032,1}.p1) < asType<integer>(\theta_{funcstart\_1032,1}).p1) < asType<integer>(\theta_{funcstart\_1032,1}).p1)
M1))
\rightarrow [simplify]
[7.2] (0 < this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1) \&\&
(this.r.value(heapIs $heap_{funcstart\_1032,1}).p1 <
asType < integer > (\text{$heap.class WHPrang} \in M1))
\rightarrow [const static or extern object]
[7.3] (0 < this.$r.value(heap
Is $heap_{funcstart\_1032,1}).p1) &&
(this.r.value(heapIs $heap_{funcstart\_1032.1}).p1 <
asType < integer > (\$heap_{init}.class WHPrang \in M1))
\rightarrow [expand definition of constant 'M1' at prang.cpp (28,26)]
[7.4] (0 < this.$r.value(heap
Is $heap_{funcstart\_1032,1}).p1) &&
(this.r.value(heapIs $heap_{funcstart\_1032,1}).p1 <
asType < integer > ((int)30269))
\rightarrow [simplify]
[7.10] (-30269 < -this.$r.value(heapIs heap_{funcstart\_1032,1}).p1) \land (0 <
this.$r.value(heapIs $heap_{funcstart\_1032.1}).p1)
[Work on sub-term 2 of conjunction in term 7.10]
[8.0] 0 < this.$r.value(heapIs $heap<sub>funcstart_1032,1</sub>).p1
[Take given term]
[50.0] (($heap_tuncstart_1032,1.r1 * static_cast<signed int>(div1.rem)) -
(\text{sheap}_{funcstart\_1032,1}.\text{b1 * static\_cast} < \text{signed int} > (\text{div1.quot}))) = \text{temp1}
\rightarrow [const static or extern object]
[50.1] (($heap<sub>init</sub>.r1 * static_cast<signed int>(div1.rem)) -
(\text{sheap}_{funcstart\_1032,1}.\text{b1 * static\_cast} < \text{signed int} > (\text{div1.quot}))) == \text{temp1}
```

```
\rightarrow [expand definition of constant 'r1' at prang.cpp (29,26)]
[50.2] (((int)171 * static_cast<signed int>(div1.rem)) -
(\text{sheap}_{funcstart\_1032,1}.\text{b1 * static\_cast} < \text{signed int} > (\text{div1.quot}))) == \text{temp1}
\rightarrow [simplify]
[50.3] ((171 * static_cast < signed int > (div1.rem)) - ($heap_{funcstart\_1032,1}.b1]
* static_cast<signed int>(div1.quot))) == temp1
\rightarrow [from term 2.6, div1 is equal to div(heapIs $heap_{funcstart\_1032,1},
this.r.value(heapIs \ heap_{funcstart\_1032.1}).p1, 177)
[50.4] ((171 * static_cast<signed int>(div(heapIs $heap_{funcstart\_1032,1},
\mathbf{this.\$r.value(heapIs}~\$ \mathrm{heap}_{funcstart\_1032,1}).\mathrm{p1},~177).\mathrm{rem})) - \\
(\text{sheap}_{funcstart\_1032,1}.\text{b1} * \text{static\_cast} < \text{signed int} > (\text{div1.quot}))) == \text{temp1}
\rightarrow [simplify]
[50.5] ((171 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs = f_{uncstart\_1032,1})
\text{Sheap}_{funcstart\_1032,1}.p1, 177).rem) - (\text{Sheap}_{funcstart\_1032,1}.b1 *
static_cast<signed int>(div1.quot))) == temp1
\rightarrow [const static or extern object]
[50.6] ((171 * div(heapIs $heap<sub>funcstart_1032,1</sub>, this.$r.value(heapIs)
\rho_{funcstart\_1032,1}.p1, 177).rem – (\rho_{funcstart\_1032,1}.p1, 177).rem) – (\rho_{funcstart\_1032,1}.p1, 177).rem)
int>(div1.quot)) == temp1
\rightarrow [expand definition of constant 'b1' at prang.cpp (31,26)]
[50.7] ((171 * div(heapIs $heap_{funcstart\_1032.1}, this.$r.value(heapIs)
\theta_{uncstart\_1032,1}.p1, 177).rem - ((int)^2 * static\_cast < signed)
int>(div1.quot)) == temp1
\rightarrow [simplify]
[50.8] ((171 * div(heapIs \$heap_{funcstart\_1032,1}, this.\$r.value(heapIs)
\theta_{funcstart\_1032,1}.p1, 177).rem) - (2 * static_cast<signed
int>(div1.quot))) == temp1
\rightarrow [from term 2.6, div1 is equal to div(heapIs $heap_{funcstart\_1032,1},
this.r.value(heapIs $heap_{funcstart\_1032,1}).p1, 177)]
[50.9] ((171 * div(heapIs $heap<sub>funcstart_1032,1</sub>, this.$r.value(heapIs)
\rho_{tuncstart\_1032.1}.p1, 177).rem - (2 * static\_cast < signed)
\mathbf{int}{>}(\mathrm{div}(\mathbf{heapIs}\ \$\mathrm{heap}_{funcstart\_1032,1},\ \mathbf{this}.\$\mathrm{r.value}(\mathbf{heapIs}
\text{Sheap}_{funcstart\_1032,1}.p1, 177).quot))) == temp1
\rightarrow [simplify]
[50.14] 0 == (-\text{temp1} + (-2 * \text{div}(\mathbf{heapIs} \$ \text{heap}_{funcstart\_1032,1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177).quot) + (171 *
div(\mathbf{heapIs} \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
heap_{funcstart_{-1032,1}}.p1, 177).rem
```

```
[Take given term]
[52.0] temp1 \leq maxof(signed int)
\rightarrow [simplify]
[52.9] - 32768 < -\text{temp1}
\rightarrow [from term 50.14, temp1 is equal to (-2 * div(heapIs $heap_{funcstart\_1032,1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177).quot) + (171 * leapIs \ heap_{funcstart\_1032,1}).p1, 177).quot)
div(\mathbf{heapIs} \ \$heap_{funcstart\_1032,1}, \ \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
heap_{funcstart\_1032.1}.p1, 177).rem
\label{eq:continuous} \mbox{$\lceil 52.10 \rceil$ -32768 < -((-2 * {\rm div}(\mathbf{heapIs} \ \${\rm heap}_{funcstart\_1032,1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177).quot) + (171 *
div(\mathbf{heapIs} \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
heap_{funcstart_{1032,1}}.p1, 177).rem
\rightarrow [simplify]
[52.13] -32768 < ((2 * div(heapIs $heap_{funcstart\_1032,1}, this.$r.value(heapIs)]
heap_{funcstart\_1032,1}.p1, 177).quot + (-171 * div(heapIs)
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).rem))
[Take goal term]
[1.0] (($heap<sub>funcstart_1032,1</sub>.M1 *
asType<int>(static_cast<integer>(static_cast<signed
\mathbf{int} > (\mathbf{operator}^*(\mathbf{heapIs}\ \$ \mathbf{heap}_{funcstart\_1032,1},\ \mathbf{this}).\mathtt{p1}) < (\mathbf{int})0))) + \mathtt{temp1})
\leq \max of(signed int)
\rightarrow [const static or extern object]
[1.1] (($heap_{init}.M1 *
as Type < int > (static\_cast < integer > (static\_cast < signed))
int>(operator^*(heapIs \$heap_{funcstart\_1032,1}, this).p1) < (int)0))) + temp1)
\leq \max of(signed\ int)
\rightarrow [expand definition of constant 'M1' at prang.cpp (28,26)]
[1.2] (((int)30269 *
asType < int > (static\_cast < integer > (static\_cast < signed)
int>(operator^*(heapIs \$heap_{funcstart\_1032,1}, this).p1) < (int)0))) + temp1)
\leq \max of(signed\ int)
\rightarrow [simplify]
[1.3] ((30269 * asType<int>(static_cast<integer>(static_cast<signed)
int>(operator^*(heapIs \$heap_{funcstart\_1032,1}, this).p1) < (int)0))) + temp1)
\leq maxof(signed int)
→ [expand definition of operator '*' in class 'pointer' at built in declaration]
[1.4] ((30269 * asType<int>(static_cast<integer>(static_cast<signed)
```

```
int>(this.\$r.value(heapIs \$heap_{funcstart\_1032.1}).p1) < (int)0))) + temp1) \le
maxof(signed int)
\rightarrow [simplify]
[1.8] ((30269 * asType<int>(static_cast<integer>(0 <
-\mathbf{this.\$r.value}(\mathbf{heapIs}\ \$\mathbf{heap}_{funcstart\_1032,1}).\mathbf{p1}))) + \mathbf{temp1}) \leq
maxof(signed int)
\rightarrow [from term 8.0, literala < -this.$r.value(heapIs $heap_{funcstart\_1032.1}).p1
is false whenever -2 < (0 + literala)
       Proof of rule precondition:
       [1.8.0] - 2 < (0 + 0)
       \rightarrow [simplify]
       [1.8.2] true
[1.9] ((30269 * asType<int>(static_cast<integer>(false))) + temp1) \leq
maxof(signed int)
\rightarrow [simplify]
[1.10] ((30269 * asType<int>(([false]: 1, []: 0))) + temp1) \leq maxof(signed)
→ [explicitly assert falsehood of skipped guards in subsequent guards]
[1.11] ((30269 * asType<int>(([false]: 1, [true]: 0))) + temp1) \leq
maxof(signed int)
\rightarrow [simplify]
[1.14] (0 + \text{temp1}) \le \text{maxof(signed int)}
\rightarrow [from term 50.14, temp1 is equal to (-2 * div(heapIs $heap_{funcstart\_1032,1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177).quot) + (171)
div(heapIs $heap_{tuncstart\_1032.1}, this.$r.value(heapIs
heap_{funcstart\_1032,1}.p1, 177).rem
[1.15]~(0+((\mbox{-}2*{\rm div}({\bf heap Is}~{\rm \$heap}_{funcstart\_1032,1},~{\bf this.\$r.value}({\bf heap Is}
\text{Sheap}_{funcstart\_1032.1}.p1, 177).quot) + (171 * div(heapIs \text{Sheap}_{funcstart\_1032.1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177).rem))) \le maxof(signed)
int)
\rightarrow [simplify]
[1.31] -32768 < ((-171 * div(heapIs $heap<sub>funcstart_1032,1</sub>,
this.r.value(heapIs \$heap_{funcstart\_1032,1}).p1, 177).rem) + (2 * div(heapIs + div(heapIs)) + (2 * div(
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot))
\rightarrow [from term 52.13, literala < ((-171 * div(heapIs $heap_{funcstart\_1032,1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177).rem) + (2 * div(heapIs \ heapIs))
heap_{funcstart\_1032,1}, this.r.value(heapIs heap_{funcstart\_1032,1}).p1,
```

```
(-177). (-1 + literala) < -32768
          Proof of rule precondition:
          [1.31.0](-32768 + -1) < -32768
          \rightarrow [simplify]
          [1.31.2] true
[1.32] true
Proof of verification condition: Arithmetic result of operator '*' is within
limit of type 'signed int'
In the context of class: WHPrang, declared at:
C:\Escher\Customers\prang-cpp\prang.cpp (18,1)
Condition generated at: C:\Escher\Customers\prang-cpp\prang.cpp
(77,30)
Condition defined at:
To prove: minof(signed int) \leq ($heap<sub>1032,1:1051,8</sub>.r2 * static_cast<signed
int>(div2.rem))
Given:
heap_{init}.LIMIT == (int)80
heap_{init}.class WHPrang \in M1 == (int)30269
heap_{init}.class WHPrang \in r1 == (int)171
heap_{init}.class WHPrang \in a1 == (int)177
heap_{init}.class WHPrang \in b1 == (int)2
heap_{init}.class WHPrang \in M2 == (int)30307
heap_{init}.class WHPrang \in r2 == (int)172
heap_{init}.class WHPrang \in a2 == (int)176
heap_{init}.class WHPrang \in b2 == (int)35
\text{$heap}_{init}.\mathbf{class} \text{ WHPrang} \in M3 == (\mathbf{int})30323
heap_{init}.class WHPrang \in r3 == (int)170
heap_{init}.class WHPrang \in a3 == (int)178
heap_{init}.class WHPrang \in b3 == (int)63
\operatorname{div} 1 == \operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_1032,1},
\mathbf{static\_cast} < \mathbf{int} > (\mathbf{operator}^*(\mathbf{heapIs}\ \$ \mathbf{heap}_{funcstart\_1032,1},\ \mathbf{this}).\mathbf{p1}),
static\_cast < int > (\$heap_{funcstart\_1032,1}.a1))
(asType < integer > (static\_cast < int > (operator*(heapIs)))
\theta_{100} = \theta_{1000} + \theta_{1000} +
```

```
asType < integer > (static\_cast < int > (\$heap_{funcstart\_1032.1}.a1))) = =
asType<integer>(div1.quot)
(asType < integer > (static\_cast < int > (operator*(heapIs
heap_{funcstart\_1032.1}, this).p1) %
asType < integer > (static\_cast < int > (\$heap_{funcstart\_1032.1}.a1))) = =
asType<integer>(div1.rem)
(\mathbf{asType}{<}\mathbf{integer}{>}(\mathbf{operator}^*(\mathbf{heapIs}\ \$\mathbf{heap}_{funcstart\_1032,1},\ \mathbf{this}).\mathtt{p1}) <
asType < integer > (\$heap_{funcstart\_1032,1}.a1)) = >
(asType<integer>(div1.rem) == asType<integer>(operator*(heapIs
heap_{funcstart\ 1032.1}, this).p1)
(asType < integer > (\$heap_{funcstart\_1032,1}.a1) \le
asType<integer>(operator*(heapIs $heap_{funcstart\_1032,1}, this).p1)) =>
!(0 == asType < integer > (div1.quot))
!(0 == asType < integer > (div1.rem)) || !(0 ==
asType<integer>(div1.quot))
div2 == div(\mathbf{heapIs} \$ heap_{funcstart\_1032.1},
static\_cast < int > (operator*(heapIs $heap_{funcstart\_1032,1}, this).p2),
\mathbf{static\_cast}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_1032,1}.\mathrm{a2}))
(asType < integer > (static\_cast < int > (operator*(heapIs
heap_{funcstart\_1032,1}, this).p2) /
asType<integer>(static_cast<int>($heap_{funcstart_1032.1}.a2))) ==
asType<integer>(div2.quot)
(asType<integer>(static_cast<int>(operator*(heapIs
heap_{funcstart\_1032,1}, this).p2)
asType < integer > (static\_cast < int > (\$heap_{funcstart\_1032,1}.a2))) = =
asType<integer>(div2.rem)
(asType<integer>(operator*(heapIs $heap_{tuncstart\_1032.1}, this).p2) <
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathrm{heap}_{funcstart\_1032,1}.\mathrm{a2})) =>
(asType<integer>(div2.rem) == asType<integer>(operator*(heapIs
heap_{funcstart\_1032,1}, this).p2)
(asType < integer > (\$heap_{funcstart\_1032,1}.a2) \le
\mathbf{asType} < \mathbf{integer} > (\mathbf{operator}^*(\mathbf{heapIs} \ \$ \mathbf{heap}_{funcstart\_1032,1}, \ \mathbf{this}).\mathtt{p2})) = >
!(0 == asType < integer > (div2.quot))
!(0 == asType < integer > (div2.rem)) || !(0 ==
asType<integer>(div2.quot))
div3 == div(\mathbf{heapIs} \$heap_{funcstart\_1032,1},
static_cast<int>(operator*(heapIs $heap_{funcstart\_1032,1}, this).p3),
\mathbf{static\_cast}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_1032,1}.\mathrm{a3}))
(asType<integer>(static_cast<int>(operator*(heapIs
heap_{funcstart\_1032,1}, this).p3)) /
asType < integer > (static\_cast < int > (\$heap_{funcstart\_1032.1}.a3))) = =
```

```
asType<integer>(div3.quot)
(asType<integer>(static_cast<int>(operator*(heapIs
heap_{funcstart\_1032,1}, this).p3)
asType < integer > (static\_cast < int > (\$heap_{funcstart\_1032.1}.a3))) = =
asType<integer>(div3.rem)
(asType < integer > (operator*(heapIs $heap_{funcstart\_1032,1}, this).p3) < footnote{the content of the conte
\mathbf{asType} < \mathbf{integer} > (\$ \mathrm{heap}_{funcstart\_1032,1}.\mathrm{a3})) = >
(asType<integer>(div3.rem) == asType<integer>(operator*(heapIs
heap_{funcstart\_1032,1}, this).p3)
(asType < integer > (\$heap_{funcstart\_1032,1}.a3) \le
asType < integer > (operator*(heapIs $heap_{funcstart\_1032,1}, this).p3)) =>
!(0 == asType < integer > (div3.quot))
!(0 == asType < integer > (div3.rem)) || !(0 ==
asType<integer>(div3.quot))
temp1 == (\$heap_{funcstart\_1032,1}.r1 * \textbf{static\_cast} < \textbf{signed int} > (div1.rem)) - (div1.rem) + (div1.r
($heap_tuncstart_1032.1.b1 * static_cast<signed int>(div1.quot))
minof(signed\ int) \le temp1
temp1 \le maxof(signed int)
\$ heap_{1032,1;1051,8} == \$ heap_{funcstart\_1032,1}.\_\mathbf{replace}(\mathbf{this}.\$r \rightarrow
operator*(heapIs heap_{funcstart\_1032,1}, this)._replace(p1 \rightarrow
\mathbf{asType}{<}\mathrm{P1Type}{>}((\$\mathrm{heap}_{funcstart\_1032,1}.\mathrm{M1}~*
asType<int>(static_cast<integer>(static_cast<signed
int>(operator^*(heapIs $heap_{funcstart\_1032,1}, this).p1) < (int)0))) +
temp1)))
Proof:
[Take given term]
[2.0] \operatorname{div1} == \operatorname{div}(\mathbf{heapIs} \ \operatorname{\$heap}_{funcstart\_1032,1},
static_cast<int>(operator*(heapIs $heap_{funcstart\_1032,1}, this).p1),
\mathbf{static\_cast}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_1032,1}.\mathrm{a1}))
→ [expand definition of operator '*' in class 'pointer' at built in declaration]
[2.1] \operatorname{div1} == \operatorname{div}(\mathbf{heapIs} \ \operatorname{\$heap}_{funcstart\_1032,1},
\mathbf{static\_cast} < \mathbf{int} > (\mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs} \$ \mathbf{heap}_{funcstart\_1032,1}).p1),
\mathbf{static\_cast}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_1032,1}.\mathrm{a1}))
\rightarrow [simplify]
[2.2]~{\rm div1} == {\rm div}(\mathbf{heapIs}~\$ \mathrm{heap}_{funcstart\_1032,1},~\mathbf{this}.\$ \mathrm{r.value}(\mathbf{heapIs}
\theta_{funcstart\_1032,1}.p1, \theta_{funcstart\_1032,1}.p1, \theta_{funcstart\_1032,1}.a1))
\rightarrow [const static or extern object]
[2.3] \operatorname{div1} == \operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_1032,1}, \mathbf{this}.\$ r. \mathbf{value}(\mathbf{heapIs})
```

```
\$ heap_{funcstart\_1032,1}).p1, \ \mathbf{static\_cast} < \mathbf{int} > (\$ heap_{init}.a1))
\rightarrow [expand definition of constant 'a1' at prang.cpp (30,26)]
[2.4] \operatorname{div1} == \operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_1032,1}, \mathbf{this}.\$ r. \mathbf{value}(\mathbf{heapIs})
\theta_{funcstart\_1032,1}.p1, \theta_{funcstart\_1032,1}.p1, \theta_{funcstart\_1032,1}.p1, \theta_{funcstart\_1032,1}.p1, \theta_{funcstart\_1032,1}.p1, \theta_{funcstart\_1032,1}.p1, \theta_{funcstart\_1032,1}.p2, \theta_{funcstart\_1032,1}.p2, \theta_{funcstart\_1032,1}.p2, \theta_{funcstart\_1032,1}.p2, \theta_{funcstart\_1032,1}.p2, \theta_{funcstart\_1032,1}.p3, \theta_{funcstart\_1032,1}.p4, \theta_{funcstart\_1032,1}.p4, \theta_{funcstart\_1032,1}.p4, \theta_{funcstart\_1032,1}.p5, \theta_{funcstart\_1032,1
\rightarrow [simplify]
[2.6] \operatorname{div1} == \operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_1032,1}, \mathbf{this.}\$ r. \mathbf{value}(\mathbf{heapIs})
heap_{funcstart\_1032,1}.p1, 177)
[Assume known post-assertion, class invariant or type constraint for term 2.6]
[7.0] (0 < asType<integer>(this.$r.value(heapIs
\theta_{funcstart\_1032,1}.p1) && (asType<integer>(this.$r.value(heapIs)
\$ heap_{funcstart\_1032,1}).p1) < \mathbf{asType} < \mathbf{integer} > (\$ heap.\mathbf{class} \ \mathbf{WHPrang} \in \texttt{Partition}) = \texttt{Class} \ \mathsf{WHPrang} \in \texttt{Class} \ \mathsf{Class} \ \mathsf{WHPrang} \in \texttt{Class} \ \mathsf{Class} \ \mathsf{
M1))
\rightarrow [simplify]
[7.2] (0 < this.$r.value(heap
Is \rho_{funcstart\_1032,1}).p1) &&
(this.r.value(heapIs $heap_{tuncstart\_1032.1}).p1 <
asType < integer > (\text{$heap.class WHPrang} \in M1))
\rightarrow [const static or extern object]
[7.3] (0 < this.$r.value(heap
Is \rho_{funcstart\_1032,1}).p1) &&
(this.r.value(heapIs $heap_{funcstart\_1032,1}).p1 <
asType < integer > (\text{$heap}_{init}.class WHPrang \in M1))
\rightarrow [expand definition of constant 'M1' at prang.cpp (28,26)]
[7.4] (0 < this.$r.value(heapIs \rho_{funcstart\_1032,1}).p1) &&
(this.$r.value(heapIs \theta_{funcstart\_1032,1}).p1 <
asType < integer > ((int)30269))
\rightarrow [simplify]
[7.10] (-30269 < -this.$r.value(heapIs $heap_{tuncstart\_1032.1}).p1) \land (0 <
this.r.value(heapIs $heap_{funcstart\_1032,1}).p1)
[Work on sub-term 2 of conjunction in term 7.10]
[8.0] 0 < this.$r.value(heapIs heap_{funcstart\_1032,1}).p1
[Take given term]
[18.0] \text{ div2} == \text{div}(\text{heapIs } \text{$heap}_{funcstart\_1032,1},
static_cast<int>(operator*(heapIs $heap_{funcstart\_1032,1}, this).p2),
\mathbf{static\_cast} < \mathbf{int} > (\$ \mathbf{heap}_{funcstart\_1032,1}.\mathbf{a2}))
→ [expand definition of operator '*' in class 'pointer' at built in declaration]
[18.1] \operatorname{div2} == \operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_1032,1},
static_cast<int>(this.$r.value(heapIs $heap_{funcstart\_1032,1}).p2),
static\_cast < int > (\$heap_{funcstart\_1032,1}.a2))
```

```
\rightarrow [simplify]
[18.2] div2 == div(\mathbf{heapIs} \ \hat{\mathbf{s}}_{heap}), this.\hat{\mathbf{s}}_{r.}value(\mathbf{heapIs}
\rho_{funcstart=1032,1}, p2, static_cast<int>(\rho_{funcstart=1032,1})
\rightarrow [const static or extern object]
[18.3] div2 == div(\mathbf{heapIs} \$ \mathbf{heap}_{funcstart\_1032,1}, \mathbf{this}.\$ \mathbf{r.value}(\mathbf{heapIs})
\theta_{funcstart\_1032,1}.p2, \theta_{funcstart\_1032,1}.p3, \theta_{funcstart\_1032,1}.p2, \theta_{funcstart\_1032,1}.p3, \theta_{funcstart\_1032,1
\rightarrow [expand definition of constant 'a2' at prang.cpp (35,26)]
[18.4] div2 == div(heapIs $heap_{funcstart\_1032,1}, this.$r.value(heapIs)
\theta_{funcstart\_1032,1}.p2, \theta_{funcstart} = \theta_{funcstart}.p2, \theta_{funcstart} = \theta_{funcstart}.p3, \theta_{funcstart} = \theta_{funcstart}.p4, \theta_{funcstart} = \theta_{funcstart}.p4, \theta_{funcstart} = \theta_{funcstart}.p4, \theta_{funcstart} = \theta_{funcstart}.p5, \theta_{funcstart} = \theta_{funcstart}.p7, \theta
\rightarrow [simplify]
[18.6] \text{ div2} == \text{div}(\mathbf{heapIs} \$ \mathbf{heap}_{funcstart\_1032,1}, \mathbf{this}.\$ \mathbf{r.value}(\mathbf{heapIs})
heap_{funcstart\_1032,1}.p2, 176)
[Assume known post-assertion, class invariant or type constraint for term 18.6]
[23.0] (0 < asType<integer>(this.$r.value(heapIs
\label{eq:continuous} $\operatorname{heap}_{funcstart\_1032,1}).p2)) \&\& (asType < integer > (this.\$r.value(heapIs)) \\
\rho_{tuncstart=1032.1}.p2 < asType<integer>(\rho_{tuncstart=1032.1}.p2) < asType<integer>(\rho_{tuncstart=1032.1}.p2)
M2))
\rightarrow [simplify]
[23.2] (0 < this.$r.value(heap
Is $heap_{funcstart\_1032,1}).p2) &&
(this.$r.value(heapIs \theta_{funcstart\_1032,1}).p2 <
asType < integer > (\text{$heap.class WHPrang} \in M2))
\rightarrow [const static or extern object]
[23.3] (0 < this.$r.value(heapIs heap_{funcstart\_1032,1}).p2) &&
(this.r.value(heapIs $heap_{funcstart\_1032,1}).p2 <
asType < integer > (\text{$heap}_{init}.class WHPrang \in M2))
\rightarrow [expand definition of constant 'M2' at prang.cpp (33,26)]
[23.4] (0 < this.$r.value(heap
Is \rho_{uncstart\_1032,1}).p2) &&
(this.$r.value(heapIs \rho_{funcstart\_1032,1}).p2 <
asType < integer > ((int)30307))
\rightarrow [simplify]
[23.10] (-30307 < -this.$r.value(heapIs $heap_{funcstart\_1032,1}).p2) \land (0 <
this.$r.value(heapIs $heap_{funcstart\_1032.1}).p2)
[Work on sub-term 2 of conjunction in term 23.10]
[24.0] 0 < this.$r.value(heapIs $heap_{funcstart\_1032.1}).p2
[Assume known post-assertion, class invariant or type constraint for term 18.6]
[26.0] (asType<integer>(this.$r.value(heapIs \rho_{tuncstart\_1032,1}).p2) %
asType<integer>(176)) == asType<integer>(div(heapIs
```

```
\rho_{tuncstart=1032.1}, this.r.value(heapIs \rho_{tuncstart=1032.1}).p2,
176).rem)
\rightarrow [simplify]
[26.2] (this.$r.value(heapIs $heap_{funcstart\_1032,1}).p2 % 176) ==
\mathbf{asType}{<}\mathbf{integer}{>}(\mathbf{div}(\mathbf{heapIs}\ \$\mathbf{heap}_{funcstart\_1032,1},\ \mathbf{this.\$r.value}(\mathbf{heapIs}
heap_{funcstart_{-1032,1}}.p2, 176).rem
→ [expand definition of operator '.%' in class 'int' at built in declaration]
[26.3] \; ([\mathbf{asType} < \mathbf{integer} > (\mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs} \; \$ \mathbf{heap}_{funcstart\_1032,1}).\mathbf{p2}) < \mathbf{p2}) 
0]: -(-asType < integer > (this.\$r.value(heapIs \$heap_{funcstart\_1032,1}).p2) \%
176), []: asType<integer>(this.$r.value(heapIs $heap_{tuncstart\_1032.1}).p2)
\% 176) == asType<integer>(div(heapIs $heap_{tuncstart\_1032.1},
this.r.value(heapIs $heap_{funcstart\_1032,1}).p2, 176).rem)
→ [explicitly assert falsehood of skipped guards in subsequent guards]
{\it [26.4]}~([{\bf asType}{<}{\bf integer}{>}({\bf this.\$r.value}({\bf heapIs}~\${\bf heap}_{funcstart\_1032,1}).{\bf p2})<
0]: -(-asType < integer > (this. r.value(heapIs  heap_{funcstart\_1032,1}).p2) \%
176), [!(asType<integer>(this.r.value(heapIs \ heap_{funcstart\_1032,1}).p2) <
0)]: asType<integer>(this.$r.value(heapIs \theta_{funcstart\_1032,1}).p2) %
176) == asType<integer>(div(heapIs $heap_{tuncstart\_1032,1},
this.r.value(heapIs $heap_{funcstart\_1032,1}).p2, 176).rem)
\rightarrow [simplify]
\label{eq:continuous} \textit{[26.7]} ([0 < -\textbf{this.}\$r.\textbf{value}(\textbf{heapIs} \ \$ heap_{funcstart\_1032,1}).p2]:
-(-asType < integer > (this. r.value(heapIs  heap_{funcstart\_1032,1}).p2) \%
176), [!(asType<integer>(this.r.value(heapIs \heap_{funcstart\_1032,1}).p2) <
0)]: asType<integer>(this.$r.value(heapIs \theta_{funcstart\_1032,1}).p2) %
176) == asType<integer>(div(heapIs heap_{funcstart\_1032.1},
this.r.value(heapIs $heap_{funcstart\_1032,1}).p2, 176).rem)
\rightarrow [from term 24.0, literala < -this.$r.value(heapIs $heap_{funcstart\_1032,1}).p2
is false whenever -2 < (0 + literala)
   Proof of rule precondition:
   [26.7.0] - 2 < (0 + 0)
   \rightarrow [simplify]
   [26.7.2] true
[26.8] ([false]: -(-asType<integer>(this.$r.value(heapIs
\theta_{funcstart\_1032,1}.p2) \% 176, [!(asType<integer>(this.$r.value(heapIs)
\rho_{tuncstart_1032.1}.p2 < 0: asType<integer>(this.$r.value(heapIs)
\theta_{funcstart\_1032,1}.p2) \% 176 = asType < integer > (div(heapIs))
\rho_{tuncstart_{1032.1}}, this.$r.value(heapIs \rho_{tuncstart_{1032.1}}).p2,
176).rem)
\rightarrow [simplify]
```

```
[26.11] ([false]: -(-asType<integer>(this.$r.value(heapIs
\theta_{funcstart\_1032,1}).p2)~\%~176),~[!(0<-{\bf this}.\r.{\bf value(heapIs})]
\rho_{uncstart_1032,1}.p2): asType<integer>(this.$r.value(heapIs)
\theta_{funcstart\_1032,1}.p2) % 176) == asType<integer>(div(heapIs)
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p2,
176).rem)
\rightarrow [from term 24.0, literala < -this.$r.value(heapIs $heap_{funcstart\_1032.1}).p2
is false whenever -2 < (0 + literala)
   Proof of rule precondition:
   [26.11.0] - 2 < (0 + 0)
   \rightarrow [simplify]
   [26.11.2] true
[26.12] ([false]: -(-asType<integer>(this.$r.value(heapIs
heap_{funcstart_{1032.1}}.p2) \% 176, [!false]:
asType<integer>(this.$r.value(heapIs $heap_{funcstart\_1032,1}).p2) % 176)
== asType < integer > (div(heapIs $heap_{funcstart\_1032,1},
this.r.value(heapIs $heap_{funcstart\_1032,1}).p2, 176).rem)
\rightarrow [simplify]
[26.17] 0 == (-\text{div}(\mathbf{heapIs} \$ \text{heap}_{funcstart\_1032,1}, \mathbf{this}.\$ \mathbf{r.value}(\mathbf{heapIs}))
\theta_{funcstart\_1032,1}.p2, 176.rem + (this.r.value(heapIs)
heap_{funcstart_{1032,1}}.p2 \% 176)
[Take given term]
[50.0] (($heap_funcstart_1032,1.r1 * static_cast<signed int>(div1.rem)) -
($heap_tuncstart_1032.1.b1 * static_cast<signed int>(div1.quot))) == temp1
\rightarrow [const static or extern object]
[50.1] (($heap<sub>init</sub>.r1 * static_cast<signed int>(div1.rem)) -
(\$heap_{funcstart\_1032,1}.b1 * \textbf{static\_cast} < \textbf{signed int} > (div1.quot))) == temp1
\rightarrow [expand definition of constant 'r1' at prang.cpp (29,26)]
[50.2] (((int)171 * static_cast<signed int>(div1.rem)) -
(\text{sheap}_{funcstart\_1032,1}.\text{b1} * \text{static\_cast} < \text{signed int} > (\text{div1.quot}))) == \text{temp1}
\rightarrow [simplify]
[50.3] ((171 * static_cast < signed int > (div1.rem)) - ($heap_{funcstart\_1032,1}.b1]
* static_cast<signed int>(div1.quot))) == temp1
\rightarrow [from term 2.6, div1 is equal to div(heapIs $heap_{funcstart\_1032.1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177)]
[50.4] ((171 * static_cast < signed int > (div(heapIs heapIs funcstart_{1032,1}),
this.r.value(heapIs $heap_{funcstart\_1032,1}).p1, 177).rem)) -
(\text{sheap}_{funcstart\_1032,1}.\text{b1 * static\_cast} < \text{signed int} > (\text{div1.quot}))) == \text{temp1}
```

```
\rightarrow [simplify]
[50.5] ((171 * div(heapIs $heap_{funcstart\_1032,1}, this.$r.value(heapIs)
\text{Sheap}_{funcstart\_1032,1}.p1, 177).rem) - (\text{Sheap}_{funcstart\_1032,1}.b1 *
static_cast<signed int>(div1.quot))) == temp1
\rightarrow [const static or extern object]
[50.6] ((171 * \mathrm{div}(\mathbf{heapIs}\ \$\mathrm{heap}_{funcstart\_1032,1},\ \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}\ 
\rho_{uncstart\_1032,1}.p1, 177).rem – (\rho_{uncstart\_1032,1}.p1, 177).rem) – (\rho_{uncstart\_1032,1}.p1, 177).rem) – (\rho_{uncstart\_1032,1}.p1, 177).rem)
int>(div1.quot)) == temp1
\rightarrow [expand definition of constant 'b1' at prang.cpp (31,26)]
[50.7] ((171 * div(heapIs \$heap_{funcstart\_1032,1}, this.\$r.value(heapIs
\theta_{uncstart\_1032,1}.p1, 177).rem - ((int)2 * static\_cast < signed)
int>(div1.quot))) == temp1
\rightarrow [simplify]
[50.8] ((171 * div(heapIs $heap_{funcstart\_1032,1}, this.$r.value(heapIs)
\theta_{funcstart\_1032,1}.p1, 177).rem - (2 * static\_cast < signed)
int>(div1.quot)) == temp1
\rightarrow [from term 2.6, div1 is equal to div(heapIs $heap_{funcstart\_1032,1},
this.r.value(heapIs $heap_{funcstart\_1032,1}).p1, 177)]
[50.9] ((171 * div(heapIs $heap_{funcstart\_1032,1}, this.$r.value(heapIs)
\theta_{tuncstart\ 1032.1},p1, 177).rem) - (2 * static_cast<signed)
int>(div(heapIs \$heap_{funcstart\_1032,1}, this.\$r.value(heapIs
\$ \operatorname{heap}_{funcstart\_1032,1}).\operatorname{p1},\ 177).\operatorname{quot}))) == \operatorname{temp1}
\rightarrow [simplify]
[50.14] 0 == (-\text{temp1} + (-2 * \text{div}(\text{heapIs } \text{$heap}_{funcstart\_1032,1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177).quot) + (171 *
div(\mathbf{heapIs} \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
heap_{funcstart_{1032,1}}.p1, 177).rem
[Take given term]
[53.0] $heap<sub>1032,1:1051,8</sub> == $heap<sub>funcstart_1032,1</sub>._replace(this.$r \rightarrow
operator*(heapIs heap_{funcstart\_1032,1}, this)._replace(p1 \rightarrow
asType < P1Type > ((\$heap_{funcstart\_1032,1}.M1 *
asType<int>(static_cast<integer>(static_cast<signed
int>(operator^*(heapIs \$heap_{funcstart\_1032,1}, this).p1) < (int)0))) +
temp1)))
→ [expand definition of operator '*' in class 'pointer' at built in declaration]
[53.1] $\text{heap}_{1032,1:1051.8} == \text{$heap}_{funcstart\_1032,1}.$\text{-replace}(\text{this}.\text{$r} \to \text{$}
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow
asType < P1Type > ((\$heap_{funcstart\_1032,1}.M1 *
as Type < int > (static\_cast < integer > (static\_cast < signed))
```

```
int>(operator^*(heapIs \$heap_{funcstart\_1032,1}, this).p1) < (int)0))) +
temp1)))
\rightarrow [const static or extern object]
[53.2] \theta_{1032,1;1051,8} == \theta_{1032,1;1051,8} = \theta_{1032,1;1051,8} == \theta
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow
asType < P1Type > ((\$heap_{init}.M1 *
asType < int > (static\_cast < integer > (static\_cast < signed
int>(operator^*(heapIs \$heap_{funcstart\_1032,1}, this).p1) < (int)0))) +
temp1)))
\rightarrow [expand definition of constant 'M1' at prang.cpp (28,26)]
[53.3] $\text{heap}_{1032,1:1051.8} == \text{$heap}_{funcstart\_1032,1}._\text{replace}(\text{this}.\text{$r} \to \text{$}
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow
asType<P1Type>(((int)30269 *
asType{<}int{>}(static\_cast{<}integer{>}(static\_cast{<}signed
int>(operator^*(heapIs $heap_{funcstart\_1032,1}, this).p1) < (int)0))) +
temp1)))
\rightarrow [simplify]
[53.4] heap_{1032,1;1051,8} == heap_{funcstart\_1032,1}.\_replace(this.\$r \rightarrow this)
\mathbf{this.\$r.value}(\mathbf{heapIs}~\$ \mathrm{heap}_{funcstart\_1032,1}).\_\mathbf{replace}(\mathrm{p1} \rightarrow
asType<P1Type>((30269 *
asType<int>(static_cast<integer>(static_cast<signed
\mathbf{int}{>}(\mathbf{operator}^*(\mathbf{heapIs}\ \$\mathbf{heap}_{funcstart\_1032,1},\ \mathbf{this}).\mathtt{p1})<(\mathbf{int})0)))+\\
temp1)))
→ [expand definition of operator '*' in class 'pointer' at built in declaration]
[53.5] \rho_{1032,1;1051,8} == \rho_{1032,1;1051,8} = \rho_{1032,1;1051,8} == \rho
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow
asType<P1Type>((30269 *
asType < int > (static\_cast < integer > (static\_cast < signed
int>(this.\$r.value(heapIs \$heap_{funcstart\_1032,1}).p1) < (int)0))) + temp1)))
\rightarrow [simplify]
[53.9] heap_{1032,1;1051,8} == heap_{funcstart\_1032,1}._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow
asType<P1Type>((30269 * asType<int>(static_cast<integer>(0 <
-\mathbf{this.}\$r.\mathbf{value}(\mathbf{heapIs}\ \$\mathrm{heap}_{funcstart\_1032,1}).\mathrm{p1}))) + \mathrm{temp1})))
\rightarrow [from term 8.0, literala < -this.$r.value(heapIs $heap_{funcstart\_1032,1}).p1
is false whenever -2 < (0 + literala)
           Proof of rule precondition:
           [53.9.0] - 2 < (0 + 0)
           \rightarrow [simplify]
```

```
[53.9.2] true
[53.10] $heap<sub>1032,1;1051,8</sub> == $heap<sub>funcstart_1032,1</sub>._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow
asType<P1Type>((30269 * asType<int>(static_cast<integer>(false)))
+ temp1)))
\rightarrow [simplify]
[53.11] $\text{heap}_{1032,1;1051,8} == $\text{heap}_{funcstart\_1032,1}.$\text{-replace}(\text{this}.$\text{$r} \to \text{
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow
asType < P1Type > ((30269 * asType < int > (([false]: 1, []: 0))) + temp1)))
→ [explicitly assert falsehood of skipped guards in subsequent guards]
[53.12] $\text{heap}_{1032,1;1051,8} == $\text{heap}_{funcstart\_1032,1}._\text{replace}(\text{this}.\text{$\frac{1}{2}r$})
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow
asType<P1Type>((30269 * asType<int>(([false]: 1, [true]: 0))) +
temp1)))
\rightarrow [simplify]
[53.15] $heap<sub>1032,1;1051,8</sub> == $heap<sub>funcstart_1032,1</sub>._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow
asType < P1Type > (0 + temp1))
\rightarrow [from term 50.14, temp1 is equal to (-2 * div(heapIs $heap_{funcstart\_1032,1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177).quot) + (171 *
div(\mathbf{heapIs} \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
heap_{funcstart_{-1032.1}}.p1, 177).rem
[53.16] $heap<sub>1032,1;1051,8</sub> == $heap<sub>funcstart_1032,1</sub>._replace(this.$r \rightarrow
this.$r.value(heapIs \rho_{tuncstart\_1032,1})._replace(p1 \rightarrow
asType < P1Type > (0 + ((-2 * div(heapIs $heap_{funcstart\_1032,1},
this.r.value(heapIs $heap_{funcstart\_1032,1}).p1, 177).quot) + (171 *
div(heapIs $heap<sub>funcstart_1032.1</sub>, this.$r.value(heapIs
heap_{funcstart_{1032.1}}.p1, 177).rem))))
\rightarrow [simplify]
[53.19] $heap<sub>1032,1;1051,8</sub> == $heap<sub>funcstart_1032,1</sub>._replace(this.$r \rightarrow
\textbf{this.\$r.value}(\textbf{heapIs}~\$\text{heap}_{funcstart\_1032,1}).\_\textbf{replace}(\text{p1} \rightarrow ((-2~*\text{div}(\textbf{heapIs}))))))
\rho_{funcstart\_1032,1}, this.\r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs \rho_{funcstart\_1032,1}, this.r.value(heapIs)
heap_{funcstart\_1032,1}.p1, 177).rem))))
[Take goal term]
[1.0] minof(signed int) \leq ($heap<sub>1032,1:1051,8</sub>.r2 * static_cast<signed
int>(div2.rem)
\rightarrow [simplify]
[1.1] -32768 \leq ($heap<sub>1032,1:1051,8</sub>.r2 * static_cast<signed int>(div2.rem))
```

```
\rightarrow [from term 53.19, $heap<sub>1032.1:1051.8</sub> is equal to
\$heap_{funcstart\_1032,1}.\_\textbf{replace}(\textbf{this}.\$r \rightarrow \textbf{this}.\$r.\textbf{value}(\textbf{heapIs}
heap_{funcstart\_1032,1}._replace(p1 \rightarrow (-2 * div(heapIs p_{funcstart\_1032,1}).
this.r.value(heapIs \ \ heap_{funcstart\_1032.1}).p1, \ 177).quot) + (171)^2
div(heapIs $heap_funcstart_1032.1, this.$r.value(heapIs
heap_{funcstart_{1032,1}}.p1, 177).rem)))
[1.2] \ -32768 \leq (\$ heap_{funcstart\_1032,1}.\_\textbf{replace}(\textbf{this}.\$r \to \textbf{this}.\$r. \textbf{value}(\textbf{heapIs}))
\text{Sheap}_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs \text{Sheap}_{funcstart\_1032,1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177).quot) + (171 *
div(\mathbf{heapIs} \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
\theta_{funcstart\_1032,1}.p1, 177).rem)))).r2 * static_cast < signed
int>(div2.rem)
\rightarrow [const member of object with modified fields]
[1.3] -32768 \leq ($heap<sub>funcstart_1032,1</sub>.r2 * static_cast<signed int>(div2.rem))
\rightarrow [const static or extern object]
[1.4] -32768 \leq ($heap<sub>init</sub>.r2 * static_cast<signed int>(div2.rem))
\rightarrow [expand definition of constant 'r2' at prang.cpp (34,26)]
[1.5] -32768 \leq ((int)172 * static_cast<signed int>(div2.rem))
\rightarrow [simplify]
[1.6] -32768 \leq (172 * static_cast<signed int>(div2.rem))
\rightarrow [from term 18.6, div2 is equal to div(heapIs $heap_{funcstart\_1032,1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p2, 176)]
[1.7] -32768 \leq (172 * static_cast<signed int>(div(heapIs)
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p2,
176).rem))
\rightarrow [simplify]
[1.10] -32769 < (172 * div(heapIs \$heap_{funcstart\_1032,1}, this.\$r.value(heapIs))
heap_{funcstart_1032,1}.p2, 176).rem
\rightarrow [literal comparison of product]
[1.11] ([172 < 0]: (-32769 / -172) < -\text{div}(\mathbf{heapIs} \ \$ \text{heap}_{funcstart\_1032,1},
this.$r.value(heapIs heap_{funcstart\_1032,1}).p2, 176).rem, [0 < 172]: (-32769 /
172) < div(heapIs heap_{funcstart\_1032,1}, this.r.value(heapIs)
\text{Sheap}_{funcstart\_1032,1}.p2, 176).rem, [0 == 172]: -32769 < 0)
→ [explicitly assert falsehood of skipped guards in subsequent guards]
[1.12] ([172 < 0]: (-32769 / -172) < -\text{div}(\mathbf{heapIs} \$ \text{heap}_{funcstart\_1032.1},
this.$r.value(heapIs heap_{funcstart\_1032,1}).p2, 176).rem, [(0 < 172) \land!(172 <
0)]: (-32769 / 172) < div(heap
Is \rho_{funcstart\_1032,1} , this.$r.value(heap
Is
\text{Sheap}_{funcstart=1032.1}).p2, 176).rem, [(0 == 172) \land !(0 < 172) \land !(172 < 0)]:
```

```
-32769 < 0)
\rightarrow [simplify]
[1.20] -191 < \text{div}(\mathbf{heapIs} \$ \text{heap}_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs} \$ \text{heap}_{funcstart\_1032,1}).p2, 176).rem
\rightarrow [negate \ goal \ and \ search \ for \ contradiction]
[1.21] !(-191 < \text{div}(\mathbf{heapIs} \$ \text{heap}_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs} \$ \text{heap}_{funcstart\_1032,1}).p2, 176).rem)
\rightarrow [simplify]
[1.23] \ 190 < -\text{div}(\mathbf{heapIs} \$ \text{heap}_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs} \$ \text{heap}_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs} \$ \text{heap}_{funcstart\_1032,1}).p2, 176).rem
[Create \ new \ term \ from \ terms \ 1.23, \ 26.17 \ using \ rule: \ transitivity \ 15]
[68.0] \ (0 + 190) < -(\mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs} \$ \text{heap}_{funcstart\_1032,1}).p2 \% \ 176)
\rightarrow [simplify]
[68.2] \ \mathbf{false}
```

Proof of verification condition: Arithmetic result of operator '*' is within limit of type 'signed int'

In the context of class: WHPrang, declared at: C:\Escher\Customers\prang-cpp\prang.cpp (18,1)

Condition generated at: C:\Escher\Customers\prang-cpp\prang.cpp (77,30)

Condition defined at:

To prove: (\$heap_{1032,1;1051,8}.r2 * static_cast<signed int>(div2.rem)) \leq maxof(signed int)

Given:

```
$heap_{init}.LIMIT == (int)80

$heap_{init}.class WHPrang \in M1 == (int)30269

$heap_{init}.class WHPrang \in r1 == (int)171

$heap_{init}.class WHPrang \in a1 == (int)177

$heap_{init}.class WHPrang \in b1 == (int)2

$heap_{init}.class WHPrang \in M2 == (int)30307

$heap_{init}.class WHPrang \in r2 == (int)172

$heap_{init}.class WHPrang \in a2 == (int)176

$heap_{init}.class WHPrang \in b2 == (int)35

$heap_{init}.class WHPrang \in M3 == (int)30323
```

```
heap_{init}.class WHPrang \in r3 == (int)170
heap_{init}.class WHPrang \in a3 == (int)178
heap_{init}.class WHPrang \in b3 == (int)63
\operatorname{div1} == \operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_1032,1},
static_cast<int>(operator*(heapIs $heap_{funcstart\_1032.1}, this).p1),
\mathbf{static\_cast}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_1032,1}.\mathrm{a1}))
(asType < integer > (static\_cast < int > (operator*(heapIs)))
heap_{funcstart\_1032.1}, this).p1)
asType < integer > (static\_cast < int > (\$heap_{funcstart\_1032.1}.a1))) = =
asType<integer>(div1.quot)
(asType < integer > (static\_cast < int > (operator*(heapIs)))
heap_{funcstart\_1032,1}, this).p1) %
asType < integer > (static\_cast < int > (\$heap_{funcstart\_1032.1}.a1))) = =
asType<integer>(div1.rem)
(asType < integer > (operator^*(heapIs \$heap_{funcstart\_1032,1}, this).p1) < footnote{this property of the content of the property of the content of the content of the property of the property of the content of the property of the prope
asType < integer > (\$heap_{funcstart\_1032,1}.a1)) = >
(asType<integer>(div1.rem) == asType<integer>(operator*(heapIs
heap_{funcstart\_1032,1}, this).p1)
(\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathsf{heap}_{funcstart\_1032,1}.\mathsf{a1}) \leq
\mathbf{asType}{<}\mathbf{integer}{>}(\mathbf{operator*}(\mathbf{heapIs}\ \$\mathbf{heap}_{funcstart\_1032,1},\ \mathbf{this}).\mathbf{p1})) =>
!(0 == asType < integer > (div1.quot))
!(0 == asType < integer > (div1.rem)) || !(0 ==
asType<integer>(div1.quot))
\operatorname{div2} == \operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_1032,1},
\mathbf{static\_cast} {<} \mathbf{int} {>} (\mathbf{operator^*(heapIs}\ \$heap_{funcstart\_1032,1},\ \mathbf{this}).p2),
\mathbf{static\_cast}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_1032,1}.\mathrm{a2}))
(asType < integer > (static\_cast < int > (operator*(heapIs)))
heap_{funcstart=1032.1}, this).p2)
asType < integer > (static\_cast < int > (\$heap_{funcstart\_1032,1}.a2))) = =
asType<integer>(div2.quot)
(asType<integer>(static_cast<int>(operator*(heapIs
heap_{funcstart\_1032,1}, this).p2)
asType < integer > (static\_cast < int > (\$heap_{funcstart\_1032.1}.a2))) = =
asType<integer>(div2.rem)
(\mathbf{asType}{<}\mathbf{integer}{>}(\mathbf{operator}^*(\mathbf{heapIs}\ \$\mathbf{heap}_{funcstart\_1032,1},\ \mathbf{this}).\mathtt{p2}) <
asType < integer > (\$heap_{funcstart\_1032,1}.a2)) = >
(asType<integer>(div2.rem) == asType<integer>(operator*(heapIs
heap_{funcstart\_1032,1}, this).p2)
(\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathrm{heap}_{funcstart\_1032,1}.\mathrm{a2}) \leq
asType<integer>(operator*(heapIs $heap_{tuncstart\_1032.1}, this).p2)) =>
```

```
!(0 == asType < integer > (div2.quot))
!(0 == asType < integer > (div2.rem)) || !(0 ==
asType<integer>(div2.quot))
\label{eq:div3} \text{div3} == \text{div}(\mathbf{heapIs} \ \$ \text{heap}_{funcstart\_1032,1},
static\_cast < int > (operator*(heapIs $heap_{funcstart\_1032,1}, this).p3),
static\_cast < int > (\$heap_{funcstart\_1032,1}.a3))
(asType<integer>(static_cast<int>(operator*(heapIs
heap_{funcstart\_1032,1}, this).p3)) /
asType < integer > (static\_cast < int > (\$heap_{funcstart\_1032.1}.a3))) = =
asType<integer>(div3.quot)
(asType < integer > (static\_cast < int > (operator*(heapIs
heap_{funcstart_{1032,1}}, this).p3)
asType < integer > (static\_cast < int > (\$heap_{funcstart\_1032,1}.a3))) = =
asType<integer>(div3.rem)
(asType<integer>(operator*(heapIs $heap_{funcstart\_1032.1}, this).p3) <
asType < integer > (\$heap_{funcstart\_1032,1}.a3)) = >
(asType<integer>(div3.rem) == asType<integer>(operator*(heapIs
heap_{funcstart\_1032,1}, this).p3)
(\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathsf{heap}_{funcstart\_1032,1}.\mathsf{a3}) \leq
asType < integer > (operator^*(heapIs \$heap_{funcstart\_1032,1}, this).p3)) = >
!(0 == asType < integer > (div3.quot))
!(0 == asType < integer > (div3.rem)) || !(0 ==
asType<integer>(div3.quot))
temp1 == (\$heap_{funcstart\_1032,1}.r1 * static\_cast < signed int > (div1.rem)) -
($heap_funcstart_1032,1.b1 * static_cast<signed int>(div1.quot))
minof(signed\ int) \le temp1
temp1 \le maxof(signed int)
\theta_{1032,1:1051,8} == \theta_{1032
operator*(heapIs heap_{funcstart\_1032,1}, this)._replace(p1 \rightarrow
\mathbf{asType}{<}P1\mathsf{Type}{>}((\$\mathsf{heap}_{funcstart\_1032,1}.\mathsf{M1}~*
asType < int > (static\_cast < integer > (static\_cast < signed
int>(operator^*(heapIs \$heap_{funcstart\_1032,1}, this).p1) < (int)0))) +
temp1)))
Proof:
[Take given term]
[2.0] \operatorname{div1} == \operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_1032,1},
static\_cast < int > (operator*(heapIs $heap_{funcstart\_1032,1}, this).p1),
\mathbf{static\_cast}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_1032,1}.\mathrm{a1}))
→ [expand definition of operator '*' in class 'pointer' at built in declaration]
```

```
[2.1] \operatorname{div1} == \operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_1032,1},
\mathbf{static\_cast} < \mathbf{int} > (\mathbf{this.\$r.value}(\mathbf{heapIs} \ \$ \mathbf{heap}_{funcstart\_1032,1}).\mathbf{p1}),
\mathbf{static\_cast}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_1032,1}.\mathrm{a1}))
\rightarrow [simplify]
[2.2] \operatorname{div1} == \operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_1032,1}, \mathbf{this.}\$ r.\mathbf{value}(\mathbf{heapIs})
\theta_{funcstart=1032,1}, p1, static_cast<int>(\theta_{funcstart=1032,1})
\rightarrow [const static or extern object]
[2.3] \text{ div1} == \text{div(heapIs } \text{$heap}_{funcstart\_1032.1}, \text{this.} \text{$r.value(heapIs)}
\theta_{tuncstart\_1032.1}.p1, \theta_{tuncstart\_1032.1}.p2, \theta_{tuncstart\_1032.1}.p2, \theta_{tuncstart\_1032.1}.p2, \theta_{tuncstart\_1032.1}.p2, \theta_{tuncstart\_1032.1}.p2, \theta_{tuncstart\_1032.1}.p2, \theta_{tuncstart\_1032.1}.p2, \theta_{tuncstart\_1032.1}.p3, \theta_{tuncstart\_1032.1}.p2, \theta_{tuncstart\_1032.1}.p2, \theta_{tuncstart\_1032.1}.p3, \theta_{tuncstart\_1032.1}.p4, \theta_{tuncstart\_1032.1}.p4, \theta_{tuncstart\_1032.1}.p4, \theta_{tuncstart\_1032.1
\rightarrow [expand definition of constant 'a1' at prang.cpp (30,26)]
[2.4] \text{ div1} == \text{div}(\text{heapIs } \text{heap}_{funcstart\_1032,1}, \text{this.}\text{\$r.value}(\text{heapIs})
\theta_{tuncstart\_1032.1}.p1, \theta_{tuncstart\_1032.1}.p1, \theta_{tuncstart\_1032.1}.p1, \theta_{tuncstart\_1032.1}.p1, \theta_{tuncstart\_1032.1}.p1, \theta_{tuncstart\_1032.1}.p1, \theta_{tuncstart\_1032.1}.p2, \theta_{tuncstart\_1032.1}.p2, \theta_{tuncstart\_1032.1}.p2, \theta_{tuncstart\_1032.1}.p2, \theta_{tuncstart\_1032.1}.p2, \theta_{tuncstart\_1032.1}.p3, \theta_{tuncstart\_1032.1}.p2, \theta_{tuncstart\_1032.1}.p3, \theta_{tuncstart\_1032.1}.p4, \theta_{tuncstart\_1032.1}.p3, \theta_{tuncstart\_1032.1}.p4, \theta_{tuncstart\_1032.1}.p4, \theta_{tuncstart\_1032.1}.p5, \theta_{tuncstart\_1032.1}.p5, \theta_{tuncstart\_1032.1}.p5, \theta_{tuncstart\_1032.1}.p5, \theta_{tuncstart\_1032.1}.p6, \theta_{tuncstart\_1032.1}.p7, \theta_{tuncstart\_1032.1
\rightarrow [simplify]
[2.6] \text{ div1} == \text{div(heapIs } \text{$heap}_{funcstart\_1032,1}, \text{this.} \text{$r.value(heapIs)}
heap_{funcstart_{-1032.1}}.p1, 177
[Assume known post-assertion, class invariant or type constraint for term 2.6]
[7.0] (0 < asType<integer>(this.$r.value(heapIs)
\verb§heap$_{funcstart\_1032,1}).p1)) \&\& (\mathbf{asType} < \mathbf{integer} > (\mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}))) \&\& (\mathbf{asType} < \mathbf{integer} > (\mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})))) \&\& (\mathbf{asType} < \mathbf{integer} > (\mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})))) \&\& (\mathbf{asType} < \mathbf{integer} > (\mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})))) \&\& (\mathbf{asType} < \mathbf{integer} > (\mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}))))) \&\& (\mathbf{asType} < \mathbf{integer} > (\mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})))) \&\& (\mathbf{asType} < \mathbf{integer} > (\mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}))))) \&\& (\mathbf{asType} < \mathbf{integer} > (\mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}))))) \&\& (\mathbf{asType} < \mathbf{integer} > (\mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})))) \&\& (\mathbf{asType} < \mathbf{integer} > (\mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}))))) \&\& (\mathbf{asType} < \mathbf{integer} > (\mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}))))) \&\& (\mathbf{asType} < \mathbf{integer} > (\mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})))))) \&\& (\mathbf{asType} < \mathbf{integer} > (\mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}))))))
\theta_{uncstart\_1032,1}.p1 < asType<integer>(\theta_{uncstart\_1032,1}.p1) < asType<integer>(\theta_{uncstart\_1032,1}.p1)
M1))
\rightarrow [simplify]
[7.2] (0 < this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1) \&\&
(this.$r.value(heapIs heap_{funcstart\_1032,1}).p1 <
asType < integer > (\text{$heap.class WHPrang} \in M1))
\rightarrow [const static or extern object]
[7.3] (0 < this.$r.value(heapIs \rho_{funcstart\_1032,1}).p1) &&
(this.r.value(heapIs $heap_{funcstart\_1032,1}).p1 <
asType < integer > (\$heap_{init}.class WHPrang \in M1))
\rightarrow [expand definition of constant 'M1' at prang.cpp (28,26)]
[7.4] (0 < this.$r.value(heapIs \theta_{funcstart\_1032,1}).p1) &&
(this.$r.value(heapIs \rho_{funcstart\_1032,1}).p1 <
asType < integer > ((int)30269))
\rightarrow [simplify]
[7.10] (-30269 < -this.$r.value(heapIs heap_{funcstart\_1032,1}).p1) <math>\land (0 < 
this.$r.value(heapIs $heap_{funcstart\_1032,1}).p1)
[Work on sub-term 2 of conjunction in term 7.10]
[8.0] 0 < this.$r.value(heapIs $heap<sub>funcstart_1032,1</sub>).p1
```

```
[Take given term]
[18.0] \operatorname{div2} == \operatorname{div}(\mathbf{heapIs} \ \text{$heap}_{funcstart\_1032,1},
\mathbf{static\_cast} < \mathbf{int} > (\mathbf{operator}^*(\mathbf{heapIs} \ \$ \mathbf{heap}_{funcstart\_1032,1}, \ \mathbf{this}).\mathtt{p2}),
\mathbf{static\_cast}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_1032,1}.\mathrm{a2}))
→ [expand definition of operator '*' in class 'pointer' at built in declaration]
[18.1] \operatorname{div2} == \operatorname{div}(\mathbf{heapIs} \ \text{$heap}_{funcstart\_1032,1},
static\_cast < int > (this. r.value(heapIs  heap_{funcstart\_1032,1}).p2),
static\_cast < int > (\$heap_{funcstart\_1032,1}.a2))
\rightarrow [simplify]
[18.2] div2 == div(heapIs \rho_{uncstart\_1032,1}, his.\r.value(heapIs
\theta_{funcstart\_1032,1}.p2, \theta_{funcstart\_1032,1}.a2))
\rightarrow [const static or extern object]
[18.3] div2 == div(heapIs \rho_{uncstart\_1032,1}, his.\r.value(heapIs
\theta_{funcstart\_1032,1}.p2, \theta_{funcstart\_1032,1
\rightarrow [expand definition of constant 'a2' at prang.cpp (35,26)]
[18.4] div2 == div(\mathbf{heapIs} \$ \mathbf{heap}_{funcstart\_1032,1}, \mathbf{this}.\$ \mathbf{r.value}(\mathbf{heapIs})
\theta_{funcstart\_1032,1}.p2, \theta_{funcstart\_1032,1}.p2, \theta_{funcstart\_1032,1}.p2, \theta_{funcstart\_1032,1}.p2
\rightarrow [simplify]
[18.6] div2 == div(\mathbf{heapIs} \ \hat{\mathbf{s}}_{funcstart\_1032,1}, \ \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
heap_{funcstart_{-1032,1}}.p2, 176)
[Assume known post-assertion, class invariant or type constraint for term 18.6]
[23.0] (0 < asType<integer>(this.$r.value(heapIs
$heap_{tuncstart_1032.1}.p2)) && (asType<integer>(this.$r.value(heapIs
\verb§heap$_{funcstart\_1032,1}).p2) < \mathbf{asType} < \mathbf{integer} > (\$ heap.\mathbf{class} \ WHPrang \in \texttt{Prang}) = \texttt{Prang} + \texttt{Prang}
M2))
\rightarrow [simplify]
[23.2] (0 < this.$r.value(heapIs $heap_{funcstart\_1032,1}).p2) &&
(this.$r.value(heapIs heap_{funcstart\_1032,1}).p2 <
asType < integer > (\text{$heap.class WHPrang} \in M2))
\rightarrow [const static or extern object]
[23.3] (0 < this.$r.value(heapIs \rho_{funcstart\_1032,1}).p2) &&
(this.$r.value(heapIs heap_{funcstart\_1032,1}).p2 <
asType < integer > (\$heap_{init}.class WHPrang \in M2))
\rightarrow [expand definition of constant 'M2' at prang.cpp (33,26)]
[23.4] (0 < this.$r.value(heap
Is \rho_{uncstart\_1032,1}).p2) &&
(this.r.value(heapIs $heap_{funcstart\_1032.1}).p2 <
asType < integer > ((int)30307))
```

```
\rightarrow [simplify]
[23.10] (-30307 < -this.$r.value(heapIs $heap_{tuncstart\_1032.1}).p2) \land (0 <
this.r.value(heapIs $heap_{funcstart\_1032,1}).p2)
[Work on sub-term 2 of conjunction in term 23.10]
[24.0] 0 < this.$r.value(heapIs $heap_{funcstart\_1032.1}).p2
[Take given term]
[50.0] \; ((\$ heap_{funcstart\_1032,1}.r1 * \textbf{static\_cast} < \textbf{signed int} > (div1.rem)) \; - \;
($heap_funcstart_1032,1.b1 * static_cast<signed int>(div1.quot))) == temp1
\rightarrow [const static or extern object]
[50.1] (($heap<sub>init</sub>.rl * static_cast<signed int>(div1.rem)) -
(\text{\$heap}_{funcstart\_1032,1}.\text{b1 * static\_cast} < \text{signed int} > (\text{div1.quot}))) == \text{temp1}
\rightarrow [expand definition of constant 'r1' at prang.cpp (29,26)]
[50.2] (((int)171 * static_cast<signed int>(div1.rem)) -
(\text{sheap}_{funcstart\_1032,1}.\text{b1} * \text{static\_cast} < \text{signed int} > (\text{div1.quot}))) == \text{temp1}
\rightarrow [simplify]
[50.3] ((171 * static_cast < signed int > (div1.rem)) - ($heap_{funcstart\_1032,1}.b1]
* static_cast<signed int>(div1.quot))) == temp1
\rightarrow [from term 2.6, div1 is equal to div(heapIs $heap_{funcstart\_1032,1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177)
[50.4] ((171 * static_cast < signed int > (div(heapIs heapIs funcstart_{1032,1}),
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177).rem)) -
($heap_tuncstart_1032.1.b1 * static_cast<signed int>(div1.quot))) == temp1
\rightarrow [simplify]
[50.5] ((171 * \operatorname{div}(\mathbf{heapIs} \ \mathbf{sheap}_{funcstart\_1032,1}, \ \mathbf{this}.\mathbf{sr.value}(\mathbf{heapIs})
\text{Sheap}_{funcstart\_1032.1}.\text{p1}, 177).\text{rem} - (\text{Sheap}_{funcstart\_1032.1}.\text{b1} *
static_cast<signed int>(div1.quot))) == temp1
\rightarrow [const static or extern object]
[50.6] ((171 * \mathrm{div}(\mathbf{heapIs}\ \$\mathrm{heap}_{funcstart\_1032,1},\ \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}\ 
\theta_{uncstart\_1032,1}.p1, 177).rem – (\theta_{unit}.b1 * static\_cast < signed
int > (div1.quot))) == temp1
\rightarrow [expand definition of constant 'b1' at prang.cpp (31,26)]
[50.7] ((171 * div(heapIs heap_{funcstart_1032.1}, this.r.value(heapIs)
\theta_{tuncstart=1032,1}.p1, 177).rem) - ((int)2 * static_cast<signed)
int>(div1.quot))) == temp1
\rightarrow [simplify]
[50.8] ((171 * div(heapIs \$heap_{funcstart\_1032,1}, this.\$r.value(heapIs
\theta_{funcstart\_1032,1}.p1, 177).rem - (2 * static\_cast < signed)
```

```
int>(div1.quot)) = temp1
\rightarrow [from term 2.6, div1 is equal to div(heapIs $heap_{funcstart\_1032,1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177)]
[50.9] ((171 * div(heapIs $heap<sub>funcstart_1032,1</sub>, this.$r.value(heapIs)
\theta_{funcstart\_1032,1}.p1, 177).rem - (2 * static\_cast < signed)
int>(div(heapIs $heap_{tuncstart\_1032.1}, this.$r.value(heapIs
\text{Sheap}_{funcstart\_1032,1}).p1, 177).quot))) == temp1
\rightarrow [simplify]
[50.14] 0 == (-\text{temp1} + (-2 * \text{div}(\text{heapIs } \text{$heap}_{funcstart\_1032.1},
this.r.value(heapIs $heap_{funcstart\_1032,1}).p1, 177).quot) + (171 *
div(heapIs $heap<sub>funcstart_1032.1</sub>, this.$r.value(heapIs
heap_{funcstart_{-1032,1}}.p1, 177).rem
[Take given term]
[53.0] heap_{1032,1;1051,8} == heap_{funcstart\_1032,1}._replace(this.$r \rightarrow
operator*(heapIs heap_{funcstart\_1032,1}, this)._replace(p1 \rightarrow
asType < P1Type > ((\$heap_{funcstart\_1032,1}.M1 *
asType<int>(static_cast<integer>(static_cast<signed
int>(operator^*(heapIs $heap_{funcstart\_1032,1}, this).p1) < (int)0))) +
temp1)))
→ [expand definition of operator '*' in class 'pointer' at built in declaration]
[53.1] \theta_{1032,1;1051,8} == \theta_{1032,1;1051,8} = \theta_{1032,1;1051,8} == \theta
this.$r.value(heapIs heap_{funcstart\_1032.1})._replace(p1 \rightarrow
asType<P1Type>(($heap<sub>funcstart 1032.1</sub>.M1 *
asType<int>(static_cast<integer>(static_cast<signed
int>(operator^*(heapIs \$heap_{funcstart\_1032,1}, this).p1) < (int)0))) +
temp1)))
\rightarrow [const static or extern object]
[53.2] \rho_{1032,1;1051,8} == \rho_{1032,1;1051,8} = \rho_{1032,1;1051,8} == \rho
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow
asType < P1Type > ((\$heap_{init}.M1 *
asType < int > (static\_cast < integer > (static\_cast < signed
int>(operator^*(heapIs $heap_{funcstart\_1032,1}, this).p1) < (int)0))) +
temp1)))
→ [expand definition of constant 'M1' at prang.cpp (28,26)]
[53.3] heap_{1032,1;1051,8} == heap_{funcstart\_1032,1}._replace(this.$r \rightarrow
\textbf{this.}\$r.\textbf{value}(\textbf{heapIs}~\$heap_{funcstart\_1032,1}).\_\textbf{replace}(p1 \rightarrow
\mathbf{asType}{<}P1Type{>}(((\mathbf{int})30269 \ *
asType<int>(static_cast<integer>(static_cast<signed
\mathbf{int}{>}(\mathbf{operator}^*(\mathbf{heapIs}\ \$\mathbf{heap}_{funcstart\_1032,1},\ \mathbf{this}).\mathrm{p1})<(\mathbf{int})0)))+\\
temp1)))
```

```
\rightarrow [simplify]
[53.4] heap_{1032,1;1051,8} == heap_{funcstart\_1032,1}._replace(this.$r \rightarrow
\mathbf{this.\$r.value}(\mathbf{heapIs}~\$\mathbf{heap}_{funcstart\_1032,1}).\_\mathbf{replace}(\mathbf{p1}\rightarrow
asType<P1Type>((30269 *
asType < int > (static\_cast < integer > (static\_cast < signed)
int>(operator^*(heapIs \$heap_{funcstart\_1032,1}, this).p1) < (int)0))) +
temp1)))
→ [expand definition of operator '*' in class 'pointer' at built in declaration]
[53.5] heap_{1032,1;1051,8} == heap_{funcstart\_1032,1}._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow
asType<P1Type>((30269 *
asType < int > (static\_cast < integer > (static\_cast < signed)
int>(this.\$r.value(heapIs \$heap_{funcstart\_1032,1}).p1) < (int)0))) + temp1)))
\rightarrow [simplify]
[53.9] \theta_{1032,1;1051,8} == \theta_{funcstart\_1032,1}._replace(this.$r \to
this.$r.value(heapIs heap_{funcstart\_1032.1})._replace(p1 \rightarrow
\mathbf{asType} {<} \mathrm{P1Type} {>} ((30269 \ * \ \mathbf{asType} {<} \mathbf{int} {>} (\mathbf{static\_cast} {<} \mathbf{integer} {>} (0 <
-\mathbf{this.\$r.value}(\mathbf{heapIs}\ \$\mathrm{heap}_{funcstart\_1032,1}).\mathrm{p1}))) + \mathrm{temp1})))
\rightarrow [from term 8.0, literala < -this.$r.value(heapIs $heap_{funcstart\_1032,1}).p1
is false whenever -2 < (0 + literala)
    Proof of rule precondition:
    [53.9.0] - 2 < (0 + 0)
    \rightarrow [simplify]
    [53.9.2] true
[53.10] $\text{heap}_{1032,1:1051,8} == $\text{heap}_{funcstart\_1032,1}.$\text{-replace}(\text{this}.$\text{$r} \to \text{
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow
asType < P1Type > ((30269 * asType < int > (static_cast < integer > (false)))
+ \text{temp1})))
\rightarrow [simplify]
[53.11] $\text{heap}_{1032,1;1051,8} == \text{$heap}_{funcstart\_1032,1}.$\text{$_-\text{replace}(this.}$\text{$r} \to \text{$_-\text{$_-$}}
this.$r.value(heapIs $heap_{funcstart\_1032,1}).\_replace(p1 \rightarrow
asType<P1Type>((30269 * asType<int>(([false]: 1, []: 0))) + temp1)))
\rightarrow [explicitly assert falsehood of skipped guards in subsequent guards]
[53.12] $\text{heap}_{1032,1;1051,8} == $\text{heap}_{funcstart\_1032,1}._\text{replace}(\text{this}.$\text{$\frac{1}{2}}\)
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow
asType<P1Type>((30269 * asType<int>(([false]: 1, [true]: 0))) +
temp1)))
\rightarrow [simplify]
```

```
[53.15] $\text{heap}_{1032,1;1051,8} == $\text{heap}_{funcstart\_1032,1}.$\text{-replace}(\text{this}.$\text{$\frac{1}{2}}$
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow
asType < P1Type > (0 + temp1))
\rightarrow [from term 50.14, temp1 is equal to (-2 * div(heapIs $heap_{tuncstart\_1032.1},
this.r.value(heapIs \ \ heap_{funcstart\_1032.1}).p1, \ 177).quot) + (171 \ \ *
div(\mathbf{heapIs} \ \$heap_{funcstart\_1032,1}, \ \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
heap_{funcstart_{1032.1}}.p1, 177).rem
[53.16] $heap<sub>1032,1;1051,8</sub> == $heap<sub>funcstart_1032,1</sub>._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow
asType < P1Type > (0 + ((-2 * div(heapIs $heap_{tuncstart 1032.1},
\mathbf{this.\$r.value(heapIs}\ \$heap_{funcstart\_1032,1}).p1,\ 177).quot) + (171\ *
div(\mathbf{heapIs} \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
heap_{funcstart\_1032,1}.p1, 177.rem))))
\rightarrow [simplify]
[53.19] $heap<sub>1032,1;1051,8</sub> == $heap<sub>funcstart_1032,1</sub>._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\$heap_{funcstart\_1032,1},\, \textbf{this}.\$r.\textbf{value}(\textbf{heapIs}\,\,\$heap_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
heap_{funcstart_{1032,1}}.p1, 177).rem)))
[Take goal term]
[1.0] ($heap<sub>1032,1:1051,8</sub>.r2 * static_cast<signed int>(div2.rem)) \leq
maxof(signed int)
\rightarrow [from term 53.19, $heap<sub>1032,1;1051,8</sub> is equal to
$heap_{funcstart\_1032,1}$.$replace(this.$r \rightarrow this.$r.value(heapIs)
heap_{funcstart\_1032,1}._replace(p1 \rightarrow (-2 * div(heapIs heap_{funcstart\_1032,1}),
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177).quot) + (171 *
div(\mathbf{heapIs}\ \$heap_{funcstart\_1032,1},\ \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}
heap_{funcstart_{1032.1}}.p1, 177).rem)))
[1.1] (\text{heap}_{funcstart\_1032,1}._replace(this.\text{r} \to \text{this}.\text{r.value}(\text{heapIs})
\rho_{tuncstart\_1032.1}._replace(p1 \rightarrow ((-2 * div(heapIs \rho_{tuncstart\_1032.1})
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177).quot) + (171 *
div(\mathbf{heapIs} \$ heap_{funcstart\_1032.1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
\label{eq:cast_signed} $$ \hat{p}_{funcstart\_1032,1}.p1,\ 177).rem))).r2** static\_cast < signed
int>(div2.rem) < maxof(signed int)
\rightarrow [const member of object with modified fields]
[1.2] (\rho_{tart_1032,1}.r2 * static_cast < signed int > (div2.rem)) \leq
maxof(signed int)
\rightarrow [const static or extern object]
[1.3] ($heap<sub>init.</sub>r2 * static_cast<signed int>(div2.rem)) \le maxof(signed
int)
```

```
\rightarrow [expand definition of constant 'r2' at prang.cpp (34,26)]
[1.4] ((int)172 * static_cast<signed int>(div2.rem)) \leq maxof(signed int)
\rightarrow [simplify]
[1.5] (172 * static_cast<signed int>(div2.rem)) \leq maxof(signed int)
\rightarrow [from term 18.6, div2 is equal to div(heapIs $heap_{funcstart\_1032,1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p2, 176)]
[1.6] (172 * static_cast<signed int>(div(heapIs \rho_{funcstart\_1032,1}),
this.$r.value(heapIs heap_{funcstart\_1032,1}).p2, 176).rem)) \leq maxof(signed)
int)
\rightarrow [simplify]
[1.17] -32768 < (-172 * div(heapIs \$heap_{funcstart\_1032,1}, this.\$r.value(heapIs))
heap_{funcstart\_1032,1}.p2, 176).rem
\rightarrow [literal comparison of product]
[1.18] ([-172 < 0]: (-32768 / 172) < -\text{div}(\mathbf{heapIs} \ \text{\$} \text{heap}_{funcstart\_1032,1},
this.$r.value(heapIs \theta_{funcstart=1032,1}).p2, 176).rem, [0 < -172]: (-32768 /
-172) < div(heapIs \$heap_{funcstart\_1032,1}, this.\$r.value(heapIs)
\text{Sheap}_{funcstart\_1032.1}.p2, 176).rem, [-172 == 0]: -32768 < 0)
→ [explicitly assert falsehood of skipped guards in subsequent guards]
[1.19] ([-172 < 0]: (-32768 / 172) < -\text{div}(\mathbf{heapIs} \ \text{\$} \text{heap}_{funcstart\_1032,1},
this.$r.value(heapIs $heap_{funcstart\_1032,1}).p2, 176).rem, [(0 < -172) \land !(-172
< 0): (-32768 / -172) < div(heapIs $heap_{funcstart\_1032.1},
this.$r.value(heapIs heap_{funcstart\_1032,1}).p2, 176).rem, [(-172 == 0) \land
!(-172 < 0) \land !(0 < -172)]: -32768 < 0)
\rightarrow [simplify]
\theta_{funcstart\_1032,1}.p2, 176).rem
\rightarrow [negate goal and search for contradiction]
[1.24] ! (-191 < -\text{div}(\textbf{heapIs} \$ \text{heap}_{funcstart\_1032,1}, \, \textbf{this}.\$ \text{r.value}(\textbf{heapIs})) 
heap_{funcstart\_1032,1}.p2, 176).rem
\rightarrow [simplify]
[1.27] 190 < div(heapIs heap_{funcstart\_1032,1}, this.r.value(heapIs)
heap_{funcstart_{1032,1}}.p2, 176.rem
[Assume known post-assertion, class invariant or type constraint for term 18.6]
[26.0] (as
Type<integer>(this.$r.value(heap
Is \rho_{uncstart\_1032,1}).p2) \%
asType<integer>(176)) == asType<integer>(div(heapIs
\rho_{tuncstart\_1032.1}, this.r.value(heapIs \rho_{tuncstart\_1032.1}).p2,
176).rem)
```

```
\rightarrow [simplify]
[26.2] (this.$r.value(heapIs $heap_{funcstart\_1032,1}).p2 % 176) ==
asType<integer>(div(heapIs $heap_funcstart_1032.1, this.$r.value(heapIs
heap_{funcstart\_1032,1}.p2, 176).rem
→ [expand definition of operator '.%' in class 'int' at built in declaration]
{\it [26.3]}~([{\bf asType}{<}{\bf integer}{>}({\bf this.\$r.value}({\bf heapIs}~\${\bf heap}_{funcstart\_1032,1}).{\bf p2})<
176), \parallel: asType<integer>(this.$r.value(heapIs $heap_{funcstart\_1032,1}).p2)
\% 176) == asType<integer>(div(heapIs $heap<sub>funcstart_1032,1</sub>,
this.r.value(heapIs $heap_{funcstart\_1032,1}).p2, 176).rem)
→ [explicitly assert falsehood of skipped guards in subsequent guards]
[26.4] ([asType<integer>(this.$r.value(heapIs $heap_{funcstart\_1032.1}).p2) <
0]: -(-asType < integer > (this.\$r.value(heapIs \$heap_{funcstart\_1032,1}).p2) \%
176), [!(asType<integer>(this.$r.value(heapIs \rho_{tuncstart\_1032,1}).p2) <
0)]: asType<integer>(this.$r.value(heapIs $heap_{tuncstart\_1032.1}).p2) %
176) == asType<integer>(div(heapIs $heap_{tuncstart\_1032.1},
this.r.value(heapIs $heap_{funcstart\_1032.1}).p2, 176).rem)
\rightarrow [simplify]
[26.7] ([0 < -this.$r.value(heapIs \rho_{tuncstart\_1032,1}).p2]:
-(-\mathbf{asType}{<}\mathbf{integer}{>}(\mathbf{this.\$r.value}(\mathbf{heapIs}~\$\mathbf{heap}_{funcstart\_1032,1}).\mathbf{p2})~\%
176), [!(asType<integer>(this.r.value(heapIs \heap_{funcstart\_1032,1}).p2) <
0)]: asType<integer>(this.$r.value(heapIs \theta_{tuncstart\_1032.1}).p2) %
176) == asType<integer>(div(heapIs heap_{funcstart\_1032,1},
\mathbf{this.\$r.value(heapIs}\ \$heap_{funcstart\_1032,1}).p2,\ 176).rem)
\rightarrow [from term 24.0, literala < -this.$r.value(heapIs $heap_{funcstart\_1032,1}).p2
is false whenever -2 < (0 + literala)
   Proof of rule precondition:
   [26.7.0] - 2 < (0 + 0)
   \rightarrow [simplify]
   [26.7.2] true
[26.8] ([false]: -(-asType<integer>(this.$r.value(heapIs
\rho_{uncstart\_1032,1}.p2 < 0: asType<integer>(this.$r.value(heapIs)
\text{Sheap}_{funcstart\_1032,1}.p2) % 176) == asType<integer>(div(heapIs)
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p2,
176).rem)
\rightarrow [simplify]
[26.11] ([false]: -(-asType<integer>(this.$r.value(heapIs
\theta_{funcstart\_1032,1}.p2) % 176), [!\theta_{funcstart\_1032,1}.p2) % 176),
```

```
\rho_{funcstart_{-1032,1}}.p2): asType<integer>(this.$r.value(heapIs)
\$heap_{funcstart\_1032,1}).p2)~\%~176) == \mathbf{asType} < \mathbf{integer} > (\mathrm{div}(\mathbf{heapIs}
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p2,
176).rem)
\rightarrow [from term 24.0, literala < -this.$r.value(heapIs $heap_{funcstart\_1032.1}).p2
is false whenever -2 < (0 + literala)
         Proof of rule precondition:
         [26.11.0] - 2 < (0 + 0)
         \rightarrow [simplify]
         [26.11.2] true
 [26.12] ([false]: -(-asType<integer>(this.$r.value(heapIs
heap_{funcstart\_1032,1}.p2) \% 176, [!false]:
asType<integer>(this.$r.value(heapIs $heap_{tuncstart\_1032.1}).p2) % 176)
== asType < integer > (div(heapIs $heap_{funcstart\_1032,1},
this.r.value(heapIs $heap_{funcstart\_1032,1}).p2, 176).rem)
\rightarrow [simplify]
[26.17] \ 0 == (-\text{div}(\textbf{heapIs} \ \$ \text{heap}_{funcstart\_1032,1}, \ \textbf{this}.\$ \textbf{r.value}(\textbf{heapIs} \ \texttt{heap}_{funcstart\_1032,1}, \ \textbf{this}.\$ \textbf{r.value}))
\theta_{funcstart\_1032,1}.p2, 176).rem + (this.\$r.value(heapIs)
heap_{funcstart_{1032,1}}.p2 \% 176)
\rightarrow [remainder is less than divisor]
         Proof of rule precondition:
          [26.17.0] (176 + -\text{div}(\text{heapIs }\text{\$heap}_{funcstart\_1032,1}, \text{this.}\text{\$r.value}(\text{heapIs})
         \text{$heap}_{funcstart\_1032,1}.p2, 176).rem) \leq 0
         \rightarrow [simplify]
          \label{eq:continuous} \textit{[26.17.11]} \ 175 < \mathrm{div}(\mathbf{heapIs} \ \$ \mathrm{heap}_{funcstart\_1032,1}, \ \mathbf{this.\$r.value}(\mathbf{heapIs} \ \texttt{heap}_{funcstart\_1032,1}, \ \mathbf{this.\$r.value}(\mathbf{heap}_{funcstart\_1032,1}, \ \mathbf{this.\$r.value}(\mathbf{heap}_{funcst
         heap_{funcstart\_1032,1}.p2, 176).rem
         \rightarrow [from term 1.27, literala < div(heapIs $heap_{funcstart\_1032,1},
         this.$r.value(heapIs $heap_{funcstart\_1032,1}).p2, 176).rem is true whenever
         (-1 + literala) < 190
                   Proof of rule precondition:
                   [26.17.11.0](-1+175) < 190
                   \rightarrow [simplify]
                   [26.17.11.2] true
         [26.17.12] true
[26.18] false
```

Proof of verification condition: Arithmetic result of operator '*' is within

```
limit of type 'signed int'
In the context of class: WHPrang, declared at:
C:\Escher\Customers\prang-cpp\prang.cpp (18,1)
Condition generated at: C:\Escher\Customers\prang-cpp\prang.cpp
(77,57)
Condition defined at:
To prove: minof(signed\ int) \le (\$heap_{1032,1;1051,8}.b2 * static\_cast < signed
int>(div2.quot))
Given:
heap_{init}.LIMIT == (int)80
heap_{init}.class WHPrang \in M1 == (int)30269
heap_{init}.class WHPrang \in r1 == (int)171
heap_{init}.class WHPrang \in a1 == (int)177
heap_{init}.class WHPrang \in b1 == (int)2
heap_{init}.class WHPrang \in M2 == (int)30307
heap_{init}.class WHPrang \in r2 == (int)172
heap_{init}.class WHPrang \in a2 == (int)176
heap_{init}.class WHPrang \in b2 == (int)35
heap_{init}.class WHPrang \in M3 == (int)30323
heap_{init}.class WHPrang \in r3 == (int)170
heap_{init}.class WHPrang \in a3 == (int)178
heap_{init}.class WHPrang \in b3 == (int)63
\operatorname{div1} == \operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_1032,1},
\mathbf{static\_cast} < \mathbf{int} > (\mathbf{operator*}(\mathbf{heapIs} \ \$ \mathbf{heap}_{funcstart\_1032,1}, \ \mathbf{this}).\mathtt{p1}),
static\_cast < int > (\$heap_{funcstart\_1032,1}.a1))
(asType < integer > (static\_cast < int > (operator*(heapIs)))
heap_{funcstart\_1032,1}, this).p1) /
asType < integer > (static\_cast < int > (\$heap_{funcstart\_1032,1}.a1))) = =
asType<integer>(div1.quot)
(asType<integer>(static_cast<int>(operator*(heapIs
heap_{funcstart\_1032,1}, this).p1) %
asType < integer > (static\_cast < int > (\$heap_{funcstart\_1032.1}.a1))) = =
asType<integer>(div1.rem)
(\mathbf{asType}{<}\mathbf{integer}{>}(\mathbf{operator}^*(\mathbf{heapIs}\ \$\mathbf{heap}_{funcstart\_1032,1},\ \mathbf{this}).\mathtt{p1}) <
asType < integer > (\$heap_{funcstart\_1032,1}.a1)) = >
```

(asType<integer>(div1.rem) == asType<integer>(operator*(heapIs

```
heap_{funcstart_1032,1}, this).p1)
(asType < integer > (\$heap_{funcstart\_1032,1}.a1) \le
asType<integer>(operator*(heapIs $heap_{funcstart\_1032,1}, this).p1)) =>
!(0 == asType < integer > (div1.quot))
!(0 == asType < integer > (div1.rem)) || !(0 ==
asType<integer>(div1.quot))
div2 == div(\mathbf{heapIs} \$heap_{funcstart\_1032,1},
\mathbf{static\_cast} < \mathbf{int} > (\mathbf{operator}^*(\mathbf{heapIs}\ \$ \mathbf{heap}_{funcstart\_1032,1},\ \mathbf{this}).\mathbf{p2}),
\mathbf{static\_cast}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_1032,1}.\mathrm{a2}))
(asType<integer>(static_cast<int>(operator*(heapIs
heap_{funcstart_1032.1}, this).p2)
\mathbf{asType} < \mathbf{integer} > (\mathbf{static\_cast} < \mathbf{int} > (\$ \mathbf{heap}_{funcstart\_1032,1}.\mathbf{a2}))) = =
asType<integer>(div2.quot)
(asType < integer > (static\_cast < int > (operator*(heapIs
heap_{funcstart\_1032.1}, this).p2)
asType < integer > (static\_cast < int > (\$heap_{funcstart\_1032,1}.a2))) = =
asType<integer>(div2.rem)
(\mathbf{asType}{<}\mathbf{integer}{>}(\mathbf{operator}^*(\mathbf{heapIs}\ \$\mathbf{heap}_{funcstart\_1032,1},\ \mathbf{this}).\mathtt{p2}) <
asType < integer > (\$heap_{funcstart\_1032,1}.a2)) = >
(asType < integer > (div2.rem) == asType < integer > (operator*(heapIs))
heap_{funcstart\ 1032.1}, this).p2)
(\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathrm{heap}_{funcstart\_1032,1}.a2) \leq
asType<integer>(operator*(heapIs $heap_{tuncstart\_1032,1}, this).p2)) =>
!(0 == asType < integer > (div2.quot))
!(0 == asType < integer > (div2.rem)) || !(0 ==
asType<integer>(div2.quot))
div3 == div(\mathbf{heapIs} \$ heap_{funcstart\_1032,1},
static\_cast < int > (operator*(heapIs $heap_{funcstart\_1032,1}, this).p3),
\mathbf{static\_cast} < \mathbf{int} > (\$ \mathbf{heap}_{funcstart\_1032,1}.\mathbf{a3}))
(asType<integer>(static_cast<int>(operator*(heapIs
heap_{funcstart\_1032,1}, this).p3) /
asType < integer > (static\_cast < int > (\$heap_{funcstart\_1032,1}.a3))) = =
asType<integer>(div3.quot)
(asType<integer>(static_cast<int>(operator*(heapIs
\theta_{funcstart\_1032,1}, this).p3)) %
asType < integer > (static\_cast < int > (\$heap_{funcstart\_1032,1}.a3))) = =
asType<integer>(div3.rem)
(\mathbf{asType}{<}\mathbf{integer}{>}(\mathbf{operator}^*(\mathbf{heapIs}\ \$\mathbf{heap}_{funcstart\_1032,1},\ \mathbf{this}).\mathrm{p3}) <
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathrm{heap}_{funcstart\_1032,1}.\mathrm{a3})) =>
(asType<integer>(div3.rem) == asType<integer>(operator*(heapIs
heap_{funcstart\_1032,1}, this).p3)
```

```
(asType < integer > (\$heap_{funcstart\_1032,1}.a3) \le
asType < integer > (operator*(heapIs $heap_{funcstart\_1032,1}, this).p3)) = >
!(0 == asType < integer > (div3.quot))
!(0 == asType < integer > (div3.rem)) || !(0 ==
asType<integer>(div3.quot))
temp1 == (\$heap_{funcstart\_1032,1}.r1 * static\_cast < signed int > (div1.rem)) -
($heap_funcstart_1032,1.b1 * static_cast<signed int>(div1.quot))
minof(signed\ int) \le temp1
temp1 < maxof(signed int)
heap_{1032,1;1051,8} == heap_{funcstart\_1032,1}._replace(this.r \rightarrow replace)
operator*(heapIs heap_{funcstart\_1032,1}, this)._replace(p1 \rightarrow
asType<P1Type>(($heap<sub>funcstart_1032,1</sub>.M1 *
asType<int>(static_cast<integer>(static_cast<signed
int>(operator^*(heapIs \$heap_{funcstart\_1032,1}, this).p1) < (int)0))) +
temp1)))
Proof:
[Take given term]
[2.0] div1 == div(heapIs $heap<sub>funcstart_1032,1</sub>,
static\_cast < int > (operator^*(heapIs \$heap_{funcstart\_1032,1}, this).p1),
\mathbf{static\_cast}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_1032,1}.\mathrm{a1}))
\rightarrow [expand definition of operator '*' in class 'pointer' at built in declaration]
[2.1] \operatorname{div1} == \operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_1032,1},
\mathbf{static\_cast} < \mathbf{int} > (\mathbf{this.\$r.value}(\mathbf{heapIs} \ \$ \mathbf{heap}_{funcstart\_1032,1}).\mathbf{p1}),
static\_cast < int > (\$heap_{funcstart\_1032.1}.a1))
\rightarrow [simplify]
[2.2] \operatorname{div1} == \operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_1032,1}, \mathbf{this}.\$ r. \mathbf{value}(\mathbf{heapIs}))
\theta_{funcstart\_1032,1}.p1, \theta_{funcstart\_1032,1}.p1, \theta_{funcstart\_1032,1}.a1))
\rightarrow [const static or extern object]
[2.3] div1 == div(\mathbf{heapIs} \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
\theta_{init}.a1).p1, \theta_{init}.a1
\rightarrow [expand definition of constant 'a1' at prang.cpp (30,26)]
[2.4]~{\rm div1} == {\rm div}(\mathbf{heapIs}~\$ \mathrm{heap}_{funcstart\_1032,1},~\mathbf{this}.\$ \mathrm{r.value}(\mathbf{heapIs}
\theta_{funcstart\_1032,1}.p1, \theta_{funcstart\_1032,1}.p2, \theta_{funcstart\_1032,1}.p2, \theta_{funcstart\_1032,1}.p2, \theta_{funcstart\_1032,1}.p2, \theta_{funcstart\_1032,1}.p2, \theta_{funcstart\_1032,1}.p3, \theta_{funcstart\_1032,1}.p4, \theta_{funcstart\_1032,1}.p4, \theta_{funcstart\_1032,1}.p4, \theta_{funcstart\_1032,1}.p5, \theta_{funcstart\_1032,1
\rightarrow [simplify]
[2.6] \operatorname{div1} == \operatorname{div}(\mathbf{heapIs} \ \hat{\mathbf{s}}_{heap}_{funcstart\_1032,1}, \ \mathbf{this.\$r.value}(\mathbf{heapIs})
heap_{funcstart_{-1032,1}}.p1, 177
[Assume known post-assertion, class invariant or type constraint for term 2.6]
```

```
[7.0] (0 < asType<integer>(this.\$r.value(heapIs
\label{eq:continuous} $\operatorname{heap}_{funcstart\_1032,1}).p1)) \&\& (\mathbf{asType} < \mathbf{integer} > (\mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}))) \&\& (\mathbf{asType} < \mathbf{integer} > (\mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})))) \&\& (\mathbf{asType} < \mathbf{integer} > (\mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}))))) \&\& (\mathbf{asType} < \mathbf{integer} > (\mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})))) \&\& (\mathbf{asType} < \mathbf{integer} > (\mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}))))) \&\& (\mathbf{asType} < \mathbf{integer} > (\mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})))))) \&\& (\mathbf{asType} < \mathbf{integer} > (\mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})))))) \&\& (\mathbf{asType} < \mathbf{integer} > (\mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})))))))))
\text{Sheap}_{funcstart\_1032,1}.\text{p1}) < \text{asType} < \text{integer} > (\text{Sheap.class WHPrang} \in
M1))
\rightarrow [simplify]
[7.2] (0 < this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1) \&\&
(this.r.value(heapIs $heap_{funcstart\_1032,1}).p1 <
asType < integer > (\text{$heap.class WHPrang} \in M1))
\rightarrow [const static or extern object]
[7.3] (0 < this.$r.value(heap
Is $heap_{funcstart\_1032,1}).p1) &&
(this.r.value(heapIs $heap_{funcstart\_1032.1}).p1 <
asType < integer > (\$heap_{init}.class WHPrang \in M1))
\rightarrow [expand definition of constant 'M1' at prang.cpp (28,26)]
[7.4] (0 < this.$r.value(heapIs $heap_{funcstart\_1032,1}).p1) &&
(this.r.value(heapIs $heap_{funcstart\_1032,1}).p1 <
asType < integer > ((int)30269))
\rightarrow [simplify]
[7.10] (-30269 < -this.$r.value(heapIs heap_{funcstart\_1032,1}).p1) \land (0 <
this.r.value(heapIs $heap_{funcstart\_1032,1}).p1)
[Work on sub-term 2 of conjunction in term 7.10]
[8.0] 0 < this.$r.value(heapIs \rho_{funcstart\_1032,1}).p1
[Take given term]
[18.0] \operatorname{div2} == \operatorname{div}(\mathbf{heapIs} \ \operatorname{\$heap}_{funcstart\_1032,1},
static_cast<int>(operator*(heapIs $heap_{funcstart\_1032,1}, this).p2),
static\_cast < int > (\$heap_{funcstart\_1032,1}.a2))
→ [expand definition of operator '*' in class 'pointer' at built in declaration]
[18.1] \operatorname{div2} == \operatorname{div}(\mathbf{heapIs} \ \operatorname{heap}_{funcstart\_1032.1},
static_cast<int>(this.$r.value(heapIs $heap_{funcstart\_1032,1}).p2),
\mathbf{static\_cast}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_1032,1}.\mathrm{a2}))
\rightarrow [simplify]
[18.2] \text{div2} == \text{div}(\mathbf{heapIs} \text{\$heap}_{funcstart\_1032,1}, \mathbf{this}.\text{\$r.value}(\mathbf{heapIs})
\theta_{funcstart\_1032,1}.p2, \theta_{funcstart\_1032,1}.p2, \theta_{funcstart\_1032,1}.a2))
\rightarrow [const static or extern object]
[18.3] \operatorname{div2} == \operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_1032,1}, \ \mathbf{this}.\$ \mathbf{r.value}(\mathbf{heapIs})
\theta_{nit}.a2).p2, \theta_{nit}.a2
\rightarrow [expand definition of constant 'a2' at prang.cpp (35,26)]
[18.4] div2 == div(heapIs $heap_{tuncstart\_1032.1}, this.$r.value(heapIs)
```

```
\theta_{funcstart\_1032,1}.p2, \theta_{funcstart\_1032,1}.p2, \theta_{funcstart\_1032,1}.p2, \theta_{funcstart\_1032,1}.p2
\rightarrow [simplify]
[18.6] div2 == div(heapIs $heap_{funcstart\_1032,1}, this.$r.value(heapIs)
heap_{funcstart_{1032,1}}.p2, 176
[Assume known post-assertion, class invariant or type constraint for term 18.6]
[23.0] (0 < asType<integer>(this.$r.value(heapIs)
\label{eq:loss_funcstart_1032,1} $$ \operatorname{heap}_{funcstart_1032,1}.p2)) \&\& (asType < integer > (this.\$r.value(heapIs)) \\
\rho_{tuncstart\_1032.1},p2) < asType<integer>(\rho_{tuncstart\_1032.1}).p2) < asType<integer>(\rho_{tuncstart\_1032.1}).p2)
M2))
\rightarrow [simplify]
[23.2] (0 < this.$r.value(heap
Is $heap_{funcstart\_1032,1}).p2) &&
(this.$r.value(heapIs heap_{funcstart\_1032,1}).p2 <
asType < integer > (\text{$heap.class WHPrang} \in M2))
\rightarrow [const static or extern object]
[23.3] (0 < this.\$r.value(heapIs \$heap_{funcstart_1032.1}).p2) &&
(this.r.value(heapIs $heap_{funcstart\_1032,1}).p2 <
asType < integer > (\text{$heap}_{init}.class WHPrang \in M2))
\rightarrow [expand definition of constant 'M2' at prang.cpp (33,26)]
[23.4] (0 < this.$r.value(heapIs $heap_{funcstart\_1032,1}).p2) &&
(this.r.value(heapIs $heap_{funcstart\_1032,1}).p2 <
asType < integer > ((int)30307))
\rightarrow [simplify]
[23.10] (-30307 < -this.$r.value(heapIs $heap_{funcstart\_1032.1}).p2) \land (0 <
this.r.value(heapIs $heap_{funcstart\_1032,1}).p2)
[Work on sub-term 2 of conjunction in term 23.10]
[24.0] 0 < this.$r.value(heapIs $heap_{funcstart\_1032.1}).p2
[Assume known post-assertion, class invariant or type constraint for term 18.6]
[25.0] (asType<integer>(this.$r.value(heapIs $heap_{funcstart\_1032,1}).p2) /
asType<integer>(176)) == asType<integer>(div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p2,
176).quot)
\rightarrow [simplify]
[25.2] (this.$r.value(heapIs heap_{funcstart\_1032,1}).p2 / 176) ==
\mathbf{asType}{<}\mathbf{integer}{>}(\mathbf{div}(\mathbf{heapIs}\ \$\mathbf{heap}_{funcstart\_1032,1},\ \mathbf{this.}\$\mathbf{r.value}(\mathbf{heapIs}\ \mathbf{heapIs})
heap_{funcstart_{1032,1}}.p2, 176).quot
→ [expand definition of operator './' in class 'int' at built in declaration]
[25.3] ([asType<integer>(this.$r.value(heapIs $heap_{funcstart\_1032.1}).p2) <
```

```
0]: -(-asType < integer > (this.\$r.value(heapIs \$heap_{funcstart\_1032,1}).p2) /
176), \parallel: asType<integer>(this.$r.value(heapIs $heap_{funcstart\_1032,1}).p2) /
176) == asType<integer>(div(heapIs heap_{funcstart\_1032,1})
this.r.value(heapIs \$heap_{funcstart\_1032,1}).p2, 176).quot)
→ [explicitly assert falsehood of skipped guards in subsequent guards]
[25.4] \; ([\mathbf{asType} < \mathbf{integer} > (\mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs} \; \$ \mathbf{heap}_{funcstart\_1032,1}).\mathbf{p2}) < \mathbf{p25.4}) 
0]: -(-asType < integer > (this. r.value(heapIs  heap_{funcstart\_1032,1}).p2) / (this. r.value(heapIs  heap_{funcstart\_1032,1}).p2)
176), [!(asType<integer>(this.$r.value(heapIs $heap_{funcstart\_1032.1}).p2) <
0)]: asType < integer > (this. r.value(heapIs  heap_{funcstart\_1032,1}).p2) / 
176) == asType<integer>(div(heapIs $heap_{tuncstart 1032.1},
this.$r.value(heapIs \theta_{funcstart\_1032,1}).p2, 176).quot)
\rightarrow [simplify]
[25.7] ([0 < -this.$r.value(heapIs $heap<sub>funcstart_1032,1</sub>).p2]:
-(-asType < integer > (this. r.value(heapIs  heap_{funcstart\_1032.1}).p2) /
176), [!(asType<integer>(this.$r.value(heapIs $heap_{tuncstart\_1032,1}).p2) <
0)]: \mathbf{asType} < \mathbf{integer} > (\mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}\ \$\mathbf{heap}_{funcstart\_1032,1}).\mathbf{p2})\ /
176) == asType<integer>(div(heapIs heap_{funcstart\_1032,1},
\mathbf{this.\$r.value}(\mathbf{heapIs}~\$ \mathrm{heap}_{funcstart\_1032,1}).\mathrm{p2},~176).\mathrm{quot})
\rightarrow [from term 24.0, literala < -this.$r.value(heapIs $heap_{funcstart\_1032.1}).p2
is false whenever -2 < (0 + literala)
        Proof of rule precondition:
        [25.7.0] - 2 < (0 + 0)
        \rightarrow [simplify]
        [25.7.2] true
[25.8] ([false]: -(-asType<integer>(this.$r.value(heapIs
$heap_funcstart_1032,1).p2) / 176), [!(asType<integer>(this.$r.value(heapIs
\label{eq:funcstart_1032,1} $$ \operatorname{heap}_{funcstart_1032,1}).p2) < 0)$ ]: $$ \mathbf{asType} < \mathbf{integer} > (\mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})).p2) < 0)$ ]: $$ $$ \mathbf{asType} < \mathbf{integer} > (\mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})).p2) < 0)$ ] $$ $$ \mathbf{asType} < \mathbf{integer} > (\mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})).p2) < 0)$ ] $$ $$ \mathbf{asType} < \mathbf{integer} > (\mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})).p2) < 0)$ ] $$ \mathbf{asType} < \mathbf{integer} > (\mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})).p2) < 0)$ ] $$ \mathbf{asType} < \mathbf{integer} > (\mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})).p2) < 0)$ ] $$ \mathbf{asType} < \mathbf{integer} > (\mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})).p2)$ ] $$ \mathbf{asType} < \mathbf{integer} > (\mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})).p3)$ ] $$ \mathbf{asType} < \mathbf{integer} > (\mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})).p3)$ ] $$ \mathbf{asType} < \mathbf{integer} > (\mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})).p4)$ ] $$ \mathbf{asType} < \mathbf{integer} > 
\theta_{funcstart=1032.1}.p2 / 176) == asType<integer>(div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p2,
176).quot)
\rightarrow [simplify]
[25.11] ([false]: -(-asType < integer > (this. r.value(heapIs))
\theta_{funcstart\_1032,1}.p2) / 176, [!\theta_{funcstart\_1032,1}.p2] / 176), [!\theta_{funcstart\_1032,1}.p2]
\rho_{uncstart_1032,1}.p2): asType<integer>(this.$r.value(heapIs)
\theta_{funcstart\_1032,1}.p2) / 176 = asType < integer > (div(heapIs))
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p2,
176).quot)
\rightarrow [from term 24.0, literala < -this.$r.value(heapIs $heap_{funcstart\_1032,1}).p2
is false whenever -2 < (0 + literala)
```

Proof of rule precondition:

```
[25.11.0] - 2 < (0 + 0)
   \rightarrow [simplify]
   [25.11.2] true
[25.12] ([false]: -(-asType < integer > (this. r.value(heapIs))
\frac{\text{sheap}_{funcstart\_1032,1}.p2}{176}, [!false]:
asType<integer>(this.r.value(heapIs \ heap_{funcstart\_1032,1}).p2) / 176)
== asType<integer>(div(heapIs $heap_{funcstart\_1032,1},
this.r.value(heapIs $heap_{funcstart\_1032,1}).p2, 176).quot)
\rightarrow [simplify]
[25.17] 0 == (-div(heapIs \theta_{funcstart\_1032,1}, this.r.value(heapIs)
\theta_{funcstart\_1032,1}.p2, 176.quot + (this.r.value(heapIs)
heap_{funcstart_{1032,1}}.p2 / 176)
[Take given term]
[50.0] (($heap_{tuncstart\_1032,1}.r1 * static_cast<signed int>(div1.rem)) -
(\text{sheap}_{funcstart\_1032,1}.\text{b1} * \text{static\_cast} < \text{signed int} > (\text{div1.quot}))) == \text{temp1}
\rightarrow [const static or extern object]
[50.1] ((\theta_{init}.r1 * static_cast<signed int>(div1.rem)) -
(\$heap_{funcstart\_1032,1}.b1 * \textbf{static\_cast} < \textbf{signed int} > (div1.quot))) == temp1
\rightarrow [expand definition of constant 'r1' at prang.cpp (29,26)]
[50.2]\;(((\mathbf{int})171\;*\;\mathbf{static\_cast}{<}\mathbf{signed}\;\mathbf{int}{>}(\mathrm{div}1.\mathrm{rem}))\;-
(\text{sheap}_{funcstart\_1032.1}.\text{b1 * static\_cast} < \text{signed int} > (\text{div1.quot}))) == \text{temp1}
\rightarrow [simplify]
[50.3] ((171 * static_cast < signed int > (div1.rem)) - ($heap_{funcstart\_1032.1}.b1
* static_cast<signed int>(div1.quot))) == temp1
\rightarrow [from term 2.6, div1 is equal to div(heapIs $heap_{funcstart\_1032,1},
this.r.value(heapIs $heap_{funcstart\_1032,1}).p1, 177)]
[50.4] ((171 * static_cast<signed int>(div(heapIs $heap_{funcstart\_1032,1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177).rem)) -
($heap_tuncstart_1032.1.b1 * static_cast<signed int>(div1.quot))) == temp1
\rightarrow [simplify]
[50.5] ((171 * div(heapIs $heap_{funcstart\_1032,1}, this.$r.value(heapIs
\text{Sheap}_{funcstart\_1032.1}.p1, 177).rem) - (\text{Sheap}_{funcstart\_1032.1}.b1 *
static_cast<signed int>(div1.quot))) == temp1
\rightarrow [const static or extern object]
[50.6] ((171 * \mathrm{div}(\mathbf{heapIs}\ \$\mathrm{heap}_{funcstart\_1032,1},\ \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}
\rho_{uncstart\_1032.1}.p1, 177.rem) - (\rho_{uncstart\_1032.1}).p1, 177.rem) - (\rho_{uncstart\_1032.1}).p1, 177.rem)
int>(div1.quot)) = temp1
```

```
\rightarrow [expand definition of constant 'b1' at prang.cpp (31,26)]
[50.7] ((171 * div(heapIs $heap<sub>funcstart_1032.1</sub>, this.$r.value(heapIs
\theta_{funcstart\_1032,1}.p1, 177).rem - ((int)2 * static\_cast < signed
int>(div1.quot))) == temp1
\rightarrow [simplify]
[50.8] ((171 * div(heapIs $heap_{funcstart\_1032,1}, this.$r.value(heapIs 
\theta_{funcstart\_1032,1}.p1, 177).rem – (2 * static_cast<signed)
int>(div1.quot)) == temp1
\rightarrow [from term 2.6, div1 is equal to div(heapIs $heap_{funcstart\_1032,1},
this.$r.value(heapIs $heap_{funcstart\_1032,1}).p1, 177)]
[50.9] ((171 * div(heapIs \$heap_{funcstart\_1032,1}, this.\$r.value(heapIs
\theta_{funcstart\_1032,1}.p1, 177).rem) - (2 * static_cast<signed
int>(div(heapIs \$heap_{funcstart\_1032,1}, this.\$r.value(heapIs
\text{Sheap}_{funcstart\_1032,1}.\text{p1}, 177).\text{quot}))) == \text{temp1}
\rightarrow [simplify]
[50.14] 0 == (-\text{temp1} + (-2 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177).quot) + (171 *
div(\mathbf{heapIs} \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
heap_{funcstart_{-1032,1}}.p1, 177).rem
[Take given term]
[53.0] heap_{1032,1;1051,8} == heap_{funcstart\_1032,1}._replace(this.$r \rightarrow
operator*(heapIs heap_{funcstart\_1032,1}, this)._replace(p1 \rightarrow
asType<P1Type>(($heap_funcstart_1032,1.M1 *
asType<int>(static_cast<integer>(static_cast<signed
\mathbf{int} > (\mathbf{operator}^*(\mathbf{heapIs} \ \$ \mathbf{heap}_{funcstart\_1032,1}, \ \mathbf{this}).\mathtt{p1}) < (\mathbf{int})0))) \ +
temp1)))
→ [expand definition of operator '*' in class 'pointer' at built in declaration]
[53.1] \theta_{1032,1;1051,8} == \theta_{1032,1;1051,8} = \theta_{1032,1;1051,8} == \theta
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow
\mathbf{asType}{<}P1\mathsf{Type}{>}((\$\mathsf{heap}_{funcstart\_1032,1}.\mathsf{M1}~*
asType<int>(static_cast<integer>(static_cast<signed
int>(operator^*(heapIs \$heap_{funcstart\_1032,1}, this).p1) < (int)0))) +
temp1)))
\rightarrow [const static or extern object]
[53.2] heap_{1032,1;1051,8} == heap_{funcstart\_1032,1}._replace(this.$r \rightarrow
\textbf{this.}\$r.\textbf{value}(\textbf{heapIs}~\$heap_{funcstart\_1032,1}).\_\textbf{replace}(p1 \rightarrow
asType < P1Type > ((\$heap_{init}.M1 *
asType < int > (static\_cast < integer > (static\_cast < signed
int>(operator^*(heapIs \$heap_{funcstart\_1032,1}, this).p1) < (int)0))) +
temp1)))
```

```
\rightarrow [expand definition of constant 'M1' at prang.cpp (28,26)]
[53.3] $heap<sub>1032,1;1051,8</sub> == $heap<sub>funcstart_1032,1</sub>._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow
asType<P1Type>(((int)30269 *
asType < int > (static\_cast < integer > (static\_cast < signed)
int>(operator^*(heapIs \$heap_{funcstart\_1032,1}, this).p1) < (int)0))) +
temp1)))
\rightarrow [simplify]
[53.4] \theta_{1032,1;1051,8} == \theta_{1032,1;1051,8} = \theta_{1032,1;1051,8} == \theta
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow
asType<P1Type>((30269 *
asType < int > (static\_cast < integer > (static\_cast < signed)
int>(operator*(heapIs $heap_{funcstart\_1032,1}, this).p1) < (int)0))) +
temp1)))
→ [expand definition of operator '*' in class 'pointer' at built in declaration]
[53.5] $heap<sub>1032,1;1051,8</sub> == $heap<sub>funcstart_1032,1</sub>._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow
asType<P1Type>((30269 *
asType{<}int{>}(static\_cast{<}integer{>}(static\_cast{<}signed
int>(this.\$r.value(heapIs \$heap_{funcstart\_1032.1}).p1) < (int)0))) + temp1)))
\rightarrow [simplify]
[53.9] $heap<sub>1032,1;1051,8</sub> == $heap<sub>funcstart_1032,1</sub>._replace(this.$r \rightarrow
this.$r.value(heapIs \rho_{funcstart\_1032,1})._replace(p1 \rightarrow
asType<P1Type>((30269 * asType<int>(static_cast<integer>(0 <
-\mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}\ \$\mathbf{heap}_{funcstart\_1032,1}).\mathbf{p1}))) + \mathbf{temp1})))
\rightarrow [from term 8.0, literala < -this.$r.value(heapIs $heap_{funcstart\_1032,1}).p1
is false whenever -2 < (0 + literala)
        Proof of rule precondition:
        [53.9.0] - 2 < (0 + 0)
        \rightarrow [simplify]
        [53.9.2] true
[53.10] $heap<sub>1032,1;1051,8</sub> == $heap<sub>funcstart_1032,1</sub>._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow
asType<P1Type>((30269 * asType<int>(static_cast<integer>(false)))
+ \text{ temp1}))
\rightarrow [simplify]
[53.11] $\text{heap}_{1032,1;1051,8} == $\text{heap}_{funcstart\_1032,1}._\text{replace}(\text{this}.\text{$\frac{1}{2}r$})
\textbf{this.}\$r.\textbf{value}(\textbf{heapIs}~\$heap_{funcstart\_1032,1}).\_\textbf{replace}(p1 \rightarrow
asType < P1Type > ((30269 * asType < int > (([false]: 1, []: 0))) + temp1)))
```

```
→ [explicitly assert falsehood of skipped guards in subsequent guards]
[53.12] $heap<sub>1032,1;1051,8</sub> == $heap<sub>funcstart_1032,1</sub>._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow
asType<P1Type>((30269 * asType<int>(([false]: 1, [true]: 0))) +
temp1)))
\rightarrow [simplify]
[53.15] $heap<sub>1032,1;1051,8</sub> == $heap<sub>funcstart_1032,1</sub>._replace(this.$r \rightarrow
\textbf{this.}\$r.\textbf{value}(\textbf{heapIs}~\$heap_{funcstart\_1032,1}).\_\textbf{replace}(p1 \rightarrow
asType < P1Type > (0 + temp1))
\rightarrow [from term 50.14, temp1 is equal to (-2 * div(heapIs $heap_{funcstart\_1032.1},
this. $r.value(heapIs heap_{funcstart\_1032.1}).p1, 177).quot) + (171 *
div(heapIs $heap_{funcstart_1032.1}, this.$r.value(heapIs
heap_{funcstart\_1032,1}.p1, 177).rem
[53.16] $heap<sub>1032,1;1051,8</sub> == $heap<sub>funcstart_1032,1</sub>._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow
asType<P1Type>(0 + ((-2 * div(heapIs $heap_{funcstart\_1032,1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177).quot) + (171 *
div(\mathbf{heapIs} \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
heap_{funcstart_{1032,1}}.p1, 177).rem))))
\rightarrow [simplify]
[53.19] heap_{1032,1;1051,8} == heap_{funcstart\_1032,1}._replace(this.$r \rightarrow
this.$r.value(heapIs \frac{1}{2} heap\frac{1}{2} ._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.} \text{\$r.value}(\text{heapIs}))
heap_{funcstart\_1032,1}.p1, 177.rem)))
[Take goal term]
[1.0] minof(signed int) \leq ($heap<sub>1032.1:1051.8</sub>.b2 * static_cast<signed
int>(div2.quot))
\rightarrow [simplify]
[1.1] -32768 \leq ($heap<sub>1032,1:1051,8</sub>.b2 * static_cast < signed int > (div2.quot))
\rightarrow [from term 53.19, $heap<sub>1032,1;1051,8</sub> is equal to
$heap_{funcstart\_1032,1}.$_replace(this.$r \rightarrow this.$r.value(heapIs)
heap_{funcstart\_1032.1}._replace(p1 \rightarrow (-2 * div(heapIs heap_{funcstart\_1032.1})
this. $r.value(heapIs heap_{funcstart\_1032,1}).p1, 177).quot) + (171 *
div(heapIs $heap_funcstart_1032.1, this.$r.value(heapIs
heap_{funcstart_{1032,1}}.p1, 177).rem)))
[1.2] -32768 \le (\text{\$heap}_{funcstart\_1032,1}.\_\textbf{replace}(\textbf{this}.\$r \to \textbf{this}.\$r.\textbf{value}(\textbf{heapIs}))
\text{Sheap}_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs \text{Sheap}_{funcstart\_1032,1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177).quot) + (171 *
div(\mathbf{heapIs} \$ heap_{funcstart\_1032.1}, \mathbf{this.}\$r.\mathbf{value}(\mathbf{heapIs})
```

```
\verb|\heap| funcstart\_1032,1|.p1,\ 177|.rem|))).b2 * \mathbf{static\_cast} < \mathbf{signed}
int>(div2.quot))
\rightarrow [const member of object with modified fields]
\text{[1.3] -32768} \leq (\$ \text{heap}_{funcstart\_1032,1}.\text{b2} * \textbf{static\_cast} {<} \textbf{signed}
int>(div2.quot))
\rightarrow [const static or extern object]
[1.4] -32768 \leq ($heap<sub>init</sub>.b2 * static_cast<signed int>(div2.quot))
\rightarrow [expand definition of constant 'b2' at prang.cpp (36,26)]
[1.5] -32768 \leq ((int)35 * static_cast<signed int>(div2.quot))
\rightarrow [simplify]
[1.6] -32768 \leq (35 * static_cast\leqsigned int\geq(div2.quot))
\rightarrow [from term 18.6, div2 is equal to div(heapIs $heap_{funcstart\_1032,1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p2, 176)]
[1.7] -32768 \leq (35 * static_cast<signed int>(div(heapIs)
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p2,
176).quot))
\rightarrow [simplify]
[1.10] -32769 < (35 * div(heapIs \$heap_{funcstart\_1032,1}, this.\$r.value(heapIs))
heap_{funcstart\_1032,1}.p2, 176).quot
\rightarrow [literal comparison of product]
[1.11] ([35 < 0]: (-32769 / -35) < -\text{div}(\mathbf{heapIs} \$ \text{heap}_{funcstart\_1032,1},
this.$r.value(heap
Is $heap_{funcstart\_1032,1}).p2, 176).quot, [0 < 35]: (-32769 /
35) < \text{div}(\text{heapIs } \text{$heap}_{funcstart\_1032,1}, \text{ this.} \text{$r.value}(\text{heapIs})
\text{Sheap}_{funcstart\_1032,1}.p2, 176).quot, [0 == 35]: -32769 < 0)
→ [explicitly assert falsehood of skipped guards in subsequent guards]
[1.12] ([35 < 0]: (-32769 / -35) < -\text{div}(\mathbf{heapIs} \$ \mathbf{heap}_{funcstart\_1032,1},
this.$r.value(heapIs heap_{funcstart\_1032,1}).p2, 176).quot, [(0 < 35) \land !(35 <
0)]: (-32769 / 35) < div(heapIs $heap_{funcstart\_1032,1}, this.$r.value(heapIs)
\text{Sheap}_{funcstart\_1032,1}.p2, 176).quot, [(0 == 35) \land !(0 < 35) \land !(35 < 0)]:
-32769 < 0
\rightarrow [simplify]
[1.20] -937 < div(heapIs heap_{funcstart\_1032,1}, this.r.value(heapIs)
heap_{funcstart\_1032,1}.p2, 176.quot
\rightarrow [negate goal and search for contradiction]
[1.21]!(-937 < div(heapIs heap_{funcstart\_1032,1}, this.$r.value(heapIs
heap_{funcstart_{-1032,1}}.p2, 176).quot
\rightarrow [simplify]
```

```
[1.23] 936 < -\text{div}(\text{heapIs }\text{\$heap}_{funcstart\_1032,1}, \text{this.}\text{\$r.value}(\text{heapIs})
heap_{funcstart_{1032,1}}.p2, 176.quot
[Create new term from terms 1.23, 25.17 using rule: transitivity 15]
[67.0] (0 + 936) < -(this.$r.value(heapIs $heap_{funcstart\_1032,1}).p2 / 176)
\rightarrow [simplify]
[67.7] 164736 < -this.$r.value(heapIs $heap_{funcstart\_1032,1}).p2
\rightarrow [from term 24.0, literala < -this.$r.value(heapIs $heap_{funcstart\_1032,1}).p2
is false whenever -2 < (0 + literala)]
   Proof of rule precondition:
   [67.7.0] - 2 < (0 + 164736)
   \rightarrow [simplify]
   [67.7.2] true
[67.8] false
Proof of verification condition: Arithmetic result of operator '*' is within
limit of type 'signed int'
In the context of class: WHPrang, declared at:
C:\Escher\Customers\prang-cpp\prang.cpp (18,1)
Condition generated at: C:\Escher\Customers\prang-cpp\prang.cpp
(77,57)
Condition defined at:
To prove: (\text{sheap}_{1032,1;1051,8}.\text{b2} * \text{static\_cast} < \text{signed int} > (\text{div}2.\text{quot})) \le
maxof(signed int)
Given:
heap_{init}.LIMIT == (int)80
heap_{init}.class WHPrang \in M1 == (int)30269
heap_{init}.class WHPrang \in r1 == (int)171
heap_{init}.class WHPrang \in a1 == (int)177
heap_{init}.class WHPrang \in b1 == (int)2
heap_{init}.class WHPrang \in M2 == (int)30307
heap_{init}.class WHPrang \in r2 == (int)172
```

\$\text{heap}_{init}.\text{class WHPrang} \in \text{a2} == (\text{int})176\$\$\$ \$\text{heap}_{init}.\text{class WHPrang} \in \text{b2} == (\text{int})35\$\$\$ \$\text{heap}_{init}.\text{class WHPrang} \in \text{M3} == (\text{int})30323\$\$\$

```
heap_{init}.class WHPrang \in r3 == (int)170
heap_{init}.class WHPrang \in a3 == (int)178
heap_{init}.class WHPrang \in b3 == (int)63
\operatorname{div1} == \operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_1032,1},
static_cast<int>(operator*(heapIs $heap_{funcstart\_1032.1}, this).p1),
\mathbf{static\_cast}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_1032,1}.\mathrm{a1}))
(asType < integer > (static\_cast < int > (operator*(heapIs)))
heap_{funcstart\_1032,1}, this).p1)
asType < integer > (static\_cast < int > (\$heap_{funcstart\_1032.1}.a1))) = =
asType<integer>(div1.quot)
(asType < integer > (static\_cast < int > (operator*(heapIs)))
heap_{funcstart\_1032,1}, this).p1) %
asType < integer > (static\_cast < int > (\$heap_{funcstart\_1032.1}.a1))) = =
asType<integer>(div1.rem)
(asType < integer > (operator^*(heapIs \$heap_{funcstart\_1032,1}, this).p1) < (asType < integer > (operator^*(heapIs \$heap_funcstart\_1032,1)) < (operator^*(heapIs \$heap_funcstart\_1032,1)) < (operator^*(heapIs \$heap_funcstart\_1032,1)) < (operator^*(heapIs \$heap_funcstart\_103
asType < integer > (\$heap_{funcstart\_1032,1}.a1)) = >
(asType<integer>(div1.rem) == asType<integer>(operator*(heapIs
heap_{funcstart\_1032,1}, this).p1)
(\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathsf{heap}_{funcstart\_1032,1}.\mathsf{a1}) \leq
\mathbf{asType}{<}\mathbf{integer}{>}(\mathbf{operator*}(\mathbf{heapIs}\ \$\mathbf{heap}_{funcstart\_1032,1},\ \mathbf{this}).\mathbf{p1})) =>
!(0 == asType < integer > (div1.quot))
!(0 == asType < integer > (div1.rem)) || !(0 ==
asType<integer>(div1.quot))
div2 == div(\mathbf{heapIs} \$ heap_{funcstart\_1032,1},
\mathbf{static\_cast} {<} \mathbf{int} {>} (\mathbf{operator^*(heapIs}\ \$heap_{funcstart\_1032,1},\ \mathbf{this}).p2),
\mathbf{static\_cast}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_1032,1}.\mathrm{a2}))
(asType < integer > (static\_cast < int > (operator*(heapIs)))
heap_{funcstart=1032.1}, this).p2)
asType < integer > (static\_cast < int > (\$heap_{funcstart\_1032,1}.a2))) = =
asType<integer>(div2.quot)
(asType<integer>(static_cast<int>(operator*(heapIs
heap_{funcstart\_1032,1}, this).p2)
asType < integer > (static\_cast < int > (\$heap_{funcstart\_1032.1}.a2))) = =
asType<integer>(div2.rem)
(\mathbf{asType}{<}\mathbf{integer}{>}(\mathbf{operator}^*(\mathbf{heapIs}\ \$\mathbf{heap}_{funcstart\_1032,1},\ \mathbf{this}).\mathtt{p2}) <
asType < integer > (\$heap_{funcstart\_1032,1}.a2)) = >
(asType<integer>(div2.rem) == asType<integer>(operator*(heapIs
heap_{funcstart\_1032,1}, this).p2)
(\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathrm{heap}_{funcstart\_1032,1}.\mathrm{a2}) \leq
asType<integer>(operator*(heapIs $heap_{tuncstart\_1032.1}, this).p2)) =>
```

```
!(0 == asType < integer > (div2.quot))
!(0 == asType < integer > (div2.rem)) || !(0 ==
asType<integer>(div2.quot))
\label{eq:div3} \text{div3} == \text{div}(\mathbf{heapIs} \ \$ \text{heap}_{funcstart\_1032,1},
static\_cast < int > (operator*(heapIs $heap_{funcstart\_1032,1}, this).p3),
static\_cast < int > (\$heap_{funcstart\_1032,1}.a3))
(asType<integer>(static_cast<int>(operator*(heapIs
heap_{funcstart\_1032,1}, this).p3)) /
asType < integer > (static\_cast < int > (\$heap_{funcstart\_1032.1}.a3))) = =
asType<integer>(div3.quot)
(asType<integer>(static_cast<int>(operator*(heapIs
heap_{funcstart=1032.1}, this).p3)
asType < integer > (static\_cast < int > (\$heap_{funcstart\_1032,1}.a3))) = =
asType<integer>(div3.rem)
(asType<integer>(operator*(heapIs $heap_{funcstart\_1032.1}, this).p3) <
asType < integer > (\$heap_{funcstart\_1032,1}.a3)) = >
(asType<integer>(div3.rem) == asType<integer>(operator*(heapIs
heap_{funcstart\_1032,1}, this).p3)
(\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathsf{heap}_{funcstart\_1032,1}.\mathbf{a3}) \leq
asType < integer > (operator^*(heapIs \$heap_{funcstart\_1032,1}, this).p3)) = >
!(0 == asType < integer > (div3.quot))
!(0 == asType < integer > (div3.rem)) || !(0 ==
asType<integer>(div3.quot))
temp1 == (\$heap_{funcstart\_1032,1}.r1 * static\_cast < signed int > (div1.rem)) -
($heap_funcstart_1032,1.b1 * static_cast<signed int>(div1.quot))
minof(signed\ int) \le temp1
temp1 \le maxof(signed int)
\theta_{1032,1:1051,8} == \theta_{1032
operator*(heapIs heap_{funcstart\_1032,1}, this)._replace(p1 \rightarrow
\mathbf{asType}{<}P1\mathsf{Type}{>}((\$\mathsf{heap}_{funcstart\_1032,1}.\mathsf{M1}~*
asType < int > (static\_cast < integer > (static\_cast < signed
int>(operator^*(heapIs \$heap_{funcstart\_1032,1}, this).p1) < (int)0))) +
temp1)))
Proof:
[Take given term]
[2.0] \operatorname{div1} == \operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_1032,1},
static\_cast < int > (operator*(heapIs $heap_{funcstart\_1032,1}, this).p1),
\mathbf{static\_cast}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_1032,1}.\mathrm{a1}))
→ [expand definition of operator '*' in class 'pointer' at built in declaration]
```

```
[2.1] \operatorname{div1} == \operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_1032,1},
\mathbf{static\_cast} < \mathbf{int} > (\mathbf{this.\$r.value}(\mathbf{heapIs} \ \$ \mathbf{heap}_{funcstart\_1032,1}).\mathbf{p1}),
\mathbf{static\_cast}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_1032,1}.\mathrm{a1}))
\rightarrow [simplify]
[2.2] \operatorname{div1} == \operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_1032,1}, \mathbf{this}.\$ \mathbf{r}.\mathbf{value}(\mathbf{heapIs})
\theta_{funcstart=1032,1}, p1, static_cast<int>(\theta_{funcstart=1032,1})
\rightarrow [const static or extern object]
[2.3] \text{ div1} == \text{div(heapIs } \text{$heap}_{funcstart\_1032.1}, \text{this.} \text{$r.value(heapIs)}
\theta_{tuncstart\_1032.1}.p1, \theta_{tuncstart\_1032.1}.p2, \theta_{tuncstart\_1032.1}.p3, \theta_{tuncstart\_1032.1}.p2, \theta_{tuncstart\_1032.1}.p3, \theta_{tuncstart\_1032.1}.p3, \theta_{tuncstart\_1032.1}.p2, \theta_{tuncstart\_1032.1}.p3, \theta_{tuncstart\_1032.1}.p4, \theta_{tuncstart\_1032.1}.p4, \theta_{tuncstart\_1032.1}.p4, \theta_{tuncstart\_1032.1
\rightarrow [expand definition of constant 'a1' at prang.cpp (30,26)]
[2.4] \text{ div1} == \text{div}(\text{heapIs } \text{heap}_{funcstart\_1032,1}, \text{this.}\text{\$r.value}(\text{heapIs})
\theta_{funcstart\_1032.1}.p1, \theta_{funcstart\_1032.1}.p1, \theta_{funcstart\_1032.1}.p1, \theta_{funcstart\_1032.1}.p1, \theta_{funcstart\_1032.1}.p1, \theta_{funcstart\_1032.1}.p2, \theta_{funcstart\_1032.1}.p2, \theta_{funcstart\_1032.1}.p2, \theta_{funcstart\_1032.1}.p2, \theta_{funcstart\_1032.1}.p2, \theta_{funcstart\_1032.1}.p3, \theta_{funcstart\_1032.1}.p3, \theta_{funcstart\_1032.1}.p2, \theta_{funcstart\_1032.1}.p3, \theta_{funcstart\_1032.1}.p4, \theta_{funcstart\_1032.1}.p3, \theta_{funcstart\_1032.1}.p4, \theta_{funcstart\_1032.1}.p5, \theta_{funcstart\_1032.1}.p4, \theta_{funcstart\_1032.1}.p5, \theta_{funcstart\_1032.1}.p6, \theta_{funcstart\_1032.1}.p7, \theta_{funcstart\_1032.1
\rightarrow [simplify]
[2.6] \text{ div1} == \text{div(heapIs } \text{$heap}_{funcstart\_1032,1}, \text{this.} \text{$r.value(heapIs)}
heap_{funcstart_{-1032.1}}.p1, 177
[Assume known post-assertion, class invariant or type constraint for term 2.6]
[7.0] (0 < asType<integer>(this.$r.value(heapIs)
\label{eq:continuous} $\operatorname{heap}_{funcstart\_1032,1}).p1)) \&\& (\mathbf{asType} < \mathbf{integer} > (\mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}))) \&\& (\mathbf{asType} < \mathbf{integer} > (\mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})))) \&\& (\mathbf{asType} < \mathbf{integer} > (\mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}))) \&\& (\mathbf{asType} < \mathbf{integer} > (\mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})))) \&\& (\mathbf{asType} < \mathbf{integer} > (\mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}))))) \&\& (\mathbf{asType} < \mathbf{integer} > (\mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})))) \&\& (\mathbf{asType} < \mathbf{integer} > (\mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}))))) \&\& (\mathbf{asType} < \mathbf{integer} > (\mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}))))) \&\& (\mathbf{asType} < \mathbf{integer} > (\mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})))) \&\& (\mathbf{asType} < \mathbf{integer} > (\mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}))))) \&\& (\mathbf{asType} < \mathbf{integer} > (\mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})))))) \&\& (\mathbf{asType} < \mathbf{integer} > (\mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})))))) \&\& (\mathbf{asType} < \mathbf{integer} > (\mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})))))))))
\theta_{uncstart\_1032,1}.p1 < asType<integer>(\theta_{uncstart\_1032,1}.p1) < asType<integer>(\theta_{uncstart\_1032,1}.p1)
M1))
\rightarrow [simplify]
[7.2] (0 < this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1) \&\&
(this.$r.value(heapIs heap_{funcstart\_1032,1}).p1 <
asType < integer > (\text{$heap.class WHPrang} \in M1))
\rightarrow [const static or extern object]
[7.3] (0 < this.$r.value(heapIs \rho_{funcstart\_1032,1}).p1) &&
(this.r.value(heapIs $heap_{funcstart\_1032,1}).p1 <
asType < integer > (\$heap_{init}.class WHPrang \in M1))
\rightarrow [expand definition of constant 'M1' at prang.cpp (28,26)]
[7.4] (0 < this.$r.value(heapIs \theta_{funcstart\_1032,1}).p1) &&
(this.$r.value(heapIs \rho_{funcstart\_1032,1}).p1 <
asType < integer > ((int)30269))
\rightarrow [simplify]
[7.10] (-30269 < -this.$r.value(heapIs heap_{funcstart\_1032,1}).p1) <math>\land (0 < 
this.$r.value(heapIs $heap_{funcstart\_1032,1}).p1)
[Work on sub-term 2 of conjunction in term 7.10]
[8.0] 0 < this.$r.value(heapIs $heap<sub>funcstart_1032,1</sub>).p1
```

```
[Take given term]
[18.0] \operatorname{div2} == \operatorname{div}(\mathbf{heapIs} \ \text{$heap}_{funcstart\_1032,1},
\mathbf{static\_cast} < \mathbf{int} > (\mathbf{operator}^*(\mathbf{heapIs} \ \$ \mathbf{heap}_{funcstart\_1032,1}, \ \mathbf{this}).\mathtt{p2}),
\mathbf{static\_cast}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_1032,1}.\mathrm{a2}))
→ [expand definition of operator '*' in class 'pointer' at built in declaration]
[18.1] \operatorname{div2} == \operatorname{div}(\mathbf{heapIs} \ \text{$heap}_{funcstart\_1032,1},
static\_cast < int > (this. r.value(heapIs  heap_{funcstart\_1032,1}).p2),
static\_cast < int > (\$heap_{funcstart\_1032,1}.a2))
\rightarrow [simplify]
[18.2] div2 == div(heapIs \rho_{uncstart\_1032,1}, his.\r.value(heapIs
\theta_{funcstart\_1032,1}.p2, \theta_{funcstart\_1032,1}.a2))
\rightarrow [const static or extern object]
[18.3] div2 == div(heapIs \rho_{uncstart\_1032,1}, his.\r.value(heapIs
\theta_{funcstart\_1032,1}.p2, \theta_{funcstart\_1032,1
\rightarrow [expand definition of constant 'a2' at prang.cpp (35,26)]
[18.4] div2 == div(\mathbf{heapIs} \$ \mathbf{heap}_{funcstart\_1032,1}, \mathbf{this}.\$ \mathbf{r.value}(\mathbf{heapIs})
\theta_{funcstart\_1032,1}.p2, \theta_{funcstart\_1032,1}.p2, \theta_{funcstart\_1032,1}.p2, \theta_{funcstart\_1032,1}.p2
\rightarrow [simplify]
[18.6] div2 == div(\mathbf{heapIs} \ \hat{\mathbf{s}}_{funcstart\_1032,1}, \ \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
heap_{funcstart_{-1032,1}}.p2, 176
[Assume known post-assertion, class invariant or type constraint for term 18.6]
[23.0] (0 < asType<integer>(this.$r.value(heapIs
$heap_{tuncstart_1032.1}.p2)) && (asType<integer>(this.$r.value(heapIs
\verb§heap$_{funcstart\_1032,1}).p2) < \mathbf{asType} < \mathbf{integer} > (\$ heap.\mathbf{class} \ WHPrang \in \texttt{Prang}) = \texttt{Prang} + \texttt{Prang}
M2))
\rightarrow [simplify]
[23.2] (0 < this.r.value(heapIs \ heap_{funcstart\_1032,1}).p2) \&\&
(this.$r.value(heapIs heap_{funcstart\_1032,1}).p2 <
asType < integer > (\text{$heap.class WHPrang} \in M2))
\rightarrow [const static or extern object]
[23.3] (0 < this.$r.value(heapIs \rho_{funcstart\_1032,1}).p2) &&
(this.$r.value(heapIs heap_{funcstart\_1032,1}).p2 <
asType < integer > (\$heap_{init}.class WHPrang \in M2))
\rightarrow [expand definition of constant 'M2' at prang.cpp (33,26)]
[23.4] (0 < this.$r.value(heap
Is \rho_{uncstart\_1032,1}).p2) &&
(this.r.value(heapIs $heap_{funcstart\_1032.1}).p2 <
asType < integer > ((int)30307))
```

```
\rightarrow [simplify]
[23.10] (-30307 < -this.$r.value(heapIs $heap_{tuncstart\_1032.1}).p2) \land (0 <
this.r.value(heapIs $heap_{funcstart\_1032,1}).p2)
\rightarrow [separate conjunction and work on first sub-term]
[23.11] -30307 < -this.$r.value(heapIs \rho_{funcstart\_1032,1}).p2
[Work on sub-term 2 of conjunction in term 23.10]
[24.0] 0 < this.$r.value(heapIs $heap_{funcstart\_1032,1}).p2
[Assume known post-assertion, class invariant or type constraint for term 18.6]
asType<integer>(176)) == asType<integer>(div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p2,
176).quot)
\rightarrow [simplify]
[25.2] (this.$r.value(heap
Is \rho_{funcstart\_1032,1}).p2 / 176) ==
asType<integer>(div(heapIs $heap_{funcstart\_1032,1}, this.$r.value(heapIs
heap_{funcstart_{-1032.1}}.p2, 176).quot
\rightarrow [expand definition of operator './' in class 'int' at built in declaration]
[25.3] ([asType<integer>(this.$r.value(heapIs $heap_{funcstart\_1032,1}).p2) <
0]: -(-asType < integer > (this. r.value(heapIs $heap_{funcstart\_1032,1}).p2) / (this. r.value(heapIs $heap_{funcstart\_1032,1}).p2)
176), []: asType<integer>(this.$r.value(heapIs $heap_{funcstart\_1032,1}).p2) /
176) == asType<integer>(div(heapIs $heap_{tuncstart_1032.1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p2, 176).quot)
→ [explicitly assert falsehood of skipped guards in subsequent guards]
{\it [25.4]}~([{\bf asType}{<}{\bf integer}{>}({\bf this.\$r.value}({\bf heapIs}~\${\bf heap}_{funcstart\_1032,1}).{\bf p2})<
0]: -(-asType < integer > (this. r.value(heapIs $heap_{funcstart\_1032,1}).p2) /
176), [!(asType<integer>(this.r.value(heapIs \heap_{funcstart\_1032,1}).p2) <
0)]: asType < integer > (this. r.value(heapIs <math>heapIs heap_{funcstart\_1032,1}).p2) / 
176) == asType<integer>(div(heapIs heap_{funcstart\_1032.1},
this.r.value(heapIs $heap_{funcstart\_1032,1}).p2, 176).quot)
\rightarrow [simplify]
[25.7] ([0 < -this.$r.value(heapIs $heap_{funcstart\_1032.1}).p2]:
-(-asType<integer>(this.$r.value(heapIs $heap_{tuncstart\_1032.1}).p2) /
0)]: as
Type<integer>(this.$r.value(heap
Is \rho_{funcstart\_1032,1}).p2) / 
176) == asType<integer>(div(heapIs $heap_{funcstart\_1032,1},
this.r.value(heapIs $heap_{funcstart\_1032,1}).p2, 176).quot)
\rightarrow [from term 24.0, literala < -this.$r.value(heapIs $heap_{funcstart\_1032,1}).p2
is false whenever -2 < (0 + literala)
```

```
Proof of rule precondition:
   [25.7.0] - 2 < (0 + 0)
   \rightarrow [simplify]
   [25.7.2] true
[25.8] ([false]: -(-asType<integer>(this.$r.value(heapIs
\rho_{funcstart\_1032,1}.p2) / 176, [!(asType<integer>(this.$r.value(heapIs)
\theta_{uncstart_{1032,1}}.p2 < 0: asType<integer>(this.$r.value(heapIs)
\theta_{funcstart\_1032,1}.p2) / 176 = asType < integer > (div(heapIs))
\rho_{tuncstart\_1032.1}, this.r.value(heapIs \rho_{tuncstart\_1032.1}).p2,
176).quot)
\rightarrow [simplify]
[25.11] ([false]: -(-asType<integer>(this.$r.value(heapIs
\text{heap}_{funcstart\_1032.1}.p2) / 176), [!(0 < -this.\$r.value(heapIs)]
\rho_{tuncstart_1032.1}.p2: asType<integer>(this.$r.value(heapIs)
\theta_{funcstart\_1032,1}.p2) / 176 = asType < integer > (div(heapIs))
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p2,
176).quot)
\rightarrow [from term 24.0, literala < -this.$r.value(heapIs $heap_{tuncstart\_1032.1}).p2
is false whenever -2 < (0 + literala)
   Proof of rule precondition:
   [25.11.0] - 2 < (0 + 0)
   \rightarrow [simplify]
   [25.11.2] true
[25.12] ([false]: -(-asType<integer>(this.$r.value(heapIs
heap_{funcstart\_1032,1}.p2) / 176, [!false]:
asType<integer>(this.$r.value(heapIs $heap_{tuncstart\_1032.1}).p2) / 176)
== asType < integer > (div(heapIs $heap_{funcstart\_1032,1},
this.r.value(heapIs $heap_{funcstart\_1032,1}).p2, 176).quot)
\rightarrow [simplify]
[25.17] 0 == (-\text{div}(\mathbf{heapIs} \$ \text{heap}_{funcstart\_1032,1}, \mathbf{this}.\$ \mathbf{r.value}(\mathbf{heapIs}))
\theta_{funcstart\_1032,1}.p2, 176).quot + (this.r.value(heapIs)
heap_{funcstart\_1032,1}.p2 / 176)
[Take given term]
[50.0] \; ((\$ heap_{funcstart\_1032,1}.r1 \; * \; \textbf{static\_cast} < \textbf{signed int} > (\text{div}1.rem)) \; - \; \text{div}1.rem)) \; - \; \text{div}1.rem)) \; + \; \text{div}1.rem)) \; + \; \text{div}1.rem)
```

 $(\text{sheap}_{funcstart_1032,1}.\text{b1 * static_cast} < \text{signed int} > (\text{div1.quot}))) == \text{temp1}$

 $(\text{sheap}_{funcstart_1032,1}.\text{b1 * static_cast} < \text{signed int} > (\text{div1.quot}))) == \text{temp1}$

[50.1] ((\$heap_{init}.r1 * static_cast<signed int>(div1.rem)) -

 \rightarrow [const static or extern object]

```
\rightarrow [expand definition of constant 'r1' at prang.cpp (29,26)]
[50.2] (((int)171 * static_cast<signed int>(div1.rem)) -
(\text{sheap}_{funcstart\_1032,1}.\text{b1 * static\_cast} < \text{signed int} > (\text{div1.quot}))) == \text{temp1}
\rightarrow [simplify]
[50.3] ((171 * static_cast < signed int > (div1.rem)) - ($heap_{funcstart\_1032,1}.b1]
* static_cast<signed int>(div1.quot))) == temp1
\rightarrow [from term 2.6, div1 is equal to div(heapIs $heap_{funcstart\_1032,1},
this.r.value(heapIs \ heap_{funcstart\_1032.1}).p1, 177)
[50.4] ((171 * static_cast<signed int>(div(heapIs $heap_{funcstart\_1032,1},
\mathbf{this.\$r.value(heapIs}\ \$heap_{funcstart\_1032,1}).p1,\ 177).rem)) \ -
(\text{sheap}_{funcstart\_1032,1}.\text{b1} * \text{static\_cast} < \text{signed int} > (\text{div1.quot}))) == \text{temp1}
\rightarrow [simplify]
[50.5] ((171 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs = f_{uncstart\_1032,1})
\text{Sheap}_{funcstart\_1032,1}.p1, 177).rem) - (\text{Sheap}_{funcstart\_1032,1}.b1 *
static_cast<signed int>(div1.quot))) == temp1
\rightarrow [const static or extern object]
[50.6] ((171 * div(heapIs $heap<sub>funcstart_1032,1</sub>, this.$r.value(heapIs)
\rho_{funcstart\_1032,1}.p1, 177).rem – (\rho_{funcstart\_1032,1}.p1, 177).rem) – (\rho_{funcstart\_1032,1}.p1, 177).rem)
int>(div1.quot)) == temp1
\rightarrow [expand definition of constant 'b1' at prang.cpp (31,26)]
[50.7] ((171 * div(heapIs $heap_{funcstart\_1032.1}, this.$r.value(heapIs)
\theta_{uncstart\_1032,1}.p1, 177).rem - ((int)^2 * static\_cast < signed)
int>(div1.quot)) == temp1
\rightarrow [simplify]
[50.8] ((171 * div(heapIs \$heap_{funcstart\_1032,1}, this.\$r.value(heapIs)
\theta_{funcstart\_1032,1}.p1, 177).rem) - (2 * static_cast<signed
int>(div1.quot))) == temp1
\rightarrow [from term 2.6, div1 is equal to div(heapIs $heap_{funcstart\_1032,1},
this.r.value(heapIs $heap_{funcstart\_1032,1}).p1, 177)
[50.9] ((171 * div(heapIs $heap<sub>funcstart_1032,1</sub>, this.$r.value(heapIs)
\rho_{tuncstart\_1032.1}.p1, 177).rem - (2 * static\_cast < signed)
\mathbf{int}{>}(\mathrm{div}(\mathbf{heapIs}\ \$\mathrm{heap}_{funcstart\_1032,1},\ \mathbf{this}.\$\mathrm{r.value}(\mathbf{heapIs}
\text{Sheap}_{funcstart\_1032,1}.p1, 177).quot))) == temp1
\rightarrow [simplify]
[50.14] 0 == (-\text{temp1} + (-2 * \text{div}(\mathbf{heapIs} \$ \text{heap}_{funcstart\_1032,1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177).quot) + (171 *
div(\mathbf{heapIs} \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
heap_{funcstart_{-1032,1}}.p1, 177).rem
```

```
[Take given term]
[53.0] heap_{1032,1;1051,8} == heap_{funcstart\_1032,1}._replace(this.$r \rightarrow
operator*(heapIs heap_{funcstart\_1032,1}, this)._replace(p1 \rightarrow
asType < P1Type > ((\$heap_{funcstart\_1032,1}.M1 *
asType<int>(static_cast<integer>(static_cast<signed
int>(operator^*(heapIs \$heap_{funcstart\_1032,1}, this).p1) < (int)0))) +
temp1)))
→ [expand definition of operator '*' in class 'pointer' at built in declaration]
[53.1] heap_{1032,1;1051,8} == heap_{funcstart\_1032,1}._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow
asType<P1Type>(($heap<sub>funcstart_1032.1</sub>.M1 *
asType<int>(static_cast<integer>(static_cast<signed
\mathbf{int} > (\mathbf{operator}^*(\mathbf{heapIs} \ \$ \mathbf{heap}_{funcstart\_1032,1}, \ \mathbf{this}).\mathbf{p1}) < (\mathbf{int})\mathbf{0}))) \ +
temp1)))
\rightarrow [const static or extern object]
[53.2] $\text{heap}_{1032,1:1051.8} == \text{$heap}_{funcstart\_1032,1}._\text{replace}(\text{this}.\text{$r} \to \text{$}
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow
asType < P1Type > ((\$heap_{init}.M1 *
asType<int>(static_cast<integer>(static_cast<signed
int>(operator^*(heapIs \$heap_{tuncstart\_1032.1}, this).p1) < (int)0))) +
temp1)))
\rightarrow [expand definition of constant 'M1' at prang.cpp (28.26)]
[53.3] heap_{1032,1;1051,8} == heap_{funcstart\_1032,1}._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow
asType < P1Type > (((int)30269 *
asType<int>(static_cast<integer>(static_cast<signed
int>(operator^*(heapIs \$heap_{funcstart\_1032,1}, this).p1) < (int)0))) +
temp1)))
\rightarrow [simplify]
[53.4] heap_{1032,1;1051,8} == heap_{funcstart\_1032,1}._replace(this.r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow
asType<P1Type>((30269 *
asType<int>(static_cast<integer>(static_cast<signed
\mathbf{int}{>}(\mathbf{operator}^*(\mathbf{heapIs}\ \$\mathbf{heap}_{funcstart\_1032,1},\ \mathbf{this}).\mathrm{p1})<(\mathbf{int})0)))\ +
temp1)))
→ [expand definition of operator '*' in class 'pointer' at built in declaration]
[53.5] heap_{1032,1;1051,8} == heap_{funcstart\_1032,1}._replace(this.$r \rightarrow
this.$r.value(heapIs \rho_{tart_1032,1})._replace(p1 \rightarrow
asType<P1Type>((30269 *
asType<int>(static_cast<integer>(static_cast<signed
int>(this.\$r.value(heapIs \$heap_{funcstart\_1032,1}).p1) < (int)0))) + temp1)))
```

```
\rightarrow [simplify]
[53.9] \theta_{1032,1;1051,8} == \theta_{1032,1;1051,8} = \theta_{1032,1;1051,8} == \theta
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow
asType<P1Type>((30269 * asType<int>(static_cast<integer>(0 <
-\mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}~\$\mathrm{heap}_{funcstart\_1032,1}).\mathrm{p1}))) + \mathrm{temp1})))
\rightarrow [from term 8.0, literala < -this.$r.value(heapIs $heap_{funcstart\_1032,1}).p1
is false whenever -2 < (0 + literala)
           Proof of rule precondition:
           [53.9.0] - 2 < (0 + 0)
           \rightarrow [simplify]
           [53.9.2] true
[53.10] $\text{heap}_{1032,1;1051,8} == $\text{heap}_{funcstart\_1032,1}._\text{replace}(\text{this}.$\text{$r} \to \text{$-$}
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow
asType<P1Type>((30269 * asType<int>(static_cast<integer>(false)))
+ \text{temp1})))
\rightarrow [simplify]
[53.11] $\text{heap}_{1032,1;1051,8} == \text{$heap}_{funcstart\_1032,1}._\text{replace}(\text{this}.\text{$r} \to \text{$}
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow
asType<P1Type>((30269 * asType<int>(([false]: 1, []: 0))) + temp1)))
→ [explicitly assert falsehood of skipped guards in subsequent guards]
[53.12] $\text{heap}_{1032,1:1051.8} == $\text{heap}_{funcstart\_1032,1}.$\text{-replace}(\text{this}.$\text{$r} \to \text{
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow
asType<P1Type>((30269 * asType<int>(([false]: 1, [true]: 0))) +
temp1)))
\rightarrow [simplify]
[53.15] $\text{heap}_{1032,1;1051,8} == $\text{heap}_{funcstart\_1032,1}.$\text{-replace}(\text{this}.$\text{$\frac{1}{2}}$
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow
asType < P1Type > (0 + temp1))
\rightarrow [from term 50.14, temp1 is equal to (-2 * div(heapIs $heap_{funcstart\_1032,1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177).quot) + (171 \ function for the first substitution of the first 
div(\mathbf{heapIs} \ \$heap_{funcstart\_1032,1}, \ \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
heap_{funcstart\_1032,1}.p1, 177).rem
[53.16] \; \$ heap_{1032,1;1051,8} == \$ heap_{funcstart\_1032,1}.\_\mathbf{replace}(\mathbf{this}.\$ r \to 0.000)
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow
asType < P1Type > (0 + ((-2 * div(heapIs $heap_{funcstart\_1032,1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177).quot) + (171 *
div(\mathbf{heapIs} \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
heap_{funcstart_{1032,1}}.p1, 177).rem))))
\rightarrow [simplify]
```

```
[53.19] $\text{heap}_{1032,1;1051,8} == $\text{heap}_{funcstart\_1032,1}.$\text{-replace}(\text{this}.$\text{$\frac{1}{2}}\)
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs $heap<sub>funcstart_1032,1</sub>, this.$r.value(heapIs
heap_{funcstart_{1032,1}}.p1, 177).rem)))
[Take goal term]
[1.0] ($heap<sub>1032,1:1051,8</sub>.b2 * static_cast<signed int>(div2.quot)) \leq
maxof(signed int)
\rightarrow [from term 53.19, heap_{1032,1;1051,8} is equal to
\$heap_{funcstart\_1032,1}.\_\textbf{replace(this.}\$r \rightarrow \textbf{this.}\$r.\textbf{value(heapIs}
heap_{funcstart\_1032,1}._replace(p1 \rightarrow (-2 * div(heapIs \$heap_{funcstart\_1032,1},
this.r.value(heapIs \ \$heap_{funcstart\_1032,1}).p1, \ 177).quot) + (171 * 
div(\mathbf{heapIs} \ \$heap_{funcstart\_1032,1}, \ \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
heap_{funcstart_{1032,1}}.p1, 177).rem)))
[1.1] (heap_{funcstart\_1032,1}._replace(this.r \rightarrow this.r.value(heapIs
heap_{funcstart\_1032,1}._replace(p1 \rightarrow ((-2 * div(heapIs heap_{funcstart\_1032,1}),
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177).quot) + (171 *
{\rm div}(\textbf{heapIs}~\$ heap_{funcstart\_1032,1},~\textbf{this}.\$ r. \textbf{value}(\textbf{heapIs}
\theta_{tuncstart_{1032,1}}.p1, 177.rem))).b2 * static_cast < signed
int > (div2.quot)) \le maxof(signed int)
→ [const member of object with modified fields]
[1.2] (\frac{1.2}{\text{heap}_{funcstart\_1032,1}}.b2 * static_cast<signed int>(div2.quot)) <
maxof(signed int)
\rightarrow [const static or extern object]
[1.3] ($heap<sub>init</sub>.b2 * static_cast<signed int>(div2.quot)) \leq maxof(signed)
int)
\rightarrow [expand definition of constant 'b2' at prang.cpp (36,26)]
[1.4] ((int)35 * static_cast<signed int>(div2.quot)) \leq maxof(signed int)
\rightarrow [simplify]
[1.5] (35 * static_cast<signed int>(div2.quot)) \leq maxof(signed int)
\rightarrow [from term 18.6, div2 is equal to div(heapIs $heap_{funcstart\_1032,1},
this.r.value(heapIs $heap_{funcstart\_1032,1}).p2, 176)
[1.6] (35 * static_cast<signed int>(div(heapIs $heap_{funcstart\_1032,1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p2, 176).quot)) \le maxof(signed)
int)
\rightarrow [simplify]
 \label{eq:continuous} \mbox{ $[1.17]$ -32768 < (-35 * div(\mathbf{heapIs} \ \$ heap_{funcstart\_1032,1}, \ \mathbf{this.}\$ r. \mathbf{value(heapIs} ) $] } 
heap_{funcstart_{1032.1}}.p2, 176).quot
```

```
\rightarrow [literal comparison of product]
[1.18] ([-35 < 0]: (-32768 / 35) < -\text{div}(\mathbf{heapIs} \ \text{\$} \text{heap}_{funcstart\_1032,1},
this.$r.value(heapIs heap_{funcstart_{-1032,1}}).p2, 176).quot, [0 < -35]: (-32768 /
-35) < div(heapIs \$heap_{funcstart\_1032,1}, this.\$r.value(heapIs)
\text{Sheap}_{funcstart\_1032.1}.p2, 176).quot, [-35 == 0]: -32768 < 0)
→ [explicitly assert falsehood of skipped guards in subsequent guards]
[1.19] ([-35 < 0]: (-32768 / 35) < -\text{div}(\mathbf{heapIs} \$ \text{heap}_{funcstart\_1032,1},
this.$r.value(heapIs \rho_{tart=1032,1}).p2, 176).quot, [(0 < -35) \rho_{tart=1032,1}.
0)]: (-32768 / -35) < div(heapIs $heap_{funcstart\_1032,1}, this.$r.value(heapIs)
\text{Sheap}_{funcstart\_1032,1}).p2, 176).quot, [(-35 == 0) \land!(-35 < 0) \land!(0 < -35)]:
-32768 < 0
\rightarrow [simplify]
[1.23] -937 < -\text{div}(\text{heapIs }\text{\$heap}_{funcstart\_1032,1}, \text{this.}\text{\$r.value}(\text{heapIs})
heap_{funcstart_{-1032,1}}.p2, 176).quot
→ [negate goal and search for contradiction]
[1.24]!(-937 < -\text{div}(\text{heapIs }\text{\$heap}_{funcstart\_1032,1}, \text{this.\$r.value}(\text{heapIs})
heap_{funcstart\_1032,1}.p2, 176).quot
\rightarrow [simplify]
[1.27] 936 < div(heapIs $heap<sub>funcstart_1032,1</sub>, this.$r.value(heapIs)
heap_{funcstart_{1032,1}}.p2, 176).quot
[Create new term from terms 1.27, 25.17 using rule: transitivity 16]
[67.0] (0 + 936) < (this.\$r.value(heapIs \$heap_{funcstart\_1032,1}).p2 / 176)
\rightarrow [simplify]
\textit{[67.8]} \ 164911 < \textbf{this.\$r.value(heapIs} \ \$heap_{funcstart\_1032,1}).p2
[Assume known post-assertion, class invariant or type constraint for term 18.6]
\label{eq:condition} \textit{[23.11] -30307} < -\textbf{this.} \\ \texttt{\$r.value}(\textbf{heapIs} \ \\ \texttt{\$heap}_{funcstart\_1032,1}).p2
\rightarrow [from term 67.8, literala < -this.$r.value(heapIs $heap_{funcstart\_1032,1}).p2
is false whenever -2 < (164911 + literala)
    Proof of rule precondition:
    [23.11.0] - 2 < (-30307 + 164911)
    \rightarrow [simplify]
    [23.11.2] true
[23.12] false
```

Proof of verification condition: Arithmetic result of operator '-' is within limit of type 'signed int'

```
In the context of class: WHPrang, declared at:
C:\Escher\Customers\prang-cpp\prang.cpp (18,1)
Condition generated at: C:\Escher\Customers\prang-cpp\prang.cpp
(77,52)
Condition defined at:
To prove: minof(signed int) \leq (($heap_{1032,1;1051,8}.r2 *
static_cast<signed int>(div2.rem)) - ($heap<sub>1032,1:1051,8</sub>.b2 *
static_cast<signed int>(div2.quot)))
Given:
heap_{init}.LIMIT == (int)80
heap_{init}.class WHPrang \in M1 == (int)30269
heap_{init}.class WHPrang \in r1 == (int)171
heap_{init}.class WHPrang \in a1 == (int)177
heap_{init}.class WHPrang \in b1 == (int)2
heap_{init}.class WHPrang \in M2 == (int)30307
heap_{init}.class WHPrang \in r2 == (int)172
heap_{init}.class WHPrang \in a2 == (int)176
heap_{init}.class WHPrang \in b2 == (int)35
heap_{init}.class WHPrang \in M3 == (int)30323
heap_{init}.class WHPrang \in r3 == (int)170
heap_{init}.class WHPrang \in a3 == (int)178
heap_{init}.class WHPrang \in b3 == (int)63
\operatorname{div} 1 == \operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_1032,1},
static_cast<int>(operator*(heapIs $heap_{funcstart\_1032,1}, this).p1),
\mathbf{static\_cast}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_1032,1}.\mathrm{a1}))
(asType<integer>(static_cast<int>(operator*(heapIs
heap_{funcstart\_1032,1}, this).p1) /
asType < integer > (static\_cast < int > (\$heap_{funcstart\_1032,1}.a1))) = =
asType<integer>(div1.quot)
(asType<integer>(static_cast<int>(operator*(heapIs
heap_{funcstart\_1032,1}, this).p1) %
asType < integer > (static\_cast < int > (\$heap_{funcstart\_1032.1}.a1))) = =
asType<integer>(div1.rem)
(\mathbf{asType}{<}\mathbf{integer}{>}(\mathbf{operator}^*(\mathbf{heapIs}\ \$\mathbf{heap}_{funcstart\_1032,1},\ \mathbf{this}).\mathtt{p1}) <
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathrm{heap}_{funcstart\_1032,1}.\mathrm{a1})) =>
(asType<integer>(div1.rem) == asType<integer>(operator*(heapIs
heap_{funcstart\_1032,1}, this).p1)
```

```
(\mathbf{asType} < \mathbf{integer} > (\$ \mathbf{heap}_{funcstart\_1032,1}.\mathbf{a1}) \le
asType < integer > (operator*(heapIs $heap_{funcstart\_1032,1}, this).p1)) = > funcsion*(heapIs $heap_{funcstart\_1032,1}, this).p1)
!(0 == asType < integer > (div1.quot))
!(0 == asType < integer > (div1.rem)) || !(0 ==
asType<integer>(div1.quot))
div2 == div(\mathbf{heapIs} \$ heap_{funcstart\_1032,1},
static\_cast < int > (operator*(heapIs $heap_{funcstart\_1032,1}, this).p2),
\mathbf{static\_cast}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_1032,1}.\mathrm{a2}))
(asType < integer > (static\_cast < int > (operator*(heapIs)))
heap_{funcstart\_1032,1}, this).p2)
asType < integer > (static\_cast < int > (\$heap_{funcstart\_1032.1}.a2))) = =
asType < integer > (div2.quot)
(asType<integer>(static_cast<int>(operator*(heapIs
heap_{funcstart\_1032,1}, this).p2)
asType < integer > (static\_cast < int > (\$heap_{funcstart\_1032,1}.a2))) = =
asType<integer>(div2.rem)
(asType<integer>(operator*(heapIs $heap_{tuncstart\_1032.1}, this).p2) <
asType < integer > (\$heap_{funcstart\_1032,1}.a2)) = >
(asType<integer>(div2.rem) == asType<integer>(operator*(heapIs
heap_{funcstart\_1032.1}, this).p2)
(asType < integer > (\$heap_{funcstart\_1032,1}.a2) \le
\mathbf{asType} < \mathbf{integer} > (\mathbf{operator}^*(\mathbf{heapIs} \ \$ \mathbf{heap}_{funcstart\_1032,1}, \ \mathbf{this}).\mathtt{p2})) = >
!(0 == asType < integer > (div2.quot))
!(0 == asType < integer > (div2.rem)) || !(0 ==
asType<integer>(div2.quot))
div3 == div(\mathbf{heapIs} \$ heap_{funcstart\_1032,1},
\mathbf{static\_cast} {<} \mathbf{int} {>} (\mathbf{operator}^*(\mathbf{heapIs}\ \$\mathbf{heap}_{funcstart\_1032,1},\ \mathbf{this}).\mathbf{p3}),
\mathbf{static\_cast} < \mathbf{int} > (\$ \mathbf{heap}_{funcstart\_1032,1}.\mathbf{a3}))
(asType<integer>(static_cast<int>(operator*(heapIs
heap_{funcstart\_1032,1}, this).p3)
asType < integer > (static\_cast < int > (\$heap_{funcstart\_1032.1}.a3))) = =
asType<integer>(div3.quot)
(asType<integer>(static_cast<int>(operator*(heapIs
heap_{funcstart\_1032,1}, this).p3)
\mathbf{asType} < \mathbf{integer} > (\mathbf{static\_cast} < \mathbf{int} > (\$ \mathbf{heap}_{funcstart\_1032,1}.\mathbf{a3}))) = =
asType<integer>(div3.rem)
(asType < integer > (operator*(heapIs $heap_{funcstart\_1032,1}, this).p3) < footnote{the content of the conte
asType < integer > (\$heap_{funcstart\_1032,1}.a3)) = >
(asType<integer>(div3.rem) == asType<integer>(operator*(heapIs
heap_{funcstart=1032.1}, this).p3)
(asType < integer > (\$heap_{funcstart\_1032,1}.a3) \le
```

```
asType < integer > (operator*(heapIs $heap_{funcstart\_1032.1}, this).p3)) = >
!(0 == asType < integer > (div3.quot))
!(0 == asType < integer > (div3.rem)) || !(0 ==
asType<integer>(div3.quot))
temp1 == (\$heap_{funcstart\_1032,1}.r1 * \textbf{static\_cast} < \textbf{signed int} > (div1.rem)) - (div1.rem) + (div1.r
(\$heap_{funcstart\_1032,1}.b1 * \textbf{static\_cast}{<} \textbf{signed int}{>} (\text{div1.quot}))
minof(signed\ int) \le temp1
temp1 \le maxof(signed int)
heap_{1032,1;1051,8} == heap_{funcstart\_1032,1}._replace(this.$r \rightarrow
\mathbf{operator}^*(\mathbf{heapIs}~\$ \mathrm{heap}_{funcstart\_1032,1},~\mathbf{this}).\_\mathbf{replace}(\mathrm{p1} \rightarrow
\mathbf{asType}{<}P1\mathsf{Type}{>}((\$\mathsf{heap}_{funcstart\_1032,1}.\mathsf{M1}~*
asType < int > (static\_cast < integer > (static\_cast < signed)
int>(operator^*(heapIs \$heap_{funcstart\_1032,1}, this).p1) < (int)0))) +
temp1)))
Proof:
[Take given term]
[2.0] div1 == div(heapIs $heap<sub>funcstart_1032,1</sub>,
static\_cast < int > (operator*(heapIs $heap_{funcstart\_1032,1}, this).p1),
static\_cast < int > (\$heap_{funcstart\_1032,1}.a1))
→ [expand definition of operator '*' in class 'pointer' at built in declaration]
[2.1] \operatorname{div1} == \operatorname{div}(\mathbf{heapIs} \ \text{$heap}_{funcstart\_1032,1},
static_cast<int>(this.$r.value(heapIs $heap_{funcstart\_1032,1}).p1),
static\_cast < int > (\$heap_{funcstart\_1032.1}.a1))
\rightarrow [simplify]
[2.2] \text{ div1} == \text{div(heapIs } \text{$heap}_{funcstart\_1032,1}, \text{this.} \text{$r.value(heapIs)}
\rho_{tuncstart_1032.1}, p1, static_cast<int>(\rho_{tuncstart_1032.1})
\rightarrow [const static or extern object]
[2.3] \text{ div1} == \text{div}(\text{heapIs } \text{heap}_{funcstart\_1032,1}, \text{this.}\text{\$r.value}(\text{heapIs})
\$ heap_{funcstart\_1032,1}).p1, \ \mathbf{static\_cast} < \mathbf{int} > (\$ heap_{init}.a1))
\rightarrow [expand definition of constant 'a1' at prang.cpp (30,26)]
[2.4]~{\rm div1} == {\rm div}(\mathbf{heapIs}~\$ \mathrm{heap}_{funcstart\_1032,1},~\mathbf{this}.\$ \mathrm{r.value}(\mathbf{heapIs}
\theta_{funcstart\_1032,1}.p1, \theta_{funcstart\_1032,1}.p1, \theta_{funcstart\_1032,1}.p1, \theta_{funcstart\_1032,1}.p1, \theta_{funcstart\_1032,1}.p1, \theta_{funcstart\_1032,1}.p2, \theta_{funcstart\_1032,1}.p2, \theta_{funcstart\_1032,1}.p2, \theta_{funcstart\_1032,1}.p2, \theta_{funcstart\_1032,1}.p2, \theta_{funcstart\_1032,1}.p3, \theta_{funcstart\_1032,1}.p4, \theta_{funcstart\_1032,1}.p4, \theta_{funcstart\_1032,1}.p4, \theta_{funcstart\_1032,1}.p4, \theta_{funcstart\_1032,1}.p5, \theta_{funcstart\_1032,1
\rightarrow [simplify]
[2.6] \operatorname{div1} == \operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_1032,1}, \mathbf{this.}\$ r. \mathbf{value}(\mathbf{heapIs})
heap_{funcstart\_1032,1}.p1, 177)
[Assume known post-assertion, class invariant or type constraint for term 2.6]
[7.0] (0 < asType<integer>(this.$r.value(heapIs
```

```
\label{eq:linear_funcstart} $$ \operatorname{heap}_{funcstart\_1032,1}.p1)) \&\& (asType < integer > (this.\$r.value(heapIs)) \\
\verb§heap$_{funcstart\_1032,1}).p1) < \mathbf{asType} < \mathbf{integer} > (\$ heap.\mathbf{class} \ \text{WHPrang} \in \texttt{Partition})
M1))
\rightarrow [simplify]
[7.2] (0 < this.$r.value(heapIs \theta_{funcstart\_1032,1}).p1) &&
(this.r.value(heapIs $heap_{funcstart\_1032.1}).p1 <
asType < integer > (\$heap.class WHPrang \in M1))
\rightarrow [const static or extern object]
[7.3] (0 < this.$r.value(heap
Is \rho_{funcstart\_1032,1}).p1) &&
(this.$r.value(heapIs heap_{funcstart\_1032,1}).p1 <
asType < integer > (\$heap_{init}.class WHPrang \in M1))
\rightarrow [expand definition of constant 'M1' at prang.cpp (28,26)]
[7.4] (0 < this.\$r.value(heapIs \$heap_{funcstart_1032.1}).p1) &&
(this.r.value(heapIs $heap_{funcstart\_1032,1}).p1 <
asType < integer > ((int)30269))
\rightarrow [simplify]
[7.10] (-30269 < -this.$r.value(heapIs heap_{funcstart\_1032,1}).p1) <math>\land (0 < 
this.r.value(heapIs $heap_{funcstart\_1032,1}).p1)
[Work on sub-term 2 of conjunction in term 7.10]
[8.0] 0 < this.$r.value(heapIs $heap<sub>funcstart_1032,1</sub>).p1
[Take given term]
[18.0] \operatorname{div2} == \operatorname{div}(\mathbf{heapIs} \ \text{$heap}_{funcstart\_1032,1},
static\_cast < int > (operator*(heapIs $heap_{funcstart\_1032,1}, this).p2),
\mathbf{static\_cast}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_1032,1}.\mathrm{a2}))
\rightarrow [expand definition of operator '*' in class 'pointer' at built in declaration]
[18.1] \operatorname{div2} == \operatorname{div}(\mathbf{heapIs} \ \operatorname{\$heap}_{funcstart\_1032,1},
\mathbf{static\_cast} < \mathbf{int} > (\mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs} \$ \mathbf{heap}_{funcstart\_1032,1}).p2),
static\_cast < int > (\$heap_{funcstart\_1032,1}.a2))
\rightarrow [simplify]
[18.2] \text{div2} == \text{div}(\mathbf{heapIs} \text{ \$heap}_{funcstart\_1032,1}, \mathbf{this.\$r.value}(\mathbf{heapIs})
\theta_{funcstart\_1032,1}.p2, \theta_{funcstart\_1032,1}.p2, \theta_{funcstart\_1032,1}.a2))
\rightarrow [const static or extern object]
[18.3] div2 == div(\mathbf{heapIs} \ \hat{\mathbf{s}}_{heap}), this.\hat{\mathbf{s}}_{r.}value(\mathbf{heapIs}
\label{eq:cast_int} $$ heap_{funcstart\_1032,1}).p2, $ static\_cast < int > ($heap_{init}.a2)) $$
\rightarrow [expand definition of constant 'a2' at prang.cpp (35,26)]
[18.4] div2 == div(heapIs $heap<sub>funcstart_1032,1</sub>, this.$r.value(heapIs)
\theta_{funcstart\_1032,1}.p2, \theta_{funcstart}(int).p2, \theta_{funcstart}(int).p3, \theta_{funcstart}(int).p4, \theta_{funcstart}(int).p4, \theta_{funcstart}(int).p4, \theta_{funcstart}(int).p5, \theta_{funcstart}(int).p6, \theta_{funcstart}(int).p7, \theta_{funcstart}(int
```

```
\rightarrow [simplify]
[18.6] div2 == div(heapIs $heap_{funcstart\_1032,1}, this.$r.value(heapIs)
heap_{funcstart_{-1032,1}}.p2, 176
[Assume known post-assertion, class invariant or type constraint for term 18.6]
[23.0] (0 < asType<integer>(this.$r.value(heapIs
$heap_funcstart_1032.1).p2)) && (asType<integer>(this.$r.value(heapIs
\rho_{funcstart\_1032,1}.p2 < asType<integer>(\rho_{funcstart\_1032,1}.p2) < asType<integer>(\rho_{funcstart\_1032,1}.p2)
M2))
\rightarrow [simplify]
[23.2] (0 < this.$r.value(heap
Is \rho_{funcstart\_1032,1}).p2) &&
(this.$r.value(heapIs heap_{funcstart\_1032,1}).p2 <
asType < integer > (\text{$heap.class WHPrang} \in M2))
\rightarrow [const static or extern object]
[23.3] (0 < this.$r.value(heapIs $heap_{funcstart\_1032,1}).p2) &&
(this.r.value(heapIs $heap_{funcstart\_1032,1}).p2 <
asType < integer > (\$heap_{init}.class WHPrang \in M2))
\rightarrow [expand definition of constant 'M2' at prang.cpp (33,26)]
[23.4] (0 < this.$r.value(heapIs heap_{funcstart\_1032,1}).p2) &&
(this.$r.value(heapIs \rho_{funcstart\_1032,1}).p2 <
asType < integer > ((int)30307))
\rightarrow [simplify]
[23.10] (-30307 < -this.$r.value(heapIs \rho_{funcstart\_1032,1}).p2) \wedge (0 <
this.r.value(heapIs $heap_{funcstart\_1032,1}).p2)
\rightarrow [separate conjunction and work on first sub-term]
[23.11] -30307 < -this.$r.value(heapIs heapIs heap_{funcstart\_1032,1}).p2
[Work on sub-term 2 of conjunction in term 23.10]
[24.0] 0 < this.$r.value(heapIs $heap_{funcstart\_1032,1}).p2
[Assume known post-assertion, class invariant or type constraint for term 18.6]
[25.0] (asType<integer>(this.r.value(heapIs \ heap_{funcstart\_1032,1}).p2) /
asType<integer>(176)) == asType<integer>(div(heapIs
\rho_{tuncstart\_1032.1}, this.r.value(heapIs \rho_{tuncstart\_1032.1}).p2,
176).quot)
\rightarrow [simplify]
[25.2] (this.$r.value(heapIs $heap_{funcstart_1032,1}).p2 / 176) ==
asType<integer>(div(heapIs $heap_{funcstart\_1032,1}, this.$r.value(heapIs
heap_{funcstart\_1032,1}.p2, 176).quot)
→ [expand definition of operator './' in class 'int' at built in declaration]
```

```
{\it [25.3]}~([{\bf asType}{<}{\bf integer}{>}({\bf this.\$r.value}({\bf heapIs}~\${\bf heap}_{funcstart\_1032,1}).{\bf p2})<
0]: -(-asType < integer > (this. r.value(heapIs  heap_{funcstart\_1032,1}).p2) / (this. r.value(heapIs  heap_{funcstart\_1032,1}).p2)
176), []: asType<integer>(this.$r.value(heapIs $heap_{tuncstart\_1032,1}).p2) /
176) == asType<integer>(div(heapIs $heap_{funcstart\_1032,1},)
this.r.value(heapIs $heap_{funcstart\_1032,1}).p2, 176).quot)
→ [explicitly assert falsehood of skipped guards in subsequent guards]
{\it [25.4]}~([{\bf asType}{<}{\bf integer}{>}({\bf this.\$r.value}({\bf heapIs}~\${\bf heap}_{funcstart\_1032,1}).{\bf p2})<
0]: -(-asType < integer > (this. r.value(heapIs $heap_{funcstart\_1032.1}).p2) / (this. r.value(heapIs $heap_{funcstart\_1032.1}).p2)
176), [!(asType<integer>(this.$r.value(heapIs \rho_{tancstart\_1032,1}).p2) <
0)]: asType<integer>(this.$r.value(heapIs $heap_{typestart 1032.1}).p2) /
176) == asType<integer>(div(heapIs heap_{funcstart\_1032,1},
this.$r.value(heapIs \theta_{funcstart\_1032,1}).p2, 176).quot)
\rightarrow [simplify]
[25.7] ([0 < -this.$r.value(heapIs $heap_{funcstart\_1032.1}).p2]:
-(-asType < integer > (this. r.value(heapIs  heap_{funcstart\_1032.1}).p2) /
176), [!(asType<integer>(this.$r.value(heapIs \rho_{tart_1032,1}.p2) <
0)]: asType < integer > (this. r.value(heapIs  heap_{funcstart\_1032,1}).p2) / 
176) == asType<integer>(div(heapIs $heap_{funcstart\_1032,1},
this.$r.value(heapIs $heap_{tuncstart_1032,1}).p2, 176).quot)
\rightarrow [from term 24.0, literala < -this.$r.value(heapIs $heap_{funcstart\_1032.1}).p2
is false whenever -2 < (0 + literala)
      Proof of rule precondition:
      [25.7.0] - 2 < (0 + 0)
      \rightarrow [simplify]
      [25.7.2] true
[25.8] \; ([\mathbf{false}] \colon -(-\mathbf{asType} < \mathbf{integer} > (\mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}))) \\
\rho_{uncstart\_1032,1}.p2) / 176, [!(asType<integer>(this.$r.value(heapIs)
\rho_{tuncstart_1032.1}.p2 < 0: asType<integer>(this.\r.value(heapIs)
\theta_{funcstart\_1032,1}.p2) / 176) == asType<integer>(div(heapIs)
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p2,
176).quot)
\rightarrow [simplify]
[25.11] ([false]: -(-asType<integer>(this.$r.value(heapIs
\theta_{funcstart\_1032,1}.p2) / 176, [!\theta_{funcstart\_1032,1}.p2] / 176), [!\theta_{funcstart\_1032,1}.p2]
\label{eq:linear_funcstart} $$ $ [-1032,1).p2) : as Type < integer > (this. r.value (heap Is the property of the property of
\theta_{funcstart\_1032,1}.p2) / 176 = asType < integer > (div(heapIs))
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p2,
176).quot)
\rightarrow [from term 24.0, literala < -this.$r.value(heapIs $heap_{funcstart\_1032,1}).p2
is false whenever -2 < (0 + literala)
```

```
Proof of rule precondition:
   [25.11.0] - 2 < (0 + 0)
   \rightarrow [simplify]
   [25.11.2] true
[25.12] ([false]: -(-asType<integer>(this.$r.value(heapIs
heap_{funcstart\_1032,1}.p2) / 176, [!false]:
asType<integer>(this.$r.value(heapIs $heap_{funcstart\_1032,1}).p2) / 176)
== asType < integer > (div(heapIs $heap_{funcstart\_1032,1},
this.r.value(heapIs $heap_{funcstart\_1032,1}).p2, 176).quot)
\rightarrow [simplify]
[25.17] 0 == (-div(heapIs \rho_{funcstart\_1032,1}, this.r.value(heapIs)
\theta_{funcstart_1032,1}.p2, 176).quot + (this.\rangle r.value(heapIs)
heap_{funcstart_{1032,1}}.p2 / 176)
[Assume known post-assertion, class invariant or type constraint for term 18.6]
[26.0] (asType<integer>(this.$r.value(heapIs $heap_{tuncstart\_1032.1}).p2) %
asType<integer>(176)) == asType<integer>(div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p2,
176).rem
\rightarrow [simplify]
[26.2] (this.$r.value(heapIs heap_{funcstart\_1032,1}).p2 % 176) ==
asType<integer>(div(heapIs $heap_{funcstart\_1032,1}, this.$r.value(heapIs
heap_{funcstart\_1032.1}.p2, 176).rem
→ [expand definition of operator '.%' in class 'int' at built in declaration]
{\it [26.3]}~([{\bf asType}{<}{\bf integer}{>}({\bf this.\$r.value}({\bf heapIs}~\${\bf heap}_{funcstart\_1032,1}).{\bf p2})<
0]: -(-asType < integer > (this.\$r.value(heapIs \$heap_{funcstart\_1032,1}).p2) \%
176), []: asType<integer>(this.$r.value(heapIs $heap_{tuncstart\_1032.1}).p2)
\% 176) == asType<integer>(div(heapIs $heap_{funcstart\_1032,1},
this.r.value(heapIs $heap_{funcstart\_1032,1}).p2, 176).rem)
\rightarrow [explicitly assert falsehood of skipped guards in subsequent guards]
[26.4] ([asType<integer>(this.$r.value(heapIs $heap_{funcstart\_1032,1}).p2) <
0]: -(-asType < integer > (this. r.value(heapIs  heap_{funcstart\_1032,1}).p2) \%
176), [!(asType<integer>(this.r.value(heapIs \heap_{funcstart\_1032,1}).p2) <
0)]: asType<integer>(this.$r.value(heapIs \theta_{funcstart\_1032,1}).p2) %
176) == asType<integer>(div(heapIs heap_{funcstart\_1032,1},
this.$r.value(heapIs $heap_{funcstart\_1032.1}).p2, 176).rem)
\rightarrow [simplify]
[26.7] ([0 < -this.$r.value(heapIs $heap<sub>funcstart_1032,1</sub>).p2]:
-(-asType < integer > (this. r.value(heapIs  heap_{funcstart\_1032,1}).p2) \%
176), [!(asType<integer>(this.$r.value(heapIs $heap_{funcstart\_1032,1}).p2) <
```

```
0)]: asType<integer>(this.$r.value(heapIs \rho_{uncstart\_1032,1}).p2)~\%
176) == asType<integer>(div(heapIs $heap_{funcstart\_1032,1},
\mathbf{this.\$r.value(heapIs}\ \$heap_{funcstart\_1032,1}).p2,\ 176).rem)
\rightarrow [from term 24.0, literala < -this.$r.value(heapIs $heap_{funcstart\_1032,1}).p2
is false whenever -2 < (0 + literala)
        Proof of rule precondition:
        [26.7.0] - 2 < (0 + 0)
        \rightarrow [simplify]
        [26.7.2] true
[26.8] ([false]: -(-asType<integer>(this.$r.value(heapIs
\label{eq:funcstart_1032,1} $$ \operatorname{heap}_{funcstart_1032,1}.p2) < 0)$ ]: $$ \mathbf{asType} < \mathbf{integer} > (\mathbf{this.\$r.value}(\mathbf{heapIs})) = \mathbf{funcstart} = \mathbf{funcst
\theta_{funcstart\_1032.1}.p2) % 176) == asType<integer>(div(heapIs)
\rho_{tuncstart\_1032.1}, this.r.value(heapIs \rho_{tuncstart\_1032.1}).p2,
176).rem)
\rightarrow [simplify]
[26.11] ([false]: -(-asType<integer>(this.$r.value(heapIs
\theta_{funcstart\_1032,1}.p2) \% 176, [!\theta_{funcstart\_1032,1}.p2] % 176), [!\theta_{funcstart\_1032,1}.p2]
\rho_{funcstart_{1032,1}}.p2): asType<integer>(this.$r.value(heapIs)
\label{eq:funcstart_1032,1} \$ heap_{funcstart\_1032,1}).p2) \% \ 176) == \mathbf{asType} < \mathbf{integer} > (\mathrm{div}(\mathbf{heapIs}
\rho_{tuncstart_1032.1}, this.r.value(heapIs \rho_{tuncstart_1032.1}).p2,
176).rem)
\rightarrow [from term 24.0, literala < -this.$r.value(heapIs $heap_{funcstart\_1032,1}).p2
is false whenever -2 < (0 + literala)
        Proof of rule precondition:
        [26.11.0] - 2 < (0 + 0)
        \rightarrow [simplify]
        [26.11.2] true
[26.12] ([false]: -(-asType<integer>(this.$r.value(heapIs
heap_{funcstart\_1032,1}.p2) \% 176, [!false]:
asType<integer>(this.$r.value(heapIs $heap_{funcstart\_1032,1}).p2) % 176)
== asType < integer > (div(heapIs $heap_{funcstart\_1032,1},
this.r.value(heapIs $heap_{funcstart\_1032,1}).p2, 176).rem)
\rightarrow [simplify]
[26.17] \ 0 == (-\text{div}(\textbf{heapIs} \ \$ \text{heap}_{funcstart\_1032,1}, \ \textbf{this}.\$ \textbf{r.value}(\textbf{heapIs} \ \texttt{heap}_{funcstart\_1032,1}, \ \textbf{this}.\$ \textbf{r.value}))
\theta_{funcstart\_1032,1}.p2, 176.rem + (this.r.value(heapIs)
heap_{funcstart_{1032,1}}.p2 \% 176)
[Take given term]
```

```
[50.0] \; ((\$ heap_{funcstart\_1032,1}.r1 \; * \; \textbf{static\_cast} < \textbf{signed int} > (\text{div1.rem})) \; - \; \text{div1.rem})) \; - \; \text{div1.rem}) \; + \; \text{div
(\text{sheap}_{funcstart\_1032,1}.\text{b1} * \text{static\_cast} < \text{signed int} > (\text{div1.quot}))) == \text{temp1}
\rightarrow [const static or extern object]
[50.1] (($heap<sub>init</sub>.r1 * static_cast<signed int>(div1.rem)) -
(\text{sheap}_{funcstart\_1032,1}.\text{b1 * static\_cast} < \text{signed int} > (\text{div1.quot}))) == \text{temp1}
\rightarrow [expand definition of constant 'r1' at prang.cpp (29,26)]
[50.2] (((int)171 * static_cast<signed int>(div1.rem)) -
(\text{\$heap}_{funcstart\_1032,1}.\text{b1 * static\_cast} < \text{signed int} > (\text{div1.quot}))) == \text{temp1}
\rightarrow [simplify]
[50.3] ((171 * static_cast < signed int > (div1.rem)) - (\text{$heap_{funcstart\_1032,1}.b1}
* static_cast<signed int>(div1.quot))) == temp1
\rightarrow [from term 2.6, div1 is equal to div(heapIs $heap_{funcstart\_1032.1},
this.$r.value(heapIs $heap_{funcstart\_1032,1}).p1, 177)]
[50.4] ((171 * static_cast<signed int>(div(heapIs $heap_{tuncstart\_1032.1})
this.r.value(heapIs $heap_{funcstart\_1032,1}).p1, 177).rem)) -
(\text{sheap}_{funcstart\_1032.1}.\text{b1} * \text{static\_cast} < \text{signed int} > (\text{div1.quot}))) == \text{temp1}
\rightarrow [simplify]
[50.5] ((171 * div(heapIs $heap<sub>funcstart_1032,1</sub>, this.$r.value(heapIs)
\text{Sheap}_{funcstart\_1032,1}.\text{p1}, 177).\text{rem} - (\text{Sheap}_{funcstart\_1032,1}.\text{b1} *
static_cast<signed int>(div1.quot))) == temp1
\rightarrow [const static or extern object]
[50.6] ((171 * div(heapIs $heap_{funcstart\_1032,1}, this.$r.value(heapIs)]
\rho_{uncstart\_1032,1}.p1, 177).rem – (\rho_{uncstart\_1032,1}.p1, 177).rem) – (\rho_{uncstart\_1032,1}.p1, 177).rem) – (\rho_{uncstart\_1032,1}.p1, 177).rem)
int>(div1.quot)) == temp1
\rightarrow [expand definition of constant 'b1' at prang.cpp (31,26)]
[50.7] ((171 * \mathrm{div}(\mathbf{heapIs}\ \$\mathrm{heap}_{funcstart\_1032,1},\ \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}
\theta_{uncstart\_1032,1}.p1, 177).rem - ((int)2 * static\_cast < signed)
int>(div1.quot)) == temp1
\rightarrow [simplify]
[50.8] ((171 * div(heapIs $heap_{funcstart\_1032,1}, this.$r.value(heapIs)]
\theta_{funcstart\_1032,1}.p1, 177).rem - (2 * static\_cast < signed)
int>(div1.quot))) == temp1
\rightarrow [from term 2.6, div1 is equal to div(heapIs $heap_{funcstart\_1032.1},
this.r.value(heapIs \ heap_{funcstart\_1032.1}).p1, 177)
[50.9] ((171 * div(heapIs $heap_{funcstart\_1032,1}, this.$r.value(heapIs)]
\theta_{funcstart\_1032,1}.p1, 177).rem) - (2 * static_cast<signed)
int>(div(heapIs \$heap_{funcstart\_1032,1}, this.\$r.value(heapIs
\$ \operatorname{heap}_{funcstart\_1032,1}).\operatorname{p1},\ 177).\operatorname{quot}))) == \operatorname{temp1}
```

```
\rightarrow [simplify]
[50.14] 0 == (-\text{temp1} + (-2 * \text{div}(\text{heapIs } \text{\$heap}_{tuncstart\_1032.1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177).quot) + (171 *
div(\mathbf{heapIs} \$ heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
heap_{funcstart_{-1032.1}}.p1, 177).rem
[Take given term]
[53.0] heap_{1032,1;1051,8} == heap_{funcstart\_1032,1}._replace(this.r \rightarrow
operator*(heapIs heap_{funcstart\_1032,1}, this)._replace(p1 \rightarrow
\mathbf{asType}{<}P1\mathsf{Type}{>}((\$\mathsf{heap}_{funcstart\_1032,1}.\mathsf{M1}~*
asType<int>(static_cast<integer>(static_cast<signed
int>(operator*(heapIs $heap_{funcstart\_1032,1}, this).p1) < (int)0))) +
temp1)))
→ [expand definition of operator '*' in class 'pointer' at built in declaration]
[53.1] $heap<sub>1032,1:1051,8</sub> == $heap<sub>funcstart_1032,1</sub>._replace(this.$r \rightarrow
this.$r.value(heapIs \theta_{funcstart\_1032,1})._replace(p1 \rightarrow
asType<P1Type>(($heap<sub>funcstart_1032.1</sub>.M1 *
asType<int>(static_cast<integer>(static_cast<signed
int>(operator^*(heapIs \$heap_{funcstart\_1032,1}, this).p1) < (int)0))) +
temp1)))
\rightarrow [const static or extern object]
[53.2] heap_{1032,1;1051,8} == heap_{funcstart\_1032,1}._replace(this.r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow
asType<P1Type>(($heap<sub>init</sub>.M1 *
asType<int>(static_cast<integer>(static_cast<signed
int>(operator^*(heapIs \$heap_{funcstart\_1032,1}, this).p1) < (int)0))) +
temp1)))
\rightarrow [expand definition of constant 'M1' at prang.cpp (28,26)]
[53.3] $\text{heap}_{1032,1:1051.8} == \text{$heap}_{funcstart\_1032,1}._\text{replace}(\text{this}.\text{$r} \to \text{$}
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow
asType<P1Type>(((int)30269 *
asType{<}int{>}(static\_cast{<}integer{>}(static\_cast{<}signed
int>(operator^*(heapIs \$heap_{funcstart\_1032,1}, this).p1) < (int)0))) +
temp1)))
\rightarrow [simplify]
[53.4] heap_{1032,1;1051,8} == heap_{funcstart\_1032,1}._replace(this.r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow
asType<P1Type>((30269 *
asType < int > (static\_cast < integer > (static\_cast < signed)
int>(operator^*(heapIs \$heap_{funcstart\_1032,1}, this).p1) < (int)0))) +
temp1)))
→ [expand definition of operator '*' in class 'pointer' at built in declaration]
```

```
[53.5] heap_{1032,1;1051,8} == heap_{funcstart\_1032,1}._replace(this.r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow
asType<P1Type>((30269 *
as Type < int > (static\_cast < integer > (static\_cast < signed
int>(this.\$r.value(heapIs \$heap_{funcstart\_1032,1}).p1) < (int)0))) + temp1)))
\rightarrow [simplify]
[53.9] $heap<sub>1032,1;1051,8</sub> == $heap<sub>funcstart_1032,1</sub>._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow
asType<P1Type>((30269 * asType<int>(static_cast<integer>(0 <
-this.r.value(heapIs heap_{funcstart\_1032,1}.p1))) + temp1)))
\rightarrow [from term 8.0, literala < -this.$r.value(heapIs $heap_{funcstart\_1032.1}).p1
is false whenever -2 < (0 + literala)
    Proof of rule precondition:
    [53.9.0] - 2 < (0 + 0)
    \rightarrow [simplify]
    [53.9.2] true
[53.10] $\text{heap}_{1032,1;1051,8} == $\text{heap}_{funcstart\_1032,1}._\text{replace}(\text{this}.\text{$\frac{1}{2}r$})
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow
asType<P1Type>((30269 * asType<int>(static_cast<integer>(false)))
+ \text{temp1})))
\rightarrow [simplify]
[53.11] $\text{heap}_{1032,1;1051,8} == $\text{heap}_{funcstart\_1032,1}._\text{replace}(\text{this}.\text{$\frac{1}{2}r$})
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow
asType < P1Type > ((30269 * asType < int > (([false]: 1, []: 0))) + temp1)))
→ [explicitly assert falsehood of skipped guards in subsequent guards]
[53.12] $\text{heap}_{1032,1:1051.8} == $\text{heap}_{funcstart\_1032,1}.$\text{-replace}(\text{this}.$\text{$r} \to \text{
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow
asType<P1Type>((30269 * asType<int>(([false]: 1, [true]: 0))) +
temp1)))
\rightarrow [simplify]
[53.15] $heap<sub>1032,1;1051,8</sub> == $heap<sub>funcstart_1032,1</sub>._replace(this.$r \rightarrow
this.$r.value(heapIs \rho_{funcstart\_1032,1})._replace(p1 \rightarrow
asType < P1Type > (0 + temp1))
\rightarrow [from term 50.14, temp1 is equal to (-2 * div(heapIs $heap_{funcstart\_1032,1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177).quot) + (171 * leapIs \ heap_{funcstart\_1032,1}).p1, 177).quot)
div(\mathbf{heapIs}\ \$heap_{funcstart\_1032,1},\ \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}
heap_{funcstart\_1032,1}.p1, 177).rem
[53.16] $heap<sub>1032.1:1051.8</sub> == $heap<sub>funcstart_1032.1</sub>._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow
```

```
asType < P1Type > (0 + ((-2 * div(heapIs $heap_{funcstart\_1032,1},
this.$r.value(heapIs \theta_{funcstart\_1032,1}).p1, 177).quot) + (171 *
div(\mathbf{heapIs} \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
heap_{funcstart\_1032,1}.p1, 177.rem))))
\rightarrow [simplify]
[53.19] $heap<sub>1032,1;1051,8</sub> == $heap<sub>funcstart_1032,1</sub>._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
heap_{funcstart\_1032,1}.p1, 177).rem)))
[Take goal term]
[1.0] minof(signed int) \leq ((\theta_{1.032,1:1051,8}.r2 * static_cast\theta_{1.032,1:1051,8}.r2 * static_cast
int>(div2.rem)) - (\$heap_{1032.1:1051.8}.b2 * static\_cast < signed)
int > (div2.quot))
\rightarrow [simplify]
[1.1] -32768 \leq (($heap<sub>1032,1;1051,8</sub>.r2 * static_cast<signed int>(div2.rem)) -
(\text{sheap}_{1032.1:1051.8}.\text{b2} * \text{static\_cast} < \text{signed int} > (\text{div}2.\text{quot})))
\rightarrow [from term 53.19, $heap<sub>1032,1:1051,8</sub> is equal to
\$heap_{funcstart\_1032,1}.\_\textbf{replace}(\textbf{this}.\$r \rightarrow \textbf{this}.\$r.\textbf{value}(\textbf{heapIs}
heap_{funcstart\_1032,1}._replace(p1 \rightarrow (-2 * div(heapIs \$heap_{funcstart\_1032,1}, -2))
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177).quot) + (171)
div(heapIs $heap_{tuncstart\_1032.1}, this.$r.value(heapIs
heap_{funcstart_{1032.1}}.p1, 177).rem)))
[1.2] -32768 \leq (($heap_funcstart_1032,1._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
\rho_{funcstart\_1032,1}.p1, 177).rem))).r2 * static\_cast < signed
int>(div2.rem)) - (\$heap_{1032,1:1051,8}.b2 * static\_cast < signed)
\mathbf{int}{>}(\mathrm{div2.quot})))
→ [const member of object with modified fields]
[1.3] -32768 \leq (($heap_funcstart_1032,1.r2 * static_cast<signed)
int>(div2.rem)) - (\$heap_{1032.1:1051.8}.b2 * static\_cast < signed)
int>(div2.quot)))
\rightarrow [const static or extern object]
[1.4] -32768 \leq (($heap<sub>init</sub>.r2 * static_cast<signed int>(div2.rem)) -
(\text{sheap}_{1032,1;1051,8}.\text{b2} * \text{static\_cast} < \text{signed int} > (\text{div2.quot})))
\rightarrow [expand definition of constant 'r2' at prang.cpp (34,26)]
[1.5] -32768 \leq (((int)172 * static_cast \leq signed int\geq(div2.rem)) -
(\$heap_{1032,1;1051,8}.b2 * \mathbf{static\_cast} {<} \mathbf{signed\ int} {>} (\mathrm{div2.quot})))
```

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\rightarrow [simplify]
[1.6] -32768 \leq ((172 * static_cast < signed int > (div2.rem)) -
(\text{sheap}_{1032,1;1051,8}.\text{b2} * \text{static\_cast} < \text{signed int} > (\text{div}2.\text{quot})))
\rightarrow [from term 18.6, div2 is equal to div(heapIs $heap_{funcstart\_1032,1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p2, 176)]
[1.7] -32768 \leq ((172 * static_cast<signed int>(div(heapIs))
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p2,
(176).rem) - (\text{sheap}_{1032,1;1051,8}.b2 * static\_cast < signed int > (div2.quot)))
\rightarrow [simplify]
[1.8] \ -32768 \le ((172 \ * \ \mathrm{div}(\mathbf{heapIs} \ \$ \mathrm{heap}_{funcstart\_1032,1}, \ \mathbf{this}.\$ r. \mathbf{value}(\mathbf{heapIs} \ \$))
heap_{funcstart\_1032,1}.p2, 176).rem - (heap_{1032,1;1051,8}.b2 *
static_cast<signed int>(div2.quot)))
\rightarrow [from term 53.19, $heap<sub>1032.1:1051.8</sub> is equal to
$heap_{funcstart\_1032,1}.$_replace(this.$r \rightarrow this.$r.value(heapIs)
heap_{funcstart\_1032,1}._replace(p1 \rightarrow (-2 * div(heapIs \$heap_{funcstart\_1032,1},
this.$r.value(heapIs heap_{funcstart\_1032,1}).p1, 177).quot) + (171 *
div(\mathbf{heapIs} \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
heap_{funcstart\_1032,1}.p1, 177).rem)))]
[1.9] -32768 \leq ((172 * div(heapIs $heap_{funcstart\_1032,1}, this.$r.value(heapIs)
\rho_{funcstart_{-1032,1}}.p2, 176).rem – (\rho_{funcstart_{-1032,1}}.replace)
\rightarrow this.$r.value(heapIs $heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 *
div(\mathbf{heapIs} \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
\text{Sheap}_{funcstart\_1032,1}.p1, 177).quot) + (171 * div(heapIs \text{Sheap}_{funcstart\_1032,1},
this.r.value(heapIs \ensuremath{\$}heap_{funcstart\_1032,1}).p1, 177).rem)))).b2 *
static_cast<signed int>(div2.quot)))
\rightarrow [const member of object with modified fields]
[1.10] -32768 \leq ((172 * div(heapIs $heap_{funcstart\_1032,1},
this.r.value(heapIs $heap_{funcstart\_1032,1}).p2, 176).rem) -
(\text{sheap}_{funcstart\_1032,1}.\text{b2} * \text{static\_cast} < \text{signed int} > (\text{div2.quot})))
\rightarrow [const static or extern object]
[1.11] -32768 \leq ((172 * div(heapIs $heap_{funcstart\_1032,1},)
this.r.value(heapIs \ensuremath{\$}heap_{funcstart\_1032,1}).p2, 176).rem) - (\ensuremath{\$}heap_{init}.b2 *
static_cast<signed int>(div2.quot)))
\rightarrow [expand definition of constant 'b2' at prang.cpp (36,26)]
[1.12] -32768 \leq ((172 * div(heapIs $heap_{funcstart\_1032,1},)
this.$r.value(heapIs \rho_{tart_1032,1}.p2,\,176).rem) - ((int)35*)
static_cast<signed int>(div2.quot)))
\rightarrow [simplify]
[1.13] -32768 \leq ((172 * div(heapIs $heap_{funcstart\_1032,1},
```

```
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p2, 176).rem) - (35 *
\mathbf{static\_cast} {<} \mathbf{signed\ int} {>} (\mathrm{div2.quot})))
\rightarrow [from term 18.6, div2 is equal to div(heapIs $heap_{funcstart\_1032,1},
this.r.value(heapIs \ \ heap_{funcstart\_1032,1}).p2, \ 176)]
[1.14] -32768 \leq ((172 * div(heapIs $heap_{funcstart\_1032,1},)
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p2, 176).rem) - (35 *
static_cast<signed int>(div(heapIs $heap_{funcstart\_1032,1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p2, 176).quot)))
\rightarrow [simplify]
 [1.19] \ -32769 < ((-35 \ * \ \mathrm{div}(\mathbf{heapIs} \ \$ \mathrm{heap}_{funcstart\_1032,1}, \ \mathbf{this}.\$ r. \mathbf{value}(\mathbf{heapIs} \ \$) 
\text{Sheap}_{funcstart\_1032.1}.p2, 176).quot) + (172 * div(heapIs \text{Sheap}_{funcstart\_1032.1},
this.$r.value(heapIs heap_{funcstart_{-1032,1}}).p2, 176).rem))
\rightarrow [negate goal and search for contradiction]
[1.20]!(-32769 < ((-35 * div(heapIs $heap_{funcstart\_1032,1},
this.$r.value(heapIs heap_{funcstart\_1032,1}).p2, 176).quot) + (172 *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_1032,1}, \ \mathbf{this}.\$ r. \mathbf{value}(\mathbf{heapIs}
heap_{funcstart_1032,1}.p2, 176).rem)
\rightarrow [simplify]
[1.25] 32768 < ((35 * div(\mathbf{heapIs} \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}))
heap_{funcstart\_1032,1}.p2, 176).quot + (-172 * div(heapIs)
\rho_{tuncstart_1032.1}, this.r.value(heapIs \rho_{tuncstart_1032.1}).p2,
176).rem))
[Copy term 1.25]
[75.0] 32768 < ((-172 * div(heapIs $heap_{funcstart\_1032,1}, this.$r.value(heapIs)]
\rho_{tuncstart_{1032,1}}.p2, 176).rem) + (35 * div(heapIs \rho_{tuncstart_{1032,1}},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p2, 176).quot))
\rightarrow [from term 26.17, div(heapIs $heap_{funcstart\_1032,1}$, this.$r.value(heapIs)
heap_{funcstart\_1032,1}.p2, 176.rem is equal to this.r.value(heapIs)
heap_{funcstart\_1032,1}).p2 \% 176
[75.1] 32768 < ((-172 * (this.\$r.value(heapIs \$heap_{funcstart\_1032.1}).p2 \%
(176)) + (35 * div(heapIs \$heap_{funcstart\_1032,1}, this.\$r.value(heapIs))
heap_{funcstart_{1032,1}}.p2, 176).quot)
[Create new term from term 25.17 using rule: condition for equality of division]
[101.0] ((176 * (0 + -(-\text{div}(\mathbf{heapIs} \$heap_{funcstart\_1032,1},
this.$r.value(heapIs \rho_{tuncstart\_1032.1}).p2, 176).quot))) < (1 +
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p2)) \land (this.\ r.value(heapIs
\text{heap}_{funcstart\_1032.1}.p2 < (176 * (0 + 1 + -(-div(heapIs)))
\rho_{funcstart\_1032,1}, this.\r.value(heapIs \rho_{funcstart\_1032,1}).p2,
176).quot))))
```

```
\rightarrow [simplify]
[101.15] (-1 < ((-176 * div(heapIs $heap<sub>funcstart_1032,1</sub>, this.$r.value(heapIs)
\theta_{tuncstart_{1032,1}}.p2, 176.quot) + this.r.value(heapIs)
\$heap_{funcstart\_1032,1}).p2)) \land (-176 < (-\mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}))) \land (-176 < (-\mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})))
\text{Sheap}_{funcstart\_1032.1}.p2 + (176 * div(heapIs \text{Sheap}_{funcstart\_1032.1}),
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p2, 176).quot)))
[Work on sub-term 2 of conjunction in term 101.15]
[102.0]-1 < ((-176 * \mathrm{div}(\mathbf{heapIs}\ \$ \mathrm{heap}_{funcstart\_1032,1},\ \mathbf{this}.\$ r. \mathbf{value}(\mathbf{heapIs}
\$heap_{funcstart\_1032,1}).p2,\,176).quot) + \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}
heap_{funcstart\_1032,1}.p2
[Create new term from terms 102.0, 23.11 using rule: transitivity 2]
[129.0] (-30307 + -1 + 1) < (-176 * div(heapIs $heap_{funcstart\_1032,1},
this.r.value(heapIs $heap_{funcstart\_1032,1}).p2, 176).quot)
\rightarrow [simplify]
[129.1] -30307 < (-176 * div(heapIs $heap<sub>funcstart_1032,1</sub>,
this.r.value(heapIs $heap_{funcstart\_1032,1}).p2, 176).quot)
\rightarrow [literal comparison of product]
[129.2] ([-176 < 0]: (-30307 / 176) < -\text{div}(\mathbf{heapIs} \$ \text{heap}_{funcstart\_1032,1},
this.$r.value(heapIs \frac{1}{1000} $\text{heap} \frac{1}{1000} \frac{1}{1000} = \frac{1}{10
/ -176) < div(heapIs $heap<sub>funcstart 1032.1</sub>, this.$r.value(heapIs
\$ heap_{funcstart\_1032,1}).p2,\ 176).quot,\ [\text{-}176 == 0]\text{: -}30307 < 0)
\rightarrow [explicitly assert falsehood of skipped guards in subsequent guards]
[129.3] ([-176 < 0]: (-30307 / 176) < -\text{div}(\mathbf{heapIs} \$ \text{heap}_{funcstart\_1032,1},
this.$r.value(heapIs heap_{funcstart\_1032,1}).p2, 176).quot, [(0 < -176) \land !(-176
< 0]: (-30307 / -176) < div(heapIs $heap_{funcstart\_1032,1},
this.$r.value(heapIs heap_{funcstart\_1032,1}).p2, 176).quot, [(-176 == 0) \land
!(-176 < 0) \land !(0 < -176)]: -30307 < 0)
\rightarrow [simplify]
[129.7] -173 < -\text{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_1032,1}, \ \mathbf{this}.\text{\$r.value}(\mathbf{heapIs})
heap_{funcstart_{1032,1}}.p2, 176.quot
[Create new term from terms 129.7, 75.1 using rule: transitivity 5]
[131.0] 32768 < ((-172 * (this.$r.value(heap
Is $heap_{funcstart\_1032,1}).p2 %
(176)) + (35 * -(-173 + 1))
\rightarrow [simplify]
[131.5] 26748 < (-172 * (this.$r.value(heap
Is \rho_{funcstart\_1032,1}).p2 \%
176))
\rightarrow [literal comparison of product]
[131.6] ([-172 < 0]: (26748 / 172) < -(this.$r.value(heapIs
```

```
\rho_{funcstart\_1032,1}.p2~\%~176), [0 < -172]: (26748 / -172) < -172)
(this.$r.value(heapIs $heap_{funcstart\_1032,1}).p2 % 176), [-172 == 0]: 26748 <
→ [explicitly assert falsehood of skipped guards in subsequent guards]
[131.7] ([-172 < 0]: (26748 / 172) < -(this.$r.value(heapIs
\rho_{tuncstart_{-1032.1}} p2 \% 176, [(0 < -172) \land !(-172 < 0)]: (26748 / -172) < 0
(this.$r.value(heapIs heap_{funcstart\_1032,1}).p2 % 176), [(-172 == 0) \land !(-172
< 0) \land !(0 < -172)]: 26748 < 0)
\rightarrow [simplify]
[131.12] false
Proof of verification condition: Arithmetic result of operator '-' is within
limit of type 'signed int'
In the context of class: WHPrang, declared at:
C:\Escher\Customers\prang-cpp\prang.cpp (18,1)
Condition generated at: C:\Escher\Customers\prang-cpp\prang.cpp
(77,52)
Condition defined at:
To prove: ((\text{\$heap}_{1032,1;1051,8}.r2 * \text{static\_cast} < \text{signed int} > (\text{div}2.rem)) -
(\text{sheap}_{1032,1:1051,8}.\text{b2} * \text{static\_cast} < \text{signed int} > (\text{div}2.\text{quot}))) \le
maxof(signed int)
Given:
heap_{init}.LIMIT == (int)80
heap_{init}.class WHPrang \in M1 == (int)30269
heap_{init}.class WHPrang \in r1 == (int)171
heap_{init}.class WHPrang \in a1 == (int)177
heap_{init}.class WHPrang \in b1 == (int)2
heap_{init}.class WHPrang \in M2 == (int)30307
heap_{init}.class WHPrang \in r2 == (int)172
heap_{init}.class WHPrang \in a2 == (int)176
heap_{init}.class WHPrang \in b2 == (int)35
heap_{init}.class WHPrang \in M3 == (int)30323
heap_{init}.class WHPrang \in r3 == (int)170
heap_{init}.class WHPrang \in a3 == (int)178
heap_{init}.class WHPrang \in b3 == (int)63
```

 $\operatorname{div1} == \operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart_1032,1},$

```
static_cast<int>(operator*(heapIs $heap_{funcstart_1032.1}, this).p1),
\mathbf{static\_cast}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_1032,1}.\mathrm{a1}))
(asType<integer>(static_cast<int>(operator*(heapIs
heap_{funcstart\_1032.1}, this).p1) /
asType < integer > (static\_cast < int > (\$heap_{funcstart\_1032,1}.a1))) = =
asType<integer>(div1.quot)
(asType<integer>(static_cast<int>(operator*(heapIs
heap_{funcstart\_1032,1}, this).p1) %
asType<integer>(static_cast<int>($heap_{tuncstart=1032.1}.a1))) ==
asType<integer>(div1.rem)
(asType<integer>(operator*(heapIs $heap_{tuncstart\_1032.1}, this).p1) <
asType < integer > ($heap_{funcstart\_1032,1}.a1)) = >
(asType<integer>(div1.rem) == asType<integer>(operator*(heapIs
heap_{funcstart\_1032.1}, this).p1)
(asType < integer > (\$heap_{funcstart\_1032,1}.a1) \le
asType < integer > (operator*(heapIs $heap_{funcstart\_1032,1}, this).p1)) = >
!(0 == asType < integer > (div1.quot))
!(0 == asType < integer > (div1.rem)) || !(0 ==
asType<integer>(div1.quot))
\operatorname{div2} == \operatorname{div}(\mathbf{heapIs} \ \text{$heap}_{funcstart\_1032,1},
static\_cast < int > (operator*(heapIs $heap_{funcstart\_1032,1}, this).p2),
\mathbf{static\_cast} < \mathbf{int} > (\$ \mathbf{heap}_{funcstart\_1032,1}.\mathbf{a2}))
(asType<integer>(static_cast<int>(operator*(heapIs
heap_{funcstart\_1032,1}, this).p2) /
\mathbf{asType} < \mathbf{integer} > (\mathbf{static\_cast} < \mathbf{int} > (\$ \mathbf{heap}_{funcstart\_1032,1}.\mathbf{a2}))) = =
asType<integer>(div2.quot)
(asType<integer>(static_cast<int>(operator*(heapIs
heap_{funcstart\_1032,1}, this).p2)
asType < integer > (static\_cast < int > (\$heap_{funcstart\_1032.1}.a2))) = =
asType<integer>(div2.rem)
(asType<integer>(operator*(heapIs $heap_{tuncstart\_1032.1}, this).p2) <
asType < integer > ($heap_{funcstart\_1032,1}.a2)) =>
(asType < integer > (div2.rem) == asType < integer > (operator*(heapIs))
heap_{funcstart\_1032,1}, this).p2)
(asType < integer > (\$heap_{funcstart\_1032,1}.a2) \le
asType < integer > (operator*(heapIs $heap_{funcstart\_1032,1}, this).p2)) =>
!(0 == asType < integer > (div2.quot))
!(0 == asType < integer > (div2.rem)) || !(0 ==
asType<integer>(div2.quot))
div3 == div(\mathbf{heapIs} \$heap_{funcstart\_1032,1},
static_cast<int>(operator*(heapIs $heap_{funcstart\_1032,1}, this).p3),
```

```
\mathbf{static\_cast} < \mathbf{int} > (\$ \mathbf{heap}_{funcstart\_1032,1}.\mathbf{a3}))
(asType < integer > (static\_cast < int > (operator*(heapIs))) \\
heap_{funcstart_1032,1}, this).p3) /
asType < integer > (static\_cast < int > (\$heap_{funcstart\_1032.1}.a3))) = =
asType<integer>(div3.quot)
(asType < integer > (static\_cast < int > (operator*(heapIs)))
heap_{funcstart\_1032,1}, this).p3)
asType < integer > (static\_cast < int > (\$heap_{funcstart\_1032.1}.a3))) = =
asType<integer>(div3.rem)
(asType < integer > (operator*(heapIs $heap_{funcstart\_1032,1}, this).p3) < footnote{the content of the conte
asType < integer > (\$heap_{funcstart\_1032,1}.a3)) = >
(asType<integer>(div3.rem) == asType<integer>(operator*(heapIs
heap_{funcstart\_1032.1}, this).p3)
(\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathsf{heap}_{funcstart\_1032,1}.\mathsf{a3}) \leq
asType<integer>(operator*(heapIs $heap_{tuncstart\_1032,1}, this).p3)) =>
!(0 == asType < integer > (div3.quot))
!(0 == asType < integer > (div3.rem)) || !(0 ==
\mathbf{asType}{<}\mathbf{integer}{>}(\mathbf{div3.quot}))
temp1 == (\$heap_{funcstart\_1032,1}.r1 * \textbf{static\_cast} < \textbf{signed int} > (div1.rem)) - (div1.rem) + (div1.r
(\text{sheap}_{funcstart\_1032,1}.\text{b1} * \text{static\_cast} < \text{signed int} > (\text{div1.quot}))
minof(signed\ int) \le temp1
temp1 \le maxof(signed\ int)
\$ heap_{1032,1;1051,8} == \$ heap_{funcstart\_1032,1}.\_\mathbf{replace}(\mathbf{this}.\$r \rightarrow
operator*(heapIs heap_{funcstart\_1032,1}, this)._replace(p1 \rightarrow
asType < P1Type > ((\$heap_{funcstart\_1032,1}.M1 *
as Type < int > (static\_cast < integer > (static\_cast < signed
int>(operator^*(heapIs $heap_{funcstart\_1032.1}, this).p1) < (int)0))) +
temp1)))
Proof:
[Take given term]
[2.0] div1 == div(heapIs $heap_{funcstart\_1032,1},
static\_cast < int > (operator^*(heapIs \$heap_{funcstart\_1032,1}, this).p1),
static\_cast < int > (\$heap_{funcstart\_1032.1}.a1))
→ [expand definition of operator '*' in class 'pointer' at built in declaration]
[2.1] \operatorname{div1} == \operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_1032,1},
static\_cast < int > (this. r.value(heapIs  heap_{funcstart\_1032,1}).p1),
static\_cast < int > (\$heap_{funcstart\_1032,1}.a1))
\rightarrow [simplify]
[2.2] \operatorname{div1} == \operatorname{div}(\mathbf{heapIs} \ \hat{\mathbf{s}}_{heap}_{funcstart\_1032,1}, \ \mathbf{this.\$r.value}(\mathbf{heapIs})
```

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\theta_{funcstart\_1032,1}.p1, \theta_{funcstart\_1032,1}.a1)
\rightarrow [const static or extern object]
[2.3] \operatorname{div1} == \operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_1032,1}, \mathbf{this}.\$ \mathbf{r}.\mathbf{value}(\mathbf{heapIs})
\theta_{uncstart\_1032,1}.p1, \theta_{uncstart\_1032,1}.p2, \theta_{uncstart\_1032,1}.p3, \theta_{uncstart\_1032,1}.p4, \theta_{uncstart\_1032,1}.p4, \theta_{uncstart\_1032,1}.p4, \theta_{uncstart\_1032
\rightarrow [expand definition of constant 'a1' at prang.cpp (30,26)]
[2.4] \text{ div1} == \text{div}(\text{heapIs } \text{heap}_{funcstart\_1032,1}, \text{this.}\text{\$r.value}(\text{heapIs})
\theta_{funcstart\_1032,1}.p1, \theta_{funcstart\_1032,1}.p1, \theta_{funcstart\_1032,1}.p1, \theta_{funcstart\_1032,1}.p1, \theta_{funcstart\_1032,1}.p1, \theta_{funcstart\_1032,1}.p1, \theta_{funcstart\_1032,1}.p2, \theta_{funcstart\_1032,1}.p2, \theta_{funcstart\_1032,1}.p2, \theta_{funcstart\_1032,1}.p2, \theta_{funcstart\_1032,1}.p2, \theta_{funcstart\_1032,1}.p3, \theta_{funcstart\_1032,1}.p4, \theta_{funcstart\_1032,1}.p4, \theta_{funcstart\_1032,1}.p4, \theta_{funcstart\_1032,1}.p5, \theta_{funcstart\_1032,1
\rightarrow [simplify]
[2.6] div1 == div(heapIs $heap_{funcstart\_1032,1}, this.$r.value(heapIs)
heap_{funcstart_{1032.1}}.p1, 177
[Assume known post-assertion, class invariant or type constraint for term 2.6]
[7.0] (0 < asType<integer>(this.$r.value(heapIs
\theta_{funcstart_1032,1}.p1) && (asType<integer>(this.$r.value(heapIs)
\label{eq:continuous} \$ \operatorname{heap}_{funcstart\_1032,1}). \operatorname{p1}) < \mathbf{asType} < \mathbf{integer} > (\$ \operatorname{heap.class} \ \operatorname{WHPrang} \in \mathsf{prop}(\mathsf{prop})) < \mathsf{prop}(\mathsf{prop}) < \mathsf{pro
M1))
\rightarrow [simplify]
[7.2] (0 < this.$r.value(heap
Is $heap_{funcstart\_1032,1}).p1) &&
(this.$r.value(heapIs heap_{funcstart\_1032,1}).p1 <
asType < integer > (\$heap.class WHPrang \in M1))
\rightarrow [const static or extern object]
[7.3] (0 < this.$r.value(heapIs \rho_{funcstart\_1032,1}).p1) &&
(this.$r.value(heapIs \theta_{funcstart\_1032,1}).p1 <
asType < integer > (\$heap_{init}.class WHPrang \in M1))
\rightarrow [expand definition of constant 'M1' at prang.cpp (28,26)]
[7.4] (0 < this.$r.value(heapIs \rho_{funcstart\_1032,1}).p1) &&
(this.r.value(heapIs $heap_{funcstart\_1032,1}).p1 <
asType < integer > ((int)30269))
\rightarrow [simplify]
[7.10] (-30269 < -this.$r.value(heapIs $heap_{tuncstart\_1032.1}).p1) \land (0 <
this.r.value(heapIs $heap_{funcstart\_1032,1}).p1)
[Work on sub-term 2 of conjunction in term 7.10]
[8.0] 0 < this.$r.value(heapIs \theta_{funcstart\_1032,1}).p1
[Take given term]
[18.0] div2 == div(heapIs heap_{funcstart\_1032,1},
static_cast<int>(operator*(heapIs $heap_{funcstart\_1032,1}, this).p2),
static\_cast < int > (\$heap_{funcstart\_1032,1}.a2))
→ [expand definition of operator '*' in class 'pointer' at built in declaration]
```

```
[18.1] \operatorname{div2} == \operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_1032,1},
\mathbf{static\_cast} < \mathbf{int} > (\mathbf{this.\$r.value}(\mathbf{heapIs} \ \$ \mathbf{heap}_{funcstart\_1032,1}).\mathbf{p2}),
\mathbf{static\_cast}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_1032,1}.\mathrm{a2}))
\rightarrow [simplify]
[18.2] div2 == div(heapIs heapIs \frac{1}{2}
\theta_{funcstart\_1032,1}.p2, \theta_{funcstart\_1032,1}.p2, \theta_{funcstart\_1032,1}.a2))
\rightarrow [const static or extern object]
[18.3] div2 == div(\mathbf{heapIs} \$ \mathbf{heap}_{funcstart\_1032.1}, \mathbf{this}.\$ \mathbf{r.value}(\mathbf{heapIs})
\theta_{tuncstart\_1032.1}.p2, \theta_{tuncstart\_1032.1}.p3, \theta_{tuncstart\_1032.1}.p4, \theta_{tuncstart\_1032.1}.p4, \theta_{tuncstart\_1032.1
\rightarrow [expand definition of constant 'a2' at prang.cpp (35,26)]
[18.4] \text{ div2} == \text{div}(\mathbf{heapIs} \text{ \$heap}_{funcstart\_1032,1}, \mathbf{this.\$r.value}(\mathbf{heapIs}))
\theta_{tuncstart\_1032.1}.p2, \theta_{tuncstart\_1032.1}.p3, \theta_{tuncstart\_1032.1}.p2, \theta_{tuncstart\_1032.1}.p2, \theta_{tuncstart\_1032.1}.p3, \theta_{tuncstart\_1032.1}.p2, \theta_{tuncstart\_1032.1}.p3, \theta_{tuncstart\_1032.1}.p3, \theta_{tuncstart\_1032.1}.p2, \theta_{tuncstart\_1032.1}.p3, \theta_{tuncstart\_1032.1}.p4, \theta_{tuncstart\_1032.1}.p4, \theta_{tuncstart\_1032.1}.p4, \theta_{tuncstart\_1032.1
\rightarrow [simplify]
[18.6] div2 == div(heapIs $heap_{funcstart\_1032,1}, this.$r.value(heapIs)
heap_{funcstart_{-1032.1}}.p2, 176
[Assume known post-assertion, class invariant or type constraint for term 18.6]
[23.0] (0 < asType<integer>(this.$r.value(heapIs
\label{eq:continuous} $\operatorname{heap}_{funcstart\_1032,1}).p2)) \&\& (\mathbf{asType} < \mathbf{integer} > (\mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})) \&\& (\mathbf{asType} < \mathbf{integer} > (\mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}))) \&\& (\mathbf{asType} < \mathbf{integer} > (\mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})))) \&\& (\mathbf{asType} < \mathbf{integer} > (\mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}))))) \&\& (\mathbf{asType} < \mathbf{integer} > (\mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}))))
\verb§heap$_{funcstart\_1032,1}).p2) < \textbf{asType} < \textbf{integer} > (\$ heap.\textbf{class} \ WHPrang \in \texttt{Partition})
M2))
\rightarrow [simplify]
[23.2] (0 < this.$r.value(heapIs heap_{funcstart\_1032,1}).p2) &&
(this.$r.value(heapIs heap_{funcstart\_1032,1}).p2 <
asType < integer > (\text{$heap.class WHPrang} \in M2))
\rightarrow [const static or extern object]
[23.3] (0 < this.$r.value(heapIs $heap_{funcstart\_1032,1}).p2) &&
(this.r.value(heapIs $heap_{funcstart\_1032,1}).p2 <
asType < integer > (\$heap_{init}.class WHPrang \in M2))
\rightarrow [expand definition of constant 'M2' at prang.cpp (33,26)]
[23.4] (0 < this.$r.value(heap
Is \rho_{uncstart\_1032,1}).p2) &&
(this.r.value(heapIs $heap_{funcstart\_1032,1}).p2 <
asType < integer > ((int)30307))
\rightarrow [simplify]
[23.10] (-30307 < -this.$r.value(heapIs \rho_{funcstart\_1032,1}).p2) \wedge (0 <
this.r.value(heapIs $heap_{funcstart\_1032,1}).p2)
[Work on sub-term 2 of conjunction in term 23.10]
[24.0] 0 < this.$r.value(heapIs \theta_{funcstart\_1032,1}).p2
```

```
[Assume known post-assertion, class invariant or type constraint for term 18.6]
[25.0] (asType<integer>(this.$r.value(heapIs \rho_{funcstart\_1032,1}).p2) /
asType<integer>(176)) == asType<integer>(div(heapIs
\rho_{tuncstart\_1032.1}, this.r.value(heapIs \rho_{tuncstart\_1032.1}).p2,
176).quot)
\rightarrow [simplify]
[25.2] (this.$r.value(heapIs $heap_{funcstart\_1032,1}).p2 / 176) ==
\mathbf{asType} {<} \mathbf{integer} {>} ( \mathbf{div} (\mathbf{heapIs} \ \$ \mathbf{heap}_{funcstart\_1032,1}, \ \mathbf{this}.\$ \mathbf{r.value} (\mathbf{heapIs} \ \mathbf{heapIs}) )
heap_{funcstart_{-1032,1}}.p2, 176).quot
→ [expand definition of operator './' in class 'int' at built in declaration]
[25.3] ([asType<integer>(this.$r.value(heapIs $heap_{funcstart\_1032,1}).p2) <
0]: -(-asType < integer > (this. r.value(heapIs  heap_{funcstart\_1032.1}).p2) / 
176), []: asType<integer>(this.$r.value(heapIs $heap_{tuncstart\_1032,1}).p2) /
176) == asType<integer>(div(heapIs $heap_{funcstart\_1032,1},
this.r.value(heapIs $heap_{funcstart\_1032,1}).p2, 176).quot)
→ [explicitly assert falsehood of skipped guards in subsequent guards]
{\it [25.4]}~([{\bf asType}{<}{\bf integer}{>}({\bf this.\$r.value}({\bf heapIs}~\${\bf heap}_{funcstart\_1032,1}).{\bf p2})<
0]: -(-asType < integer > (this.\$r.value(heapIs \$heap_{funcstart\_1032,1}).p2) /
176), [!(asType<integer>(this.$r.value(heapIs \rho_{tancstart\_1032,1}).p2) <
0)]: asType < integer > (this. r.value(heapIs  heap_{funcstart\_1032,1}).p2) / 
176) == asType<integer>(div(heapIs heap_{funcstart\_1032,1},
this.r.value(heapIs \ heap_{funcstart\_1032.1}).p2, 176).quot)
\rightarrow [simplify]
[25.7] ([0 < -this.$r.value(heapIs $heap_{funcstart\_1032.1}).p2]:
-(-\mathbf{asType} < \mathbf{integer} > (\mathbf{this.\$r.value} (\mathbf{heapIs}\ \$ \mathbf{heap}_{funcstart\_1032,1}).\mathbf{p2}) \ / \\
176), [!(asType<integer>(this.$r.value(heapIs $heap_{funcstart\_1032,1}).p2) <  
0)]: asType < integer > (this. r.value(heapIs <math>heapIs heap_{funcstart\_1032,1}).p2) / 
176) == asType<integer>(div(heapIs heap_{funcstart\_1032,1},
this.r.value(heapIs $heap_{funcstart\_1032,1}).p2, 176).quot)
\rightarrow [from term 24.0, literala < -this.$r.value(heapIs $heap_{funcstart\_1032,1}).p2
is false whenever -2 < (0 + literala)
   Proof of rule precondition:
   [25.7.0] - 2 < (0 + 0)
   \rightarrow [simplify]
   [25.7.2] true
[25.8] ([false]: -(-asType < integer > (this. r.value(heapIs))
\rho_{funcstart\_1032,1}.p2) / 176, [!(asType<integer>(this.$r.value(heapIs)
\rho_{uncstart_1032,1}.p2 < 0: asType<integer>(this.$r.value(heapIs)
\theta_{uncstart\_1032,1}.p2) / 176 = asType < integer > (div(heapIs))
```

```
\rho_{funcstart_1032,1}, this. r.value(heapIs \rho_{funcstart_1032,1}).p2,
176).quot)
\rightarrow [simplify]
[25.11] ([false]: -(-asType<integer>(this.$r.value(heapIs
\rho_{funcstart_1032,1}.p2) / 176, [!\rho_{funcstart_1032,1}.p2] / 176], [!\rho_{funcstart_1032,1}.p2]
\rho_{funcstart_{-1032,1}}.p2): asType<integer>(this.$r.value(heapIs)
\theta_{funcstart\_1032,1}.p2) / 176 = asType < integer > (div(heapIs))
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p2,
176).quot)
\rightarrow [from term 24.0, literala < -this.$r.value(heapIs $heap_{funcstart\_1032,1}).p2
is false whenever -2 < (0 + literala)
   Proof of rule precondition:
   [25.11.0] - 2 < (0 + 0)
   \rightarrow [simplify]
   [25.11.2] true
[25.12] ([false]: -(-asType<integer>(this.$r.value(heapIs
heap_{funcstart\_1032,1}.p2) / 176, [!false]:
asType<integer>(this.$r.value(heapIs $heap_{funcstart\_1032,1}).p2) / 176)
== asType < integer > (div(heapIs \$heap_{funcstart\_1032,1},
this.r.value(heapIs $heap_{funcstart\_1032,1}).p2, 176).quot)
\rightarrow [simplify]
[25.17] 0 == (-div(heapIs \rho_{funcstart\_1032,1}, this.r.value(heapIs)
\theta_{tuncstart\_1032.1}.p2, 176).quot + (this.r.value(heapIs)
heap_{funcstart_{1032,1}}.p2 / 176)
[Assume known post-assertion, class invariant or type constraint for term 18.6]
[26.0] (asType<integer>(this.r.value(heapIs \heap_{funcstart\_1032,1}).p2) \%
asType<integer>(176)) == asType<integer>(div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p2,
176).rem)
\rightarrow [simplify]
[26.2] (this.$r.value(heapIs $heap_{funcstart\_1032,1}).p2 % 176) ==
asType < integer > (div(heapIs \$heap_{funcstart\_1032,1}, this.\$r.value(heapIs \})
heap_{funcstart\_1032,1}.p2, 176).rem
→ [expand definition of operator '.%' in class 'int' at built in declaration]
{\it [26.3]}\;([{\bf asType}{<}{\bf integer}{>}({\bf this.\$r.value}({\bf heapIs}\;\${\bf heap}_{funcstart\_1032,1}).{\bf p2})<
0]: -(-asType < integer > (this.\$r.value(heapIs \$heap_{funcstart\_1032,1}).p2) \%
176), []: asType<integer>(this.$r.value(heapIs $heap_{funcstart\_1032,1}).p2)
\% 176) == asType<integer>(div(heapIs $heap_{funcstart\_1032,1},)
this.r.value(heapIs $heap_{funcstart\_1032,1}).p2, 176).rem)
```

```
→ [explicitly assert falsehood of skipped guards in subsequent guards]
{\it [26.4]}~([{\bf asType}{<}{\bf integer}{>}({\bf this.\$r.value}({\bf heapIs}~\${\bf heap}_{funcstart\_1032,1}).{\bf p2})<
0]: -(-asType < integer > (this. r.value(heapIs  heap_{funcstart\_1032,1}).p2) \%
176), [!(asType<integer>(this.$r.value(heapIs \rho_{tart_1032,1}.p2) <
0)]: asType<integer>(this.$r.value(heapIs $heap_{funcstart\_1032.1}).p2) %
176) == asType < integer > (div(heapIs $heap_{funcstart\_1032,1},
\mathbf{this.\$r.value(heapIs}\ \$heap_{funcstart\_1032,1}).p2,\ 176).rem)
\rightarrow [simplify]
\label{eq:continuous} \textit{[26.7]} ([0 < -\textbf{this.}\$r.\textbf{value}(\textbf{heapIs}~\$heap_{funcstart\_1032,1}).p2]:
-(-asType < integer > (this. r.value(heapIs  heap_{funcstart\_1032,1}).p2) \%
176), [!(asType<integer>(this.$r.value(heapIs \rho_{funcstart\_1032,1}).p2) <
0)]: asType<integer>(this.$r.value(heapIs \rho_{uncstart\_1032,1}).p2) %
176) == asType<integer>(div(heapIs heap_{funcstart\_1032,1},
this.$r.value(heapIs $heap_{funcstart\_1032.1}).p2, 176).rem)
\rightarrow [from term 24.0, literala < -this.$r.value(heapIs $heap_{funcstart\_1032.1}).p2
is false whenever -2 < (0 + literala)
   Proof of rule precondition:
   [26.7.0] - 2 < (0 + 0)
   \rightarrow [simplify]
   [26.7.2] true
[26.8] ([false]: -(-asType<integer>(this.$r.value(heapIs
$heap_funcstart_1032,1).p2) % 176), [!(asType<integer>(this.$r.value(heapIs
\{\text{heap}_{funcstart\_1032,1}\}.p2) < 0): asType<integer>(this.r.value(\text{heapIs})
\theta_{funcstart\_1032,1}.p2) % 176) == asType<integer>(div(heapIs)
\rho_{funcstart=1032,1}, this.r.value(heapIs \rho_{funcstart=1032,1}).p2,
176).rem)
\rightarrow [simplify]
[26.11] ([false]: -(-asType<integer>(this.$r.value(heapIs
\theta_{funcstart\_1032,1}.p2)~\%~176),~[!(0<-this.\$r.value(heapIs)]
\rho_{funcstart=1032,1}.p2): asType<integer>(this.$r.value(heapIs)
\theta_{funcstart=1032,1}.p2) \% 176 = asType < integer > (div(heapIs))
\rho_{funcstart\_1032,1}, this. r.value(heapIs \rho_{funcstart\_1032,1}).p2,
176).rem)
\rightarrow [from term 24.0, literala < -this.$r.value(heapIs $heap_{tuncstart 1032.1}).p2
is false whenever -2 < (0 + literala)
   Proof of rule precondition:
   [26.11.0] - 2 < (0 + 0)
   \rightarrow [simplify]
   [26.11.2] true
```

```
[26.12] ([false]: -(-asType<integer>(this.$r.value(heapIs
heap_{funcstart\_1032,1}.p2) \% 176, [!false]:
asType<integer>(this.$r.value(heapIs $heap_{funcstart\_1032,1}).p2) % 176)
== asType < integer > (div(heapIs $heap_{funcstart\_1032,1},
this.r.value(heapIs $heap_{funcstart\_1032,1}).p2, 176).rem)
\rightarrow [simplify]
[26.17] 0 == (-\text{div}(\text{heapIs }\text{\$heap}_{funcstart\_1032.1}, \text{this.}\text{\$r.value}(\text{heapIs}))
\theta_{tuncstart\_1032,1}.p2, 176.rem + (this.r.value(heapIs)
heap_{funcstart_1032,1}.p2 \% 176)
[Take given term]
[31.0] (asType<integer>(operator*(heapIs $heap_{tuncstart\_1032.1}, this).p2)
< asType<integer>($heap<sub>funcstart_1032,1</sub>.a2)) =>
(asType<integer>(div2.rem) == asType<integer>(operator*(heapIs
heap_{funcstart\_1032,1}, this).p2)
→ [expand definition of operator '*' in class 'pointer' at built in declaration]
[31.1] \; (\mathbf{asType} < \mathbf{integer} > (\mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs} \; \$ \mathbf{heap}_{funcstart\_1032,1}).\mathbf{p2}) < \mathbf{page}(\mathbf{page}) <
asType < integer > (\$heap_{funcstart\_1032,1}.a2)) = > 
(asType<integer>(div2.rem) == asType<integer>(operator*(heapIs
heap_{funcstart\_1032,1}, this).p2)
\rightarrow [simplify]
[31.2] (this.r.value(heapIs \ heap_{funcstart\_1032,1}).p2 <
asType < integer > (\$heap_{funcstart\_1032.1}.a2)) = >
(asType<integer>(div2.rem) == asType<integer>(operator*(heapIs
heap_{funcstart\_1032,1}, this).p2)
\rightarrow [const static or extern object]
/31.3/ (this.$r.value(heapIs \rho_{funcstart\_1032,1}).p2 <
asType < integer > (\$heap_{init}.a2)) = > (asType < integer > (div2.rem) = =
\mathbf{asType} < \mathbf{integer} > (\mathbf{operator}^*(\mathbf{heapIs} \ \$ \mathbf{heap}_{funcstart\_1032,1}, \ \mathbf{this}).\mathtt{p2}))
\rightarrow [expand definition of constant 'a2' at prang.cpp (35,26)]
[31.4] (this.r.value(heapIs \ heap_{funcstart\_1032.1}).p2 <
asType<integer>((int)176)) => (asType<integer>(div2.rem) ==
asType < integer > (operator^*(heapIs \$heap_{funcstart\_1032,1}, this).p2))
\rightarrow [simplify]
[31.9] (-176 < -this.$r.value(heap
Is \rho_{funcstart\_1032,1}).p2) =>
(\mathbf{asType} < \mathbf{integer} > (\mathbf{div2}.\mathbf{rem}) == \mathbf{asType} < \mathbf{integer} > (\mathbf{operator} * (\mathbf{heapIs}))
heap_{funcstart\_1032,1}, this).p2)
\rightarrow [from term 18.6, div2 is equal to div(heapIs $heap_{funcstart\_1032,1},
this.r.value(heapIs $heap_{funcstart\_1032,1}).p2, 176)
[31.10] (-176 < -this.$r.value(heapIs $heap_{tuncstart\_1032.1}).p2) =>
```

```
(asType<integer>(div(heapIs $heap_{funcstart\_1032,1}, this.$r.value(heapIs
heap_{funcstart\_1032,1}.p2, 176).rem = 
asType<integer>(operator*(heapIs $heap_{funcstart\_1032.1}, this).p2))
\rightarrow [simplify]
[31.11] (-176 < -this.$r.value(heapIs $heap_{funcstart\_1032,1}).p2) =>
(\text{div}(\mathbf{heapIs} \$ \text{heap}_{funcstart\_1032.1}, \mathbf{this}.\$ \text{r.value}(\mathbf{heapIs}))
\text{Sheap}_{funcstart\_1032,1}).p2, 176).rem ==
asType < integer > (operator^*(heapIs $heap_{funcstart\_1032,1}, this).p2))
→ [expand definition of operator '*' in class 'pointer' at built in declaration]
\textit{[31.12]} \; (\text{-176} < -\textbf{this}.\$r.\textbf{value}(\textbf{heapIs} \; \$\text{heap}_{funcstart\_1032,1}).p2) =>
(\text{div}(\mathbf{heapIs} \$ \text{heap}_{funcstart\_1032,1}, \mathbf{this}.\$ r. \mathbf{value}(\mathbf{heapIs}))
heap_{funcstart=1032.1}.p2, 176).rem ==
\mathbf{asType} < \mathbf{integer} > (\mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs} \$ heap_{funcstart\_1032,1}).p2))
\rightarrow [simplify]
[31.18] (0 == (-this.$r.value(heapIs $heap_{funcstart\_1032,1}).p2 + div(heapIs)
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p2,
176).rem)) \vee (175 < this.$r.value(heapIs $heap<sub>funcstart_1032,1</sub>).p2)
[Take given term]
[50.0] (($heap<sub>funcstart_1032,1</sub>.r1 * static_cast<signed int>(div1.rem)) -
(\text{sheap}_{funcstart\_1032,1}.\text{b1 * static\_cast} < \text{signed int} > (\text{div1.quot}))) == \text{temp1}
\rightarrow [const static or extern object]
[50.1] (($heap<sub>init</sub>.rl * static_cast<signed int>(div1.rem)) -
(\$heap_{funcstart\_1032,1}.b1 * \textbf{static\_cast} < \textbf{signed int} > (div1.quot))) == temp1
\rightarrow [expand definition of constant 'r1' at prang.cpp (29,26)]
[50.2] (((int)171 * static_cast<signed int>(div1.rem)) -
($heap_tuncstart_1032.1.b1 * static_cast<signed int>(div1.quot))) == temp1
\rightarrow [simplify]
[50.3] ((171 * static_cast<signed int>(div1.rem)) - ($heap_{tuncstart_1032.1}.b1
* static_cast<signed int>(div1.quot))) == temp1
\rightarrow [from term 2.6, div1 is equal to div(heapIs $heap_{funcstart\_1032,1},
this.$r.value(heapIs $heap_{funcstart\_1032,1}).p1, 177)]
[50.4] ((171 * static_cast<signed int>(div(heapIs $heap_{tuncstart\_1032,1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177).rem)) -
(\text{sheap}_{funcstart\_1032,1}.\text{b1 * static\_cast} < \text{signed int} > (\text{div1.quot}))) == \text{temp1}
\rightarrow [simplify]
[50.5] ((171 * div(heapIs $heap_{funcstart\_1032,1}, this.$r.value(heapIs)]
\text{Sheap}_{funcstart\_1032,1}.\text{p1}, 177).\text{rem} - (\text{Sheap}_{funcstart\_1032,1}.\text{b1} *
static_cast<signed int>(div1.quot))) == temp1
```

```
\rightarrow [const static or extern object]
[50.6] ((171 * div(heapIs $heap_{funcstart\_1032,1}, this.$r.value(heapIs)
\rho_{uncstart\_1032,1}.p1, 177).rem – (\rho_{uncstart\_1032,1}.p1, 177).rem) – (\rho_{uncstart\_1032,1}.p1, 177).rem) – (\rho_{uncstart\_1032,1}.p1, 177).rem)
int>(div1.quot)) == temp1
\rightarrow [expand definition of constant 'b1' at prang.cpp (31,26)]
[50.7] ((171 * div(heapIs \rho_{funcstart\_1032,1}, this.\rho_{r.value}
\theta_{uncstart\_1032,1}.p1, 177).rem - ((int)2 * static\_cast < signed)
int>(div1.quot)) == temp1
\rightarrow [simplify]
[50.8] ((171 * \mathrm{div}(\mathbf{heapIs}\ \$\mathrm{heap}_{funcstart\_1032,1},\ \mathbf{this}.\$\mathrm{r.value}(\mathbf{heapIs}
\theta_{funcstart\_1032,1}.p1, 177).rem - (2 * static\_cast < signed)
int>(div1.quot)) == temp1
\rightarrow [from term 2.6, div1 is equal to div(heapIs $heap_{funcstart\_1032,1},
this.r.value(heapIs \ heap_{funcstart\_1032.1}).p1, 177)
[50.9] ((171 * div(heapIs $heap_{funcstart\_1032,1}, this.$r.value(heapIs)]
\theta_{funcstart\_1032,1}.p1, 177).rem - (2 * static\_cast < signed)
int>(div(heapIs \$heap_{tuncstart\_1032,1}, this.\$r.value(heapIs
heap_{funcstart_1032,1}.p1, 177).quot))) == temp1
\rightarrow [simplify]
[50.14] 0 == (-\text{temp1} + (-2 * \text{div}(\text{heapIs } \text{$heap}_{funcstart\_1032.1})]
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177).quot) + (171 *
div(\mathbf{heapIs} \$ heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
heap_{funcstart_{-1032,1}}.p1, 177).rem)
[Take given term]
[53.0] heap_{1032,1;1051,8} == heap_{funcstart\_1032,1}._replace(this.$r \rightarrow
operator*(heapIs heap_{funcstart\_1032,1}, this)._replace(p1 \rightarrow
asType<P1Type>(($heap_funcstart_1032,1.M1 *
asType<int>(static_cast<integer>(static_cast<signed
int>(operator^*(heapIs $heap_{funcstart\_1032,1}, this).p1) < (int)0))) +
temp1)))
→ [expand definition of operator '*' in class 'pointer' at built in declaration]
[53.1] heap_{1032,1;1051,8} == heap_{funcstart\_1032,1}._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow
asType<P1Type>(($heap<sub>funcstart_1032,1</sub>.M1 *
asType<int>(static_cast<integer>(static_cast<signed
int>(operator*(heapIs $heap_{funcstart\_1032,1}, this).p1) < (int)0))) +
temp1)))
\rightarrow [const static or extern object]
[53.2] heap_{1032,1;1051,8} == heap_{funcstart\_1032,1}._replace(this.$r \rightarrow
```

```
this.$r.value(heapIs \theta_{funcstart\_1032,1})._replace(p1 \rightarrow
asType < P1Type > ((\$heap_{init}.M1))
as Type < int > (static\_cast < integer > (static\_cast < signed))
int>(operator^*(heapIs $heap_{funcstart\_1032,1}, this).p1) < (int)0))) +
temp1)))
\rightarrow [expand definition of constant 'M1' at prang.cpp (28,26)]
[53.3] $heap<sub>1032,1;1051,8</sub> == $heap<sub>funcstart_1032,1</sub>._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow
asType<P1Type>(((int)30269 *
asType<int>(static_cast<integer>(static_cast<signed
\mathbf{int} > (\mathbf{operator}^*(\mathbf{heapIs} \ \$ \mathbf{heap}_{funcstart\_1032,1}, \ \mathbf{this}).\mathtt{p1}) < (\mathbf{int})0))) \ +
temp1)))
\rightarrow [simplify]
[53.4] heap_{1032,1;1051,8} == heap_{funcstart\_1032,1}.\_replace(this.\$r \rightarrow this)
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow
asType<P1Type>((30269 *
as Type < int > (static\_cast < integer > (static\_cast < signed))
int>(operator^*(heapIs \$heap_{funcstart\_1032,1}, this).p1) < (int)0))) +
temp1)))
→ [expand definition of operator '*' in class 'pointer' at built in declaration]
[53.5] $heap<sub>1032,1;1051,8</sub> == $heap<sub>funcstart_1032,1</sub>._replace(this.$r \rightarrow
\mathbf{this.\$r.value}(\mathbf{heapIs}~\$\mathbf{heap}_{funcstart\_1032,1}).\_\mathbf{replace}(\mathbf{p1}\rightarrow
asType<P1Type>((30269 *
as Type < int > (static\_cast < integer > (static\_cast < signed))
int>(this.\$r.value(heapIs \$heap_{funcstart\_1032,1}).p1) < (int)0))) + temp1)))
\rightarrow [simplify]
[53.9] heap_{1032,1;1051,8} == heap_{funcstart\_1032,1}._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow
asType<P1Type>((30269 * asType<int>(static_cast<integer>(0 <
-this.r.value(heapIs heap_{funcstart\_1032,1}.p1)) + temp1)))
\rightarrow [from term 8.0, literala < -this.$r.value(heapIs $heap_{funcstart\_1032.1}).p1
is false whenever -2 < (0 + literala)
   Proof of rule precondition:
   [53.9.0] - 2 < (0 + 0)
   \rightarrow [simplify]
   [53.9.2] true
[53.10] $\text{heap}_{1032,1;1051,8} == $\text{heap}_{funcstart\_1032,1}.$\text{-replace}(\text{this}.$\text{$\frac{1}{2}}\)
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow
asType<P1Type>((30269 * asType<int>(static_cast<integer>(false)))
+ \text{ temp1})))
```

```
\rightarrow [simplify]
[53.11] $\text{heap}_{1032,1;1051,8} == \text{$heap}_{funcstart\_1032,1}.$\text{$_-replace}(this.$\text{$r} \to \text{$_-replace})$
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow
asType<P1Type>((30269 * asType<int>(([false]: 1, []: 0))) + temp1)))
→ [explicitly assert falsehood of skipped guards in subsequent guards]
[53.12] $heap<sub>1032,1;1051,8</sub> == $heap<sub>funcstart_1032,1</sub>._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow
asType<P1Type>((30269 * asType<int>(([false]: 1, [true]: 0))) +
temp1)))
\rightarrow [simplify]
[53.15] $heap<sub>1032,1;1051,8</sub> == $heap<sub>funcstart_1032,1</sub>._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow
asType < P1Type > (0 + temp1))
\rightarrow [from term 50.14, temp1 is equal to (-2 * div(heapIs $heap_{funcstart\_1032.1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177).quot) + (171 *
div(\mathbf{heapIs} \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
heap_{funcstart_{-1032.1}}.p1, 177).rem
[53.16] $heap<sub>1032,1;1051,8</sub> == $heap<sub>funcstart_1032,1</sub>._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow
asType < P1Type > (0 + ((-2 * div(heapIs $heap_{funcstart\_1032,1},
this.r.value(heapIs \ensuremath{\$}heap_{funcstart\_1032,1}).p1, 177).quot) + (171 *
div(\mathbf{heapIs} \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
heap_{funcstart_{1032,1}}.p1, 177).rem))))
\rightarrow [simplify]
[53.19] \rho_{1032,1;1051,8} == \rho_{1032,1;1051,8} = \rho_{1032,1;1051,
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{tuncstart\_1032.1}, this.r.value(heapIs \rho_{tuncstart\_1032.1}).p1,
177).quot) + (171 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
heap_{funcstart\_1032,1}.p1, 177.rem)))
[Take goal term]
{\rm [1.0]}\;((\${\rm heap_{1032,1;1051,8}.r2}\;*\;{\bf static\_cast}{<}{\bf signed\;int}{>}({\rm div2.rem}))\;-\;
(\text{sheap}_{1032,1;1051,8}.\text{b2} * \text{static\_cast} < \text{signed int} > (\text{div2.quot}))) \le
maxof(signed int)
\rightarrow [from term 53.19, $heap<sub>1032.1:1051.8</sub> is equal to
\$heap_{funcstart\_1032,1}.\_\textbf{replace}(\textbf{this}.\$r \rightarrow \textbf{this}.\$r.\textbf{value}(\textbf{heapIs}
heap_{funcstart\_1032,1}._replace(p1 \rightarrow (-2 * div(heapIs \$heap_{funcstart\_1032,1}, -2))
this.r.value(heapIs \ \ heap_{funcstart\_1032,1}).p1, \ 177).quot) + (171 \ \ *
div(\mathbf{heapIs} \ \$heap_{funcstart\_1032,1}, \ \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
heap_{funcstart\_1032,1}.p1, 177).rem)))]
[1.1] \; ((\$ heap_{funcstart\_1032,1}.\_\textbf{replace}(\textbf{this}.\$r \rightarrow \textbf{this}.\$r.\textbf{value}(\textbf{heapIs}
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\text{Sheap}_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs \text{Sheap}_{funcstart\_1032,1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177).quot) + (171)
div(\mathbf{heapIs} \$ heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
\theta_{funcstart\_1032,1}.p1, 177).rem))).r2 * static_cast < signed
int>(div2.rem)) - (\$heap_{1032,1:1051,8}.b2 * static\_cast < signed)
int > (div2.quot))) \le maxof(signed int)
\rightarrow [const member of object with modified fields]
[1.2] \; ((\$heap_{funcstart\_1032,1}.r2 * \textbf{static\_cast} < \textbf{signed int} > (\text{div}2.rem)) \; - \;
(\text{sheap}_{1032.1:1051.8}.\text{b2} * \text{static\_cast} < \text{signed int} > (\text{div}2.\text{quot}))) \le
maxof(signed int)
\rightarrow [const static or extern object]
[1.3] (($heap<sub>init</sub>.r2 * static_cast<signed int>(div2.rem)) -
(\text{sheap}_{1032.1:1051.8}.\text{b2} * \text{static\_cast} < \text{signed int} > (\text{div}2.\text{quot}))) \le
maxof(signed int)
\rightarrow [expand definition of constant 'r2' at prang.cpp (34,26)]
[1.4](((int)172 * static\_cast < signed int > (div2.rem)) - ($heap_{1032.1:1051.8}.b2)
* static\_cast < signed int > (div2.quot))) \le maxof(signed int)
\rightarrow [simplify]
[1.5] ((172 * static_cast<signed int>(div2.rem)) - ($heap_{1032.1:1051.8}.b2 *
static\_cast < signed int > (div2.quot))) \le maxof(signed int)
\rightarrow [from term 18.6, div2 is equal to div(heapIs $heap_{funcstart\_1032,1},
this.r.value(heapIs $heap_{funcstart\_1032,1}).p2, 176)
[1.6] ((172 * static_cast<signed int>(div(heapIs $heap_{funcstart\_1032,1},
this.r.value(heapIs \heap_{funcstart\_1032.1}).p2, 176).rem)) -
(\text{sheap}_{1032,1:1051,8}.\text{b2} * \text{static\_cast} < \text{signed int} > (\text{div}2.\text{quot}))) <
maxof(signed int)
\rightarrow [simplify]
[1.7] ((172 * div(heapIs \$heap_{funcstart\_1032,1}, this.\$r.value(heapIs
heap_{funcstart\_1032,1}.p2, 176).rem - (heap_{1032,1;1051,8}.b2 *
static\_cast < signed int > (div2.quot))) \le maxof(signed int)
\rightarrow [from term 53.19, $heap<sub>1032,1;1051,8</sub> is equal to
\$heap_{funcstart\_1032,1}.\_\textbf{replace}(\textbf{this}.\$r \rightarrow \textbf{this}.\$r.\textbf{value}(\textbf{heapIs}
heap_{funcstart\_1032,1}._replace(p1 \rightarrow (-2 * div(heapIs p_{funcstart\_1032,1}).
div(\mathbf{heapIs}\ \$heap_{funcstart\_1032,1},\ \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}
heap_{funcstart_{-1032,1}}.p1, 177).rem)))]
[1.8] ((172 * div(heapIs $heap<sub>funcstart_1032,1</sub>, this.$r.value(heapIs)
\rho_{uncstart_{1032,1},1}.p2, 176).rem – (\rho_{uncstart_{1032,1},1}.p2).rem
\rightarrow this.$r.value(heapIs $heap_{tuncstart\_1032.1})._replace(p1 \rightarrow ((-2 *
div(\mathbf{heapIs} \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
```

```
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177).rem)))).b2 *
static\_cast < signed int > (div2.quot))) \le maxof(signed int)
\rightarrow [const member of object with modified fields]
[1.9] ((172 * div(heapIs $heap_{funcstart\_1032,1}, this.$r.value(heapIs)
\text{Sheap}_{funcstart\_1032.1}.p2, 176).rem) - (\text{Sheap}_{funcstart\_1032.1}.b2 *
static\_cast < signed int > (div2.quot))) \le maxof(signed int)
\rightarrow [const static or extern object]
[1.10] ((172 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs = f_{uncstart\_1032,1})
\rho_{tuncstart\_1032.1}.p2, 176).rem) - (\rho_{tuncstart\_1032.1}.p2, 176).rem) - (\rho_{tuncstart\_1032.1}.p2, 176).rem)
int>(div2.quot))) < maxof(signed int)
\rightarrow [expand definition of constant 'b2' at prang.cpp (36,26)]
[1.11] ((172 * div(heapIs heapIs funcstart_{1032.1}, this.r.value(heapIs funcstart_{1032.1})
\theta_{funcstart\_1032.1}.p2, 176).rem) - ((int)35 * static_cast<signed)
int>(div2.quot))) \le maxof(signed int)
\rightarrow [simplify]
[1.12] ((172 * div(heapIs heapIs  heap_{funcstart\_1032,1}, this.r.value(heapIs 
\theta_{funcstart\_1032,1}.p2, 176).rem - (35 * static\_cast < signed)
int>(div2.quot)) \le maxof(signed int)
\rightarrow [from term 18.6, div2 is equal to div(heapIs $heap_{funcstart\_1032,1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p2, 176)]
[1.13] ((172 * div(heapIs $heap<sub>funcstart_1032,1</sub>, this.$r.value(heapIs)
\rho_{tuncstart\_1032.1}.p2, 176).rem) - (35 * static_cast<signed)
int>(div(heapIs $heap_{tuncstart\_1032.1}, this.$r.value(heapIs
\text{Sheap}_{funcstart\_1032,1}).\text{p2}, 176).\text{quot}))) \leq \text{maxof}(\text{signed int})
\rightarrow [simplify]
[1.30] -32768 < ((-172 * div(heapIs $heap_{funcstart\_1032,1}),
this.$r.value(heapIs \rho_{funcstart\_1032,1}).p2, 176).rem) + (35 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p2,
176).quot))
\rightarrow [negate goal and search for contradiction]
[1.31]!(-32768 < ((-172 * div(\mathbf{heapIs} \$heap_{funcstart\_1032,1}, 
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p2, 176).rem) + (35 * div(heapIs)
\rho_{funcstart\_1032,1}, this. r.value(heapIs \rho_{funcstart\_1032,1}).p2,
176).quot)))
\rightarrow [simplify]
[1.36] 32767 < ((172 * div(heapIs $heap_{funcstart\_1032,1}, this.$r.value(heapIs)]
\text{Sheap}_{funcstart\_1032.1}.p2, 176).rem) + (-35 * div(heapIs \text{Sheap}_{funcstart\_1032.1},
this.r.value(heapIs $heap_{funcstart\_1032,1}).p2, 176).quot))
```

 $\text{Sheap}_{funcstart_1032,1}$.p1, 177).quot) + (171 * div(heapIs $\text{Sheap}_{funcstart_1032,1}$,

```
[Branch on disjunction or conditional in term 31.18]
[61.0] (0 == (-this.\$r.value(heapIs \$heap_{funcstart\_1032,1}).p2 + div(heapIs)
\rho_{funcstart_{1032,1}}, this.r.value(heapIs \rho_{funcstart_{1032,1}}).p2,
176).rem)) \vee (175 < this.$r.value(heapIs $heap_{funcstart\_1032,1}).p2) \vee !(0 ==
(-this.\$r.value(heapIs \$heap_{funcstart\_1032.1}).p2 + div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p2,
176).rem))
[Copy term 1.36]
[62.0]~(32767 < ((-35~* \mathrm{div}(\mathbf{heapIs}~\$ \mathrm{heap}_{funcstart\_1032,1},\, \mathbf{this}.\$ \mathrm{r.value}(\mathbf{heapIs}
\text{Sheap}_{funcstart\_1032,1}.p2, 176).quot) + (172 * div(heapIs \text{Sheap}_{funcstart\_1032,1},
this.$r.value(heapIs heap_{funcstart\_1032,1}).p2, 176).rem))) \vee (175 <
this.$r.value(heapIs heap_{funcstart\_1032,1}).p2) \lor !(0 ==
(-\mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}\ \$\mathbf{heap}_{funcstart\_1032,1}).\mathbf{p}2\ +\ \mathrm{div}(\mathbf{heapIs}
\rho_{tuncstart\_1032.1}, this.r.value(heapIs \rho_{tuncstart\_1032.1}).p2,
176).rem))
\rightarrow [from term 61.0, div(heapIs $heap_{funcstart\_1032,1}$, this.$r.value(heapIs)
heap_{funcstart\_1032,1}.p2, 176.rem is equal to this.r.value(heapIs)
$heap_{funcstart\_1032,1}).p2]
\textit{[62.1]}\ (32767 < ((-35\ ^*\ \mathrm{div}(\mathbf{heapIs}\ \$ \mathrm{heap}_{funcstart\_1032,1},\ \mathbf{this}.\$ r. \mathbf{value}(\mathbf{heapIs}\ \$)
\theta_{funcstart\_1032,1}.p2, 176.quot) + (172 * this.$r.value(heapIs
heap_{funcstart_1032,1}.p2)) \lor ...
[Copy term 26.17]
[63.0] \ (0 == (-\text{div}(\mathbf{heapIs} \ \$ heap_{funcstart\_1032,1}, \ \mathbf{this}.\$ r. \mathbf{value}(\mathbf{heapIs} \ \mathsf{heap} \mathbf{Is}))
\theta_{funcstart\_1032,1}.p2, 176).rem + (this.r.value(heapIs)
\theta_{funcstart\_1032,1}.p2 % 176))) \vee (175 < this.$r.value(heapIs)
\theta_{funcstart\_1032.1}.p2) \vee !(0 == (-this.\$r.value(heapIs))
\text{Sheap}_{funcstart\_1032,1}).p2 + div(heapIs \text{Sheap}_{funcstart\_1032,1},
this.r.value(heapIs $heap_{funcstart\_1032,1}).p2, 176).rem))
\rightarrow [from\ term\ 61.0,\ div(\textbf{heapIs}\ \$heap_{funcstart\_1032,1},\ \textbf{this.}\$r.\textbf{value}(\textbf{heapIs}
$heap_funcstart_1032,1).p2, 176).rem is equal to this.$r.value(heapIs
heap_{funcstart\_1032,1}.p2
[63.1] (0 == (-this.$r.value(heapIs \theta_{funcstart\_1032,1}).p2 +
(this.$r.value(heapIs heap_{funcstart\_1032,1}).p2 % 176))) \vee ...
[Assume known post-assertion, class invariant or type constraint for term 63.1]
[64.0] (this.$r.value(heapIs heap_{funcstart\_1032,1}).p2 < 176) \vee (175 <
this.$r.value(heapIs heap_{funcstart\_1032,1}).p2) \lor !(0 ==
(-this.\$r.value(heapIs \$heap_{funcstart\_1032.1}).p2 + div(heapIs
\rho_{tuncstart\_1032.1}, this.r.value(heapIs \rho_{tuncstart\_1032.1}).p2,
176).rem))
\rightarrow [simplify]
```

```
[64.3] (-176 < -this.$r.value(heapIs $heap<sub>funcstart_1032,1</sub>).p2) \vee \dots
[Copy term 62.1]
[70.0] (32767 < ((-35 * div(heapIs heapIs _{funcstart\_1032,1}, this. r.value(heapIs _funcstart\_1032,1)
\theta_{funcstart\_1032,1}.p2, 176).quot + (172 * this. r.value(heapIs)
\$heap_{funcstart\_1032,1}).p2))) \lor (175 < \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}
\theta_{funcstart_{-1032,1}}.p2) \lor !(0 == (-this.\$r.value(heapIs))
\text{Sheap}_{funcstart\_1032,1}.p2 + div(heapIs \text{Sheap}_{funcstart\_1032,1},
this.r.value(heapIs $heap_{funcstart\_1032.1}).p2, 176).rem))
\rightarrow [from term 25.17, div(heapIs $heap_{funcstart\_1032,1}$, this.$r.value(heapIs)
$heap_funcstart_1032,1).p2, 176).quot is equal to this.$r.value(heapIs
heap_{funcstart\_1032,1}).p2 / 176]
\label{eq:condition} \mbox{[70.1] (32767 < ((-35 * (this.\$r.value(heapIs \$heap_{funcstart\_1032,1}).p2 \ / \ 176))}}
+ (172 * this.\$r.value(heapIs \$heap_{funcstart\_1032,1}).p2))) \lor ...
\rightarrow [division by larger divisor]
    Proof of rule precondition 1:
    [70.1.0.0] literald < -this.$r.value(heapIs $heap<sub>funcstart_1032,1</sub>).p2
    \rightarrow [unify with term 64.3]
    [70.1.0.1] true
    Proof of rule precondition 2:
    [70.1.1.0] literalc < this.$r.value(heapIs $heap_{funcstart\_1032.1}).p2
    \rightarrow [unify with term 24.0]
    [70.1.1.1] true
    Proof of rule precondition 3:
    [70.1.2.0] --176 \le 176
    \rightarrow [simplify]
    [70.1.2.2] true
    Proof of rule precondition 4:
    [70.1.3.0] - 2 < 0
    \rightarrow [simplify]
    [70.1.3.1] true
\label{eq:condition} \mbox{[70.2] (32767 < ((-35 * this.\$r.value(heapIs \$heap_{funcstart\_1032,1}).p2) + (172 + (-35 * this.\$r.value(heapIs \$heap_{funcstart\_1032,1}).p2)) + (172 + (-35 * this.\$r.value(heapIs \$heap_{funcstart\_1032,1}).p2)))}
* this.$r.value(heapIs \theta_{funcstart\_1032,1}).p2))) \vee ...
\rightarrow [simplify]
[70.4] (32767 < (137 * this.$r.value(heap
Is $heap_{funcstart\_1032,1}).p2)) \lor \dots
\rightarrow [literal comparison of product]
```

```
[70.5] ([137 < 0]: (32767 / -137) < -this.$r.value(heapIs
\$heap_{funcstart\_1032,1}).p2, \ [0 < 137]: \ (32767 \ / \ 137) < \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
\label{eq:heapfuncstart_1032,1} $$ heap_{funcstart_1032,1}.p2, [0 == 137]: 32767 < 0) \lor \dots $$
→ [explicitly assert falsehood of skipped guards in subsequent guards]
[70.6] ([137 < 0]: (32767 / -137) < -this.$r.value(heapIs)
\text{Sheap}_{funcstart=1032.1}).p2, [(0 < 137) \land !(137 < 0)]: (32767 / 137) <
this.$r.value(heapIs p_{funcstart\_1032,1}).p2, [(0 == 137) \land !(0 < 137) \land
!(137 < 0)]: 32767 < 0) \lor ...
\rightarrow [simplify]
[70.13] (true \land (239 < this.$r.value(heapIs $heap_{funcstart\_1032.1}).p2)) \lor \dots
\rightarrow [from term 64.3, literala < this.$r.value(heapIs $heap_{funcstart\_1032,1}).p2
is false whenever -2 < (-176 + literala)]
   Proof of rule precondition:
   [70.13.0] - 2 < (-176 + 239)
   \rightarrow [simplify]
   [70.13.2] true
[70.14] (true \wedge false) \vee ...
\rightarrow [simplify]
[70.15] false \vee ...
[Remove 'false' term 70.15 and fetch new term from containing clause]
[71.0] 175 < this.$r.value(heapIs \rho_{funcstart\_1032,1}).p2
[Copy term 1.36]
[74.0] 32767 < ((-35 * div(heapIs $heap_{funcstart\_1032,1}, this.$r.value(heapIs)]
\rho_{funcstart_{1032,1}}.p2, 176).quot + (172 * div(heapIs $heap_{funcstart_{1032,1}})
this.r.value(heapIs \ heap_{funcstart\_1032.1}).p2, 176).rem))
\rightarrow [from term 26.17, div(heapIs $heap_{funcstart\_1032,1}$, this.$r.value(heapIs)
heap_{funcstart\_1032,1}.p2, 176.rem is equal to this.r.value(heapIs)
heap_{funcstart_{-1032,1}}.p2 \% 176
[74.1] 32767 < ((-35 * div(heapIs $heap_{funcstart\_1032,1}, this.$r.value(heapIs)
\theta_{funcstart\_1032,1}.p2, 176).quot + (172 * (this. r.value(heapIs))
heap_{funcstart_{-1032.1}}.p2 \% 176)
[Create new term from term 25.17 using rule: condition for equality of division]
[101.0] ((176 * (0 + -(-\text{div}(\mathbf{heapIs} \$ \text{heap}_{funcstart\_1032,1},
this.$r.value(heapIs heap_{funcstart_{-1032,1}}).p2, 176).quot))) < (1 +
heap_{funcstart\_1032,1}.p2 < (176 * (0 + 1 + -(-div(heapIs)))
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p2,
```

```
176).quot))))
\rightarrow [simplify]
[101.15] (-1 < ((-176 * div(heapIs $heap_{funcstart\_1032,1}, this.$r.value(heapIs)]
\theta_{funcstart\_1032,1}.p2, 176).quot) + this.r.value(heapIs)
\$heap_{funcstart\_1032,1}).p2)) \, \wedge \, (\text{-}176 < (\textbf{-this.}\$r.\textbf{value}(\textbf{heapIs}
\text{Sheap}_{funcstart\_1032,1}.p2 + (176 * div(heapIs \text{Sheap}_{funcstart\_1032,1},
this.r.value(heapIs $heap_{funcstart\_1032,1}).p2, 176).quot)))
\rightarrow [separate conjunction and work on first sub-term]
[101.16]-176 < (-this.$r.value(heapIs \rho_{funcstart\_1032,1}).p2 + (176 *
{\rm div}(\mathbf{heapIs}~\$\mathrm{heap}_{funcstart\_1032,1},~\mathbf{this}.\$\mathrm{r.value}(\mathbf{heapIs}
heap_{funcstart_{-1032.1}}.p2, 176).quot))
[Create new term from terms 101.16, 71.0 using rule: transitivity 2]
[126.0] (-176 + 1 + 175) < (176 * div(heapIs $heap_{tuncstart\_1032.1},
this.r.value(heapIs \ heap_{funcstart\_1032.1}).p2, 176).quot)
\rightarrow [simplify]
[126.1] 0 < (176 * div(heapIs $heap_{funcstart\_1032,1}, this.$r.value(heapIs
heap_{funcstart_{1032,1}}.p2, 176).quot
\rightarrow [product is positive]
[126.2] ((0 < 176) \wedge (0 < div(heapIs $heap_{funcstart\_1032,1},
this.$r.value(heapIs \theta_{funcstart\_1032,1}).p2, 176).quot)) \vee ((176 < 0) \wedge
(\text{div}(\mathbf{heapIs} \$ \text{heap}_{funcstart\_1032,1}, \mathbf{this}.\$ \text{r.value}(\mathbf{heapIs}))
heap_{funcstart\_1032,1}.p2, 176).quot < 0
\rightarrow [simplify]
[126.7] 0 < \text{div}(\mathbf{heapIs} \$ \text{heap}_{funcstart\_1032,1}, \mathbf{this}.\$ \mathbf{r.value}(\mathbf{heapIs})
heap_{funcstart\_1032,1}.p2, 176).quot
[Create new term from terms 126.7, 74.1 using rule: transitivity 11]
[129.0] (1 + 32767 + (0 * 35)) < (172 * (this.\$r.value(heapIs))
heap_{funcstart_{1032,1}}.p2 \% 176)
\rightarrow [simplify]
[129.2] 32768 < (172 * (this.\$r.value(heapIs \$heap_{funcstart\_1032,1}).p2 \% 176))
\rightarrow [literal comparison of product]
[129.3] ([172 < 0]: (32768 / -172) < -(this.$r.value(heapIs
heap_{funcstart\_1032,1}.p2 \% 176, [0 < 172]: (32768 / 172) < 172
(this.$r.value(heap
Is $heap_{funcstart\_1032,1}).p2 % 176), [0 == 172]: 32768 <
0)
→ [explicitly assert falsehood of skipped guards in subsequent guards]
[129.4] ([172 < 0]: (32768 / -172) < -(this.$r.value(heapIs
```

```
$\text{heap}_{funcstart_1032,1}.p2 \% 176), [(0 < 172) \land !(172 < 0)]: (32768 / 172) < (this.$\text{r.value}(heapIs $\text{heap}_{funcstart_1032,1}).p2 \% 176), [(0 == 172) \land !(0 < 172) \land !(172 < 0)]: 32768 < 0)
$\to [simplify]$
[129.13] false
```

Proof of verification condition: Type constraint satisfied in explicit conversion from 'integer' to 'int'

In the context of class: WHPrang, declared at: C:\Escher\Customers\prang-cpp\prang.cpp (18,1)

Condition generated at: C:\Escher\Customers\prang-cpp\prang.cpp (78,18)

Condition defined at:

To prove: $minof(int) \le static_cast < integer > (static_cast < signed int > (operator*(heapIs <math>heapI_{0.32,1;1051,8}, this).p2) < (int)0)$

Given:

```
heap_{init}.LIMIT == (int)80
heap_{init}.class WHPrang \in M1 == (int)30269
heap_{init}.class WHPrang \in r1 == (int)171
heap_{init}.class WHPrang \in a1 == (int)177
heap_{init}.class WHPrang \in b1 == (int)2
heap_{init}.class WHPrang \in M2 == (int)30307
heap_{init}.class WHPrang \in r2 == (int)172
heap_{init}.class WHPrang \in a2 == (int)176
heap_{init}.class WHPrang \in b2 == (int)35
heap_{init}.class WHPrang \in M3 == (int)30323
heap_{init}.class WHPrang \in r3 == (int)170
heap_{init}.class WHPrang \in a3 == (int)178
heap_{init}.class WHPrang \in b3 == (int)63
\operatorname{div1} == \operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_1032,1},
\mathbf{static\_cast} {<} \mathbf{int} {>} (\mathbf{operator^*(heapIs}\ \$heap_{funcstart\_1032,1},\ \mathbf{this}).p1),
\mathbf{static\_cast}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_1032,1}.\mathrm{a1}))
(asType < integer > (static\_cast < int > (operator*(heapIs)))
heap_{funcstart\_1032,1}, this).p1) /
asType<integer>(static_cast<int>($heap_{tuncstart\_1032.1}.a1))) ==
asType<integer>(div1.quot)
```

```
(asType<integer>(static_cast<int>(operator*(heapIs
heap_{funcstart\_1032,1}, this).p1) %
asType < integer > (static\_cast < int > (\$heap_{funcstart\_1032.1}.a1))) = =
asType<integer>(div1.rem)
(asType<integer>(operator*(heapIs $heap_{funcstart\_1032.1}, this).p1) <
asType < integer > (\$heap_{funcstart\_1032,1}.a1)) = >
(\mathbf{asType} < \mathbf{integer} > (\mathbf{div1.rem}) = = \mathbf{asType} < \mathbf{integer} > (\mathbf{operator}^*(\mathbf{heapIs}))
heap_{funcstart\_1032,1}, this).p1)
(asType < integer > (\$heap_{funcstart\_1032,1}.a1) \le
asType < integer > (operator*(heapIs $heap_{funcstart\_1032,1}, this).p1)) =>
!(0 == asTvpe < integer > (div1.quot))
!(0 == asType < integer > (div1.rem)) || !(0 ==
asType<integer>(div1.quot))
div2 == div(\mathbf{heapIs} \$heap_{funcstart\_1032,1},
static_cast<int>(operator*(heapIs $heap_{funcstart\_1032.1}, this).p2),
\mathbf{static\_cast}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_1032,1}.\mathrm{a2}))
(asType<integer>(static_cast<int>(operator*(heapIs
heap_{funcstart\_1032.1}, this).p2)
asType < integer > (static\_cast < int > (\$heap_{funcstart\_1032.1}.a2))) = =
asType<integer>(div2.quot)
(asType<integer>(static_cast<int>(operator*(heapIs
heap_{funcstart\_1032,1}, this).p2) %
asType < integer > (static\_cast < int > (\$heap_{funcstart\_1032.1}.a2))) = =
asType<integer>(div2.rem)
(\mathbf{asType}{<}\mathbf{integer}{>}(\mathbf{operator}^*(\mathbf{heapIs}\ \$\mathbf{heap}_{funcstart\_1032,1},\ \mathbf{this}).\mathtt{p2}) <
asType < integer > (\$heap_{funcstart\_1032.1}.a2)) = >
(asType<integer>(div2.rem) == asType<integer>(operator*(heapIs
heap_{funcstart\_1032.1}, this).p2)
(\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathsf{heap}_{funcstart\_1032,1}.\mathsf{a2}) \leq
asType<integer>(operator*(heapIs $heap_funcstart_1032,1, this).p2)) =>
!(0 == asType < integer > (div2.quot))
!(0 == asType < integer > (div2.rem)) || !(0 ==
asType<integer>(div2.quot))
div3 == div(\mathbf{heapIs} \$heap_{funcstart\_1032,1},
static\_cast < int > (operator*(heapIs $heap_{funcstart\_1032,1}, this).p3),
static\_cast < int > (\$heap_{funcstart\_1032,1}.a3))
(asType < integer > (static\_cast < int > (operator*(heapIs)))
heap_{funcstart\_1032.1}, this).p3)
asType < integer > (static\_cast < int > (\$heap_{funcstart\_1032.1}.a3))) = =
asType<integer>(div3.quot)
(asType < integer > (static\_cast < int > (operator*(heapIs)))
```

```
heap_{funcstart=1032.1}, this).p3)
\mathbf{asType} < \mathbf{integer} > (\mathbf{static\_cast} < \mathbf{int} > (\$ \mathbf{heap}_{funcstart\_1032,1}.\mathbf{a3}))) = =
asType<integer>(div3.rem)
(\mathbf{asType}{<}\mathbf{integer}{>}(\mathbf{operator}^*(\mathbf{heapIs}\ \$\mathbf{heap}_{funcstart\_1032,1},\ \mathbf{this}).\mathrm{p3}) <
asType < integer > (\$heap_{funcstart\_1032,1}.a3)) = >
(asType<integer>(div3.rem) == asType<integer>(operator*(heapIs
heap_{funcstart\_1032,1}, this).p3)
(\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathsf{heap}_{funcstart\_1032,1}.\mathsf{a3}) \leq
asType < integer > (operator*(heapIs $heap_{funcstart\_1032,1}, this).p3)) = > 
!(0 == asType < integer > (div3.quot))
!(0 == asType < integer > (div3.rem)) || !(0 ==
asType<integer>(div3.quot))
temp1 == (\$heap_{funcstart\_1032,1}.r1 * \textbf{static\_cast} < \textbf{signed int} > (div1.rem)) -
(\text{\$heap}_{funcstart\_1032,1}.\text{b1 * static\_cast} < \text{signed int} > (\text{div1.quot}))
minof(signed int) < temp1
temp1 \le maxof(signed int)
\theta_{1032,1:1051,8} == \theta_{1032
operator*(heapIs heap_{funcstart\_1032,1}, this)._replace(p1 \rightarrow
asType < P1Type > ((\$heap_{funcstart\_1032,1}.M1 *
asType < int > (static\_cast < integer > (static\_cast < signed
int>(operator^*(heapIs \$heap_{funcstart\_1032,1}, this).p1) < (int)0))) +
temp1)))
temp2 == (\$heap_{1032,1;1051,8}.r2 * \textbf{static\_cast} < \textbf{signed int} > (div2.rem)) -
(\text{sheap}_{1032.1:1051.8}.\text{b2} * \text{static\_cast} < \text{signed int} > (\text{div2.quot}))
minof(signed int) \le temp2
temp2 \le maxof(signed int)
Proof:
[Take given term]
[2.0] div1 == div(heapIs $heap<sub>funcstart_1032,1</sub>,
static_cast<int>(operator*(heapIs $heap_{funcstart\_1032,1}, this).p1),
static\_cast < int > (\$heap_{funcstart\_1032,1}.a1))
→ [expand definition of operator '*' in class 'pointer' at built in declaration]
[2.1] \operatorname{div1} == \operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_1032,1},
\mathbf{static\_cast} < \mathbf{int} > (\mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs} \$ \mathbf{heap}_{funcstart\_1032,1}).p1),
\mathbf{static\_cast}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_1032,1}.\mathrm{a1}))
\rightarrow [simplify]
[2.2] \operatorname{div1} == \operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_1032,1}, \mathbf{this.}\$ r.\mathbf{value}(\mathbf{heapIs})
\theta_{funcstart\_1032,1}.p1, \theta_{funcstart\_1032,1}.p1, \theta_{funcstart\_1032,1}.a1))
```

```
\rightarrow [const static or extern object]
[2.3] \text{ div1} == \text{div(heapIs } \text{$heap}_{funcstart\_1032,1}, \text{ this.} \text{$r.value(heapIs)}
\theta_{tuncstart\_1032,1}.p1, \theta_{tuncstart\_1032,1}.p2, \theta_{tuncstart\_1032,1}.p2, \theta_{tuncstart\_1032,1}.p2, \theta_{tuncstart\_1032,1}.p1, \theta_{tuncstart\_1032,1}.p1, \theta_{tuncstart\_1032,1}.p2, \theta_{tuncstart\_1032,1}.p3, \theta_{tuncstart\_1032,1
\rightarrow [expand definition of constant 'a1' at prang.cpp (30,26)]
[2.4] \operatorname{div1} == \operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_1032,1}, \mathbf{this}.\$ r. \mathbf{value}(\mathbf{heapIs})
\theta_{funcstart\_1032,1}.p1, \theta_{funcstart} (int)177)
\rightarrow [simplify]
[2.6] \operatorname{div1} == \operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_1032,1}, \mathbf{this}.\$ r. \mathbf{value}(\mathbf{heapIs}))
heap_{funcstart\_1032,1}.p1, 177)
[Assume known post-assertion, class invariant or type constraint for term 2.6]
[7.0] (0 < asType<integer>(this.$r.value(heapIs
\verb§heap$_{funcstart\_1032,1}).p1)) \&\& (\textbf{asType} < \textbf{integer} > (\textbf{this}.\$r.\textbf{value}(\textbf{heapIs}))) \&\& (\textbf{asType} < \textbf{integer})) \\
\$ heap_{funcstart\_1032,1}).p1) < \mathbf{asType} < \mathbf{integer} > (\$ heap.\mathbf{class} \ WHPrang \in \texttt{Prance})
M1))
\rightarrow [simplify]
[7.2] (0 < this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1) \&\&
(this.r.value(heapIs $heap_{funcstart\_1032,1}).p1 <
asType < integer > (\text{$heap.class WHPrang} \in M1))
\rightarrow [const static or extern object]
[7.3] (0 < this.$r.value(heap
Is $heap_{funcstart\_1032,1}).p1) &&
(this.r.value(heapIs $heap_{funcstart\_1032.1}).p1 <
asType < integer > (\$heap_{init}.class WHPrang \in M1))
\rightarrow [expand definition of constant 'M1' at prang.cpp (28,26)]
[7.4] (0 < this.$r.value(heap
Is $heap_{funcstart\_1032,1}).p1) &&
(this.r.value(heapIs $heap_{funcstart\_1032,1}).p1 <
asType < integer > ((int)30269))
\rightarrow [simplify]
[7.10] (-30269 < -this.$r.value(heapIs heap_{funcstart\_1032,1}).p1) \land (0 <
this.$r.value(heapIs $heap_{funcstart\_1032.1}).p1)
[Work on sub-term 2 of conjunction in term 7.10]
[8.0] 0 < this.$r.value(heapIs $heap<sub>funcstart_1032,1</sub>).p1
[Take given term]
[18.0] \operatorname{div2} == \operatorname{div}(\mathbf{heapIs} \ \operatorname{\$heap}_{funcstart\_1032,1},
static_cast<int>(operator*(heapIs $heap_{funcstart\_1032,1}, this).p2),
\mathbf{static\_cast}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_1032,1}.\mathrm{a2}))
→ [expand definition of operator '*' in class 'pointer' at built in declaration]
[18.1] \operatorname{div2} == \operatorname{div}(\mathbf{heapIs} \ \operatorname{\$heap}_{funcstart\_1032,1},
```

```
static_cast<int>(this.$r.value(heapIs $heap_{tuncstart_1032.1}).p2),
static\_cast < int > (\$heap_{funcstart\_1032,1}.a2))
\rightarrow [simplify]
[18.2] div2 == div(\mathbf{heapIs} \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
\theta_{funcstart\_1032,1}.p2, \theta_{funcstart\_1032,1}.p2, \theta_{funcstart\_1032,1}.a2))
\rightarrow [const static or extern object]
[18.3] div2 == div(heapIs heapIs heap_{funcstart\_1032,1}, this.r.value(heapIs
\theta_{uncstart\_1032.1}.p2, static_cast<int>(\theta_{unit}.a2))
\rightarrow [expand definition of constant 'a2' at prang.cpp (35,26)]
[18.4] div2 == div(heapIs $heap_{tuncstart\_1032.1}, this.$r.value(heapIs)
\label{eq:cast_int} $$ p_{funcstart\_1032,1}.p2, \ \mathbf{static\_cast} < \mathbf{int} > ((\mathbf{int})176))$$
\rightarrow [simplify]
[18.6] \text{ div2} == \text{div}(\mathbf{heapIs} \$ \mathbf{heap}_{funcstart\_1032,1}, \mathbf{this}.\$ \mathbf{r.value}(\mathbf{heapIs})
heap_{funcstart\_1032,1}.p2, 176)
[Assume known post-assertion, class invariant or type constraint for term 18.6]
[23.0] (0 < asType<integer>(this.$r.value(heapIs
\rho_{uncstart_{1032,1}.p2} & (asType<integer>(this.$r.value(heapIs)
\$ heap_{funcstart\_1032,1}).p2) < \mathbf{asType} < \mathbf{integer} > (\$ heap.\mathbf{class} \ WHPrang \in \texttt{Constart} = \texttt{Constart}
M2))
\rightarrow [simplify]
[23.2] (0 < this.$r.value(heapIs $heap_{funcstart\_1032,1}).p2) &&
(this.r.value(heapIs $heap_{funcstart\_1032,1}).p2 <
asType < integer > (\text{$heap.class WHPrang} \in M2))
\rightarrow [const static or extern object]
[23.3] (0 < this.$r.value(heapIs \rho_{funcstart\_1032,1}).p2) &&
(this.r.value(heapIs $heap_{funcstart\_1032,1}).p2 <
asType < integer > (\$heap_{init}.class WHPrang \in M2))
\rightarrow [expand definition of constant 'M2' at prang.cpp (33,26)]
[23.4] (0 < this.$r.value(heapIs $heap_{funcstart\_1032,1}).p2) &&
(this.r.value(heapIs $heap_{funcstart\_1032,1}).p2 <
\mathbf{asType}{<}\mathbf{integer}{>}((\mathbf{int})30307))
\rightarrow [simplify]
this.r.value(heapIs $heap_{funcstart\_1032,1}).p2)
[Work on sub-term 2 of conjunction in term 23.10]
[24.0] 0 < this.$r.value(heapIs $heap_{funcstart\_1032,1}).p2
[Take given term]
```

```
[50.0] \; ((\$ heap_{funcstart\_1032,1}.r1 \; * \; \textbf{static\_cast} < \textbf{signed int} > (\text{div1.rem})) \; - \; \text{div1.rem})) \; - \; \text{div1.rem}) \; + \; \text{div
(\text{sheap}_{funcstart\_1032,1}.\text{b1} * \text{static\_cast} < \text{signed int} > (\text{div1.quot}))) == \text{temp1}
\rightarrow [const static or extern object]
[50.1] (($heap<sub>init</sub>.r1 * static_cast<signed int>(div1.rem)) -
(\text{sheap}_{funcstart\_1032,1}.\text{b1 * static\_cast} < \text{signed int} > (\text{div1.quot}))) == \text{temp1}
\rightarrow [expand definition of constant 'r1' at prang.cpp (29,26)]
[50.2] (((int)171 * static_cast<signed int>(div1.rem)) -
(\text{\$heap}_{funcstart\_1032,1}.\text{b1 * static\_cast} < \text{signed int} > (\text{div1.quot}))) == \text{temp1}
\rightarrow [simplify]
[50.3] ((171 * static_cast < signed int > (div1.rem)) - (\text{$heap_{funcstart\_1032,1}.b1}
* static_cast<signed int>(div1.quot))) == temp1
\rightarrow [from term 2.6, div1 is equal to div(heapIs $heap_{funcstart\_1032.1},
this.$r.value(heapIs $heap_{funcstart\_1032,1}).p1, 177)]
[50.4] ((171 * static_cast<signed int>(div(heapIs $heap_{tuncstart\_1032.1})
this.r.value(heapIs $heap_{funcstart\_1032,1}).p1, 177).rem)) -
(\text{sheap}_{funcstart\_1032.1}.\text{b1} * \text{static\_cast} < \text{signed int} > (\text{div1.quot}))) == \text{temp1}
\rightarrow [simplify]
[50.5] ((171 * div(heapIs $heap<sub>funcstart_1032,1</sub>, this.$r.value(heapIs)
\text{Sheap}_{funcstart\_1032,1}.\text{p1}, 177).\text{rem} - (\text{Sheap}_{funcstart\_1032,1}.\text{b1} *
static_cast<signed int>(div1.quot))) == temp1
\rightarrow [const static or extern object]
[50.6] ((171 * div(heapIs $heap_{funcstart\_1032,1}, this.$r.value(heapIs)]
\rho_{uncstart\_1032,1}.p1, 177).rem – (\rho_{uncstart\_1032,1}.p1, 177).rem) – (\rho_{uncstart\_1032,1}.p1, 177).rem) – (\rho_{uncstart\_1032,1}.p1, 177).rem)
int>(div1.quot)) == temp1
\rightarrow [expand definition of constant 'b1' at prang.cpp (31,26)]
[50.7] ((171 * \mathrm{div}(\mathbf{heapIs}\ \$\mathrm{heap}_{funcstart\_1032,1},\ \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}
\theta_{uncstart\_1032,1}.p1, 177).rem - ((int)2 * static\_cast < signed)
int>(div1.quot)) == temp1
\rightarrow [simplify]
[50.8] ((171 * div(heapIs $heap_{funcstart\_1032,1}, this.$r.value(heapIs 
\theta_{funcstart\_1032,1}.p1, 177).rem - (2 * static\_cast < signed)
int>(div1.quot))) == temp1
\rightarrow [from term 2.6, div1 is equal to div(heapIs $heap_{funcstart\_1032.1},
this.r.value(heapIs \ heap_{funcstart\_1032.1}).p1, 177)
[50.9] ((171 * div(heapIs $heap_{funcstart\_1032,1}, this.$r.value(heapIs 
\theta_{funcstart\_1032,1}.p1, 177).rem) - (2 * static_cast<signed)
int>(div(heapIs \$heap_{funcstart\_1032,1}, this.\$r.value(heapIs
\$heap_{funcstart\_1032,1}).p1,\,177).quot)))) == temp1
```

```
\rightarrow [simplify]
[50.14] 0 == (-\text{temp1} + (-2 * \text{div}(\text{heapIs } \text{\$heap}_{tuncstart\_1032.1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177).quot) + (171 *
div(\mathbf{heapIs} \$ heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
heap_{funcstart_{-1032.1}}.p1, 177).rem
[Take given term]
[53.0] heap_{1032,1;1051,8} == heap_{funcstart\_1032,1}._replace(this.r \rightarrow
operator*(heapIs heap_{funcstart\_1032,1}, this)._replace(p1 \rightarrow
\mathbf{asType}{<}P1\mathsf{Type}{>}((\$\mathsf{heap}_{funcstart\_1032,1}.\mathsf{M1}~*
asType<int>(static_cast<integer>(static_cast<signed
int>(operator*(heapIs $heap_{funcstart\_1032,1}, this).p1) < (int)0))) +
temp1)))
→ [expand definition of operator '*' in class 'pointer' at built in declaration]
[53.1] $heap<sub>1032,1:1051,8</sub> == $heap<sub>funcstart_1032,1</sub>._replace(this.$r \rightarrow
this.$r.value(heapIs \theta_{funcstart\_1032,1})._replace(p1 \rightarrow
asType<P1Type>(($heap<sub>funcstart_1032.1</sub>.M1 *
asType<int>(static_cast<integer>(static_cast<signed
int>(operator^*(heapIs \$heap_{funcstart\_1032,1}, this).p1) < (int)0))) +
temp1)))
\rightarrow [const static or extern object]
[53.2] heap_{1032,1;1051,8} == heap_{funcstart\_1032,1}._replace(this.r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow
asType < P1Type > ((\$heap_{init}.M1 *
asType<int>(static_cast<integer>(static_cast<signed
int>(operator^*(heapIs \$heap_{funcstart\_1032,1}, this).p1) < (int)0))) +
temp1)))
\rightarrow [expand definition of constant 'M1' at prang.cpp (28,26)]
[53.3] $\text{heap}_{1032,1:1051.8} == \text{$heap}_{funcstart\_1032,1}._\text{replace}(\text{this}.\text{$r} \to \text{$}
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow
asType<P1Type>(((int)30269 *
asType<int>(static_cast<integer>(static_cast<signed
int>(operator^*(heapIs \$heap_{funcstart\_1032,1}, this).p1) < (int)0))) +
temp1)))
\rightarrow [simplify]
[53.4] heap_{1032,1;1051,8} == heap_{funcstart\_1032,1}._replace(this.r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow
asType<P1Type>((30269 *
asType < int > (static\_cast < integer > (static\_cast < signed)
int>(operator^*(heapIs \$heap_{funcstart\_1032,1}, this).p1) < (int)0))) +
temp1)))
→ [expand definition of operator '*' in class 'pointer' at built in declaration]
```

```
[53.5] heap_{1032,1;1051,8} == heap_{funcstart\_1032,1}._replace(this.r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow
asType<P1Type>((30269 *
as Type < int > (static\_cast < integer > (static\_cast < signed
int>(this.\$r.value(heapIs \$heap_{funcstart\_1032,1}).p1) < (int)0))) + temp1)))
\rightarrow [simplify]
[53.9] $heap<sub>1032,1;1051,8</sub> == $heap<sub>funcstart_1032,1</sub>._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow
asType<P1Type>((30269 * asType<int>(static_cast<integer>(0 <
-this.r.value(heapIs heap_{funcstart\_1032,1}.p1))) + temp1)))
\rightarrow [from term 8.0, literala < -this.$r.value(heapIs $heap_{funcstart\_1032.1}).p1
is false whenever -2 < (0 + literala)
    Proof of rule precondition:
    [53.9.0] - 2 < (0 + 0)
    \rightarrow [simplify]
    [53.9.2] true
[53.10] $\text{heap}_{1032,1;1051,8} == $\text{heap}_{funcstart\_1032,1}._\text{replace}(\text{this}.\text{$\frac{1}{2}r$})
this.$r.value(heapIs \rho_{funcstart\_1032,1})._replace(p1 \rightarrow
asType<P1Type>((30269 * asType<int>(static_cast<integer>(false)))
+ \text{temp1})))
\rightarrow [simplify]
[53.11] $\text{heap}_{1032,1;1051,8} == $\text{heap}_{funcstart\_1032,1}._\text{replace}(\text{this}.\text{$\frac{1}{2}r$})
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow
asType < P1Type > ((30269 * asType < int > (([false]: 1, []: 0))) + temp1)))
→ [explicitly assert falsehood of skipped guards in subsequent guards]
[53.12] $\text{heap}_{1032,1:1051.8} == $\text{heap}_{funcstart\_1032,1}.$\text{-replace}(\text{this}.$\text{$r} \to \text{
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow
asType<P1Type>((30269 * asType<int>(([false]: 1, [true]: 0))) +
temp1)))
\rightarrow [simplify]
[53.15] $\text{heap}_{1032,1;1051,8} == $\text{heap}_{funcstart\_1032,1}._\text{replace}(\text{this}.\text{$\frac{1}{2}r$})
this.$r.value(heapIs \rho_{funcstart\_1032,1})._replace(p1 \rightarrow
asType < P1Type > (0 + temp1))
\rightarrow [from term 50.14, temp1 is equal to (-2 * div(heapIs $heap_{funcstart\_1032,1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177).quot) + (171 * leapIs \ heap_{funcstart\_1032,1}).p1, 177).quot)
div(\mathbf{heapIs}\ \$heap_{funcstart\_1032,1},\ \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}
heap_{funcstart\_1032,1}.p1, 177).rem
[53.16] $heap<sub>1032.1:1051.8</sub> == $heap<sub>funcstart_1032.1</sub>._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow
```

```
asType < P1Type > (0 + ((-2 * div(heapIs $heap_{funcstart\_1032,1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177).quot) + (171 *
{\rm div}(\textbf{heapIs}~\$ heap_{funcstart\_1032,1},~\textbf{this}.\$ r. \textbf{value}(\textbf{heapIs}
heap_{funcstart\_1032,1}.p1, 177.rem))))
\rightarrow [simplify]
[53.19] $heap<sub>1032,1;1051,8</sub> == $heap<sub>funcstart_1032,1</sub>._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.\r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
heap_{funcstart\ 1032.1}.p1, 177).rem))))
[Take goal term]
[1.0] minof(int) < static_cast<integer>(static_cast<signed)
int>(operator^*(heapIs $heap_{1032.1:1051.8}, this).p2) < (int)0)
\rightarrow [simplify]
[1.1] -32768 \leq static_cast<integer>(static_cast<signed
int>(operator^*(heapIs $heap_{1032,1;1051,8}, this).p2) < (int)0)
\rightarrow [from term 53.19, $heap<sub>1032,1:1051,8</sub> is equal to
\$heap_{funcstart\_1032,1}.\_\textbf{replace}(\textbf{this}.\$r \rightarrow \textbf{this}.\$r.\textbf{value}(\textbf{heapIs}
heap_{funcstart\_1032,1}._replace(p1 \rightarrow (-2 * div(heapIs p_{funcstart\_1032,1}).
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, \ 177).quot) + (171 \ funcstart\_1032,1).p1
div(\mathbf{heapIs} \ \$heap_{funcstart\_1032,1}, \ \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
heap_{funcstart\_1032,1}.p1, 177).rem)))]
[1.2] -32768 < static_cast<integer>(static_cast<signed)
int>(operator^*(heapIs \$heap_{funcstart\_1032,1}.\_replace(this.\$r \rightarrow
this.$r.value(heapIs \theta_{funcstart\_1032.1})._replace(p1 \theta (-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs $heap<sub>funcstart_1032,1</sub>, this.$r.value(heapIs
\text{heap}_{funcstart\_1032,1}.\text{p1}, 177).\text{rem})), \text{this}).\text{p2}) < (\text{int})0)
→ [expand definition of operator '*' in class 'pointer' at built in declaration]
[1.3] -32768 \leq static_cast<integer>(static_cast<signed
\mathbf{int}{>}(\mathbf{this.\$r.value}(\mathbf{heapIs}\ \$\mathbf{heap}_{funcstart\_1032,1}.\mathbf{\_replace}(\mathbf{this.\$r} \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
$\text{heap}_{funcstart=1032,1}$, this.$\text{r.value}(\text{heapIs} \text{$heap}_{funcstart=1032,1}).p1,
177).quot) + (171 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
\text{Sheap}_{funcstart\_1032,1}.\text{p1}, 177).\text{rem})))).\text{p2}) < (int)0)
\rightarrow [evaluate dereferenced pointer into modified heap]
[1.4] -32768 \leq static_cast<integer>(static_cast<signed int>(([this.$r ==
this.$r]: this.$r.value(heapIs \rho_{funcstart\_1032.1})._replace(p1 \rightarrow (-2 *
div(\mathbf{heapIs} \$ heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
\text{Sheap}_{funcstart\_1032,1}.p1, 177).quot) + (171 * div(heapIs \text{Sheap}_{funcstart\_1032,1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177).rem)), []:
```

```
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p2) < (int)0)
→ [explicitly assert falsehood of skipped guards in subsequent guards]
[1.5] -32768 \leq static_cast<integer>(static_cast<signed int>(([this.$r ==
this.$r]: this.$r.value(heapIs \rho_{uncstart\_1032,1})._replace(p1 \rightarrow (-2 *
div(\mathbf{heapIs} \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
\text{Sheap}_{funcstart\_1032,1}.p1, 177).quot) + (171 * div(heapIs \text{Sheap}_{funcstart\_1032,1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177).rem)), [!(this.<math>r = 
this.$r)]: this.$r.value(heapIs \theta_{funcstart\_1032,1}).p2) < (int)0)
\rightarrow [simplify]
[1.12] -32768 < static_cast<integer>(0 < -this.$r.value(heapIs)
heap_{funcstart_1032.1}.p2
\rightarrow [from term 24.0, literala < -this.$r.value(heapIs $heap_{funcstart\_1032,1}).p2
is false whenever -2 < (0 + literala)
   Proof of rule precondition:
   [1.12.0] - 2 < (0 + 0)
   \rightarrow [simplify]
   [1.12.2] true
[1.13] -32768 \leq static_cast<integer>(false)
\rightarrow [simplify]
[1.14] -32768 \le ([false]: 1, []: 0)
→ [explicitly assert falsehood of skipped guards in subsequent guards]
[1.15] - 32768 \le ([false]: 1, [true]: 0)
\rightarrow [simplify]
[1.17] true
Proof of verification condition: Type constraint satisfied in explicit
conversion from 'integer' to 'int'
In the context of class: WHPrang, declared at:
C:\Escher\Customers\prang-cpp\prang.cpp\ (18,1)
Condition generated at: C:\Escher\Customers\prang-cpp\prang.cpp
(78,18)
Condition defined at:
To prove: static_cast<integer>(static_cast<signed
int>(operator^*(heapIs $heap_{1032,1:1051,8}, this).p2) < (int)0) \le maxof(int)
Given:
```

 $heap_{init}.LIMIT == (int)80$

```
heap_{init}.class WHPrang \in M1 == (int)30269
heap_{init}.class WHPrang \in r1 == (int)171
heap_{init}.class WHPrang \in a1 == (int)177
heap_{init}.class WHPrang \in b1 == (int)2
\text{$heap}_{init}.\mathbf{class} \text{ WHPrang} \in M2 == (\mathbf{int})30307
heap_{init}.class WHPrang \in r2 == (int)172
heap_{init}.class WHPrang \in a2 == (int)176
heap_{init}.class WHPrang \in b2 == (int)35
heap_{init}.class WHPrang \in M3 == (int)30323
heap_{init}.class WHPrang \in r3 == (int)170
heap_{init}.class WHPrang \in a3 == (int)178
heap_{init}.class WHPrang \in b3 == (int)63
\operatorname{div1} == \operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_1032,1},
static_cast<int>(operator*(heapIs $heap_{tuncstart\_1032.1}, this).p1),
static\_cast < int > (\$heap_{funcstart\_1032,1}.a1))
(asType<integer>(static_cast<int>(operator*(heapIs
heap_{funcstart_1032,1}, this).p1) /
asType < integer > (static\_cast < int > (\$heap_{funcstart\_1032.1}.a1))) = =
asType<integer>(div1.quot)
(asType<integer>(static_cast<int>(operator*(heapIs
heap_{funcstart\_1032,1}, this).p1) %
asType < integer > (static\_cast < int > (\$heap_{funcstart\_1032.1}.a1))) = =
asType<integer>(div1.rem)
(\mathbf{asType}{<}\mathbf{integer}{>}(\mathbf{operator}^*(\mathbf{heapIs}\ \$\mathbf{heap}_{funcstart\_1032,1},\ \mathbf{this}).\mathtt{p1}) <
asType < integer > (\$heap_{funcstart\_1032.1}.a1)) = >
(asType<integer>(div1.rem) == asType<integer>(operator*(heapIs
heap_{funcstart\_1032,1}, this).p1)
(\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathsf{heap}_{funcstart\_1032,1}.\mathsf{a1}) \leq
asType < integer > (operator^*(heapIs \$heap_{funcstart\_1032,1}, this).p1)) = >
!(0 == asType < integer > (div1.quot))
!(0 == asType < integer > (div1.rem)) || !(0 ==
asType<integer>(div1.quot))
div2 == div(\mathbf{heapIs} \$heap_{funcstart\_1032,1},
static\_cast < int > (operator*(heapIs $heap_{funcstart\_1032,1}, this).p2),
static\_cast < int > (\$heap_{funcstart\_1032,1}.a2))
(asType < integer > (static\_cast < int > (operator*(heapIs)))
heap_{funcstart\_1032,1}, this).p2)
asType < integer > (static\_cast < int > (\$heap_{funcstart\_1032,1}.a2))) = =
```

```
asType<integer>(div2.quot)
(asType<integer>(static_cast<int>(operator*(heapIs
heap_{funcstart\_1032,1}, this).p2)
asType < integer > (static\_cast < int > (\$heap_{funcstart\_1032.1}.a2))) = =
asType<integer>(div2.rem)
(asType < integer > (operator*(heapIs $heap_{funcstart\_1032,1}, this).p2) < footnote{the content of the conte
asType < integer > (\$heap_{funcstart\_1032,1}.a2)) = >
(asType<integer>(div2.rem) == asType<integer>(operator*(heapIs
heap_{funcstart\_1032,1}, this).p2)
(\mathbf{asType} < \mathbf{integer} > (\$ \mathbf{heap}_{funcstart\_1032,1}.\mathbf{a2}) \le
asType < integer > (operator*(heapIs $heap_{funcstart\_1032,1}, this).p2)) =>
!(0 == asType < integer > (div2.quot))
!(0 == asType < integer > (div2.rem)) || !(0 ==
asType<integer>(div2.quot))
\label{eq:div3} \text{div3} == \text{div}(\mathbf{heapIs} \ \$ \text{heap}_{funcstart\_1032,1},
static_cast<int>(operator*(heapIs $heap_{funcstart\_1032,1}, this).p3),
static\_cast < int > (\$heap_{funcstart\_1032.1}.a3))
(asType<integer>(static_cast<int>(operator*(heapIs
heap_{funcstart\_1032,1}, this).p3)) /
asType < integer > (static\_cast < int > (\$heap_{funcstart\_1032,1}.a3))) = =
asType<integer>(div3.quot)
(asType<integer>(static_cast<int>(operator*(heapIs
heap_{funcstart\_1032.1}, this).p3)
asType < integer > (static\_cast < int > (\$heap_{funcstart\_1032,1}.a3))) = =
asType<integer>(div3.rem)
(\mathbf{asType}{<}\mathbf{integer}{>}(\mathbf{operator}^*(\mathbf{heapIs}\ \$\mathbf{heap}_{funcstart\_1032,1},\ \mathbf{this}).\mathrm{p3}) <
asType < integer > (\$heap_{funcstart\_1032,1}.a3)) = >
(asType<integer>(div3.rem) == asType<integer>(operator*(heapIs
heap_{funcstart\_1032,1}, this).p3)
(\mathbf{asType} {<} \mathbf{integer} {>} (\$ \mathbf{heap}_{funcstart\_1032,1}.\mathbf{a3}) \leq
asType < integer > (operator*(heapIs $heap_{funcstart\_1032.1}, this).p3)) =>
!(0 == asType < integer > (div3.quot))
!(0 == asType < integer > (div3.rem)) || !(0 ==
asType<integer>(div3.quot))
temp1 == (\$heap_{funcstart\_1032,1}.r1 * \textbf{static\_cast} < \textbf{signed int} > (div1.rem)) - (div1.rem) + (div1.r
(\text{sheap}_{funcstart\_1032,1}.\text{b1} * \text{static\_cast} < \text{signed int} > (\text{div1.quot}))
minof(signed int) \le temp1
temp1 \le maxof(signed int)
\theta_{1032.1:1051.8} == \theta_{1032
operator*(heapIs heap_{funcstart\_1032,1}, this)._replace(p1 \rightarrow
```

```
asType < P1Type > ((\$heap_{funcstart\_1032,1}.M1 *
asType<int>(static_cast<integer>(static_cast<signed
\mathbf{int}{>}(\mathbf{operator}^*(\mathbf{heapIs}\ \$\mathbf{heap}_{funcstart\_1032,1},\ \mathbf{this}).\mathrm{p1}) < (\mathbf{int})0))) \ +
temp1)))
temp2 == (\$heap_{1032.1:1051.8}.r2 * static\_cast < signed int > (div2.rem)) -
(\text{sheap}_{1032,1:1051.8}.\text{b2} * \text{static\_cast} < \text{signed int} > (\text{div}2.\text{quot}))
minof(signed\ int) \le temp2
temp2 \le maxof(signed int)
Proof:
[Take given term]
[2.0] \text{ div1} == \text{div}(\mathbf{heapIs} \$ heap_{funcstart\_1032,1},
static\_cast < int > (operator*(heapIs $heap_{funcstart\_1032,1}, this).p1),
\mathbf{static\_cast}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_1032,1}.\mathrm{a1}))
→ [expand definition of operator '*' in class 'pointer' at built in declaration]
[2.1] \operatorname{div1} == \operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_1032,1},
\mathbf{static\_cast} < \mathbf{int} > (\mathbf{this.\$r.value}(\mathbf{heapIs} \ \$ \mathbf{heap}_{funcstart\_1032,1}).\mathbf{p1}),
\mathbf{static\_cast}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_1032,1}.\mathrm{a1}))
\rightarrow [simplify]
[2.2] \operatorname{div1} == \operatorname{div}(\mathbf{heapIs} \ \mathbf{\$heap}_{funcstart\_1032,1}, \ \mathbf{this}.\mathbf{\$r.value}(\mathbf{heapIs})
\theta_{funcstart\_1032,1}, p1, static_cast<int>(\theta_{funcstart\_1032,1})
\rightarrow [const static or extern object]
[2.3] \text{ div1} == \text{div(heapIs } \text{$heap}_{funcstart\_1032,1}, \text{ this.} \text{$r.value(heapIs)}
\theta_{tuncstart\_1032,1}.p1, \theta_{tuncstart\_1032,1}.p2, \theta_{tuncstart\_1032,1}.p2, \theta_{tuncstart\_1032,1}.p2, \theta_{tuncstart\_1032,1}.p2, \theta_{tuncstart\_1032,1}.p2, \theta_{tuncstart\_1032,1}.p2, \theta_{tuncstart\_1032,1}.p2, \theta_{tuncstart\_1032,1}.p3, \theta_{tuncstart\_1032,1}.p4, \theta_{tuncstart\_1032,1}.p4, \theta_{tuncstart\_1032,1
\rightarrow [expand definition of constant 'a1' at prang.cpp (30,26)]
[2.4] \text{ div1} == \text{div}(\text{heapIs } \text{heap}_{funcstart\_1032,1}, \text{this.}\text{\$r.value}(\text{heapIs})
\$ heap_{funcstart\_1032,1}).p1, \ \mathbf{static\_cast} < \mathbf{int} > ((\mathbf{int})177))
\rightarrow [simplify]
[2.6] \operatorname{div1} == \operatorname{div}(\mathbf{heapIs} \ \mathbf{\$heap}_{funcstart\_1032,1}, \ \mathbf{this}.\mathbf{\$r.value}(\mathbf{heapIs})
heap_{funcstart_{-1032,1}}.p1, 177
[Assume known post-assertion, class invariant or type constraint for term 2.6]
[7.0] (0 < asType<integer>(this.$r.value(heapIs
\$ heap_{funcstart\_1032,1}).p1)) \ \&\& \ (\textbf{asType} < \textbf{integer} > (\textbf{this}.\$r.\textbf{value}(\textbf{heapIs}))) \}
\text{Sheap}_{funcstart\_1032,1}).\text{p1} < \text{asType} < \text{integer} > (\text{Sheap.class WHPrang} \in
M1))
\rightarrow [simplify]
[7.2] (0 < this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1) \&\&
(this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1 <
```

```
asType < integer > (\text{$heap.class WHPrang} \in M1))
\rightarrow [const static or extern object]
[7.3] (0 < this.$r.value(heap
Is $heap_{funcstart\_1032,1}).p1) &&
(this.$r.value(heapIs heap_{funcstart\_1032,1}).p1 <
asType < integer > (\text{$heap}_{init}.class WHPrang \in M1))
\rightarrow [expand definition of constant 'M1' at prang.cpp (28,26)]
[7.4] (0 < this.$r.value(heapIs \theta_{funcstart\_1032,1}).p1) &&
(this.r.value(heapIs $heap_{funcstart\_1032.1}).p1 <
asType < integer > ((int)30269))
\rightarrow [simplify]
[7.10] (-30269 < -this.$r.value(heap
Is \rho_{funcstart\_1032,1}.p1) \land (0 < 0.00)
this.$r.value(heapIs $heap_{funcstart\_1032.1}).p1)
[Work on sub-term 2 of conjunction in term 7.10]
[8.0] 0 < this.$r.value(heap
Is $heap_{funcstart\_1032,1}).p1
[Take given term]
[18.0] \operatorname{div2} == \operatorname{div}(\mathbf{heapIs} \ \text{$heap}_{funcstart\_1032,1},
static_cast<int>(operator*(heapIs $heap_{funcstart\_1032,1}, this).p2),
\mathbf{static\_cast} < \mathbf{int} > (\$ \mathbf{heap}_{funcstart\_1032,1}.\mathbf{a2}))
→ [expand definition of operator '*' in class 'pointer' at built in declaration]
[18.1] \operatorname{div2} == \operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_1032,1},
static_cast<int>(this.$r.value(heapIs $heap_{funcstart\_1032,1}).p2),
static\_cast < int > (\$heap_{funcstart\_1032,1}.a2))
\rightarrow [simplify]
[18.2] \text{ div2} == \text{div}(\text{heapIs } \text{$heap}_{funcstart\_1032,1}, \text{this.}\text{$r.value}(\text{heapIs})
\verb|\ensuremath{"heap}_{funcstart\_1032,1}|.p2, \ \textbf{static\_cast} < \textbf{int} > (\verb|\ensuremath{"heap}_{funcstart\_1032,1}|.a2))
\rightarrow [const static or extern object]
[18.3] div2 == div(\mathbf{heapIs} \$ \mathbf{heap}_{funcstart\_1032,1}, \mathbf{this}.\$ \mathbf{r.value}(\mathbf{heapIs})
\$ heap_{funcstart\_1032,1}).p2, \ \mathbf{static\_cast} < \mathbf{int} > (\$ heap_{init}.a2))
\rightarrow [expand definition of constant 'a2' at prang.cpp (35,26)]
[18.4] \text{ div2} == \text{div}(\text{heapIs } \text{$heap}_{funcstart\_1032,1}, \text{this.}\text{$r.value}(\text{heapIs})
heap_{funcstart\_1032,1}.p2, static\_cast < int > ((int)176)
\rightarrow [simplify]
[18.6] div2 == div(heapIs $heap<sub>funcstart_1032,1</sub>, this.$r.value(heapIs)
heap_{funcstart_{1032,1}}.p2, 176
[Assume known post-assertion, class invariant or type constraint for term 18.6]
[23.0] (0 < asType<integer>(this.$r.value(heapIs
```

```
\verb§heap$_{funcstart\_1032,1}).p2)) \&\& (\mathbf{asType} < \mathbf{integer} > (\mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}))) \&\& (\mathbf{asType} < \mathbf{integer} > (\mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}))) \&\& (\mathbf{asType} < \mathbf{integer} > (\mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})))) \&\& (\mathbf{asType} < \mathbf{integer} > (\mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}))))) \&\& (\mathbf{asType} < \mathbf{integer} > (\mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}))))) \&\& (\mathbf{asType} < \mathbf{integer} > (\mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})))))
\label{eq:class} \$ heap_{funcstart\_1032,1}).p2) < \mathbf{asType} < \mathbf{integer} > (\$ heap.\mathbf{class} \ \mathbf{WHPrang} \in \texttt{Constart} = \texttt{Con
M2))
\rightarrow [simplify]
[23.2] (0 < this.$r.value(heapIs \rho_{funcstart\_1032,1}).p2) &&
(this.r.value(heapIs $heap_{funcstart\_1032.1}).p2 <
asType < integer > (\$heap.class WHPrang \in M2))
\rightarrow [const static or extern object]
[23.3] (0 < this.$r.value(heap
Is \rho_{uncstart\_1032,1}).p2) &&
(this.$r.value(heapIs heap_{funcstart\_1032,1}).p2 <
asType < integer > (\$heap_{init}.class WHPrang \in M2))
\rightarrow [expand definition of constant 'M2' at prang.cpp (33,26)]
[23.4] (0 < this.\$r.value(heapIs \$heap_{tuncstart\_1032.1}).p2) &&
(this.r.value(heapIs $heap_{funcstart\_1032,1}).p2 <
asType < integer > ((int)30307))
\rightarrow [simplify]
this.r.value(heapIs $heap_{funcstart\_1032,1}).p2)
[Work on sub-term 2 of conjunction in term 23.10]
[24.0] 0 < this.$r.value(heapIs $heap_{funcstart\_1032,1}).p2
[Take given term]
[50.0] (($heap_funcstart_1032,1.r1 * static_cast<signed int>(div1.rem)) -
(\text{sheap}_{funcstart\_1032,1}.\text{b1} * \text{static\_cast} < \text{signed int} > (\text{div1.quot}))) == \text{temp1}
\rightarrow [const static or extern object]
[50.1] (($heap<sub>init</sub>.r1 * static_cast<signed int>(div1.rem)) -
(\$heap_{funcstart\_1032,1}.b1 * \textbf{static\_cast} < \textbf{signed int} > (div1.quot))) == temp1
\rightarrow [expand definition of constant 'r1' at prang.cpp (29,26)]
[50.2] (((int)171 * static_cast<signed int>(div1.rem)) -
(\$heap_{funcstart\_1032,1}.b1 * \textbf{static\_cast} < \textbf{signed int} > (div1.quot))) == temp1
\rightarrow [simplify]
[50.3] ((171 * static_cast < signed int > (div1.rem)) - ($heap_funcstart_1032.1.b1
* static_cast<signed int>(div1.quot))) == temp1
\rightarrow [from term 2.6, div1 is equal to div(heapIs $heap_{funcstart\_1032,1},
this.r.value(heapIs $heap_{funcstart\_1032,1}).p1, 177)]
[50.4] ((171 * static_cast < signed int > (div(heapIs heapIs funcstart_{1032,1}),
this.r.value(heapIs $heap_{funcstart\_1032,1}).p1, 177).rem)) -
(\text{sheap}_{funcstart\_1032,1}.\text{b1 * static\_cast} < \text{signed int} > (\text{div1.quot}))) == \text{temp1}
```

```
\rightarrow [simplify]
[50.5] ((171 * div(heapIs $heap_{funcstart\_1032,1}, this.$r.value(heapIs)
\text{Sheap}_{funcstart\_1032,1}.p1, 177).rem) - (\text{Sheap}_{funcstart\_1032,1}.b1 *
static_cast<signed int>(div1.quot))) == temp1
\rightarrow [const static or extern object]
[50.6] ((171 * \mathrm{div}(\mathbf{heapIs}\ \$\mathrm{heap}_{funcstart\_1032,1},\ \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}\ 
\rho_{uncstart\_1032,1}.p1, 177).rem – (\rho_{uncstart\_1032,1}.p1, 177).rem) – (\rho_{uncstart\_1032,1}.p1, 177).rem) – (\rho_{uncstart\_1032,1}.p1, 177).rem)
int>(div1.quot)) == temp1
\rightarrow [expand definition of constant 'b1' at prang.cpp (31,26)]
[50.7] ((171 * div(heapIs \$heap_{funcstart\_1032,1}, this.\$r.value(heapIs
\theta_{uncstart\_1032,1}.p1, 177).rem - ((int)2 * static\_cast < signed)
int > (div1.quot))) == temp1
\rightarrow [simplify]
[50.8] ((171 * div(heapIs $heap_{funcstart\_1032,1}, this.$r.value(heapIs)
\theta_{funcstart\_1032,1}.p1, 177).rem - (2 * static\_cast < signed)
int>(div1.quot)) == temp1
\rightarrow [from term 2.6, div1 is equal to div(heapIs $heap_{funcstart\_1032,1},
this.r.value(heapIs $heap_{funcstart\_1032,1}).p1, 177)]
[50.9] ((171 * div(heapIs $heap_{funcstart\_1032,1}, this.$r.value(heapIs)
\theta_{tuncstart\ 1032.1},p1, 177).rem) - (2 * static_cast<signed)
int>(div(heapIs \$heap_{funcstart\_1032,1}, this.\$r.value(heapIs
\$ \operatorname{heap}_{funcstart\_1032,1}).\operatorname{p1},\ 177).\operatorname{quot}))) == \operatorname{temp1}
\rightarrow [simplify]
[50.14] 0 == (-\text{temp1} + (-2 * \text{div}(\text{heapIs } \text{$heap}_{funcstart\_1032,1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177).quot) + (171 *
div(\mathbf{heapIs} \$ heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
heap_{funcstart_{1032,1}}.p1, 177).rem
[Take given term]
[53.0] $heap<sub>1032,1:1051,8</sub> == $heap<sub>funcstart_1032,1</sub>._replace(this.$r \rightarrow
operator*(heapIs heap_{funcstart\_1032,1}, this)._replace(p1 \rightarrow
asType<P1Type>(($heap_funcstart_1032,1.M1 *
asType<int>(static_cast<integer>(static_cast<signed
int>(operator^*(heapIs \$heap_{funcstart\_1032,1}, this).p1) < (int)0))) +
temp1)))
→ [expand definition of operator '*' in class 'pointer' at built in declaration]
[53.1] $\text{heap}_{1032,1:1051.8} == \text{$heap}_{funcstart\_1032,1}.$\text{-replace}(\text{this}.\text{$r} \to \text{$}
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow
asType < P1Type > ((\$heap_{funcstart\_1032,1}.M1 *
as Type < int > (static\_cast < integer > (static\_cast < signed))
```

```
int>(operator^*(heapIs \$heap_{funcstart\_1032,1}, this).p1) < (int)0))) +
temp1)))
\rightarrow [const static or extern object]
[53.2] \theta_{1032,1;1051,8} == \theta_{1032,1;1051,8} = \theta_{1032,1;1051,8} == \theta
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow
asType < P1Type > ((\$heap_{init}.M1 *
asType < int > (static\_cast < integer > (static\_cast < signed
int>(operator^*(heapIs \$heap_{funcstart\_1032,1}, this).p1) < (int)0))) +
temp1)))
\rightarrow [expand definition of constant 'M1' at prang.cpp (28,26)]
[53.3] heap_{1032,1;1051,8} == heap_{funcstart\_1032,1}._replace(this.r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow
asType<P1Type>(((int)30269 *
asType{<}int{>}(static\_cast{<}integer{>}(static\_cast{<}signed
int>(operator^*(heapIs $heap_{funcstart\_1032,1}, this).p1) < (int)0))) +
temp1)))
\rightarrow [simplify]
[53.4] heap_{1032,1;1051,8} == heap_{funcstart\_1032,1}.\_replace(this.\$r \rightarrow this)
\mathbf{this.\$r.value}(\mathbf{heapIs}~\$ \mathrm{heap}_{funcstart\_1032,1}).\_\mathbf{replace}(\mathrm{p1} \rightarrow
asType<P1Type>((30269 *
asType<int>(static_cast<integer>(static_cast<signed
\mathbf{int}{>}(\mathbf{operator}^*(\mathbf{heapIs}\ \$\mathbf{heap}_{funcstart\_1032,1},\ \mathbf{this}).\mathtt{p1})<(\mathbf{int})0)))+\\
temp1)))
→ [expand definition of operator '*' in class 'pointer' at built in declaration]
[53.5] \rho_{1032,1;1051,8} == \rho_{1032,1;1051,8} = \rho_{1032,1;1051,8} == \rho
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow
asType<P1Type>((30269 *
as Type < int > (static\_cast < integer > (static\_cast < signed))
int>(this.\$r.value(heapIs \$heap_{funcstart\_1032,1}).p1) < (int)0))) + temp1)))
\rightarrow [simplify]
[53.9] heap_{1032,1;1051,8} == heap_{funcstart\_1032,1}._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow
asType<P1Type>((30269 * asType<int>(static_cast<integer>(0 <
-\mathbf{this.}\$r.\mathbf{value}(\mathbf{heapIs}\ \$\mathrm{heap}_{funcstart\_1032,1}).\mathrm{p1}))) + \mathrm{temp1})))
\rightarrow [from term 8.0, literala < -this.$r.value(heapIs $heap_{funcstart\_1032,1}).p1
is false whenever -2 < (0 + literala)
           Proof of rule precondition:
           [53.9.0] - 2 < (0 + 0)
           \rightarrow [simplify]
```

```
[53.9.2] true
[53.10] $heap<sub>1032,1;1051,8</sub> == $heap<sub>funcstart_1032,1</sub>._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow
asType<P1Type>((30269 * asType<int>(static_cast<integer>(false)))
+ temp1)))
\rightarrow [simplify]
[53.11] \theta_{1032,1;1051,8} == \theta_{1032,1;1051,8} == \theta_{1032,1}._replace(this.$r \to
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow
asType < P1Type > ((30269 * asType < int > (([false]: 1, []: 0))) + temp1)))
→ [explicitly assert falsehood of skipped guards in subsequent guards]
[53.12] $\text{heap}_{1032,1;1051,8} == $\text{heap}_{funcstart\_1032,1}._\text{replace}(\text{this}.\text{$\frac{1}{2}r$})
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow
asType<P1Type>((30269 * asType<int>(([false]: 1, [true]: 0))) +
temp1)))
\rightarrow [simplify]
[53.15] $heap<sub>1032,1;1051,8</sub> == $heap<sub>funcstart_1032,1</sub>._replace(this.$r \rightarrow
\mathbf{this.\$r.value}(\mathbf{heapIs}~\$\mathbf{heap}_{funcstart\_1032,1}).\_\mathbf{replace}(\mathbf{p1}\rightarrow
asType < P1Type > (0 + temp1))
\rightarrow [from term 50.14, temp1 is equal to (-2 * div(heapIs $heap_{funcstart\_1032,1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177).quot) + (171 *
div(\mathbf{heapIs} \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
heap_{funcstart_{-1032.1}}.p1, 177).rem
[53.16] $heap<sub>1032,1;1051,8</sub> == $heap<sub>funcstart_1032,1</sub>._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow
asType < P1Type > (0 + ((-2 * div(heapIs $heap_{funcstart\_1032,1},
this.r.value(heapIs \ensuremath{\$}heap_{funcstart\_1032,1}).p1, 177).quot) + (171 *
div(heapIs $heap<sub>funcstart_1032.1</sub>, this.$r.value(heapIs
heap_{funcstart_{1032.1}}.p1, 177).rem))))
\rightarrow [simplify]
[53.19] $heap<sub>1032,1;1051,8</sub> == $heap<sub>funcstart_1032,1</sub>._replace(this.$r \rightarrow
\textbf{this.\$r.value}(\textbf{heapIs}~\$\text{heap}_{funcstart\_1032,1}).\_\textbf{replace}(\text{p1} \rightarrow ((-2~*\text{div}(\textbf{heapIs}))))))
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.} \text{\$r.value}(\text{heapIs}))
heap_{funcstart_{1032,1}}.p1, 177).rem))))
[Take goal term]
[1.0] static_cast<integer>(static_cast<signed int>(operator*(heapIs
\text{$heap}_{1032,1;1051,8}, \, \mathbf{this}).p2) < (\mathbf{int})0) \leq \mathbf{maxof}(\mathbf{int})
\rightarrow [from term 53.19, p_{1032,1;1051,8} is equal to
\$heap_{funcstart\_1032,1}.\_\textbf{replace}(\textbf{this.}\$r \rightarrow \textbf{this.}\$r.\textbf{value}(\textbf{heapIs}
heap_{funcstart\_1032,1}._replace(p1 \rightarrow (-2 * div(heapIs heap_{funcstart\_1032,1}),
```

```
this.r.value(heapIs \ \ heap_{funcstart\_1032,1}).p1, \ 177).quot) + (171 *
div(\textbf{heapIs}~\$heap_{funcstart\_1032,1},~\textbf{this.}\$r.\textbf{value}(\textbf{heapIs}
heap_{funcstart\_1032,1}.p1, 177).rem)))]
[1.1] static_cast<integer>(static_cast<signed int>(operator*(heapIs
\theta_{tuncstart\_1032.1}._replace(this.r \to this.r.value(heapIs)
heap_{funcstart\_1032,1}._replace(p1 \rightarrow (-2 * div(heapIs p_{funcstart\_1032,1}).
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177).quot) + (171 *
div(\mathbf{heapIs} \$ heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
\theta_{funcstart\_1032,1}.p1, 177).rem)), this).p2) < (int)0) \le maxof(int)
→ [expand definition of operator '*' in class 'pointer' at built in declaration]
[1.2] static_cast<integer>(static_cast<signed int>(this.$r.value(heapIs
\$heap_{funcstart\_1032,1}.\_\textbf{replace}(\textbf{this}.\$r \rightarrow \textbf{this}.\$r.\textbf{value}(\textbf{heapIs}
heap_{funcstart\_1032,1}._replace(p1 \rightarrow ((-2 * div(heapIs heap_{funcstart\_1032,1}),
this.r.value(heapIs $heap_{funcstart\_1032,1}).p1, 177).quot) + (171 *
{\rm div}(\textbf{heapIs}~\$ heap_{funcstart\_1032,1},~\textbf{this}.\$ r. \textbf{value}(\textbf{heapIs}
\$ heap_{funcstart\_1032,1}).p1,\,177).rem))))).p2) < (\mathbf{int})0) \le \mathbf{maxof}(\mathbf{int})
\rightarrow [evaluate dereferenced pointer into modified heap]
[1.3] static_cast<integer>(static_cast<signed int>(([this.$r == this.$r]:
this.$r.value(heapIs heapIs $heapfuncstart_1032,1)._replace(p1 \rightarrow (-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.} \text{\$r.value}(\text{heapIs}))
heap_{funcstart\_1032,1}.p1, 177).rem), [: this.$r.value(heapIs)
\text{Sheap}_{funcstart\_1032,1}).p2) < (int)0) \leq \maxof(int)
→ [explicitly assert falsehood of skipped guards in subsequent guards]
[1.4] static_cast<integer>(static_cast<signed int>(([this.$r == this.$r]:
this.$r.value(heapIs \rho_{tuncstart\_1032.1})._replace(p1 \rightarrow (-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.\r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(\mathbf{heapIs} \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}))
\frac{\text{heap}_{funcstart\_1032,1}.p1, 177).rem}{, [!(this.$r == this.$r)]}:
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p2) < (int)0) \le maxof(int)
\rightarrow [simplify]
[1.11] static\_cast < integer > (0 < -this.\$r.value(heapIs)
heap_{funcstart\_1032,1}.p2) \le maxof(int)
\rightarrow [from term 24.0, literala < -this.$r.value(heapIs $heap_{funcstart\_1032,1}).p2
is false whenever -2 < (0 + literala)
   Proof of rule precondition:
   [1.11.0] - 2 < (0 + 0)
   \rightarrow [simplify]
   [1.11.2] true
```

```
[1.12] static_cast<integer>(false) \leq maxof(int)
\rightarrow [simplify]
[1.13] ([false]: 1, []: 0) \leq maxof(int)
→ [explicitly assert falsehood of skipped guards in subsequent guards]
[1.14] ([false]: 1, [true]: 0) \leq maxof(int)
\rightarrow [simplify]
[1.17] true
Proof of verification condition: Arithmetic result of operator '*' is within
limit of type 'signed int'
In the context of class: WHPrang, declared at:
C:\Escher\Customers\prang-cpp\prang.cpp\ (18,1)
Condition generated at: C:\Escher\Customers\prang-cpp\prang.cpp
(78,32)
Condition defined at:
To prove: minof(signed int) \leq ($heap_{1032,1;1051,8}.M2 *
asType < int > (static\_cast < integer > (static\_cast < signed)
int>(operator^*(heapIs $heap_{1032.1:1051.8}, this).p2) < (int)0)))
Given:
heap_{init}.LIMIT == (int)80
heap_{init}.class WHPrang \in M1 == (int)30269
heap_{init}.class WHPrang \in r1 == (int)171
heap_{init}.class WHPrang \in a1 == (int)177
heap_{init}.class WHPrang \in b1 == (int)2
heap_{init}.class WHPrang \in M2 == (int)30307
heap_{init}.class WHPrang \in r2 == (int)172
heap_{init}.class WHPrang \in a2 == (int)176
heap_{init}.class WHPrang \in b2 == (int)35
heap_{init}.class WHPrang \in M3 == (int)30323
heap_{init}.class WHPrang \in r3 == (int)170
heap_{init}.class WHPrang \in a3 == (int)178
heap_{init}.class WHPrang \in b3 == (int)63
\operatorname{div1} == \operatorname{div}(\mathbf{heapIs} \ \operatorname{\$heap}_{funcstart\_1032,1},
\mathbf{static\_cast} < \mathbf{int} > (\mathbf{operator}^*(\mathbf{heapIs}\ \$ \mathbf{heap}_{funcstart\_1032,1},\ \mathbf{this}).\mathtt{p1}),
\mathbf{static\_cast} < \mathbf{int} > (\$ \mathbf{heap}_{funcstart\_1032,1}.\mathbf{a1}))
```

```
(asType<integer>(static_cast<int>(operator*(heapIs
heap_{funcstart\_1032,1}, this).p1) /
asType < integer > (static\_cast < int > (\$heap_{funcstart\_1032.1}.a1))) = =
asType<integer>(div1.quot)
(asType<integer>(static_cast<int>(operator*(heapIs
\theta_{funcstart\_1032,1}, this).p1)
asType < integer > (static\_cast < int > (\$heap_{funcstart\_1032.1}.a1))) = =
asType<integer>(div1.rem)
(\mathbf{asType}{<}\mathbf{integer}{>}(\mathbf{operator}^*(\mathbf{heapIs}\ \$\mathbf{heap}_{funcstart\_1032,1},\ \mathbf{this}).\mathtt{p1}) <
asType < integer > (\$heap_{tuncstart=1032.1}.a1)) = >
(asType<integer>(div1.rem) == asType<integer>(operator*(heapIs
heap_{funcstart\_1032,1}, this).p1)
(\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathbf{heap}_{funcstart\_1032,1}.\mathbf{a1}) \leq
asType<integer>(operator*(heapIs $heap_{funcstart\_1032,1}, this).p1)) =>
!(0 == asType < integer > (div1.quot))
!(0 == asType < integer > (div1.rem)) || !(0 ==
asType<integer>(div1.quot))
div2 == div(\mathbf{heapIs} \$heap_{funcstart\_1032,1},
\mathbf{static\_cast} < \mathbf{int} > (\mathbf{operator}^*(\mathbf{heapIs}\ \$ \mathbf{heap}_{funcstart\_1032,1},\ \mathbf{this}).\mathbf{p2}),
static\_cast < int > (\$heap_{funcstart\_1032.1}.a2))
(asType<integer>(static_cast<int>(operator*(heapIs
heap_{funcstart\_1032,1}, this).p2)
asType < integer > (static\_cast < int > (\$heap_{funcstart\_1032.1}.a2))) = =
asType<integer>(div2.quot)
(asType < integer > (static\_cast < int > (operator*(heapIs)))
heap_{funcstart\_1032,1}, this).p2)
\mathbf{asType} < \mathbf{integer} > (\mathbf{static\_cast} < \mathbf{int} > (\$ \mathbf{heap}_{funcstart\_1032,1}.\mathbf{a2}))) = =
asType<integer>(div2.rem)
(\mathbf{asType}{<}\mathbf{integer}{>}(\mathbf{operator}^*(\mathbf{heapIs}\ \$\mathbf{heap}_{funcstart\_1032,1},\ \mathbf{this}).\mathtt{p2}) <
asType < integer > (\$heap_{funcstart\_1032,1}.a2)) = >
(asType<integer>(div2.rem) == asType<integer>(operator*(heapIs
heap_{funcstart\_1032,1}, this).p2)
(asType < integer > (\$heap_{funcstart\_1032,1}.a2) \le
\mathbf{asType} < \mathbf{integer} > (\mathbf{operator}^*(\mathbf{heapIs} \ \$ \mathbf{heap}_{funcstart\_1032,1}, \ \mathbf{this}).\mathtt{p2})) = >
!(0 == asType < integer > (div2.quot))
!(0 == asType < integer > (div2.rem)) || !(0 ==
asType<integer>(div2.quot))
\label{eq:div3} \text{div3} == \text{div}(\mathbf{heapIs} \ \$ \text{heap}_{funcstart\_1032,1},
static_cast<int>(operator*(heapIs $heap_{tuncstart\_1032.1}, this).p3),
static\_cast < int > (\$heap_{funcstart\_1032,1}.a3))
(asType < integer > (static\_cast < int > (operator*(heapIs)))
```

```
heap_{funcstart\_1032,1}, this).p3) /
\mathbf{asType} < \mathbf{integer} > (\mathbf{static\_cast} < \mathbf{int} > (\$ \mathbf{heap}_{funcstart\_1032,1}.\mathbf{a3}))) = =
asType<integer>(div3.quot)
(asType < integer > (static\_cast < int > (operator*(heapIs)))
heap_{funcstart\_1032,1}, this).p3)
asType < integer > (static\_cast < int > (\$heap_{funcstart\_1032.1}.a3))) = =
asType<integer>(div3.rem)
(\mathbf{asType}{<}\mathbf{integer}{>}(\mathbf{operator}^*(\mathbf{heapIs}\ \$\mathbf{heap}_{funcstart\_1032,1},\ \mathbf{this}).\mathtt{p3}) <
asType < integer > (\$heap_{funcstart\_1032,1}.a3)) = >
(asType<integer>(div3.rem) == asType<integer>(operator*(heapIs
heap_{funcstart_{1032,1}}, this).p3)
(\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathbf{heap}_{funcstart\_1032,1}.\mathbf{a3}) \leq
asType < integer > (operator*(heapIs $heap_{funcstart\_1032,1}, this).p3)) = >
!(0 == asType < integer > (div3.quot))
!(0 == asType < integer > (div3.rem)) || !(0 ==
asType<integer>(div3.quot))
temp1 == (\$heap_{funcstart\_1032,1}.r1 * static\_cast < signed int > (div1.rem)) -
(\text{\$heap}_{funcstart\_1032,1}.\text{b1 * static\_cast} < \text{signed int} > (\text{div1.quot}))
minof(signed\ int) \le temp1
temp1 \le maxof(signed\ int)
\theta_{1032,1;1051,8} == \theta_{1032
operator*(heapIs heap_{funcstart\_1032.1}, this)._replace(p1 \rightarrow
asType<P1Type>(($heap<sub>funcstart 1032.1</sub>.M1 *
asType<int>(static_cast<integer>(static_cast<signed
int>(operator^*(heapIs \$heap_{funcstart\_1032,1}, this).p1) < (int)0))) +
temp1)))
temp2 == (\$heap_{1032.1:1051.8}.r2 * static\_cast < signed int > (div2.rem)) -
(\text{sheap}_{1032,1;1051,8}.\text{b2} * \text{static\_cast} < \text{signed int} > (\text{div2.quot}))
minof(signed\ int) \le temp2
temp2 \le maxof(signed int)
Proof:
[Take given term]
[2.0] \operatorname{div1} == \operatorname{div}(\mathbf{heapIs} \ \text{$heap}_{funcstart\_1032,1},
\mathbf{static\_cast} < \mathbf{int} > (\mathbf{operator}^*(\mathbf{heapIs} \ \$ \mathbf{heap}_{funcstart\_1032,1}, \ \mathbf{this}).\mathtt{p1}),
static_cast<int>($heap_{tuncstart\_1032.1}.a1))
→ [expand definition of operator '*' in class 'pointer' at built in declaration]
[2.1] \operatorname{div1} == \operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_1032,1},
static_cast<int>(this.$r.value(heapIs $heap_{tuncstart\_1032.1}).p1),
static\_cast < int > (\$heap_{funcstart\_1032,1}.a1))
```

```
\rightarrow [simplify]
[2.2] \text{ div1} == \text{div}(\text{heapIs } \text{heap}_{funcstart\_1032,1}, \text{this.}\text{\$r.value}(\text{heapIs})
\rho_{tuncstart_{1032,1}}, p1, static_cast<int>(\rho_{tuncstart_{1032,1}})
\rightarrow [const static or extern object]
[2.3] \operatorname{div1} == \operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_1032,1}, \mathbf{this}.\$ r. \mathbf{value}(\mathbf{heapIs})
\theta_{funcstart\_1032,1}.p1, \theta_{funcstart\_1032,1}.p1, \theta_{funcstart\_1032,1}.p1, \theta_{funcstart\_1032,1}.p1, \theta_{funcstart\_1032,1}.p1, \theta_{funcstart\_1032,1}.p1, \theta_{funcstart\_1032,1}.p2, \theta_{funcstart\_1032,1}.p2, \theta_{funcstart\_1032,1}.p2, \theta_{funcstart\_1032,1}.p2, \theta_{funcstart\_1032,1}.p2, \theta_{funcstart\_1032,1}.p3, \theta_{funcstart\_1032,1}.p4, \theta_{funcstart\_1032,1}.p4, \theta_{funcstart\_1032,1}.p4, \theta_{funcstart\_1032,1}.p5, \theta_{funcstart\_1032,1}.p5, \theta_{funcstart\_1032,1
\rightarrow [expand definition of constant 'a1' at prang.cpp (30,26)]
[2.4] \text{ div1} == \text{div}(\text{heapIs } \text{heap}_{funcstart\_1032,1}, \text{this.}\text{\$r.value}(\text{heapIs})
\theta_{funcstart\_1032,1}.p1, \theta_{funcstart} (int)177)
\rightarrow [simplify]
[2.6] \operatorname{div1} == \operatorname{div}(\mathbf{heapIs} \ \mathbf{\$heap}_{funcstart\_1032,1}, \ \mathbf{this}.\mathbf{\$r.value}(\mathbf{heapIs})
heap_{funcstart\_1032,1}.p1, 177)
[Assume known post-assertion, class invariant or type constraint for term 2.6]
[7.0] (0 < asType<integer>(this.$r.value(heapIs
\$heap_{funcstart\_1032,1}).p1)) \ \&\& \ (\textbf{asType} < \textbf{integer} > (\textbf{this}.\$r.\textbf{value}(\textbf{heapIs}))) \ \&\& \ (\textbf{asType} < \textbf{integer} > (\textbf{this}.\$r.\textbf{value}))
\text{heap}_{funcstart=1032.1}).p1) < asType<integer>(\text{heap.class WHPrang} \in
M1)
\rightarrow [simplify]
[7.2] (0 < this.$r.value(heap
Is $heap_{funcstart\_1032,1}).p1) &&
(this.$r.value(heapIs heap_{funcstart\_1032,1}).p1 <
asType < integer > (\text{heap.class WHPrang} \in M1))
\rightarrow [const static or extern object]
[7.3] (0 < this.$r.value(heapIs $heap_{funcstart\_1032,1}).p1) &&
(this.$r.value(heapIs heap_{funcstart\_1032,1}).p1 <
asType < integer > (\text{$heap}_{init}.class WHPrang \in M1))
\rightarrow [expand definition of constant 'M1' at prang.cpp (28,26)]
[7.4] (0 < this.\$r.value(heapIs \$heap_{funcstart\_1032,1}).p1) &&
(this.$r.value(heapIs \rho_{funcstart\_1032,1}).p1 <
asType < integer > ((int)30269))
\rightarrow [simplify]
[7.10] (-30269 < -this.$r.value(heapIs heap_{funcstart\_1032,1}).p1) \land (0 <
this.$r.value(heapIs $heap_{funcstart\_1032.1}).p1)
[Work on sub-term 2 of conjunction in term 7.10]
[8.0] 0 < this.$r.value(heapIs $heap_{tuncstart\_1032,1}).p1
[Take given term]
[18.0] \operatorname{div2} == \operatorname{div}(\mathbf{heapIs} \ \operatorname{\$heap}_{funcstart\_1032,1},
static_cast<int>(operator*(heapIs $heap_{funcstart\_1032.1}, this).p2),
```

```
\mathbf{static\_cast}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_1032,1}.\mathrm{a2}))
→ [expand definition of operator '*' in class 'pointer' at built in declaration]
[18.1] \operatorname{div2} == \operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_1032,1},
static_cast<int>(this.$r.value(heapIs $heap_{funcstart\_1032,1}).p2),
\mathbf{static\_cast}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_1032,1}.\mathrm{a2}))
\rightarrow [simplify]
[18.2] div2 == div(heapIs $heap<sub>funcstart_1032,1</sub>, this.$r.value(heapIs)
\rho_{tuncstart\_1032.1}, p2, static_cast<int>(\rho_{tuncstart\_1032.1})
\rightarrow [const static or extern object]
[18.3] div2 == div(heapIs heapIs = funcstart_{1032,1}, this.r.value(heapIs)
\label{eq:cast_int} $$ $ p_{funcstart\_1032,1}.p2, $ static\_cast < int > ($ p_{init}.a2) ) $$
\rightarrow [expand definition of constant 'a2' at prang.cpp (35,26)]
[18.4] div2 == div(\mathbf{heapIs} \ \hat{\mathbf{s}}_{heap}), \mathbf{this.} \cdot \mathbf{r.value}(\mathbf{heapIs})
\theta_{funcstart\_1032,1}, p2, \theta_{funcstart} (int)176))
\rightarrow [simplify]
[18.6] div2 == div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
heap_{funcstart_{-1032,1}}.p2, 176
[Assume known post-assertion, class invariant or type constraint for term 18.6]
[23.0] (0 < asType<integer>(this.$r.value(heapIs
\label{eq:continuous} $\operatorname{heap}_{funcstart\_1032,1}).p2)) \&\& (\mathbf{asType}{<}\mathbf{integer}{>} (\mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})) \&\& (\mathbf{asType}{<}\mathbf{integer}{>} (\mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}))) \&\& (\mathbf{asType}{<}\mathbf{integer}{>} (\mathbf{heapIs})) \&\& (\mathbf{asType}{<}\mathbf{
\label{eq:class} \$ heap_{funcstart\_1032,1}).p2) < \mathbf{asType} < \mathbf{integer} > (\$ heap.\mathbf{class} \ \mathrm{WHPrang} \in
M2))
\rightarrow [simplify]
[23.2] (0 < this.$r.value(heap
Is $heap_{funcstart\_1032,1}).p2) &&
(this.$r.value(heapIs heap_{funcstart\_1032,1}).p2 <
asType < integer > (\text{$heap.class WHPrang} \in M2))
\rightarrow [const static or extern object]
[23.3] (0 < this.$r.value(heap
Is $heap_{tuncstart\_1032,1}).p2) &&
(this.r.value(heapIs $heap_{funcstart\_1032,1}).p2 <
asType < integer > (\$heap_{init}.class WHPrang \in M2))
\rightarrow [expand definition of constant 'M2' at prang.cpp (33,26)]
[23.4] (0 < this.$r.value(heapIs $heap_{funcstart\_1032,1}).p2) &&
(this.$r.value(heapIs heap_{funcstart\_1032,1}).p2 <
asType < integer > ((int)30307))
\rightarrow [simplify]
[23.10] (-30307 < -this.$r.value(heapIs \rho_{funcstart\_1032,1}).p2) \wedge (0 <
this.r.value(heapIs $heap_{funcstart\_1032,1}).p2)
```

```
[Work on sub-term 2 of conjunction in term 23.10]
[24.0] 0 < this.$r.value(heapIs \rho_{funcstart\_1032,1}).p2
[Take given term]
[50.0] \; ((\$ heap_{funcstart\_1032,1}.r1 * \textbf{static\_cast} < \textbf{signed int} > (div1.rem)) \; - \;
(\text{\$heap}_{funcstart\_1032,1}.\text{b1 * static\_cast} < \text{signed int} > (\text{div1.quot}))) = \text{temp1}
\rightarrow [const static or extern object]
[50.1] (($heap<sub>init</sub>.r1 * static_cast<signed int>(div1.rem)) -
(\text{sheap}_{funcstart\_1032,1}.\text{b1 * static\_cast} < \text{signed int} > (\text{div1.quot}))) == \text{temp1}
\rightarrow [expand definition of constant 'r1' at prang.cpp (29,26)]
[50.2] (((int)171 * static_cast<signed int>(div1.rem)) -
(\$heap_{funcstart\_1032,1}.b1 * \textbf{static\_cast} < \textbf{signed int} > (div1.quot))) == temp1
\rightarrow [simplify]
[50.3] ((171 * static_cast<signed int>(div1.rem)) - ($heap_{tuncstart_1032.1}.b1
* static_cast<signed int>(div1.quot))) == temp1
\rightarrow [from term 2.6, div1 is equal to div(heapIs $heap_{funcstart\_1032,1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177)]
[50.4] ((171 * static_cast < signed int > (div(heapIs heapIs funcstart_{1032,1}),
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177).rem)) -
($heap_tuncstart_1032.1.b1 * static_cast<signed int>(div1.quot))) == temp1
\rightarrow [simplify]
[50.5] ((171 * \operatorname{div}(\mathbf{heapIs} \ \mathbf{sheap}_{funcstart\_1032,1}, \ \mathbf{this}.\mathbf{sr.value}(\mathbf{heapIs})
\text{Sheap}_{funcstart\_1032,1}.\text{p1}, 177).\text{rem} - (\text{Sheap}_{funcstart\_1032,1}.\text{b1} *
static_cast<signed int>(div1.quot))) == temp1
\rightarrow [const static or extern object]
[50.6] ((171 * div(heapIs \rho_{funcstart\_1032,1}, this.r.value(heapIs)
\theta_{funcstart\_1032,1}.p1, 177).rem) - (\theta_{init}.b1 * static_cast<signed
int>(div1.quot))) == temp1
\rightarrow [expand definition of constant 'b1' at prang.cpp (31,26)]
[50.7] ((171 * div(heapIs \rho_{funcstart\_1032,1}, this.\r.value(heapIs
int>(div1.quot)) = temp1
\rightarrow [simplify]
[50.8] ((171 * div(heapIs \$heap_{funcstart\_1032,1}, this.\$r.value(heapIs
\theta_{funcstart\_1032,1}.p1, 177).rem – (2 * static_cast<signed)
int>(div1.quot))) == temp1
\rightarrow [from term 2.6, div1 is equal to div(heapIs $heap_{funcstart\_1032,1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177)]
```

```
[50.9] ((171 * \operatorname{div}(\mathbf{heapIs} \ \mathbf{sheap}_{funcstart\_1032,1}, \ \mathbf{this}.\mathbf{sr.value}(\mathbf{heapIs})
\theta_{funcstart\_1032,1}.p1, 177).rem - (2 * static\_cast < signed)
int>(div(heapIs \$heap_{funcstart\_1032,1}, this.\$r.value(heapIs
\text{Sheap}_{funcstart\_1032,1}.\text{p1}, 177).\text{quot}))) == \text{temp1}
\rightarrow [simplify]
[50.14] 0 == (-\text{temp1} + (-2 * \text{div}(\text{heapIs} \$\text{heap}_{funcstart\_1032,1},
this.$r.value(heapIs heap_{funcstart\_1032,1}).p1, 177).quot) + (171 *
div(\mathbf{heapIs} \$ heap_{funcstart\_1032.1}, \mathbf{this.}\$r.\mathbf{value}(\mathbf{heapIs})
heap_{funcstart_1032,1}.p1, 177.rem)
[Take given term]
[53.0] $\text{heap}_{1032,1:1051.8} == \text{$heap}_{funcstart\_1032,1}._\text{replace}(\text{this}.\text{$r} \to \text{$}
operator*(heapIs heap_{funcstart\_1032,1}, this)._replace(p1 \rightarrow
asType<P1Type>(($heap<sub>funcstart_1032,1</sub>.M1 *
as Type < int > (static\_cast < integer > (static\_cast < signed))
int>(operator^*(heapIs $heap_{funcstart\_1032,1}, this).p1) < (int)0))) +
temp1)))
→ [expand definition of operator '*' in class 'pointer' at built in declaration]
[53.1] heap_{1032,1;1051,8} == heap_{funcstart\_1032,1}._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow
asType<P1Type>(($heap<sub>funcstart_1032,1</sub>.M1 *
asType<int>(static_cast<integer>(static_cast<signed
int>(operator^*(heapIs \$heap_{funcstart\_1032,1}, this).p1) < (int)0))) +
temp1)))
\rightarrow [const static or extern object]
[53.2] \rho_{1032,1;1051,8} == \rho_{1032,1;1051,8} = \rho_{1032,1;1051,8} == \rho
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow
asType<P1Type>(($heap<sub>init</sub>.M1*
asType<int>(static_cast<integer>(static_cast<signed
int>(operator^*(heapIs \$heap_{funcstart\_1032,1}, this).p1) < (int)0))) +
temp1)))
\rightarrow [expand definition of constant 'M1' at prang.cpp (28,26)]
[53.3] heap_{1032,1;1051,8} == heap_{funcstart\_1032,1}._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow
asType<P1Type>(((int)30269 *
asType<int>(static_cast<integer>(static_cast<signed
int>(operator^*(heapIs $heap_{funcstart\_1032,1}, this).p1) < (int)0))) +
temp1)))
\rightarrow [simplify]
[53.4] heap_{1032,1;1051,8} == heap_{funcstart\_1032,1}._replace(this.r \rightarrow
\textbf{this.}\$r.\textbf{value}(\textbf{heapIs}~\$heap_{funcstart\_1032,1}).\_\textbf{replace}(p1 \rightarrow
asType<P1Type>((30269 *
```

```
asType<int>(static_cast<integer>(static_cast<signed
int>(operator*(heapIs $heap_{funcstart\_1032,1}, this).p1) < (int)0))) +
temp1)))
→ [expand definition of operator '*' in class 'pointer' at built in declaration]
[53.5] heap_{1032,1;1051,8} == heap_{funcstart\_1032,1}._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow
asType<P1Type>((30269 *
as Type < int > (static\_cast < integer > (static\_cast < signed))
int>(this.\$r.value(heapIs \$heap_{funcstart\_1032,1}).p1) < (int)0))) + temp1)))
\rightarrow [simplify]
[53.9] $\text{heap}_{1032,1:1051.8} == \text{$heap}_{funcstart\_1032,1}._\text{replace}(\text{this}.\text{$r} \to \text{$}
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow
asType<P1Type>((30269 * asType<int>(static_cast<integer>(0 <
-this.r.value(heapIs heap_{funcstart\_1032,1}.p1))) + temp1)))
\rightarrow [from term 8.0, literala < -this.$r.value(heapIs $heap_{funcstart\_1032.1}).p1
is false whenever -2 < (0 + literala)
   Proof of rule precondition:
   [53.9.0] - 2 < (0 + 0)
   \rightarrow [simplify]
   [53.9.2] true
[53.10] $\text{heap}_{1032,1;1051,8} == $\text{heap}_{funcstart\_1032,1}._\text{replace}(\text{this}.\text{$\frac{1}{2}r$})
\mathbf{this.\$r.value}(\mathbf{heapIs}~\$ \mathrm{heap}_{funcstart\_1032,1}).\_\mathbf{replace}(\mathrm{p1} \rightarrow
asType<P1Type>((30269 * asType<int>(static_cast<integer>(false)))
+ temp1)))
\rightarrow [simplify]
[53.11] heap_{1032,1:1051,8} == heap_{funcstart\_1032,1}._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow
asType < P1Type > ((30269 * asType < int > (([false]: 1, []: 0))) + temp1)))
→ [explicitly assert falsehood of skipped guards in subsequent guards]
[53.12] $heap<sub>1032,1;1051,8</sub> == $heap<sub>funcstart_1032,1</sub>._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow
asType<P1Type>((30269 * asType<int>(([false]: 1, [true]: 0))) +
temp1)))
\rightarrow [simplify]
[53.15] $heap<sub>1032,1;1051,8</sub> == $heap<sub>funcstart_1032,1</sub>._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow
asType < P1Type > (0 + temp1))
\rightarrow [from term 50.14, temp1 is equal to (-2 * div(heapIs $heap_{funcstart\_1032,1},
```

```
this.r.value(heapIs \ \ heap_{funcstart\_1032,1}).p1, \ 177).quot) + (171 *
div(\mathbf{heapIs} \ \$heap_{funcstart\_1032,1}, \ \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
heap_{funcstart\_1032,1}.p1, 177).rem
[53.16] $heap<sub>1032,1;1051,8</sub> == $heap<sub>funcstart_1032,1</sub>._replace(this.$r \rightarrow
this.$r.value(heapIs heapI_{funcstart\_1032,1})._replace(p1 \rightarrow asType<P1Type>(0 + ((-2 * div(heapIs heapI_{funcstart\_1032,1}),
this.$r.value(heapIs heap_{funcstart\_1032,1}).p1, 177).quot) + (171 *
\label{eq:div_heapIs} $ \text{heap}_{funcstart\_1032,1}, \ \textbf{this}.\$r. \textbf{value} (\textbf{heapIs} \\
heap_{funcstart_{1032.1}}.p1, 177).rem))))
\rightarrow [simplify]
[53.19] $\text{heap}_{1032,1;1051,8} == $\text{heap}_{funcstart\_1032,1}._\text{replace}(\text{this}.\text{$\frac{1}{2}r$})
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{tuncstart\_1032.1}, this.r.value(heapIs \rho_{tuncstart\_1032.1}).p1,
177).quot) + (171 * div(heapIs $heap<sub>funcstart_1032,1</sub>, this.$r.value(heapIs
heap_{funcstart_{1032,1}}.p1, 177).rem)))
[Take goal term]
[1.0] minof(signed int) < ($\ext{heap}_{1032,1:1051,8}.\text{M2} *
asType < int > (static\_cast < integer > (static\_cast < signed)
\mathbf{int}{>}(\mathbf{operator}^*(\mathbf{heapIs}\ \$\mathrm{heap}_{1032,1;1051,8},\ \mathbf{this}).\mathrm{p2})<(\mathbf{int})0)))
\rightarrow [simplify]
[1.1] -32768 \leq ($heap<sub>1032,1;1051,8</sub>.M2 *
asType<int>(static_cast<integer>(static_cast<signed
int>(operator^*(heapIs \$heap_{1032.1:1051.8}, this).p2) < (int)0)))
\rightarrow [from term 53.19, $heap<sub>1032,1;1051,8</sub> is equal to
\$heap_{funcstart\_1032,1}.\_\textbf{replace}(\textbf{this}.\$r \rightarrow \textbf{this}.\$r.\textbf{value}(\textbf{heapIs}
heap_{funcstart\_1032,1}._replace(p1 \rightarrow (-2 * div(heapIs \$heap_{funcstart\_1032,1}, -2))
this. $r.value(heapIs heap_{funcstart\_1032,1}).p1, 177).quot) + (171 heapIs
div(\mathbf{heapIs} \ \$heap_{funcstart\_1032,1}, \ \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
heap_{funcstart_{1032,1}}.p1, 177).rem)))]
[1.2] -32768 \le (\$heap_{funcstart\_1032,1}.\_replace(this.\$r \rightarrow this.\$r.value(heapIs))
\text{Sheap}_{funcstart\_1032.1})._replace(p1 \rightarrow ((-2 * div(heapIs \text{Sheap}_{funcstart\_1032.1}),
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177).quot) + (171 *
div(\mathbf{heapIs} \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
heap_{funcstart_{1032,1}}.p1, 177).rem))).M2 *
asType<int>(static_cast<integer>(static_cast<signed
int>(operator^*(heapIs $heap_{1032,1;1051,8}, this).p2) < (int)0)))
→ [const member of object with modified fields]
[1.3] -32768 \leq ($heap_{funcstart\_1032,1}.M2 *
asType<int>(static_cast<integer>(static_cast<signed
int>(operator^*(heapIs $heap_{1032,1;1051,8}, this).p2) < (int)0)))
\rightarrow [const static or extern object]
```

```
[1.4] -32768 < ($heap_{init}.M2 *
asType<int>(static_cast<integer>(static_cast<signed
int>(operator^*(heapIs $heap_{1032,1;1051,8}, this).p2) < (int)0)))
\rightarrow [expand definition of constant 'M2' at prang.cpp (33,26)]
[1.5] -32768 \le ((int)30307 *
asType < int > (static\_cast < integer > (static\_cast < signed)
int>(operator^*(heapIs $heap_{1032,1;1051,8}, this).p2) < (int)0)))
\rightarrow [simplify]
[1.6] -32768 \le (30307 *
asType<int>(static_cast<integer>(static_cast<signed
int>(operator^*(heapIs $heap_{1032,1;1051,8}, this).p2) < (int)0)))
\rightarrow [from term 53.19, $heap<sub>1032,1:1051,8</sub> is equal to
heap_{funcstart\_1032,1}._replace(this.r \rightarrow this.r.value(heapIs)
heap_{funcstart\_1032,1}._replace(p1 \rightarrow (-2 * div(heapIs \$heap_{funcstart\_1032,1}, -2))
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177).quot) + (171)
div(\mathbf{heapIs} \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
heap_{funcstart\_1032,1}.p1, 177).rem)))]
[1.7] -32768 \le (30307 *
as Type < int > (static\_cast < integer > (static\_cast < signed))
int>(operator*(heapIs \rho_{tuncstart\_1032,1}._replace(this.\rho_{tuncstart\_1032,1}._replace(this.
this.$r.value(heapIs \rho_{tuncstart 1032.1})._replace(p1 \rightarrow (-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
\text{Sheap}_{funcstart\_1032,1}.\text{p1}, 177).\text{rem})), \text{this}.\text{p2}) < (\text{int})0)))
→ [expand definition of operator '*' in class 'pointer' at built in declaration]
[1.8] -32768 \le (30307 *
asType<int>(static_cast<integer>(static_cast<signed
\mathbf{int}{>}(\mathbf{this.\$r.value}(\mathbf{heapIs}\ \$\mathbf{heap}_{funcstart\_1032,1}.\mathbf{\_replace}(\mathbf{this.\$r} \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs $heap<sub>funcstart_1032,1</sub>, this.$r.value(heapIs
heap_{funcstart_{-1032,1}}.p1, 177).rem)))).p2) < (int)0))
\rightarrow [evaluate dereferenced pointer into modified heap]
[1.9] -32768 < (30307 *
asType<int>(static_cast<integer>(static_cast<signed int>(([this.$r
== this.$r]: this.$r.value(heapIs \rho_{tuncstart_1032.1})._replace(p1 \rightarrow (-2 *
\label{eq:continuous} \text{div}(\textbf{heapIs} \ \$ \text{heap}_{funcstart\_1032,1}, \ \textbf{this}.\$ \text{r.value}(\textbf{heapIs}
\text{Sheap}_{funcstart\_1032,1}.p1, 177).quot) + (171 * div(heapIs \text{Sheap}_{funcstart\_1032,1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177).rem)), []:
this.$r.value(heapIs heap_{funcstart\_1032.1}).p2) < (int)0)))
→ [explicitly assert falsehood of skipped guards in subsequent guards]
```

```
[1.10] -32768 < (30307 *
as Type < int > (static\_cast < integer > (static\_cast < signed\ int > (([this.\$r])))) \\
== this.$r]: this.$r.value(heapIs \rho_{funcstart\_1032,1})._replace(p1 \rightarrow (-2 *
div(\mathbf{heapIs} \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
\text{Sheap}_{funcstart\_1032,1}.p1, 177).quot) + (171 * div(heapIs \text{Sheap}_{funcstart\_1032,1},
this.r.value(heapIs \ensuremath{\$}heap_{funcstart\_1032,1}).p1, 177).rem)), [!(this.\ensuremath{\$}r ==
\mathbf{this.\$r.}\mathbf{value}(\mathbf{heapIs}~\$\mathbf{heap}_{funcstart\_1032,1})).\mathbf{p2}) < (\mathbf{int})\mathbf{0})))
\rightarrow [simplify]
[1.17] -32768 \leq (30307 * asType<int>(static_cast<integer>(0 <
-this.$r.value(heapIs heap_{funcstart\_1032,1}.p2)))
\rightarrow [from term 24.0, literala < -this.$r.value(heapIs $heap_{funcstart\_1032.1}).p2
is false whenever -2 < (0 + literala)
   Proof of rule precondition:
   [1.17.0] - 2 < (0 + 0)
   \rightarrow [simplify]
   [1.17.2] true
[1.18] -32768 \leq (30307 * asType<int>(static_cast<integer>(false)))
\rightarrow [simplify]
[1.19] -32768 \leq (30307 * asType<int>(([false]: 1, []: 0)))
→ [explicitly assert falsehood of skipped guards in subsequent guards]
[1.20] -32768 \leq (30307 * asType<int>(([false]: 1, [true]: 0)))
\rightarrow [simplify]
[1.24] true
Proof of verification condition: Arithmetic result of operator '*' is within
limit of type 'signed int'
In the context of class: WHPrang, declared at:
C:\Escher\Customers\prang-cpp\prang.cpp (18,1)
Condition generated at: C:\Escher\Customers\prang-cpp\prang.cpp
(78,32)
Condition defined at:
To prove: ($heap<sub>1032,1:1051,8</sub>.M2 *
asType<int>(static_cast<integer>(static_cast<signed
int>(operator^*(heapIs $heap_{1032,1:1051,8}, this).p2) < (int)0))) \le
maxof(signed int)
Given:
heap_{init}.LIMIT == (int)80
```

```
heap_{init}.class WHPrang \in M1 == (int)30269
heap_{init}.class WHPrang \in r1 == (int)171
heap_{init}.class WHPrang \in a1 == (int)177
heap_{init}.class WHPrang \in b1 == (int)2
\text{$heap}_{init}.\mathbf{class} \text{ WHPrang} \in M2 == (\mathbf{int})30307
heap_{init}.class WHPrang \in r2 == (int)172
heap_{init}.class WHPrang \in a2 == (int)176
heap_{init}.class WHPrang \in b2 == (int)35
heap_{init}.class WHPrang \in M3 == (int)30323
heap_{init}.class WHPrang \in r3 == (int)170
heap_{init}.class WHPrang \in a3 == (int)178
heap_{init}.class WHPrang \in b3 == (int)63
\operatorname{div1} == \operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_1032,1},
static_cast<int>(operator*(heapIs $heap_{tuncstart\_1032.1}, this).p1),
static\_cast < int > (\$heap_{funcstart\_1032,1}.a1))
(asType<integer>(static_cast<int>(operator*(heapIs
heap_{funcstart_1032,1}, this).p1) /
asType < integer > (static\_cast < int > (\$heap_{funcstart\_1032.1}.a1))) = =
asType<integer>(div1.quot)
(asType<integer>(static_cast<int>(operator*(heapIs
heap_{funcstart\_1032,1}, this).p1) %
asType < integer > (static\_cast < int > (\$heap_{funcstart\_1032.1}.a1))) = =
asType<integer>(div1.rem)
(\mathbf{asType}{<}\mathbf{integer}{>}(\mathbf{operator}^*(\mathbf{heapIs}\ \$\mathbf{heap}_{funcstart\_1032,1},\ \mathbf{this}).\mathtt{p1}) <
asType < integer > (\$heap_{funcstart\_1032.1}.a1)) = >
(asType<integer>(div1.rem) == asType<integer>(operator*(heapIs
heap_{funcstart\_1032,1}, this).p1)
(\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathsf{heap}_{funcstart\_1032,1}.\mathsf{a1}) \leq
asType < integer > (operator^*(heapIs \$heap_{funcstart\_1032,1}, this).p1)) = >
!(0 == asType < integer > (div1.quot))
!(0 == asType < integer > (div1.rem)) || !(0 ==
asType<integer>(div1.quot))
div2 == div(\mathbf{heapIs} \$heap_{funcstart\_1032,1},
static\_cast < int > (operator*(heapIs $heap_{funcstart\_1032,1}, this).p2),
static\_cast < int > (\$heap_{funcstart\_1032,1}.a2))
(asType < integer > (static\_cast < int > (operator*(heapIs)))
heap_{funcstart\_1032,1}, this).p2)
asType < integer > (static\_cast < int > (\$heap_{funcstart\_1032,1}.a2))) = =
```

```
asType<integer>(div2.quot)
(asType<integer>(static_cast<int>(operator*(heapIs
heap_{funcstart\_1032,1}, this).p2)
asType < integer > (static\_cast < int > (\$heap_{funcstart\_1032.1}.a2))) = =
asType<integer>(div2.rem)
(asType < integer > (operator*(heapIs $heap_{funcstart\_1032,1}, this).p2) < footnote{the content of the conte
asType < integer > (\$heap_{funcstart\_1032,1}.a2)) = >
(asType<integer>(div2.rem) == asType<integer>(operator*(heapIs
heap_{funcstart\_1032,1}, this).p2)
(\mathbf{asType} < \mathbf{integer} > (\$ \mathbf{heap}_{funcstart\_1032,1}.\mathbf{a2}) \le
asType < integer > (operator*(heapIs $heap_{funcstart\_1032,1}, this).p2)) =>
!(0 == asType < integer > (div2.quot))
!(0 == asType < integer > (div2.rem)) || !(0 ==
asType<integer>(div2.quot))
\label{eq:div3} \text{div3} == \text{div}(\mathbf{heapIs} \ \$ \text{heap}_{funcstart\_1032,1},
static_cast<int>(operator*(heapIs $heap_{funcstart\_1032,1}, this).p3),
static\_cast < int > (\$heap_{funcstart\_1032.1}.a3))
(asType<integer>(static_cast<int>(operator*(heapIs
heap_{funcstart\_1032,1}, this).p3)) /
asType < integer > (static\_cast < int > (\$heap_{funcstart\_1032,1}.a3))) = =
asType<integer>(div3.quot)
(asType<integer>(static_cast<int>(operator*(heapIs
heap_{funcstart\_1032.1}, this).p3)
asType < integer > (static\_cast < int > (\$heap_{funcstart\_1032,1}.a3))) = =
asType<integer>(div3.rem)
(\mathbf{asType}{<}\mathbf{integer}{>}(\mathbf{operator}^*(\mathbf{heapIs}\ \$\mathbf{heap}_{funcstart\_1032,1},\ \mathbf{this}).\mathrm{p3}) <
asType < integer > (\$heap_{funcstart\_1032,1}.a3)) = >
(asType<integer>(div3.rem) == asType<integer>(operator*(heapIs
heap_{funcstart\_1032,1}, this).p3)
(\mathbf{asType} {<} \mathbf{integer} {>} (\$ \mathbf{heap}_{funcstart\_1032,1}.\mathbf{a3}) \leq
asType < integer > (operator*(heapIs $heap_{funcstart\_1032.1}, this).p3)) =>
!(0 == asType < integer > (div3.quot))
!(0 == asType < integer > (div3.rem)) || !(0 ==
asType<integer>(div3.quot))
temp1 == (\$heap_{funcstart\_1032,1}.r1 * \textbf{static\_cast} < \textbf{signed int} > (div1.rem)) - (div1.rem) + (div1.r
(\text{sheap}_{funcstart\_1032,1}.\text{b1} * \text{static\_cast} < \text{signed int} > (\text{div1.quot}))
minof(signed int) \le temp1
temp1 \le maxof(signed int)
heap_{1032.1:1051.8} == heap_{funcstart\_1032.1}._replace(this.$r \rightarrow
operator*(heapIs heap_{funcstart\_1032,1}, this)._replace(p1 \rightarrow
```

```
asType < P1Type > ((\$heap_{funcstart\_1032,1}.M1 *
asType<int>(static_cast<integer>(static_cast<signed
\mathbf{int}{>}(\mathbf{operator}^*(\mathbf{heapIs}\ \$\mathbf{heap}_{funcstart\_1032,1},\ \mathbf{this}).\mathrm{p1})<(\mathbf{int})0)))+\\
temp1)))
temp2 == (\$heap_{1032.1:1051.8}.r2 * static\_cast < signed int > (div2.rem)) -
(\text{sheap}_{1032,1:1051.8}.\text{b2} * \text{static\_cast} < \text{signed int} > (\text{div}2.\text{quot}))
minof(signed\ int) \le temp2
temp2 \le maxof(signed int)
Proof:
[Take given term]
[2.0] \text{ div1} == \text{div}(\mathbf{heapIs} \$ heap_{funcstart\_1032,1},
static\_cast < int > (operator*(heapIs $heap_{funcstart\_1032,1}, this).p1),
\mathbf{static\_cast}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_1032,1}.\mathrm{a1}))
→ [expand definition of operator '*' in class 'pointer' at built in declaration]
[2.1] \operatorname{div1} == \operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_1032,1},
\mathbf{static\_cast} < \mathbf{int} > (\mathbf{this.\$r.value}(\mathbf{heapIs} \ \$ \mathbf{heap}_{funcstart\_1032,1}).\mathbf{p1}),
\mathbf{static\_cast}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_1032,1}.\mathrm{a1}))
\rightarrow [simplify]
[2.2] \operatorname{div1} == \operatorname{div}(\mathbf{heapIs} \ \mathbf{\$heap}_{funcstart\_1032,1}, \ \mathbf{this}.\mathbf{\$r.value}(\mathbf{heapIs})
\theta_{funcstart\_1032,1}.p1, \theta_{funcstart\_1032,1}.p1, \theta_{funcstart\_1032,1}.a1))
\rightarrow [const static or extern object]
[2.3] \text{ div1} == \text{div(heapIs } \text{$heap}_{funcstart\_1032,1}, \text{ this.} \text{$r.value(heapIs)}
\theta_{tuncstart\_1032,1}.p1, \theta_{tuncstart\_1032,1}.p2, \theta_{tuncstart\_1032,1}.p2, \theta_{tuncstart\_1032,1}.p1, \theta_{tuncstart\_1032,1}.p1, \theta_{tuncstart\_1032,1}.p1, \theta_{tuncstart\_1032,1}.p1, \theta_{tuncstart\_1032,1}.p1, \theta_{tuncstart\_1032,1}.p2, \theta_{tuncstart\_1032,1}.p3, \theta_{tuncstart\_1032,1}.p3, \theta_{tuncstart\_1032,1}.p3, \theta_{tuncstart\_1032,1}.p3, \theta_{tuncstart\_1032,1}.p3, \theta_{tuncstart\_1032,1}.p3, \theta_{tuncstart\_1032,1}.p3, \theta_{tuncstart\_1032,1}.p3, \theta_{tuncstart\_1032,1
\rightarrow [expand definition of constant 'a1' at prang.cpp (30,26)]
[2.4] \text{ div1} == \text{div}(\text{heapIs } \text{heap}_{funcstart\_1032,1}, \text{this.}\text{\$r.value}(\text{heapIs})
\$ heap_{funcstart\_1032,1}).p1, \ \mathbf{static\_cast} < \mathbf{int} > ((\mathbf{int})177))
\rightarrow [simplify]
[2.6] \operatorname{div1} == \operatorname{div}(\mathbf{heapIs} \ \mathbf{\$heap}_{funcstart\_1032,1}, \ \mathbf{this}.\mathbf{\$r.value}(\mathbf{heapIs})
heap_{funcstart_{-1032,1}}.p1, 177
[Assume known post-assertion, class invariant or type constraint for term 2.6]
[7.0] (0 < asType<integer>(this.$r.value(heapIs
\$ heap_{funcstart\_1032,1}).p1)) \ \&\& \ (\textbf{asType} < \textbf{integer} > (\textbf{this}.\$r.\textbf{value}(\textbf{heapIs}))) \}
\text{Sheap}_{funcstart\_1032,1}).\text{p1} < \text{asType} < \text{integer} > (\text{Sheap.class WHPrang} \in
M1))
\rightarrow [simplify]
[7.2] (0 < this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1) \&\&
(this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1 <
```

```
asType < integer > (\text{$heap.class WHPrang} \in M1))
\rightarrow [const static or extern object]
[7.3] (0 < this.$r.value(heap
Is \rho_{funcstart\_1032,1}).p1) &&
(this.$r.value(heapIs heap_{funcstart\_1032,1}).p1 <
asType < integer > (\text{$heap}_{init}.class WHPrang \in M1))
\rightarrow [expand definition of constant 'M1' at prang.cpp (28,26)]
[7.4] (0 < this.$r.value(heapIs \theta_{funcstart\_1032,1}).p1) &&
(this.r.value(heapIs $heap_{funcstart\_1032.1}).p1 <
asType < integer > ((int)30269))
\rightarrow [simplify]
[7.10] (-30269 < -this.$r.value(heap
Is \rho_{funcstart\_1032,1}.p1) \land (0 < 0.00)
this.$r.value(heapIs $heap_{funcstart\_1032.1}).p1)
[Work on sub-term 2 of conjunction in term 7.10]
[8.0] 0 < this.$r.value(heap
Is $heap_{funcstart\_1032,1}).p1
[Take given term]
[18.0] \operatorname{div2} == \operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_1032,1},
static_cast<int>(operator*(heapIs $heap_{funcstart\_1032,1}, this).p2),
\mathbf{static\_cast} < \mathbf{int} > (\$ \mathbf{heap}_{funcstart\_1032,1}.\mathbf{a2}))
→ [expand definition of operator '*' in class 'pointer' at built in declaration]
[18.1] \operatorname{div2} == \operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_1032,1},
static_cast<int>(this.$r.value(heapIs $heap_{funcstart\_1032,1}).p2),
static\_cast < int > (\$heap_{funcstart\_1032,1}.a2))
\rightarrow [simplify]
[18.2] \text{ div2} == \text{div}(\text{heapIs } \text{$heap}_{funcstart\_1032,1}, \text{this.}\text{$r.value}(\text{heapIs})
\verb|\ensuremath{"heap}_{funcstart\_1032,1}|.p2, \ \textbf{static\_cast} < \textbf{int} > (\verb|\ensuremath{"heap}_{funcstart\_1032,1}|.a2))
\rightarrow [const static or extern object]
[18.3] div2 == div(\mathbf{heapIs} \ \mathbf{sheap}_{funcstart\_1032,1}, \ \mathbf{this}.\mathbf{sr.value}(\mathbf{heapIs})
\$ heap_{funcstart\_1032,1}).p2, \ \mathbf{static\_cast} < \mathbf{int} > (\$ heap_{init}.a2))
\rightarrow [expand definition of constant 'a2' at prang.cpp (35,26)]
[18.4] \text{ div2} == \text{div}(\text{heapIs } \text{$heap}_{funcstart\_1032,1}, \text{this.}\text{$r.value}(\text{heapIs})
heap_{funcstart\_1032,1}.p2, static\_cast < int > ((int)176)
\rightarrow [simplify]
[18.6] div2 == div(heapIs $heap<sub>funcstart_1032,1</sub>, this.$r.value(heapIs)
heap_{funcstart_{1032,1}}.p2, 176
[Assume known post-assertion, class invariant or type constraint for term 18.6]
[23.0] (0 < asType<integer>(this.$r.value(heapIs
```

```
\verb§heap$_{funcstart\_1032,1}).p2)) \&\& (\mathbf{asType} < \mathbf{integer} > (\mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}))) \&\& (\mathbf{asType} < \mathbf{integer} > (\mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}))) \&\& (\mathbf{asType} < \mathbf{integer} > (\mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})))) \&\& (\mathbf{asType} < \mathbf{integer} > (\mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}))))) \&\& (\mathbf{asType} < \mathbf{integer} > (\mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})))))
\label{eq:class} \$ heap_{funcstart\_1032,1}).p2) < \mathbf{asType} < \mathbf{integer} > (\$ heap.\mathbf{class} \ \mathbf{WHPrang} \in \texttt{Constart} = \texttt{Con
M2))
\rightarrow [simplify]
[23.2] (0 < this.$r.value(heapIs \rho_{funcstart\_1032,1}).p2) &&
(this.r.value(heapIs $heap_{funcstart\_1032.1}).p2 <
asType < integer > (\$heap.class WHPrang \in M2))
\rightarrow [const static or extern object]
[23.3] (0 < this.$r.value(heap
Is \rho_{uncstart\_1032,1}).p2) &&
(this.$r.value(heapIs heap_{funcstart\_1032,1}).p2 <
asType < integer > (\$heap_{init}.class WHPrang \in M2))
\rightarrow [expand definition of constant 'M2' at prang.cpp (33,26)]
[23.4] (0 < this.\$r.value(heapIs \$heap_{tuncstart\_1032.1}).p2) &&
(this.r.value(heapIs $heap_{funcstart\_1032,1}).p2 <
asType < integer > ((int)30307))
\rightarrow [simplify]
this.r.value(heapIs $heap_{funcstart\_1032,1}).p2)
[Work on sub-term 2 of conjunction in term 23.10]
[24.0] 0 < this.$r.value(heapIs $heap_{funcstart\_1032,1}).p2
[Take given term]
[50.0] (($heap_funcstart_1032,1.r1 * static_cast<signed int>(div1.rem)) -
(\text{sheap}_{funcstart\_1032,1}.\text{b1 * static\_cast} < \text{signed int} > (\text{div1.quot}))) == \text{temp1}
\rightarrow [const static or extern object]
[50.1] (($heap<sub>init</sub>.r1 * static_cast<signed int>(div1.rem)) -
(\$heap_{funcstart\_1032,1}.b1 * \textbf{static\_cast} < \textbf{signed int} > (div1.quot))) == temp1
\rightarrow [expand definition of constant 'r1' at prang.cpp (29,26)]
[50.2] (((int)171 * static_cast<signed int>(div1.rem)) -
(\$heap_{funcstart\_1032,1}.b1 * \textbf{static\_cast} < \textbf{signed int} > (div1.quot))) == temp1
\rightarrow [simplify]
[50.3] ((171 * static_cast < signed int > (div1.rem)) - ($heap_funcstart_1032.1.b1
* static_cast < signed int > (div1.quot))) == temp1
\rightarrow [from term 2.6, div1 is equal to div(heapIs $heap_{funcstart\_1032,1},
this.r.value(heapIs $heap_{funcstart\_1032,1}).p1, 177)]
[50.4] ((171 * static_cast < signed int > (div(heapIs heapIs funcstart_{1032,1}),
this.r.value(heapIs $heap_{funcstart\_1032,1}).p1, 177).rem)) -
(\text{sheap}_{funcstart\_1032,1}.\text{b1 * static\_cast} < \text{signed int} > (\text{div1.quot}))) == \text{temp1}
```

```
\rightarrow [simplify]
[50.5] ((171 * div(heapIs $heap_{funcstart\_1032,1}, this.$r.value(heapIs)
\text{Sheap}_{funcstart\_1032,1}.p1, 177).rem) - (\text{Sheap}_{funcstart\_1032,1}.b1 *
static_cast<signed int>(div1.quot))) == temp1
\rightarrow [const static or extern object]
[50.6] ((171 * \mathrm{div}(\mathbf{heapIs}\ \$\mathrm{heap}_{funcstart\_1032,1},\ \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}\ 
\rho_{uncstart\_1032,1}.p1, 177).rem – (\rho_{uncstart\_1032,1}.p1, 177).rem) – (\rho_{uncstart\_1032,1}.p1, 177).rem) – (\rho_{uncstart\_1032,1}.p1, 177).rem)
int>(div1.quot)) == temp1
\rightarrow [expand definition of constant 'b1' at prang.cpp (31,26)]
[50.7] ((171 * div(heapIs \$heap_{funcstart\_1032,1}, this.\$r.value(heapIs
\theta_{uncstart\_1032,1}.p1, 177).rem - ((int)2 * static\_cast < signed)
int > (div1.quot))) == temp1
\rightarrow [simplify]
[50.8] ((171 * div(heapIs $heap_{funcstart\_1032,1}, this.$r.value(heapIs)
\theta_{funcstart\_1032,1}.p1, 177).rem - (2 * static\_cast < signed)
int>(div1.quot)) == temp1
\rightarrow [from term 2.6, div1 is equal to div(heapIs $heap_{funcstart\_1032,1},
this.r.value(heapIs $heap_{funcstart\_1032,1}).p1, 177)]
[50.9] ((171 * div(heapIs $heap_{funcstart\_1032,1}, this.$r.value(heapIs)
\theta_{tuncstart\ 1032.1},p1, 177).rem) - (2 * static_cast<signed)
int>(div(heapIs \$heap_{funcstart\_1032,1}, this.\$r.value(heapIs
\$ \operatorname{heap}_{funcstart\_1032,1}).\operatorname{p1},\ 177).\operatorname{quot}))) == \operatorname{temp1}
\rightarrow [simplify]
[50.14] 0 == (-\text{temp1} + (-2 * \text{div}(\text{heapIs } \text{$heap}_{funcstart\_1032,1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177).quot) + (171 *
div(\mathbf{heapIs} \$ heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
heap_{funcstart_{1032,1}}.p1, 177).rem
[Take given term]
[53.0] $heap<sub>1032,1:1051,8</sub> == $heap<sub>funcstart_1032,1</sub>._replace(this.$r \rightarrow
operator*(heapIs heap_{funcstart\_1032,1}, this)._replace(p1 \rightarrow
asType < P1Type > ((\$heap_{funcstart\_1032,1}.M1 *
asType<int>(static_cast<integer>(static_cast<signed
int>(operator^*(heapIs \$heap_{funcstart\_1032,1}, this).p1) < (int)0))) +
temp1)))
→ [expand definition of operator '*' in class 'pointer' at built in declaration]
[53.1] $\text{heap}_{1032,1:1051.8} == \text{$heap}_{funcstart\_1032,1}.$\text{-replace}(\text{this}.\text{$r} \to \text{$}
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow
asType < P1Type > ((\$heap_{funcstart\_1032,1}.M1 *
as Type < int > (static\_cast < integer > (static\_cast < signed))
```

```
int>(operator^*(heapIs \$heap_{funcstart\_1032,1}, this).p1) < (int)0))) +
temp1)))
\rightarrow [const static or extern object]
[53.2] \theta_{1032,1;1051,8} == \theta_{1032,1;1051,8} = \theta_{1032,1;1051,8} == \theta
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow
asType < P1Type > ((\$heap_{init}.M1 *
asType < int > (static\_cast < integer > (static\_cast < signed
int>(operator^*(heapIs \$heap_{funcstart\_1032,1}, this).p1) < (int)0))) +
temp1)))
\rightarrow [expand definition of constant 'M1' at prang.cpp (28,26)]
[53.3] heap_{1032,1;1051,8} == heap_{funcstart\_1032,1}._replace(this.r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow
asType<P1Type>(((int)30269 *
asType{<}int{>}(static\_cast{<}integer{>}(static\_cast{<}signed
int>(operator^*(heapIs $heap_{funcstart\_1032,1}, this).p1) < (int)0))) +
temp1)))
\rightarrow [simplify]
[53.4] heap_{1032,1;1051,8} == heap_{funcstart\_1032,1}.\_replace(this.\$r \rightarrow this)
\mathbf{this.\$r.value}(\mathbf{heapIs}~\$ \mathrm{heap}_{funcstart\_1032,1}).\_\mathbf{replace}(\mathrm{p1} \rightarrow
asType<P1Type>((30269 *
asType<int>(static_cast<integer>(static_cast<signed
\mathbf{int}{>}(\mathbf{operator}^*(\mathbf{heapIs}\ \$\mathbf{heap}_{funcstart\_1032,1},\ \mathbf{this}).\mathtt{p1})<(\mathbf{int})0)))+\\
temp1)))
→ [expand definition of operator '*' in class 'pointer' at built in declaration]
[53.5] \rho_{1032,1;1051,8} == \rho_{1032,1;1051,8} = \rho_{1032,1;1051,8} == \rho
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow
asType<P1Type>((30269 *
as Type < int > (static\_cast < integer > (static\_cast < signed))
int>(this.\$r.value(heapIs \$heap_{funcstart\_1032,1}).p1) < (int)0))) + temp1)))
\rightarrow [simplify]
[53.9] heap_{1032,1;1051,8} == heap_{funcstart\_1032,1}._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow
asType<P1Type>((30269 * asType<int>(static_cast<integer>(0 <
-\mathbf{this.}\$r.\mathbf{value}(\mathbf{heapIs}\ \$\mathrm{heap}_{funcstart\_1032,1}).\mathrm{p1}))) + \mathrm{temp1})))
\rightarrow [from term 8.0, literala < -this.$r.value(heapIs $heap_{funcstart\_1032,1}).p1
is false whenever -2 < (0 + literala)
           Proof of rule precondition:
           [53.9.0] - 2 < (0 + 0)
           \rightarrow [simplify]
```

```
[53.9.2] true
[53.10] $heap<sub>1032,1;1051,8</sub> == $heap<sub>funcstart_1032,1</sub>._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow
asType<P1Type>((30269 * asType<int>(static_cast<integer>(false)))
+ temp1)))
\rightarrow [simplify]
[53.11] \theta_{1032,1;1051,8} == \theta_{1032,1;1051,8} == \theta_{1032,1}._replace(this.$r \to
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow
asType < P1Type > ((30269 * asType < int > (([false]: 1, []: 0))) + temp1)))
→ [explicitly assert falsehood of skipped guards in subsequent guards]
[53.12] $\text{heap}_{1032,1;1051,8} == $\text{heap}_{funcstart\_1032,1}._\text{replace}(\text{this}.\text{$\frac{1}{2}r$})
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow
asType<P1Type>((30269 * asType<int>(([false]: 1, [true]: 0))) +
temp1)))
\rightarrow [simplify]
[53.15] $heap<sub>1032,1;1051,8</sub> == $heap<sub>funcstart_1032,1</sub>._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow
asType < P1Type > (0 + temp1))
\rightarrow [from term 50.14, temp1 is equal to (-2 * div(heapIs $heap_{funcstart\_1032,1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177).quot) + (171 *
div(\mathbf{heapIs} \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
heap_{funcstart_{-1032.1}}.p1, 177).rem
[53.16] $heap<sub>1032,1;1051,8</sub> == $heap<sub>funcstart_1032,1</sub>._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow
asType < P1Type > (0 + ((-2 * div(heapIs $heap_{funcstart\_1032,1},
this.r.value(heapIs \ensuremath{\$}heap_{funcstart\_1032,1}).p1, 177).quot) + (171 *
div(heapIs $heap<sub>funcstart_1032.1</sub>, this.$r.value(heapIs
heap_{funcstart_{1032.1}}.p1, 177).rem))))
\rightarrow [simplify]
[53.19] $heap<sub>1032,1;1051,8</sub> == $heap<sub>funcstart_1032,1</sub>._replace(this.$r \rightarrow
\textbf{this.\$r.value}(\textbf{heapIs}~\$\text{heap}_{funcstart\_1032,1}).\_\textbf{replace}(\text{p1} \rightarrow ((-2~*\text{div}(\textbf{heapIs}))))))
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.} \text{\$r.value}(\text{heapIs}))
\$ \operatorname{heap}_{funcstart\_1032,1}).\operatorname{p1},\ 177).\operatorname{rem}))))
[Take goal term]
[1.0] ($heap<sub>1032,1;1051,8</sub>.M2 *
as Type < int > (static\_cast < integer > (static\_cast < signed))
int>(operator^*(heapIs $heap_{1032,1;1051,8}, this).p2) < (int)0))) \le
maxof(signed int)
\rightarrow [from term 53.19, $heap<sub>1032,1:1051,8</sub> is equal to
```

```
\$heap_{funcstart\_1032,1}.\_\textbf{replace}(\textbf{this.}\$r \rightarrow \textbf{this.}\$r.\textbf{value}(\textbf{heapIs}
heap_{funcstart\_1032,1}._replace(p1 \rightarrow (-2 * div(heapIs heap_{funcstart\_1032,1}),
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177).quot) + (171 *
div(heapIs $heap_{funcstart\_1032,1}, this.$r.value(heapIs)
heap_{funcstart_{1032,1}}.p1, 177).rem)))
[1.1] (heap_{funcstart\_1032,1}._replace(this.r \rightarrow this.r.value(heapIs)
\text{Sheap}_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs \text{Sheap}_{funcstart\_1032,1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177).quot) + (171 * 
div(\mathbf{heapIs} \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
heap_{funcstart\_1032,1}.p1, 177).rem))).M2 *
asType{<}int{>}(static\_cast{<}integer{>}(static\_cast{<}signed
int>(operator^*(heapIs $heap_{1032,1:1051.8}, this).p2) < (int)0))) \le
maxof(signed int)
\rightarrow [const member of object with modified fields]
[1.2] ($heap<sub>funcstart_1032.1</sub>.M2 *
asType<int>(static_cast<integer>(static_cast<signed
int>(operator^*(heapIs $heap_{1032,1:1051.8}, this).p2) < (int)0))) \le
maxof(signed int)
\rightarrow [const static or extern object]
[1.3] ($heap<sub>init</sub>.M2 *
asType<int>(static_cast<integer>(static_cast<signed
int>(operator^*(heapIs $heap_{1032,1;1051,8}, this).p2) < (int)0))) \le
maxof(signed int)
\rightarrow [expand definition of constant 'M2' at prang.cpp (33,26)]
[1.4] ((int)30307 *
asType < int > (static\_cast < integer > (static\_cast < signed)
int>(operator^*(heapIs $heap_{1032,1:1051,8}, this).p2) < (int)0))) \le
maxof(signed int)
\rightarrow [simplify]
{\it [1.5]\ (30307\ * asType<int>(static\_cast<integer>(static\_cast<signed)}
int>(operator^*(heapIs $heap_{1032,1:1051.8}, this).p2) < (int)0))) \le
maxof(signed int)
\rightarrow [from term 53.19, $heap<sub>1032,1:1051,8</sub> is equal to
$heap_{funcstart\_1032,1}$.$replace(this.$r \rightarrow this.$r.value(heapIs)
heap_{funcstart\_1032,1}._replace(p1 \rightarrow (-2 * div(heapIs \$heap_{funcstart\_1032,1}, -2))
div(\textbf{heapIs}~\$heap_{funcstart\_1032,1},~\textbf{this.}\$r.\textbf{value}(\textbf{heapIs}
heap_{funcstart\_1032,1}.p1, 177).rem)))]
[1.6] (30307 * asType<int>(static_cast<integer>(static_cast<signed)
int>(operator*(heapIs \rho_{tuncstart\_1032.1}._replace(this.\rho_{tuncstart\_1032.1}._replace(this.
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow (-2 * div(heapIs
```

```
\rho_{funcstart=1032,1}, this.r.value(heapIs \rho_{funcstart=1032,1}).p1,
177).quot) + (171 * div(heapIs $heap_{funcstart\_1032,1}, this.$r.value(heapIs
\theta_{uncstart\_1032,1}.p1, 177).rem)), this).p2) < (int)0))) \le maxof(signed)
int)
→ [expand definition of operator '*' in class 'pointer' at built in declaration]
[1.7] (30307 * asType<int>(static_cast<integer>(static_cast<signed
int>(this.r.value(heapIs \ heap_{funcstart\_1032,1}.\_replace(this.\rdotsr)
this.$r.value(heapIs \frac{1}{2} heap\frac{1}{2} heap\frac{1}{2}
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs $heap<sub>funcstart_1032,1</sub>, this.$r.value(heapIs
\{\text{heap}_{funcstart\_1032,1}\}, p1, 177).rem\}\})))).p2) < \{\text{int}\}0))) \leq \text{maxof}(\text{signed int})
→ [evaluate dereferenced pointer into modified heap]
[1.8] (30307 * asType<int>(static_cast<integer>(static_cast<signed)
int>(([this.\$r == this.\$r]: this.\$r.value(heapIs)))
\rho_{tuncstart\_1032.1}._replace(p1 \rightarrow (-2 * div(heapIs \rho_{tuncstart\_1032.1})
this.r.value(heapIs \ensuremath{\$}heap_{funcstart\_1032,1}).p1, 177).quot) + (171 *
div(\mathbf{heapIs} \ \text{$heap}_{funcstart\_1032,1}, \ \mathbf{this}.\text{$r.value}(\mathbf{heapIs})
\theta_{funcstart\_1032,1}.p1, 177).rem), []: this.$r.value(heapIs)
\text{Sheap}_{funcstart\_1032,1}).\text{p2} < (\text{int})0)) \leq \text{maxof}(\text{signed int})
→ [explicitly assert falsehood of skipped guards in subsequent guards]
[1.9] (30307 * asType<int>(static_cast<integer>(static_cast<signed
int>(([this.$r == this.$r]: this.$r.value(heapIs
\rho_{tuncstart\_1032.1}._replace(p1 \rightarrow (-2 * div(heapIs \rho_{tuncstart\_1032.1})
this.r.value(heapIs \ heap_{funcstart\_1032.1}).p1, 177).quot) + (171)
div(heapIs $heap_tuncstart_1032.1, this.$r.value(heapIs
heap_{funcstart_{1032,1}}.p1, 177).rem), [!(this.$r == this.$r)]:
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p2) < (int)0))) \le maxof(signed)
int)
\rightarrow [simplify]
[1.16] (30307 * asType<int>(static_cast<integer>(0 <
-this.$r.value(heapIs \theta_{funcstart\_1032,1}).p2))) \leq \max_{funcstart\_1032,1}
\rightarrow [from term 24.0, literala < -this.$r.value(heapIs $heap_{funcstart\_1032.1}).p2
is false whenever -2 < (0 + literala)
      Proof of rule precondition:
      [1.16.0] - 2 < (0 + 0)
      \rightarrow [simplify]
      [1.16.2] true
[1.17] (30307 * asType<int>(static_cast<integer>(false))) \le \text{
maxof(signed int)
```

```
\rightarrow [simplify]
[1.18] (30307 * asType < int > (([false]: 1, []: 0))) \le maxof(signed int)
→ [explicitly assert falsehood of skipped guards in subsequent guards]
[1.19] (30307 * asType<int>(([false]: 1, [true]: 0))) \leq maxof(signed int)
\rightarrow [simplify]
[1.24] true
Proof of verification condition: Arithmetic result of operator '+' is within
limit of type 'signed int'
In the context of class: WHPrang, declared at:
C:\Escher\Customers\prang-cpp\prang.cpp (18,1)
Condition generated at: C:\Escher\Customers\prang-cpp\prang.cpp
(78,16)
Condition defined at:
To prove: minof(signed int) \leq (($heap_{1032,1;1051,8}.M2 *
as Type < int > (static\_cast < integer > (static\_cast < signed))
int>(operator^*(heapIs \$heap_{1032,1;1051,8}, this).p2) < (int)(0))) + temp2)
Given:
heap_{init}.LIMIT == (int)80
heap_{init}.class WHPrang \in M1 == (int)30269
heap_{init}.class WHPrang \in r1 == (int)171
heap_{init}.class WHPrang \in a1 == (int)177
heap_{init}.class WHPrang \in b1 == (int)2
heap_{init}.class WHPrang \in M2 == (int)30307
heap_{init}.class WHPrang \in r2 == (int)172
heap_{init}.class WHPrang \in a2 == (int)176
heap_{init}.class WHPrang \in b2 == (int)35
heap_{init}.class WHPrang \in M3 == (int)30323
heap_{init}.class WHPrang \in r3 == (int)170
heap_{init}.class WHPrang \in a3 == (int)178
heap_{init}.class WHPrang \in b3 == (int)63
\label{eq:div1} \text{div1} == \text{div}(\mathbf{heapIs} \ \$ \text{heap}_{funcstart\_1032,1},
static\_cast < int > (operator^*(heapIs \$heap_{funcstart\_1032,1}, this).p1),
static\_cast < int > (\$heap_{funcstart\_1032,1}.a1))
(asType<integer>(static_cast<int>(operator*(heapIs
```

```
\theta_{funcstart_{-1032,1}}, this).p1)) /
\mathbf{asType} {<} \mathbf{integer} {>} (\mathbf{static\_cast} {<} \mathbf{int} {>} (\$ \mathbf{heap}_{funcstart\_1032,1}.\mathbf{a1}))) = =
asType<integer>(div1.quot)
(\mathbf{asType} {<} \mathbf{integer} {>} (\mathbf{static\_cast} {<} \mathbf{int} {>} (\mathbf{operator}^* (\mathbf{heapIs}
heap_{funcstart\_1032.1}, this).p1)
asType < integer > (static\_cast < int > (\$heap_{funcstart\_1032.1}.a1))) = =
asType<integer>(div1.rem)
(\mathbf{asType}{<}\mathbf{integer}{>}(\mathbf{operator}^*(\mathbf{heapIs}\ \$\mathbf{heap}_{funcstart\_1032,1},\ \mathbf{this}).\mathtt{p1}) <
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathrm{heap}_{funcstart\_1032,1}.\mathrm{a1})) =>
(asType<integer>(div1.rem) == asType<integer>(operator*(heapIs
heap_{funcstart\_1032,1}, this).p1)
(\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathbf{heap}_{funcstart\_1032,1}.\mathbf{a1}) \leq
asType < integer > (operator*(heapIs $heap_{funcstart\_1032,1}, this).p1)) = > funcstart\_1032,1, this)
!(0 == asType < integer > (div1.quot))
!(0 == asType < integer > (div1.rem)) || !(0 ==
asType<integer>(div1.quot))
\operatorname{div2} == \operatorname{div}(\mathbf{heapIs} \ \operatorname{\$heap}_{funcstart\_1032,1},
\mathbf{static\_cast} < \mathbf{int} > (\mathbf{operator}^*(\mathbf{heapIs}\ \$ \mathbf{heap}_{funcstart\_1032,1},\ \mathbf{this}).\mathbf{p2}),
\mathbf{static\_cast}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_1032,1}.\mathrm{a2}))
(asType < integer > (static\_cast < int > (operator*(heapIs
heap_{funcstart\ 1032.1}, this).p2) /
\mathbf{asType} < \mathbf{integer} > (\mathbf{static\_cast} < \mathbf{int} > (\$ \mathbf{heap}_{funcstart\_1032,1}.\mathbf{a2}))) = =
asType<integer>(div2.quot)
(asType<integer>(static_cast<int>(operator*(heapIs
heap_{funcstart\_1032,1}, this).p2)
asType < integer > (static\_cast < int > (\$heap_{funcstart\_1032.1}.a2))) = =
asType<integer>(div2.rem)
(\mathbf{asType}{<}\mathbf{integer}{>}(\mathbf{operator}^*(\mathbf{heapIs}\ \$\mathbf{heap}_{funcstart\_1032,1},\ \mathbf{this}).\mathtt{p2}) <
\mathbf{asType} < \mathbf{integer} > (\$ \mathbf{heap}_{funcstart\_1032,1}.\mathbf{a2})) = >
(asType<integer>(div2.rem) == asType<integer>(operator*(heapIs
heap_{funcstart\_1032,1}, this).p2)
(asType < integer > (\$heap_{funcstart\_1032,1}.a2) \le
asType < integer > (operator^*(heapIs \$heap_{funcstart\_1032,1}, this).p2)) =>
!(0 == asType < integer > (div2.quot))
!(0 == asType < integer > (div2.rem)) || !(0 ==
asType<integer>(div2.quot))
div3 == div(\mathbf{heapIs} \$ heap_{funcstart\_1032,1},
\mathbf{static\_cast} < \mathbf{int} > (\mathbf{operator}^*(\mathbf{heapIs}\ \$ \mathbf{heap}_{funcstart\_1032,1},\ \mathbf{this}).\mathbf{p3}),
\mathbf{static\_cast}{<}\mathbf{int}{>}(\$\mathbf{heap}_{funcstart\_1032,1}.\mathbf{a3}))
(asType < integer > (static\_cast < int > (operator*(heapIs)))
heap_{funcstart\_1032,1}, this).p3)
```

```
asType < integer > (static\_cast < int > (\$heap_{funcstart\_1032.1}.a3))) = =
asType<integer>(div3.quot)
(asType<integer>(static_cast<int>(operator*(heapIs
heap_{funcstart\_1032,1}, this).p3)
asType < integer > (static\_cast < int > (\$heap_{funcstart\_1032.1}.a3))) = =
asType<integer>(div3.rem)
(\mathbf{asType}{<}\mathbf{integer}{>}(\mathbf{operator}^*(\mathbf{heapIs}\ \$\mathbf{heap}_{funcstart\_1032,1},\ \mathbf{this}).\mathrm{p3}) <
asType < integer > (\$heap_{funcstart\_1032,1}.a3)) = >
(asType<integer>(div3.rem) == asType<integer>(operator*(heapIs
heap_{funcstart\ 1032.1}, this).p3)
(asType < integer > (\$heap_{funcstart\_1032,1}.a3) \le
asType<integer>(operator*(heapIs $heap_{tuncstart\_1032,1}, this).p3)) =>
!(0 == asType < integer > (div3.quot))
!(0 == asType < integer > (div3.rem)) || !(0 ==
asType<integer>(div3.quot))
temp1 == ($heap_funcstart_1032.1.r1 * static_cast<signed int>(div1.rem)) -
(\text{\$heap}_{funcstart\_1032,1}.\text{b1 * static\_cast} < \text{signed int} > (\text{div1.quot}))
minof(signed int) \le temp1
temp1 \le maxof(signed int)
\theta_{1032,1;1051,8} == \theta_{1032
operator*(heapIs heap_{funcstart\_1032,1}, this)._replace(p1 \rightarrow
asType<P1Type>(($heap<sub>funcstart_1032.1</sub>.M1 *
asType<int>(static_cast<integer>(static_cast<signed
int>(operator^*(heapIs \$heap_{funcstart\_1032,1}, this).p1) < (int)0))) +
temp1)))
temp2 == (\$heap_{1032,1;1051,8}.r2 * static\_cast < signed int > (div2.rem)) -
(\text{\$heap}_{1032,1;1051,8}.\text{b2} * \text{static\_cast} < \text{signed int} > (\text{div}2.\text{quot}))
minof(signed\ int) \le temp2
temp2 \le maxof(signed int)
Proof:
[Take given term]
[2.0] div1 == div(heapIs heap_{funcstart\_1032,1},
static\_cast < int > (operator*(heapIs $heap_{funcstart\_1032,1}, this).p1),
\mathbf{static\_cast}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_1032,1}.\mathrm{a1}))
→ [expand definition of operator '*' in class 'pointer' at built in declaration]
[2.1] \operatorname{div1} == \operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_1032,1},
static\_cast < int > (this. r.value(heapIs  heap_{funcstart\_1032,1}).p1),
static\_cast < int > (\$heap_{funcstart\_1032.1}.a1))
```

```
\rightarrow [simplify]
[2.2] \text{ div1} == \text{div}(\text{heapIs } \text{heap}_{funcstart\_1032,1}, \text{this.}\text{\$r.value}(\text{heapIs})
\rho_{tuncstart_{1032,1}}, p1, static_cast<int>(\rho_{tuncstart_{1032,1}})
\rightarrow [const static or extern object]
[2.3] \operatorname{div1} == \operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_1032,1}, \mathbf{this}.\$ r. \mathbf{value}(\mathbf{heapIs})
\theta_{funcstart\_1032,1}.p1, \theta_{funcstart\_1032,1}.p1, \theta_{funcstart\_1032,1}.p1, \theta_{funcstart\_1032,1}.p1, \theta_{funcstart\_1032,1}.p1, \theta_{funcstart\_1032,1}.p1, \theta_{funcstart\_1032,1}.p2, \theta_{funcstart\_1032,1}.p2, \theta_{funcstart\_1032,1}.p2, \theta_{funcstart\_1032,1}.p2, \theta_{funcstart\_1032,1}.p2, \theta_{funcstart\_1032,1}.p3, \theta_{funcstart\_1032,1}.p4, \theta_{funcstart\_1032,1}.p4, \theta_{funcstart\_1032,1}.p4, \theta_{funcstart\_1032,1}.p5, \theta_{funcstart\_1032,1}.p5, \theta_{funcstart\_1032,1
\rightarrow [expand definition of constant 'a1' at prang.cpp (30,26)]
[2.4] \text{ div1} == \text{div}(\text{heapIs } \text{heap}_{funcstart\_1032,1}, \text{this.}\text{\$r.value}(\text{heapIs})
\theta_{funcstart\_1032,1}.p1, \theta_{funcstart} (int)177)
\rightarrow [simplify]
[2.6] \operatorname{div1} == \operatorname{div}(\mathbf{heapIs} \ \mathbf{\$heap}_{funcstart\_1032,1}, \ \mathbf{this}.\mathbf{\$r.value}(\mathbf{heapIs})
heap_{funcstart\_1032,1}.p1, 177)
[Assume known post-assertion, class invariant or type constraint for term 2.6]
[7.0] (0 < asType<integer>(this.$r.value(heapIs
\$heap_{funcstart\_1032,1}).p1)) \ \&\& \ (\textbf{asType} < \textbf{integer} > (\textbf{this}.\$r.\textbf{value}(\textbf{heapIs}))) \ \&\& \ (\textbf{asType} < \textbf{integer} > (\textbf{this}.\$r.\textbf{value}))
\text{heap}_{funcstart=1032.1}).p1) < asType<integer>(\text{heap.class WHPrang} \in
M1)
\rightarrow [simplify]
[7.2] (0 < this.$r.value(heap
Is $heap_{funcstart\_1032,1}).p1) &&
(this.$r.value(heapIs heap_{funcstart\_1032,1}).p1 <
asType < integer > (\text{heap.class WHPrang} \in M1))
\rightarrow [const static or extern object]
[7.3] (0 < this.$r.value(heapIs $heap_{funcstart\_1032,1}).p1) &&
(this.$r.value(heapIs heap_{funcstart\_1032,1}).p1 <
asType < integer > (\text{$heap}_{init}.class WHPrang \in M1))
\rightarrow [expand definition of constant 'M1' at prang.cpp (28,26)]
[7.4] (0 < this.\$r.value(heapIs \$heap_{funcstart\_1032,1}).p1) &&
(this.$r.value(heapIs \rho_{funcstart\_1032,1}).p1 <
asType < integer > ((int)30269))
\rightarrow [simplify]
[7.10] (-30269 < -this.$r.value(heapIs heap_{funcstart\_1032,1}).p1) \land (0 <
this.$r.value(heapIs $heap_{funcstart\_1032.1}).p1)
[Work on sub-term 2 of conjunction in term 7.10]
[8.0] 0 < this.$r.value(heapIs $heap_{tuncstart\_1032,1}).p1
[Take given term]
[18.0] \operatorname{div2} == \operatorname{div}(\mathbf{heapIs} \ \operatorname{\$heap}_{funcstart\_1032,1},
static_cast<int>(operator*(heapIs $heap_{funcstart\_1032.1}, this).p2),
```

```
\mathbf{static\_cast}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_1032,1}.\mathrm{a2}))
→ [expand definition of operator '*' in class 'pointer' at built in declaration]
[18.1] \operatorname{div2} == \operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_1032,1},
static_cast<int>(this.$r.value(heapIs $heap_{funcstart\_1032,1}).p2),
\mathbf{static\_cast}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_1032,1}.\mathrm{a2}))
\rightarrow [simplify]
[18.2] div2 == div(heapIs $heap<sub>funcstart_1032,1</sub>, this.$r.value(heapIs)
\rho_{tuncstart\_1032.1}, p2, static_cast<int>(\rho_{tuncstart\_1032.1})
\rightarrow [const static or extern object]
[18.3] div2 == div(heapIs heapIs = funcstart_{1032,1}, this.r.value(heapIs)
\label{eq:cast_int} $$ $ p_{funcstart\_1032,1}.p2, $ static\_cast < int > ($ p_{init}.a2) ) $$
\rightarrow [expand definition of constant 'a2' at prang.cpp (35,26)]
[18.4] div2 == div(\mathbf{heapIs} \ \hat{\mathbf{s}}_{heap}), \mathbf{this.} \cdot \mathbf{r.value}(\mathbf{heapIs})
\theta_{funcstart\_1032,1}, p2, \theta_{funcstart} (int)176))
\rightarrow [simplify]
[18.6] div2 == div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
heap_{funcstart_{-1032,1}}.p2, 176
[Assume known post-assertion, class invariant or type constraint for term 18.6]
[23.0] (0 < asType<integer>(this.$r.value(heapIs
\label{eq:continuous} $\operatorname{heap}_{funcstart\_1032,1}).p2)) \&\& (\mathbf{asType}{<}\mathbf{integer}{>} (\mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})) \&\& (\mathbf{asType}{<}\mathbf{integer}{>} (\mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}))) \&\& (\mathbf{asType}{<}\mathbf{integer}{>} (\mathbf{heapIs})) \&\& (\mathbf{asType}{<}\mathbf{
\label{eq:class} \$ heap_{funcstart\_1032,1}).p2) < \mathbf{asType} < \mathbf{integer} > (\$ heap.\mathbf{class} \ \mathrm{WHPrang} \in
M2))
\rightarrow [simplify]
[23.2] (0 < this.$r.value(heap
Is $heap_{funcstart\_1032,1}).p2) &&
(this.$r.value(heapIs heap_{funcstart\_1032,1}).p2 <
asType < integer > (\text{$heap.class WHPrang} \in M2))
\rightarrow [const static or extern object]
[23.3] (0 < this.$r.value(heap
Is $heap_{tuncstart\_1032,1}).p2) &&
(this.r.value(heapIs $heap_{funcstart\_1032,1}).p2 <
asType < integer > (\$heap_{init}.class WHPrang \in M2))
\rightarrow [expand definition of constant 'M2' at prang.cpp (33,26)]
[23.4] (0 < this.$r.value(heapIs heap_{funcstart\_1032,1}).p2) &&
(this.$r.value(heapIs heap_{funcstart\_1032,1}).p2 <
asType < integer > ((int)30307))
\rightarrow [simplify]
[23.10] (-30307 < -this.$r.value(heapIs \rho_{funcstart\_1032,1}).p2) \wedge (0 <
this.r.value(heapIs $heap_{funcstart\_1032,1}).p2)
```

```
[Work on sub-term 2 of conjunction in term 23.10]
[24.0] 0 < this.$r.value(heapIs \rho_{funcstart\_1032,1}).p2
[Take given term]
[50.0] \; ((\$ heap_{funcstart\_1032,1}.r1 * \textbf{static\_cast} < \textbf{signed int} > (div1.rem)) \; - \;
(\text{\$heap}_{funcstart\_1032,1}.\text{b1 * static\_cast} < \text{signed int} > (\text{div1.quot}))) = \text{temp1}
\rightarrow [const static or extern object]
[50.1] (($heap<sub>init</sub>.r1 * static_cast<signed int>(div1.rem)) -
(\text{sheap}_{funcstart\_1032,1}.\text{b1 * static\_cast} < \text{signed int} > (\text{div1.quot}))) == \text{temp1}
\rightarrow [expand definition of constant 'r1' at prang.cpp (29,26)]
[50.2] (((int)171 * static_cast<signed int>(div1.rem)) -
(\$heap_{funcstart\_1032,1}.b1 * \textbf{static\_cast} < \textbf{signed int} > (div1.quot))) == temp1
\rightarrow [simplify]
[50.3] ((171 * static_cast<signed int>(div1.rem)) - ($heap_{tuncstart_1032.1}.b1
* static_cast<signed int>(div1.quot))) == temp1
\rightarrow [from term 2.6, div1 is equal to div(heapIs $heap_{funcstart\_1032,1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177)]
[50.4] ((171 * static_cast < signed int > (div(heapIs heapIs funcstart_{1032,1}),
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177).rem)) -
($heap_tuncstart_1032.1.b1 * static_cast<signed int>(div1.quot))) == temp1
\rightarrow [simplify]
[50.5] ((171 * \operatorname{div}(\mathbf{heapIs} \ \mathbf{sheap}_{funcstart\_1032,1}, \mathbf{this}.\mathbf{sr.value}(\mathbf{heapIs})
\text{Sheap}_{funcstart\_1032,1}.\text{p1}, 177).\text{rem} - (\text{Sheap}_{funcstart\_1032,1}.\text{b1} *
static_cast<signed int>(div1.quot))) == temp1
\rightarrow [const static or extern object]
[50.6] ((171 * div(heapIs \rho_{funcstart\_1032,1}, this.r.value(heapIs)
\theta_{funcstart\_1032,1}.p1, 177).rem) - (\theta_{init}.b1 * static_cast<signed
int>(div1.quot))) == temp1
\rightarrow [expand definition of constant 'b1' at prang.cpp (31,26)]
[50.7] ((171 * div(heapIs \$heap_{funcstart\_1032,1}, this.\$r.value(heapIs)
int>(div1.quot)) == temp1
\rightarrow [simplify]
[50.8] ((171 * div(heapIs \$heap_{funcstart\_1032,1}, this.\$r.value(heapIs
\theta_{funcstart\_1032,1}.p1, 177).rem – (2 * static_cast<signed)
int>(div1.quot))) == temp1
\rightarrow [from term 2.6, div1 is equal to div(heapIs $heap_{funcstart\_1032,1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177)]
```

```
[50.9] ((171 * \operatorname{div}(\mathbf{heapIs} \ \mathbf{sheap}_{funcstart\_1032,1}, \ \mathbf{this}.\mathbf{sr.value}(\mathbf{heapIs})
\theta_{funcstart\_1032,1}.p1, 177).rem - (2 * static\_cast < signed)
int>(div(heapIs \$heap_{funcstart\_1032,1}, this.\$r.value(heapIs
\text{Sheap}_{funcstart\_1032,1}.\text{p1}, 177).\text{quot}))) == \text{temp1}
\rightarrow [simplify]
[50.14] 0 == (-\text{temp1} + (-2 * \text{div}(\text{heapIs} \$\text{heap}_{funcstart\_1032,1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177).quot) + (171 *
div(\mathbf{heapIs} \$ heap_{funcstart\_1032.1}, \mathbf{this.}\$r.\mathbf{value}(\mathbf{heapIs})
heap_{funcstart_1032,1}.p1, 177.rem)
[Take given term]
[53.0] $\text{heap}_{1032,1:1051.8} == \text{$heap}_{funcstart\_1032,1}._\text{replace}(\text{this}.\text{$r} \to \text{$}
operator*(heapIs heap_{funcstart\_1032,1}, this)._replace(p1 \rightarrow
asType<P1Type>(($heap<sub>funcstart_1032,1</sub>.M1 *
as Type < int > (static\_cast < integer > (static\_cast < signed))
int>(operator^*(heapIs $heap_{funcstart\_1032,1}, this).p1) < (int)0))) +
temp1)))
→ [expand definition of operator '*' in class 'pointer' at built in declaration]
[53.1] heap_{1032,1;1051,8} == heap_{funcstart\_1032,1}._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow
asType<P1Type>(($heap<sub>funcstart_1032,1</sub>.M1 *
asType<int>(static_cast<integer>(static_cast<signed
int>(operator^*(heapIs \$heap_{funcstart\_1032,1}, this).p1) < (int)0))) +
temp1)))
\rightarrow [const static or extern object]
[53.2] \rho_{1032,1;1051,8} == \rho_{1032,1;1051,8} = \rho_{1032,1;1051,8} == \rho
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow
asType<P1Type>(($heap<sub>init</sub>.M1*
asType<int>(static_cast<integer>(static_cast<signed
int>(operator*(heapIs $heap_{funcstart\_1032,1}, this).p1) < (int)0))) +
temp1)))
\rightarrow [expand definition of constant 'M1' at prang.cpp (28,26)]
[53.3] heap_{1032,1;1051,8} == heap_{funcstart\_1032,1}._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow
asType<P1Type>(((int)30269 *
asType<int>(static_cast<integer>(static_cast<signed
int>(operator^*(heapIs $heap_{funcstart\_1032,1}, this).p1) < (int)0))) +
temp1)))
\rightarrow [simplify]
[53.4] heap_{1032,1;1051,8} == heap_{funcstart\_1032,1}._replace(this.r \rightarrow
\textbf{this.}\$r.\textbf{value}(\textbf{heapIs}~\$heap_{funcstart\_1032,1}).\_\textbf{replace}(p1 \rightarrow
asType<P1Type>((30269 *
```

```
asType<int>(static_cast<integer>(static_cast<signed
int>(operator*(heapIs $heap_{funcstart\_1032,1}, this).p1) < (int)0))) +
temp1)))
→ [expand definition of operator '*' in class 'pointer' at built in declaration]
[53.5] heap_{1032,1;1051,8} == heap_{funcstart\_1032,1}._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow
asType<P1Type>((30269 *
as Type < int > (static\_cast < integer > (static\_cast < signed))
int>(this.\$r.value(heapIs \$heap_{funcstart\_1032,1}).p1) < (int)0))) + temp1)))
\rightarrow [simplify]
[53.9] $\text{heap}_{1032,1:1051.8} == \text{$heap}_{funcstart\_1032,1}._\text{replace}(\text{this}.\text{$r} \to \text{$}
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow
asType<P1Type>((30269 * asType<int>(static_cast<integer>(0 <
-this.r.value(heapIs heap_{funcstart\_1032,1}.p1))) + temp1)))
\rightarrow [from term 8.0, literala < -this.$r.value(heapIs $heap_{funcstart\_1032.1}).p1
is false whenever -2 < (0 + literala)
   Proof of rule precondition:
   [53.9.0] - 2 < (0 + 0)
   \rightarrow [simplify]
   [53.9.2] true
[53.10] $\text{heap}_{1032,1;1051,8} == $\text{heap}_{funcstart\_1032,1}._\text{replace}(\text{this}.\text{$\frac{1}{2}r$})
\mathbf{this.\$r.value}(\mathbf{heapIs}~\$ \mathrm{heap}_{funcstart\_1032,1}).\_\mathbf{replace}(\mathrm{p1} \rightarrow
asType<P1Type>((30269 * asType<int>(static_cast<integer>(false)))
+ temp1)))
\rightarrow [simplify]
[53.11] heap_{1032,1:1051,8} == heap_{funcstart\_1032,1}._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow
asType < P1Type > ((30269 * asType < int > (([false]: 1, []: 0))) + temp1)))
→ [explicitly assert falsehood of skipped guards in subsequent guards]
[53.12] $heap<sub>1032,1;1051,8</sub> == $heap<sub>funcstart_1032,1</sub>._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow
asType<P1Type>((30269 * asType<int>(([false]: 1, [true]: 0))) +
temp1)))
\rightarrow [simplify]
[53.15] $heap<sub>1032,1;1051,8</sub> == $heap<sub>funcstart_1032,1</sub>._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow
asType < P1Type > (0 + temp1))
\rightarrow [from term 50.14, temp1 is equal to (-2 * div(heapIs $heap_{funcstart\_1032,1},
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this.r.value(heapIs \ \ heap_{funcstart\_1032,1}).p1, \ 177).quot) + (171 *
div(\mathbf{heapIs} \ \$heap_{funcstart\_1032,1}, \ \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
heap_{funcstart\_1032,1}.p1, 177).rem
[53.16] $heap<sub>1032,1;1051,8</sub> == $heap<sub>funcstart_1032,1</sub>._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow
asType < P1Type > (0 + ((-2 * div(heapIs $heap_{funcstart\_1032,1},
this.$r.value(heapIs \rho_{tuncstart\_1032,1}).p1, 177).quot) + (171 *
div(\mathbf{heapIs} \$ heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
heap_{funcstart_{1032,1}}.p1, 177).rem))))
\rightarrow [simplify]
[53.19] \rho_{1032,1;1051,8} == \rho_{funcstart\_1032,1}.
this.$r.value(heapIs \theta_{funcstart\_1032,1})._replace(p1 \theta ((-2 * div(heapIs
\$heap_{funcstart\_1032,1},\, \textbf{this.}\$r.\textbf{value}(\textbf{heapIs}\,\,\$heap_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs $heap_{tuncstart\_1032.1}, this.$r.value(heapIs
heap_{funcstart_{1032,1}}.p1, 177).rem)))
[Take given term]
[54.0] \; ((\$ heap_{1032,1;1051,8}.r2 \; * \; \textbf{static\_cast} < \textbf{signed int} > (\text{div}2.rem)) \; - \;
(\text{sheap}_{1032,1;1051,8}.\text{b2} * \text{static\_cast} < \text{signed int} > (\text{div2.quot}))) == \text{temp2}
\rightarrow [from term 53.19, $heap<sub>1032,1;1051,8</sub> is equal to
\$heap_{funcstart\_1032,1}.\_\textbf{replace}(\textbf{this}.\$r \rightarrow \textbf{this}.\$r.\textbf{value}(\textbf{heapIs}
heap_{funcstart\_1032,1}._replace(p1 \rightarrow (-2 * div(heapIs p_{funcstart\_1032,1}).
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177).quot) + (171 * leapIs \ heap_{funcstart\_1032,1}).p1, 177).quot)
div(\mathbf{heapIs} \ \$heap_{funcstart\_1032,1}, \ \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
heap_{funcstart\_1032,1}.p1, 177).rem)))
[54.1] \; ((\$ heap_{funcstart\_1032,1}. \verb"replace" (this.\$r) \to this.\$r. \verb"value" (heapIs")) \\
\text{Sheap}_{funcstart\_1032.1})._replace(p1 \rightarrow ((-2 * div(heapIs \text{Sheap}_{funcstart\_1032.1}),
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177).quot) + (171 *
{\rm div}(\mathbf{heapIs}~\$\mathrm{heap}_{funcstart\_1032,1},~\mathbf{this}.\$\mathrm{r.value}(\mathbf{heapIs}
\rho_{tuncstart_1032,1}.p1, 177).rem))).r2 * static_cast < signed
\mathbf{int}{>}(\mathrm{div2.rem})) - (\$\mathrm{heap}_{1032,1;1051,8}.\mathrm{b2} * \mathbf{static\_cast}{<} \mathbf{signed}
int>(div2.quot)) == temp2
→ [const member of object with modified fields]
[54.2] (($heap_funcstart_1032,1.r2 * static_cast<signed int>(div2.rem)) -
(\text{sheap}_{1032,1;1051,8}.\text{b2} * \text{static\_cast} < \text{signed int} > (\text{div2.quot}))) == \text{temp2}
\rightarrow [const static or extern object]
[54.3] (($heap<sub>init</sub>.r2 * static_cast<signed int>(div2.rem)) -
(\text{sheap}_{1032,1;1051,8}.\text{b2} * \text{static\_cast} < \text{signed int} > (\text{div2.quot}))) == \text{temp2}
\rightarrow [expand definition of constant 'r2' at prang.cpp (34,26)]
[54.4] (((int)172 * static_cast<signed int>(div2.rem)) -
(\text{sheap}_{1032,1:1051.8}.\text{b2} * \text{static\_cast} < \text{signed int} > (\text{div2.quot}))) == \text{temp2}
```

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\rightarrow [simplify]
[54.5] ((172 * static_cast<signed int>(div2.rem)) - ($heap_{1032,1:1051,8}.b2 *
static_cast<signed int>(div2.quot))) == temp2
\rightarrow [from term 18.6, div2 is equal to div(heapIs $heap_{funcstart\_1032,1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p2, 176)]
[54.6] ((172 * static_cast<signed int>(div(heapIs $heap_{funcstart\_1032.1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p2, 176).rem)) -
(\text{sheap}_{1032,1:1051,8}.\text{b2} * \text{static\_cast} < \text{signed int} > (\text{div2.quot}))) == \text{temp2}
\rightarrow [simplify]
[54.7] ((172 * div(heapIs \rho_{funcstart\_1032,1}, this.\r.value(heapIs
heap_{funcstart\_1032,1}.p2, 176).rem - (heap_{1032,1;1051,8}.b2 *
static_cast<signed int>(div2.quot))) == temp2
\rightarrow [from term 53.19, $heap<sub>1032.1:1051.8</sub> is equal to
$heap_{funcstart\_1032,1}.$_replace(this.$r \rightarrow this.$r.value(heapIs)
heap_{funcstart\_1032,1}._replace(p1 \rightarrow (-2 * div(heapIs \$heap_{funcstart\_1032,1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, \ 177).quot) + (171 * 
div(\mathbf{heapIs} \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
heap_{funcstart\_1032,1}.p1, 177).rem)))]
[54.8] ((172 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs = f_{uncstart\_1032,1})
\rho_{uncstart_{-1032,1},2} $\text{176}.rem \) - (\paralle{e}\text{heap}_{funcstart_{-1032,1}}.\text{-replace}(\text{this}.\text{$\frac{1}{3}}\text{replace})
\rightarrow this.$r.value(heapIs $heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{$heap}_{funcstart\_1032.1}, \ \mathbf{this}. \ \text{$r.value}(\mathbf{heapIs})
\text{Sheap}_{funcstart\_1032,1}.p1, 177).quot) + (171 * div(heapIs \text{Sheap}_{funcstart\_1032,1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177).rem)))).b2 *
static_cast<signed int>(div2.quot))) == temp2
\rightarrow [const member of object with modified fields]
[54.9] ((172 * div(heapIs $heap_{tuncstart\_1032.1}, this.$r.value(heapIs
\text{Sheap}_{funcstart\_1032.1}.p2, 176).rem) - (\text{Sheap}_{funcstart\_1032.1}.b2 *
static_cast<signed int>(div2.quot))) == temp2
\rightarrow [const static or extern object]
[54.10]~((172~^*~{\rm div}({\bf heap Is}~\${\rm heap}_{funcstart\_1032,1},~{\bf this.}\${\rm r.value}({\bf heap Is}
int>(div2.quot)) = temp2
\rightarrow [expand definition of constant 'b2' at prang.cpp (36,26)]
[54.11] ((172 * div(heapIs $heap<sub>funcstart_1032,1</sub>, this.$r.value(heapIs)
\theta_{nucstart_{1032,1}}.p2, 176).rem - ((int)35 * static_cast < signed)
int>(div2.quot)) == temp2
\rightarrow [simplify]
[54.12] ((172 * div(heapIs heap_{funcstart\_1032,1}, this.r.value(heapIs)
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\theta_{funcstart\_1032,1}.p2, 176).rem - (35 * static\_cast < signed)
int>(div2.quot)) == temp2
\rightarrow [from term 18.6, div2 is equal to div(heapIs $heap_{funcstart\_1032,1},
this.r.value(heapIs \ \ heap_{funcstart\_1032,1}).p2, \ 176)]
[54.13] ((172 * div(heapIs heap_{funcstart\_1032,1}, this.r.value(heapIs)
\theta_{funcstart\_1032,1}.p2, 176).rem - (35 * static\_cast < signed)
int>(div(heapIs \$heap_{tuncstart\_1032.1}, this.\$r.value(heapIs
\text{Sheap}_{funcstart\_1032,1}.p2, 176).quot))) == temp2
\rightarrow [simplify]
[54.18] 0 == (-\text{temp2} + (-35 * \text{div}(\text{heapIs } \text{$heap}_{funcstart\_1032.1})]
this.r.value(heapIs \ensuremath{\$}heap_{funcstart\_1032,1}).p2, 176).quot) + (172 *
div(\mathbf{heapIs} \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
heap_{funcstart\_1032,1}.p2, 176).rem
[Take given term]
[55.0] minof(signed int) \leq temp2
\rightarrow [simplify]
[55.3] - 32769 < \text{temp2}
\rightarrow [from term 54.18, temp2 is equal to (-35 * div(heapIs $heap_{funcstart\_1032,1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p2, 176).quot) + (172 \ heap_{funcstart\_1032,1}).p2
div(heapIs $heap_{tuncstart 1032.1}, this.$r.value(heapIs
heap_{funcstart\_1032,1}.p2, 176).rem
[55.4] \ -32769 < ((-35 \ * \ \mathrm{div}(\mathbf{heapIs} \ \$ \mathrm{heap}_{funcstart\_1032,1}, \ \mathbf{this}.\$ r. \mathbf{value}(\mathbf{heapIs} \ \$))
\rho_{tuncstart_1032.1}, p2, 176).quot) + (172 * div(heapIs \rho_{tuncstart_1032.1},
this.r.value(heapIs \ heap_{funcstart\_1032.1}).p2, 176).rem))
[Take goal term]
[1.0] minof(signed int) \leq (($heap_{1032.1:1051.8}.M2 *
asType<int>(static_cast<integer>(static_cast<signed
int>(operator^*(heapIs \$heap_{1032,1;1051,8}, this).p2) < (int)0))) + temp2)
\rightarrow [simplify]
[1.1] -32768 \leq (($heap<sub>1032,1;1051,8</sub>.M2 *
asType<int>(static_cast<integer>(static_cast<signed
int>(operator^*(heapIs \$heap_{1032,1:1051.8}, this).p2) < (int)(0))) + temp2)
\rightarrow [from term 53.19, $heap<sub>1032,1;1051,8</sub> is equal to
$heap_{funcstart\_1032,1}.$_replace(this.$r \rightarrow this.$r.value(heapIs)
heap_{funcstart\_1032,1}._replace(p1 \rightarrow (-2 * div(heapIs heap_{funcstart\_1032,1}),
this.r.value(heapIs $heap_{funcstart\_1032,1}).p1, 177).quot) + (171 *
div(\mathbf{heapIs} \ \$heap_{funcstart\_1032,1}, \ \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
heap_{funcstart\_1032,1}.p1, 177).rem)))]
[1.2] -32768 \le ((\$heap_{funcstart\_1032,1}.\_replace(this.\$r \rightarrow
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this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
heap_{funcstart_{1032,1}}.p1, 177).rem))).M2 *
asType<int>(static_cast<integer>(static_cast<signed
int>(operator*(heapIs $heap_{1032,1:1051.8}, this).p2) < (int)0))) + temp2)
→ [const member of object with modified fields]
[1.3] -32768 \le ((\$heap_{funcstart\_1032,1}.M2 *
asType<int>(static_cast<integer>(static_cast<signed
int>(operator^*(heapIs \$heap_{1032.1:1051.8}, this).p2) < (int)(0))) + temp2)
\rightarrow [const static or extern object]
[1.4] -32768 < ((\$heap_{init}.M2 *
asType<int>(static_cast<integer>(static_cast<signed
int > (operator^*(heapIs \$heap_{1032,1;1051,8}, this).p2) < (int)0))) + temp2)
\rightarrow [expand definition of constant 'M2' at prang.cpp (33,26)]
[1.5] -32768 \le (((int)30307 *
asType<int>(static_cast<integer>(static_cast<signed
int>(operator^*(heapIs \$heap_{1032,1;1051,8}, this).p2) < (int)(0))) + temp2)
\rightarrow [simplify]
[1.6] -32768 \le ((30307 *
asType < int > (static\_cast < integer > (static\_cast < signed
int>(operator^*(heapIs $heap_{1032.1:1051.8}, this).p2) < (int)0))) + temp2)
\rightarrow [from term 53.19, $heap<sub>1032,1:1051,8</sub> is equal to
$heap_{funcstart\_1032,1}.$_replace(this.$r \rightarrow this.$r.value(heapIs)
heap_{funcstart\_1032,1}._replace(p1 \rightarrow (-2 * div(heapIs p_{funcstart\_1032,1}).
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177).quot) + (171 *
div(\mathbf{heapIs} \ \$heap_{funcstart\_1032,1}, \ \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
heap_{funcstart_{1032,1}}.p1, 177).rem)))
[1.7] - 32768 \le ((30307)^*)
asType<int>(static_cast<integer>(static_cast<signed
\mathbf{int}{>}(\mathbf{operator}^*(\mathbf{heapIs}\ \$\mathbf{heap}_{funcstart\_1032,1}.\_\mathbf{replace}(\mathbf{this}.\$\mathbf{r}\rightarrow
this.$r.value(heapIs heapIs $heapfuncstart_1032,1)._replace(p1 \rightarrow (-2 * div(heapIs
$\text{heap}_{funcstart=1032,1}$, this.$\text{r.value}(\text{heapIs} \text{$heap}_{funcstart=1032,1}).p1,
177).quot) + (171 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
\frac{\text{heap}_{funcstart\_1032,1}.p1, 177).rem}{\text{his}.p2} < (int)0)) + temp2}
→ [expand definition of operator '*' in class 'pointer' at built in declaration]
[1.8] -32768 \le ((30307 *
asType<int>(static_cast<integer>(static_cast<signed
\mathbf{int}{>}(\mathbf{this.\$r.value}(\mathbf{heapIs}\ \$\mathbf{heap}_{funcstart\_1032,1}.\mathbf{\_replace}(\mathbf{this.\$r} \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
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177).quot) + (171 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.} \text{\$r.value}(\text{heapIs}))
\text{Sheap}_{funcstart\_1032,1}.\text{p1}, 177).\text{rem})))).\text{p2}) < (int)0))) + \text{temp2})
→ [evaluate dereferenced pointer into modified heap]
[1.9] -32768 < ((30307 *
asType < int > (static\_cast < integer > (static\_cast < signed\ int > (([this.\$r
== this.$r]: this.$r.value(heapIs \rho_{tuncstart\_1032.1})._replace(p1 \rightarrow (-2 *
div(\mathbf{heapIs} \$ heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
\text{Sheap}_{funcstart\_1032.1}.p1, 177).quot) + (171 * div(heapIs \text{Sheap}_{funcstart\_1032.1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177).rem)), []:
this.$r.value(heapIs heap_{funcstart 1032,1}).p2) < (int)0)) + temp2)
→ [explicitly assert falsehood of skipped guards in subsequent guards]
[1.10] -32768 < ((30307 *
asType<int>(static_cast<integer>(static_cast<signed int>(([this.$r
== this.$r]: this.$r.value(heapIs \rho_{tuncstart\_1032,1})._replace(p1 \rightarrow (-2 *
{\rm div}(\mathbf{heapIs}\ \$ \mathrm{heap}_{funcstart\_1032,1},\ \mathbf{this}.\$ \mathrm{r.value}(\mathbf{heapIs}
\text{Sheap}_{funcstart\_1032,1}.p1, 177).quot) + (171 * div(heapIs \text{Sheap}_{funcstart\_1032,1},
\mathbf{this.\$r.value(heapIs}~\$ \mathrm{heap}_{funcstart\_1032,1}).\mathrm{p1},~177).\mathrm{rem})),~[!(\mathbf{this.\$r}==
\mathbf{this.\$r.}\mathbf{value}(\mathbf{heapIs}\ \$\mathbf{heap}_{funcstart\_1032,1})).\mathbf{p2}) < (\mathbf{int})\mathbf{0}))) \ +
temp2)
\rightarrow [simplify]
[1.17] -32768 \leq ((30307 * asType<int>(static_cast<integer>(0 <
-this.$r.value(heapIs heap_{funcstart\_1032,1}).p2))) + temp2)
\rightarrow [from term 24.0, literala < -this.$r.value(heapIs $heap_{funcstart\_1032.1}).p2
is false whenever -2 < (0 + literala)
    Proof of rule precondition:
    [1.17.0] - 2 < (0 + 0)
    \rightarrow [simplify]
    [1.17.2] true
[1.18] -32768 \leq ((30307 * asType<int>(static_cast<integer>(false))) +
temp2)
\rightarrow [simplify]
[1.19] -32768 \le ((30307 * asType < int > (([false]: 1, []: 0))) + temp2)
→ [explicitly assert falsehood of skipped guards in subsequent guards]
[1.20] -32768 \leq ((30307 * asType < int > (([false]: 1, [true]: 0))) + temp2)
\rightarrow [simplify]
[1.23] - 32768 \le (0 + \text{temp2})
\rightarrow [from term 54.18, temp2 is equal to (-35 * div(heapIs $heap_{funcstart\_1032,1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p2, 176).quot) + (172 *
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div(\mathbf{heapIs} \ \$heap_{funcstart\_1032,1}, \ \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
heap_{funcstart\_1032,1}.p2, 176).rem
[1.24] -32768 \leq (0 + ((-35 * div(heapIs $heap_{tuncstart\_1032,1}, 
this.r.value(heapIs \ensuremath{\$}heap_{funcstart\_1032,1}).p2, 176).quot) + (172 *
div(heapIs $heap<sub>funcstart_1032.1</sub>, this.$r.value(heapIs
heap_{funcstart_{1032,1}}.p2, 176).rem))
\rightarrow [simplify]
[1.28] -32769 < ((-35 * div(heap
Is \rho_{funcstart\_1032,1},\ this.\r.value(heap
Is
\text{Sheap}_{funcstart\_1032,1}.p2, 176).quot) + (172 * div(heapIs \text{Sheap}_{funcstart\_1032,1},
this.$r.value(heapIs heap_{funcstart\_1032,1}).p2, 176).rem))
\rightarrow [from term 55.4, literala < ((-35 * div(heapIs $heap_{funcstart\_1032.1},
this.r.value(heapIs \ \ heap_{funcstart\_1032,1}).p2, \ 176).quot) + (172 \ \ *
div(\mathbf{heapIs} \ \$heap_{funcstart\_1032,1}, \ \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
heap_{funcstart\_1032,1}.p2, 176).rem) is true whenever (-1 + literala) < -32769
   Proof of rule precondition:
   [1.28.0](-32769 + -1) < -32769
   \rightarrow [simplify]
   [1.28.2] true
[1.29] true
Proof of verification condition: Arithmetic result of operator '+' is within
limit of type 'signed int'
In the context of class: WHPrang, declared at:
C:\Escher\Customers\prang-cpp\prang.cpp (18,1)
Condition generated at: C:\Escher\Customers\prang-cpp\prang.cpp
(78,16)
Condition defined at:
To prove: (($heap<sub>1032,1;1051,8</sub>.M2 *
asType<int>(static_cast<integer>(static_cast<signed
int>(operator^*(heapIs $heap_{1032,1;1051,8}, this).p2) < (int)(0))) + temp2) \le
maxof(signed int)
Given:
heap_{init}.LIMIT == (int)80
heap_{init}.class WHPrang \in M1 == (int)30269
heap_{init}.class WHPrang \in r1 == (int)171
heap_{init}.class WHPrang \in a1 == (int)177
heap_{init}.class WHPrang \in b1 == (int)2
```

```
heap_{init}.class WHPrang \in M2 == (int)30307
heap_{init}.class WHPrang \in r2 == (int)172
heap_{init}.class WHPrang \in a2 == (int)176
heap_{init}.class WHPrang \in b2 == (int)35
\text{$heap}_{init}.\mathbf{class} \text{ WHPrang} \in M3 == (\mathbf{int})30323
heap_{init}.class WHPrang \in r3 == (int)170
heap_{init}.class WHPrang \in a3 == (int)178
heap_{init}.class WHPrang \in b3 == (int)63
\operatorname{div1} == \operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_1032,1},
static\_cast < int > (operator*(heapIs $heap_{funcstart\_1032,1}, this).p1),
static\_cast < int > (\$heap_{funcstart\_1032,1}.a1))
(asType < integer > (static\_cast < int > (operator*(heapIs)))
heap_{funcstart\_1032,1}, this).p1) /
\mathbf{asType} < \mathbf{integer} > (\mathbf{static\_cast} < \mathbf{int} > (\$ \mathbf{heap}_{funcstart\_1032,1}.\mathbf{a1}))) = =
asType<integer>(div1.quot)
(asType < integer > (static\_cast < int > (operator*(heapIs)))
heap_{funcstart\_1032,1}, this).p1) %
asType < integer > (static\_cast < int > (\$heap_{funcstart\_1032,1}.a1))) = =
asType<integer>(div1.rem)
(\mathbf{asType}{<}\mathbf{integer}{>}(\mathbf{operator}^*(\mathbf{heapIs}\ \$\mathbf{heap}_{funcstart\_1032,1},\ \mathbf{this}).\mathtt{p1}) <
asType < integer > (\$heap_{funcstart_1032.1}.a1)) = >
(asType<integer>(div1.rem) == asType<integer>(operator*(heapIs
heap_{funcstart\_1032,1}, this).p1)
(\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathsf{heap}_{funcstart\_1032,1}.\mathsf{a1}) \leq
\mathbf{asType} < \mathbf{integer} > (\mathbf{operator}^*(\mathbf{heapIs} \ \$ \mathbf{heap}_{funcstart\_1032,1}, \ \mathbf{this}).\mathtt{p1})) = >
!(0 == asType < integer > (div1.quot))
!(0 == asType < integer > (div1.rem)) || !(0 ==
asType<integer>(div1.quot))
div2 == div(\mathbf{heapIs} \$heap_{funcstart\_1032,1},
\mathbf{static\_cast} < \mathbf{int} > (\mathbf{operator*}(\mathbf{heapIs}\ \$ \mathbf{heap}_{funcstart\_1032,1},\ \mathbf{this}).\mathbf{p2}),
\mathbf{static\_cast}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_1032,1}.\mathrm{a2}))
(\mathbf{asType} {<} \mathbf{integer} {>} (\mathbf{static\_cast} {<} \mathbf{int} {>} (\mathbf{operator}^* (\mathbf{heapIs}
heap_{funcstart\_1032,1}, this).p2) /
\mathbf{asType} < \mathbf{integer} > (\mathbf{static\_cast} < \mathbf{int} > (\$ \mathbf{heap}_{funcstart\_1032,1}.\mathbf{a2}))) = =
asType<integer>(div2.quot)
(asType < integer > (static\_cast < int > (operator*(heapIs)))
heap_{funcstart\_1032.1}, this).p2)
asType < integer > (static\_cast < int > (\$heap_{funcstart\_1032.1}.a2))) = =
asType<integer>(div2.rem)
```

```
(asType<integer>(operator*(heapIs $heap_{tuncstart\_1032.1}, this).p2) <
\mathbf{asType} < \mathbf{integer} > (\$ \mathrm{heap}_{funcstart\_1032,1}.\mathrm{a2})) = >
(asType<integer>(div2.rem) == asType<integer>(operator*(heapIs
heap_{funcstart\_1032,1}, this).p2)
(asType < integer > (\$heap_{funcstart\_1032.1}.a2) \le
asType < integer > (operator*(heapIs $heap_{funcstart\_1032.1}, this).p2)) =>
!(0 == asType < integer > (div2.quot))
!(0 == asType < integer > (div2.rem)) || !(0 ==
asType<integer>(div2.quot))
div3 == div(\mathbf{heapIs} \$ heap_{funcstart\_1032,1},
static\_cast < int > (operator^*(heapIs \$heap_{funcstart\_1032,1}, this).p3),
\mathbf{static\_cast}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_1032,1}.\mathrm{a3}))
(asType<integer>(static_cast<int>(operator*(heapIs
heap_{funcstart\_1032,1}, this).p3)) /
asType < integer > (static\_cast < int > (\$heap_{funcstart\_1032,1}.a3))) = =
asType<integer>(div3.quot)
(asType<integer>(static_cast<int>(operator*(heapIs
heap_{funcstart\_1032.1}, this).p3)
asType < integer > (static\_cast < int > (\$heap_{funcstart\_1032.1}.a3))) = =
asType<integer>(div3.rem)
(asType<integer>(operator*(heapIs $heap_{tuncstart=1032.1}, this).p3) <
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathrm{heap}_{funcstart\_1032,1}.\mathrm{a3})) =>
(asType<integer>(div3.rem) == asType<integer>(operator*(heapIs
heap_{funcstart\_1032,1}, this).p3)
(asType < integer > (\$heap_{funcstart\_1032,1}.a3) \le
asType < integer > (operator*(heapIs $heap_{funcstart\_1032,1}, this).p3)) =>
!(0 == asType < integer > (div3.quot))
!(0 == asType < integer > (div3.rem)) || !(0 ==
asType<integer>(div3.quot))
temp1 == (\$heap_{funcstart\_1032,1}.r1 * \textbf{static\_cast} < \textbf{signed int} > (div1.rem)) - (div1.rem) + (div1.r
($heap_funcstart_1032.1.b1 * static_cast<signed int>(div1.quot))
minof(signed\ int) \le temp1
temp1 \le maxof(signed int)
heap_{1032,1;1051,8} == heap_{funcstart\_1032,1}._replace(this.$r \rightarrow
operator*(heapIs heap_{funcstart\_1032,1}, this)._replace(p1 \rightarrow
asType < P1Type > ((\$heap_{funcstart\_1032,1}.M1 *
asType < int > (static\_cast < integer > (static\_cast < signed
int>(operator^*(heapIs $heap_{funcstart\_1032,1}, this).p1) < (int)0))) +
temp1)))
temp2 == (\$heap_{1032.1:1051.8}.r2 * static\_cast < signed int > (div2.rem)) -
```

```
(\text{$heap}_{1032,1;1051,8}.b2 * \textbf{static\_cast} < \textbf{signed int} > (\text{div}2.\text{quot}))
minof(signed int) \le temp2
temp2 \le maxof(signed int)
Proof:
[Take given term]
[2.0] div1 == div(heapIs heap_{funcstart\_1032,1},
\mathbf{static\_cast} < \mathbf{int} > (\mathbf{operator}^*(\mathbf{heapIs} \ \$ \mathbf{heap}_{funcstart\_1032,1}, \ \mathbf{this}).\mathtt{p1}),
\mathbf{static\_cast}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_1032,1}.\mathrm{a1}))
→ [expand definition of operator '*' in class 'pointer' at built in declaration]
[2.1] \operatorname{div1} == \operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_1032,1},
static_cast<int>(this.$r.value(heapIs $heap_{funcstart\_1032,1}).p1),
static\_cast < int > (\$heap_{funcstart\_1032,1}.a1))
\rightarrow [simplify]
[2.2] \text{ div1} == \text{div}(\mathbf{heapIs} \text{ \$heap}_{funcstart\_1032,1}, \mathbf{this.\$r.value}(\mathbf{heapIs}))
\theta_{funcstart\_1032,1}.p1, \theta_{funcstart\_1032,1}.a1)
\rightarrow [const static or extern object]
[2.3] \operatorname{div1} == \operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_1032,1}, \mathbf{this}.\$ r. \mathbf{value}(\mathbf{heapIs})
\theta_{funcstart\_1032.1}.p1, \theta_{funcstart\_1032.1}.p1, \theta_{funcstart\_1032.1}.p1, \theta_{funcstart\_1032.1}.p1, \theta_{funcstart\_1032.1}.p1, \theta_{funcstart\_1032.1}.p1, \theta_{funcstart\_1032.1}.p2, \theta_{funcstart\_1032.1}.p2, \theta_{funcstart\_1032.1}.p2, \theta_{funcstart\_1032.1}.p2, \theta_{funcstart\_1032.1}.p2, \theta_{funcstart\_1032.1}.p3, \theta_{funcstart\_1032.1}.p2, \theta_{funcstart\_1032.1}.p3, \theta_{funcstart\_1032.1}.p4, \theta_{funcstart\_1032.1}.p4, \theta_{funcstart\_1032.1}.p4, \theta_{funcstart\_1032.1}.p4, \theta_{funcstart\_1032.1}.p4, \theta_{funcstart\_1032.1}.p5, \theta_{funcstart\_1032.1
\rightarrow [expand definition of constant 'a1' at prang.cpp (30,26)]
[2.4] div1 == div(heapIs heap_{funcstart\_1032,1}, this.r.value(heapIs)
\theta_{funcstart\_1032,1}.p1, \theta_{funcstart\_1032,1}.p1, \theta_{funcstart\_1032,1}.p1, \theta_{funcstart\_1032,1}.p1, \theta_{funcstart\_1032,1}.p1, \theta_{funcstart\_1032,1}.p1, \theta_{funcstart\_1032,1}.p2, \theta_{funcstart\_1032,1}.p2, \theta_{funcstart\_1032,1}.p2, \theta_{funcstart\_1032,1}.p2, \theta_{funcstart\_1032,1}.p2, \theta_{funcstart\_1032,1}.p3, \theta_{funcstart\_1032,1}.p4, \theta_{funcstart\_1032,1}.p4, \theta_{funcstart\_1032,1}.p4, \theta_{funcstart\_1032,1}.p5, \theta_{funcstart\_1032,1
\rightarrow [simplify]
[2.6] \operatorname{div1} == \operatorname{div}(\mathbf{heapIs} \ \hat{\mathbf{s}}_{heap}_{funcstart\_1032,1}, \ \mathbf{this.\$r.value}(\mathbf{heapIs})
heap_{funcstart\_1032,1}.p1, 177)
[Assume known post-assertion, class invariant or type constraint for term 2.6]
[7.0] (0 < asType<integer>(this.$r.value(heapIs)
\theta_{funcstart_{1032,1}}.p1) && (asType<integer>(this.$r.value(heapIs)
\theta_{funcstart\_1032,1}.p1 < asType<integer>(\theta_{funcstart\_1032,1}).p1) < asType<integer>(\theta_{funcstart\_1032,1}).p1)
M1))
\rightarrow [simplify]
[7.2] (0 < this.$r.value(heapIs $heap_{funcstart\_1032,1}).p1) &&
(this.r.value(heapIs \ heap_{funcstart\_1032.1}).p1 <
asType < integer > (\text{$heap.class WHPrang} \in M1))
\rightarrow [const static or extern object]
[7.3] (0 < this.$r.value(heap
Is $heap_{funcstart\_1032,1}).p1) &&
(this.$r.value(heapIs \theta_{funcstart\_1032,1}).p1 <
asType < integer > (\$heap_{init}.class WHPrang \in M1))
```

```
\rightarrow [expand definition of constant 'M1' at prang.cpp (28,26)]
[7.4] (0 < this.$r.value(heapIs \rho_{funcstart\_1032,1}).p1) &&
(this.$r.value(heapIs \theta_{funcstart\_1032,1}).p1 <
asType < integer > ((int)30269))
\rightarrow [simplify]
[7.10] (-30269 < -this.$r.value(heapIs $heap_{tuncstart\_1032.1}).p1) \land (0 <
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1)
[Work on sub-term 2 of conjunction in term 7.10]
[8.0] 0 < this.$r.value(heapIs \theta_{funcstart\_1032,1}).p1
[Take given term]
[18.0] \operatorname{div2} == \operatorname{div}(\mathbf{heapIs} \ \operatorname{heap}_{funcstart\_1032,1},
\mathbf{static\_cast} < \mathbf{int} > (\mathbf{operator}^*(\mathbf{heapIs} \ \$ \mathbf{heap}_{funcstart\_1032,1}, \ \mathbf{this}).\mathtt{p2}),
\mathbf{static\_cast}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_1032,1}.\mathrm{a2}))
→ [expand definition of operator '*' in class 'pointer' at built in declaration]
[18.1] \operatorname{div2} == \operatorname{div}(\mathbf{heapIs} \ \text{$heap}_{funcstart\_1032,1},
static\_cast < int > (this. r.value(heapIs  heap_{funcstart\_1032,1}).p2),
\mathbf{static\_cast} < \mathbf{int} > (\$ \mathbf{heap}_{funcstart\_1032,1}.\mathbf{a2}))
\rightarrow [simplify]
[18.2] div2 == div(\mathbf{heapIs} \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
\theta_{funcstart\_1032,1}.p2, \theta_{funcstart\_1032,1}.p2, \theta_{funcstart\_1032,1}.a2))
\rightarrow [const static or extern object]
[18.3] div2 == div(heapIs heapIs = funcstart_{1032,1}, this.r.value(heapIs)
\theta_{funcstart\_1032,1}.p2, \theta_{funcstart\_1032,1}.p3, \theta_{funcstart\_1032,1}.p2, \theta_{funcstart\_1032,1}.p3, \theta_{funcstart\_1032,1
\rightarrow [expand definition of constant 'a2' at prang.cpp (35,26)]
[18.4] div2 == div(\mathbf{heapIs} \ \hat{\mathbf{s}}_{heap}), this. r.value(\mathbf{heapIs})
\theta_{funcstart\_1032,1}.p2, \theta_{funcstart}
\rightarrow [simplify]
[18.6] \text{ div2} == \text{div}(\mathbf{heapIs} \$ \mathbf{heap}_{funcstart\_1032,1}, \mathbf{this.\$r.value}(\mathbf{heapIs}))
heap_{funcstart_{1032,1}}.p2, 176
[Assume known post-assertion, class invariant or type constraint for term 18.6]
[23.0] (0 < asType<integer>(this.$r.value(heapIs
$\text{heap}_{tuncstart_1032.1}\text{).p2})) && (asType<integer>(this.$r.value(heapIs)
\$ heap_{funcstart\_1032,1}).p2) < \mathbf{asType} < \mathbf{integer} > (\$ heap.\mathbf{class} \ WHPrang \in \texttt{Constart} = \texttt{Constart}
M2))
\rightarrow [simplify]
[23.2] (0 < this.$r.value(heapIs heap_{funcstart\_1032,1}).p2) &&
(this.r.value(heapIs \ heap_{funcstart\_1032,1}).p2 <
```

```
asType < integer > (\text{$heap.class WHPrang} \in M2))
\rightarrow [const static or extern object]
[23.3] (0 < this.$r.value(heap
Is \rho_{uncstart\_1032,1}).p2) &&
(this.r.value(heapIs $heap_{funcstart\_1032,1}).p2 <
asType < integer > (\$heap_{init}.class WHPrang \in M2))
\rightarrow [expand definition of constant 'M2' at prang.cpp (33,26)]
[23.4] (0 < this.r.value(heapIs \ heap_{funcstart\_1032,1}).p2) \&\&
(this.r.value(heapIs $heap_{funcstart\_1032.1}).p2 <
asType < integer > ((int)30307))
\rightarrow [simplify]
[23.10] (-30307 < -this.$r.value(heapIs $heap_{funcstart\_1032.1}).p2) \land (0 <
this.$r.value(heapIs $heap_{funcstart\_1032.1}).p2)
[Work on sub-term 2 of conjunction in term 23.10]
[24.0] 0 < this.$r.value(heap
Is $heap_{funcstart\_1032,1}).p2
[Take given term]
[50.0] (($heap_tuncstart_1032,1.r1 * static_cast<signed int>(div1.rem)) -
(\text{sheap}_{funcstart\_1032,1}.\text{b1 * static\_cast} < \text{signed int} > (\text{div1.quot}))) == \text{temp1}
\rightarrow [const static or extern object]
[50.1] (($heap<sub>init</sub>.r1 * static_cast<signed int>(div1.rem)) -
(\text{sheap}_{funcstart\_1032,1}.\text{b1 * static\_cast} < \text{signed int} > (\text{div1.quot}))) == \text{temp1}
\rightarrow [expand definition of constant 'r1' at prang.cpp (29,26)]
[50.2] (((int)171 * static_cast<signed int>(div1.rem)) -
(\$heap_{funcstart\_1032,1}.b1 * \mathbf{static\_cast} < \mathbf{signed\ int} > (div1.quot))) == temp1
\rightarrow [simplify]
[50.3] ((171 * static_cast < signed int > (div1.rem)) - ($heap_funcstart_1032.1.b1
* static_cast<signed int>(div1.quot))) == temp1
\rightarrow [from term 2.6, div1 is equal to div(heapIs $heap_{funcstart\_1032,1},
this.r.value(heapIs $heap_{funcstart\_1032,1}).p1, 177)
[50.4] ((171 * static_cast < signed int > (div(heapIs heapIs funcstart_{1032,1}),
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177).rem)) -
(\text{sheap}_{funcstart\_1032,1}.\text{b1 * static\_cast} < \text{signed int} > (\text{div1.quot}))) == \text{temp1}
\rightarrow [simplify]
[50.5] ((171 * div(\mathbf{heapIs} \ \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
\text{Sheap}_{funcstart\_1032,1}.p1, 177).rem) - (\text{Sheap}_{funcstart\_1032,1}.b1 *
static_cast<signed int>(div1.quot))) == temp1
\rightarrow [const static or extern object]
```

```
[50.6] ((171 * div(heapIs $heap_{funcstart\_1032,1}, this.$r.value(heapIs)
\rho_{funcstart\_1032,1}.p1, 177).rem – (\rho_{funcstart\_1032,1}.p1, 177).rem) – (\rho_{funcstart\_1032,1}.p1, 177).rem) – (\rho_{funcstart\_1032,1}.p1, 177).rem)
int>(div1.quot))) == temp1
\rightarrow [expand definition of constant 'b1' at prang.cpp (31,26)]
[50.7] ((171 * div(heapIs heap_{funcstart\_1032,1}, this.r.value(heapIs)
\theta_{funcstart\_1032,1}.p1, 177).rem - ((int)2 * static\_cast < signed)
int>(div1.quot))) == temp1
\rightarrow [simplify]
[50.8] ((171 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs = f_{uncstart\_1032,1})
\theta_{funcstart\_1032.1}.p1, 177).rem) - (2 * static_cast<signed)
int>(div1.quot)) == temp1
\rightarrow [from term 2.6, div1 is equal to div(heapIs $heap_{funcstart\_1032,1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177)]
[50.9] ((171 * div(heapIs $heap_{funcstart\_1032,1}, this.$r.value(heapIs)
\theta_{funcstart\_1032,1}.p1, 177).rem - (2 * static\_cast < signed)
int>(div(heapIs \$heap_{funcstart\_1032,1}, this.\$r.value(heapIs
heap_{funcstart_1032,1}.p1, 177.quot)) = temp1
\rightarrow [simplify]
[50.14] 0 == (-\text{temp1} + (-2 * \text{div}(\text{heapIs } \text{$heap}_{funcstart\_1032,1},
this.r.value(heapIs \ensuremath{\$}heap_{funcstart\_1032,1}).p1, 177).quot) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_1032,1}, \ \mathbf{this}.\$ r. \mathbf{value}(\mathbf{heapIs}
heap_{funcstart_{-1032.1}}.p1, 177).rem
[Take given term]
[53.0] heap_{1032,1;1051,8} == heap_{funcstart\_1032,1}._replace(this.$r \rightarrow
operator*(heapIs heap_{funcstart\_1032,1}, this)._replace(p1 \rightarrow
asType < P1Type > ((\$heap_{funcstart\_1032,1}.M1 *
asType<int>(static_cast<integer>(static_cast<signed
int>(operator*(heapIs $heap_{funcstart\_1032,1}, this).p1) < (int)0))) +
temp1)))
→ [expand definition of operator '*' in class 'pointer' at built in declaration]
[53.1] heap_{1032,1;1051,8} == heap_{funcstart\_1032,1}._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow
asType<P1Type>(($heap_funcstart_1032,1.M1 *
asType<int>(static_cast<integer>(static_cast<signed
int>(operator^*(heapIs \$heap_{funcstart\_1032,1}, this).p1) < (int)0))) +
temp1)))
\rightarrow [const static or extern object]
[53.2] heap_{1032,1;1051,8} == heap_{funcstart\_1032,1}._replace(this.r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow
asType<P1Type>(($heap<sub>init</sub>.M1 *
```

```
asType<int>(static_cast<integer>(static_cast<signed
int>(operator*(heapIs $heap_{funcstart\_1032,1}, this).p1) < (int)0))) +
temp1)))
\rightarrow [expand definition of constant 'M1' at prang.cpp (28,26)]
[53.3] heap_{1032,1;1051,8} == heap_{funcstart\_1032,1}._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow
asType<P1Type>(((int)30269 *
asType < int > (static\_cast < integer > (static\_cast < signed)
int>(operator^*(heapIs \$heap_{funcstart\_1032,1}, this).p1) < (int)0))) +
temp1)))
\rightarrow [simplify]
[53.4] heap_{1032,1;1051,8} == heap_{funcstart\_1032,1}._replace(this.r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow
asType<P1Type>((30269 *
as Type < int > (static\_cast < integer > (static\_cast < signed))
int>(operator^*(heapIs $heap_{funcstart\_1032,1}, this).p1) < (int)0))) +
temp1)))
→ [expand definition of operator '*' in class 'pointer' at built in declaration]
[53.5] heap_{1032,1;1051,8} == heap_{funcstart\_1032,1}._replace(this.$r \rightarrow
\mathbf{this.\$r.value}(\mathbf{heapIs}~\$ \mathrm{heap}_{funcstart\_1032,1}).\_\mathbf{replace}(\mathrm{p1} \rightarrow
asType<P1Type>((30269 *
asType<int>(static_cast<integer>(static_cast<signed
int>(this.\$r.value(heapIs \$heap_{funcstart\_1032,1}).p1) < (int)0))) + temp1)))
\rightarrow [simplify]
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow
\mathbf{asType} {<} P1Type {>} ((30269 * \mathbf{asType} {<} \mathbf{int} {>} (\mathbf{static\_cast} {<} \mathbf{integer} {>} (0 <
-this.r.value(heapIs heap_{funcstart\_1032,1}.p1))) + temp1)))
\rightarrow [from term 8.0, literala < -this.$r.value(heapIs $heap_{funcstart\_1032,1}).p1
is false whenever -2 < (0 + literala)
   Proof of rule precondition:
   [53.9.0] - 2 < (0 + 0)
   \rightarrow [simplify]
   [53.9.2] true
[53.10] $\text{heap}_{1032,1:1051.8} == $\text{heap}_{funcstart\_1032,1}.$\text{replace}(\text{this}.$\text{$r} \to \text{$}
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow
asType<P1Type>((30269 * asType<int>(static_cast<integer>(false)))
+ \text{temp1})))
\rightarrow [simplify]
```

```
[53.11] heap_{1032,1:1051,8} == heap_{funcstart\_1032,1}._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow
asType<P1Type>((30269 * asType<int>(([false]: 1, []: 0))) + temp1)))
→ [explicitly assert falsehood of skipped guards in subsequent guards]
[53.12] $\text{heap}_{1032,1;1051,8} == $\text{heap}_{funcstart\_1032,1}._\text{replace}(\text{this}.\text{$\frac{1}{2}r$})
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow
asType<P1Type>((30269 * asType<int>(([false]: 1, [true]: 0))) +
temp1)))
\rightarrow [simplify]
[53.15] $heap<sub>1032,1;1051,8</sub> == $heap<sub>funcstart_1032,1</sub>._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032.1})._replace(p1 \rightarrow
asType < P1Type > (0 + temp1))
\rightarrow [from term 50.14, temp1 is equal to (-2 * div(heapIs $heap_{funcstart\_1032,1},
this.$r.value(heapIs $heap_{funcstart\_1032,1}).p1, 177).quot) + (171 *
div(heapIs $heap_{tuncstart\_1032.1}, this.$r.value(heapIs
heap_{funcstart_{1032.1}}.p1, 177).rem
[53.16] heap_{1032,1;1051,8} == heap_{funcstart\_1032,1}._replace(this.$r \rightarrow
this.r.value(heapIs \ heap_{funcstart\_1032,1}).\_replace(p1 \rightarrow
asType < P1Type > (0 + ((-2 * div(heapIs $heap_{funcstart\_1032,1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177).quot) + (171 *
div(\mathbf{heapIs} \$ heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
heap_{funcstart_{1032,1}}.p1, 177).rem))))
\rightarrow [simplify]
[53.19] $heap<sub>1032,1;1051,8</sub> == $heap<sub>funcstart_1032,1</sub>._replace(this.$r \rightarrow
\textbf{this.\$r.value}(\textbf{heapIs}~\$ heap_{funcstart\_1032,1}).\_\textbf{replace}(p1 \rightarrow ((\text{-}2~*\text{div}(\textbf{heapIs}
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.}\text{\$r.value}(\text{heapIs}))
heap_{funcstart\_1032,1}.p1, 177.rem)))
[Take given term]
[54.0] (($heap_{1032,1;1051,8}.r2 * static_cast < signed int > (div2.rem)) -
(\text{sheap}_{1032,1:1051,8}.\text{b2} * \text{static\_cast} < \text{signed int} > (\text{div2.quot}))) == \text{temp2}
\rightarrow [from term 53.19, $heap_{1032,1;1051,8}$ is equal to
$heap_{funcstart\_1032,1}.$_replace(this.$r \rightarrow this.$r.value(heapIs)
heap_{funcstart\_1032,1}._replace(p1 \rightarrow (-2 * div(heapIs $heap_{funcstart\_1032,1},
this.r.value(heapIs \ \ heap_{funcstart\_1032,1}).p1,\ 177).quot) + (171 * 
div(\mathbf{heapIs} \ \$heap_{funcstart\_1032,1}, \ \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
heap_{funcstart_{1032.1}}.p1, 177).rem)))
[54.1] (({\rm sheap}_{funcstart\_1032,1}._replace(this.{\rm sr} \rightarrow {\rm this.} {\rm sr.value}({\rm heapIs})
\text{Sheap}_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs \text{Sheap}_{funcstart\_1032,1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177).quot) + (171 *
div(\mathbf{heapIs} \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
```

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\rho_{tuncstart=1032.1}.p1, 177.rem))).r2 * static_cast < signed
int>(div2.rem)) - (\$heap_{1032,1:1051,8}.b2 * static\_cast < signed)
int>(div2.quot))) == temp2
→ [const member of object with modified fields]
[54.2] (($heap_funcstart_1032,1.r2 * static_cast<signed int>(div2.rem)) -
(\text{sheap}_{1032,1;1051,8}.\text{b2} * \text{static\_cast} < \text{signed int} > (\text{div2.quot}))) == \text{temp2}
\rightarrow [const static or extern object]
[54.3] (($heap<sub>init</sub>.r2 * static_cast<signed int>(div2.rem)) -
(\text{sheap}_{1032,1;1051,8}.\text{b2} * \text{static\_cast} < \text{signed int} > (\text{div2.quot}))) == \text{temp2}
\rightarrow [expand definition of constant 'r2' at prang.cpp (34,26)]
[54.4] (((int)172 * static_cast<signed int>(div2.rem)) -
(\text{sheap}_{1032,1;1051,8}.\text{b2} * \text{static\_cast} < \text{signed int} > (\text{div2.quot}))) == \text{temp2}
\rightarrow [simplify]
[54.5] ((172 * static_cast<signed int>(div2.rem)) - ($heap_{1032.1:1051.8}.b2 *
static_cast<signed int>(div2.quot))) == temp2
\rightarrow [from term 18.6, div2 is equal to div(heapIs $heap_{funcstart\_1032,1},
this.r.value(heapIs $heap_{funcstart\_1032,1}).p2, 176)
[54.6] ((172 * static_cast<signed int>(div(heapIs $heap_{tuncstart\_1032,1},
this.r.value(heapIs $heap_{funcstart\_1032,1}).p2, 176).rem)) -
(\text{sheap}_{1032,1;1051,8}.\text{b2} * \text{static\_cast} < \text{signed int} > (\text{div2.quot}))) == \text{temp2}
\rightarrow [simplify]
[54.7] ((172 * div(heapIs heapIs_{funcstart\_1032,1}, this.r.value(heapIs_{funcstart\_1032,1})
\text{heap}_{funcstart\_1032,1}.p2, 176).rem) - (\text{heap}_{1032,1;1051,8}.b2 *
static_cast<signed int>(div2.quot))) == temp2
\rightarrow [from term 53.19, $heap<sub>1032,1;1051,8</sub> is equal to
\$heap_{funcstart\_1032,1}.\_\textbf{replace}(\textbf{this}.\$r \rightarrow \textbf{this}.\$r.\textbf{value}(\textbf{heapIs}
heap_{funcstart\_1032,1}._replace(p1 \rightarrow (-2 * div(heapIs $heap_{funcstart\_1032,1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177).quot) + (171 *
div(heapIs $heap_funcstart_1032.1, this.$r.value(heapIs
heap_{funcstart\_1032,1}.p1, 177).rem)))
[54.8] ((172 * div(heapIs $heap_{funcstart\_1032,1}, this.$r.value(heapIs)
\rho_{funcstart\_1032,1}.p2, 176).rem – (\rho_{funcstart\_1032,1}.replace(his.replace)
div(\mathbf{heapIs} \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
\text{Sheap}_{funcstart\_1032.1}.p1, 177).quot) + (171 * div(heapIs \text{Sheap}_{funcstart\_1032.1},
this.r.value(heapIs \ heap_{funcstart\_1032.1}).p1, 177).rem)))).b2 *
static_cast<signed int>(div2.quot))) == temp2
\rightarrow [const member of object with modified fields]
[54.9] ((172 * div(heapIs \rho_{funcstart\_1032,1}, this.r.value(heapIs)
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\text{Sheap}_{funcstart\_1032,1}.p2, 176).rem) - (\text{Sheap}_{funcstart\_1032,1}.b2 *
static_cast<signed int>(div2.quot))) == temp2
\rightarrow [const static or extern object]
[54.10]~((172~^*~{\rm div}({\bf heap Is}~\${\rm heap}_{funcstart\_1032,1},~{\bf this.\$r.value}({\bf heap Is}
\rho_{uncstart\_1032,1}.p2, 176).rem – (\rho_{uncstart\_1032,1}.p2, 176).rem
int>(div2.quot)) == temp2
\rightarrow [expand definition of constant 'b2' at prang.cpp (36,26)]
[54.11] ((172 * div(heapIs $heap<sub>funcstart_1032.1</sub>, this.$r.value(heapIs)
\rho_{tuncstart\_1032.1}.p2, 176).rem - ((int)35 * static\_cast < signed)
int>(div2.quot))) == temp2
\rightarrow [simplify]
[54.12] ((172 * div(heapIs $heap_{funcstart\_1032,1}, this.$r.value(heapIs
\rho_{funcstart\_1032.1}.p2, 176).rem) - (35 * static_cast<signed)
int>(div2.quot)) = temp2
\rightarrow [from term 18.6, div2 is equal to div(heapIs $heap_{funcstart\_1032,1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p2, 176)]
[54.13] ((172 * div(heapIs \$heap_{funcstart\_1032,1}, this.\$r.value(heapIs
\theta_{funcstart\_1032,1}.p2, 176).rem - (35 * static\_cast < signed)
int>(div(heapIs \$heap_{funcstart\_1032,1}, this.\$r.value(heapIs
\text{Sheap}_{funcstart\_1032,1}.p2, 176).quot))) == temp2
\rightarrow [simplify]
[54.18] 0 == (-\text{temp2} + (-35 * \text{div}(\text{heapIs} \$\text{heap}_{funcstart\_1032,1},
this.r.value(heapIs \ensuremath{\$}heap_{funcstart\_1032,1}).p2, 176).quot) + (172 *
div(heapIs $heap<sub>funcstart_1032.1</sub>, this.$r.value(heapIs
heap_{funcstart\_1032,1}.p2, 176).rem
[Take given term]
[56.0] temp2 \leq maxof(signed int)
\rightarrow [simplify]
[56.9] - 32768 < -\text{temp}2
\rightarrow [from term 54.18, temp2 is equal to (-35 * div(heapIs $heap_{funcstart\_1032,1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p2, 176).quot) + (172 * 
div(heapIs $heap_{tuncstart_1032.1}, this.$r.value(heapIs
heap_{funcstart\_1032,1}.p2, 176).rem
[56.10] -32768 < -((-35 * div(heapIs $heap_{funcstart\_1032,1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p2, 176).quot) + (172 *
div(\mathbf{heapIs} \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
heap_{funcstart_{-1032.1}}.p2, 176).rem
\rightarrow [simplify]
```

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56.13 -32768 < ((35 * div(heapIs $heap_{funcstart\_1032,1},))
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p2, 176).quot) + (-172 *
div(\mathbf{heapIs} \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
heap_{funcstart\_1032,1}.p2, 176).rem
[Take goal term]
[1.0] (($heap<sub>1032.1:1051.8</sub>.M2 *
asType<int>(static_cast<integer>(static_cast<signed
int > (operator^*(heapIs \$heap_{1032,1;1051,8}, this).p2) < (int)0))) + temp2) \le 
maxof(signed int)
\rightarrow [from term 53.19, $heap_{1032,1;1051,8}$ is equal to
$heap_{funcstart\_1032,1}.$_replace(this.$r \rightarrow this.$r.value(heapIs)
heap_{funcstart\_1032,1}._replace(p1 \rightarrow (-2 * div(heapIs $heap_{funcstart\_1032,1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177).quot) + (171 *
div(heapIs $heap_{tuncstart\_1032.1}, this.$r.value(heapIs
heap_{funcstart_{1032.1}}.p1, 177).rem)))
[1.1] ((\theta_{tan} = 1.1)) ((\theta_{tan} = 1.1) ((\theta_{tan} = 1.1)) 
heap_{funcstart\_1032,1}._replace(p1 \rightarrow ((-2 * div(heapIs heap_{funcstart\_1032,1}),
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177).quot) + (171 *
div(\mathbf{heapIs} \$ heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
heap_{funcstart_{1032,1}}.p1, 177).rem))).M2 *
asType<int>(static_cast<integer>(static_cast<signed
int>(operator^*(heapIs \$heap_{1032,1;1051,8}, this).p2) < (int)0))) + temp2) \le
maxof(signed int)
\rightarrow [const member of object with modified fields]
[1.2] (($heap_tuncstart_1032.1.M2 *
asType<int>(static_cast<integer>(static_cast<signed
int>(operator^*(heapIs $heap_{1032,1;1051,8}, this).p2) < (int)(0))) + temp2) \le
maxof(signed int)
\rightarrow [const static or extern object]
[1.3] (($heap<sub>init</sub>.M2 *
asType<int>(static_cast<integer>(static_cast<signed
int>(operator^*(heapIs \$heap_{1032,1:1051.8}, this).p2) < (int)(0))) + temp2) \le
maxof(signed int)
\rightarrow [expand definition of constant 'M2' at prang.cpp (33,26)]
[1.4] (((int)30307 *
asType<int>(static_cast<integer>(static_cast<signed
int>(operator^*(heapIs \$heap_{1032,1:1051.8}, this).p2) < (int)(0))) + temp2) \le
maxof(signed int)
\rightarrow [simplify]
[1.5] ((30307 * asType<int>(static_cast<integer>(static_cast<signed
int > (operator^*(heapIs \$heap_{1032,1;1051,8}, this).p2) < (int)0))) + temp2) \le 1
```

```
maxof(signed int)
\rightarrow [from term 53.19, $heap<sub>1032.1:1051.8</sub> is equal to
$heap_{funcstart\_1032,1}.$_replace(this.$r \rightarrow this.$r.value(heapIs)
heap_{funcstart\_1032,1}._replace(p1 \rightarrow (-2 * div(heapIs heap_{funcstart\_1032,1}),
this.r.value(heapIs \ \ heap_{funcstart\_1032.1}).p1, 177).quot) + (171 *
div(\mathbf{heapIs}\ \$heap_{funcstart\_1032,1},\ \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}
heap_{funcstart\_1032,1}.p1, 177).rem)))]
[1.6] ((30307 * asType<int>(static_cast<integer>(static_cast<signed
int>(operator^*(heapIs \ heap_{funcstart\_1032,1}.\_replace(this.\$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow (-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs \theta_{funcstart\_1032,1}, this.r.value(heapIs)
\text{Sheap}_{funcstart\_1032,1}.\text{p1}, 177).\text{rem})), \text{this}.\text{p2}) < (\text{int})0)) + \text{temp2}) \le
maxof(signed int)
→ [expand definition of operator '*' in class 'pointer' at built in declaration]
[1.7] ((30307 * asType<int>(static_cast<integer>(static_cast<signed
\mathbf{int}{>}(\mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}~\$\mathbf{heap}_{funcstart\_1032,1}.\_\mathbf{replace}(\mathbf{this}.\$\mathbf{r}\rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{tuncstart_1032,1}, this. r.value(heapIs \rho_{tuncstart_1032,1}).p1,
177).quot) + (171 * div(\mathbf{heapIs} \$ heap_{funcstart\_1032,1}, \mathbf{this}.\$ r. \mathbf{value}(\mathbf{heapIs})
\text{Sheap}_{funcstart\_1032,1}.\text{p1}, 177).\text{rem})))).\text{p2}) < (int)0))) + \text{temp2}) \le
maxof(signed int)
→ [evaluate dereferenced pointer into modified heap]
[1.8] ((30307 * asType<int>(static_cast<integer>(static_cast<signed
int>(([this.\$r == this.\$r]: this.\$r.value(heapIs)))
\rho_{funcstart\_1032,1}._replace(p1 \rightarrow (-2 * div(heapIs \rho_{funcstart\_1032,1}).
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177).quot) + (171 *
div(\mathbf{heapIs} \$ heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
$heap_{tuncstart_1032.1}).p1, 177).rem)), []: this.$r.value(heapIs
\theta_{1} = \theta_{1} + \theta_{2} = \theta_{2} + \theta_{3} = \theta_{2} + \theta_{3} = \theta_{3} \theta_{3
→ [explicitly assert falsehood of skipped guards in subsequent guards]
[1.9] ((30307 * asType<int>(static_cast<integer>(static_cast<signed
int>(([this.\$r == this.\$r]: this.\$r.value(heapIs
\rho_{tuncstart_1032.1}._replace(p1 \rightarrow (-2 * div(heapIs \rho_{tuncstart_1032.1})
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177).quot) + (171 *
div(\mathbf{heapIs} \$ heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
\hat{p}_{funcstart_1032,1}.p1, 177).rem), [!(this.\$r == this.\$r)]:
this.$r.value(heapIs heap_{funcstart\_1032.1}).p2) < (int)0))) + temp2) \leq
```

[1.16] ((30307 * asType<int>(static_cast<integer>(0 <

maxof(signed int)

 \rightarrow [simplify]

```
-this.$r.value(heapIs \theta_{funcstart\_1032,1}).p2))) + temp2) \leq
maxof(signed int)
\rightarrow [from term 24.0, literala < -this.$r.value(heapIs $heap_{funcstart\_1032.1}).p2
is false whenever -2 < (0 + literala)
   Proof of rule precondition:
   [1.16.0] - 2 < (0 + 0)
   \rightarrow [simplify]
   [1.16.2] true
[1.17] ((30307 * asType<int>(static_cast<integer>(false))) + temp2) \leq
maxof(signed int)
\rightarrow [simplify]
[1.18] ((30307 * asType<int>(([false]: 1, []: 0))) + temp2) \leq maxof(signed)
→ [explicitly assert falsehood of skipped guards in subsequent guards]
[1.19] ((30307 * asType<int>(([false]: 1, [true]: 0))) + temp2) \leq
maxof(signed int)
\rightarrow [simplify]
[1.22] (0 + \text{temp2}) \le \text{maxof(signed int)}
\rightarrow [from term 54.18, temp2 is equal to (-35 * div(heapIs $heap_{funcstart\_1032.1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p2, 176).quot) + (172 *
div(\mathbf{heapIs} \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
heap_{funcstart_{1032,1}}.p2, 176).rem
[1.23] (0 + ((-35 * div(heap
Is \rho_{funcstart\_1032,1}, this.\r.value(heap
Is
\text{Sheap}_{funcstart\ 1032.1}.p2, 176).quot) + (172 * div(heapIs \text{Sheap}_{funcstart\ 1032.1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p2, 176).rem))) \le maxof(signed)
int)
\rightarrow [simplify]
[1.39] -32768 < ((-172 * div(heapIs $heap_{funcstart\_1032,1},)
this.$r.value(heapIs heap_{funcstart\_1032,1}).p2, 176).rem) + (35 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p2,
176).quot))
\rightarrow [from term 56.13, literala < ((-172 * div(heapIs $heap_{funcstart\_1032,1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p2, 176).rem) + (35 * div(heapIs)
heap_{funcstart\_1032.1}, this.r.value(heapIs heap_{funcstart\_1032.1}).p2,
(176).guot)) is true whenever (-1 + literala) < -32768
   Proof of rule precondition:
   [1.39.0] (-32768 + -1) < -32768
```

```
\rightarrow [simplify]
   [1.39.2] true
[1.40] true
Proof of verification condition: Type constraint satisfied in implicit
conversion from 'signed int' to 'P2Type'
In the context of class: WHPrang, declared at:
C:\Escher\Customers\prang-cpp\prang.cpp (18,1)
Condition generated at: C:\Escher\Customers\prang-cpp\prang.cpp
(78,16)
Condition defined at:
To prove: minof(signed int) \leq (($heap_{1032,1;1051,8}.M2 *
as Type < int > (static\_cast < integer > (static\_cast < signed))
int>(operator*(heapIs $heap_{1032,1:1051.8}, this).p2) < (int)0))) + temp2)
Given:
heap_{init}.LIMIT == (int)80
heap_{init}.class WHPrang \in M1 == (int)30269
heap_{init}.class WHPrang \in r1 == (int)171
heap_{init}.class WHPrang \in a1 == (int)177
heap_{init}.class WHPrang \in b1 == (int)2
heap_{init}.class WHPrang \in M2 == (int)30307
heap_{init}.class WHPrang \in r2 == (int)172
heap_{init}.class WHPrang \in a2 == (int)176
heap_{init}.class WHPrang \in b2 == (int)35
heap_{init}.class WHPrang \in M3 == (int)30323
heap_{init}.class WHPrang \in r3 == (int)170
heap_{init}.class WHPrang \in a3 == (int)178
heap_{init}.class WHPrang \in b3 == (int)63
\operatorname{div1} == \operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_1032,1},
static\_cast < int > (operator*(heapIs $heap_{funcstart\_1032,1}, this).p1),
\mathbf{static\_cast}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_1032,1}.\mathrm{a1}))
(asType < integer > (static\_cast < int > (operator*(heapIs)))
heap_{funcstart\_1032.1}, this).p1) /
asType<integer>(static_cast<int>($heap_{tuncstart\_1032.1}.a1))) ==
asType<integer>(div1.quot)
(asType < integer > (static\_cast < int > (operator*(heapIs)))
```

```
heap_{funcstart=1032.1}, this).p1) %
asType < integer > (static\_cast < int > (\$heap_{funcstart\_1032.1}.a1))) = =
asType<integer>(div1.rem)
(\mathbf{asType}{<}\mathbf{integer}{>}(\mathbf{operator}^*(\mathbf{heapIs}\ \$\mathbf{heap}_{funcstart\_1032,1},\ \mathbf{this}).\mathtt{p1}) <
asType < integer > (\$heap_{funcstart\_1032,1}.a1)) = >
(asType<integer>(div1.rem) == asType<integer>(operator*(heapIs
heap_{funcstart\_1032,1}, this).p1)
(\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathsf{heap}_{funcstart\_1032,1}.\mathsf{a1}) \leq
asType < integer > (operator*(heapIs $heap_{funcstart\_1032,1}, this).p1)) = >
!(0 == asType < integer > (div1.quot))
!(0 == asType < integer > (div1.rem)) || !(0 ==
asType<integer>(div1.quot))
div2 == div(\mathbf{heapIs} \$heap_{funcstart\_1032,1},
\mathbf{static\_cast} {<} \mathbf{int} {>} (\mathbf{operator^*(heapIs}\ \$heap_{funcstart\_1032,1},\ \mathbf{this}).p2),
\mathbf{static\_cast} < \mathbf{int} > (\$ \mathbf{heap}_{funcstart\_1032,1}.\mathbf{a2}))
(asType<integer>(static_cast<int>(operator*(heapIs
heap_{funcstart\_1032.1}, this).p2)
\mathbf{asType} {<} \mathbf{integer} {>} (\mathbf{static\_cast} {<} \mathbf{int} {>} (\$ \mathbf{heap}_{funcstart\_1032,1}.\mathbf{a2}))) = =
asType<integer>(div2.quot)
(\mathbf{asType} {<} \mathbf{integer} {>} (\mathbf{static\_cast} {<} \mathbf{int} {>} (\mathbf{operator}^* (\mathbf{heapIs}
heap_{funcstart\ 1032.1}, this).p2)
asType<integer>(static_cast<int>($heap_{funcstart_1032.1}.a2))) ==
asType<integer>(div2.rem)
(asType < integer > (operator^*(heapIs $heap_{funcstart\_1032,1}, this).p2) < footnote{the content of the cont
asType < integer > (\$heap_{funcstart\_1032,1}.a2)) = >
(asType<integer>(div2.rem) == asType<integer>(operator*(heapIs
heap_{funcstart\_1032.1}, this).p2)
(\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathsf{heap}_{funcstart\_1032,1}.\mathsf{a2}) \leq
\mathbf{asType} < \mathbf{integer} > (\mathbf{operator}^*(\mathbf{heapIs} \ \$ \mathbf{heap}_{funcstart\_1032,1}, \ \mathbf{this}).\mathbf{p2})) = >
!(0 == asType < integer > (div2.quot))
!(0 == asType < integer > (div2.rem)) || !(0 ==
asType<integer>(div2.quot))
div3 == div(\mathbf{heapIs} \$ heap_{funcstart\_1032,1},
static\_cast < int > (operator*(heapIs $heap_{funcstart\_1032,1}, this).p3),
\mathbf{static\_cast}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_1032,1}.\mathrm{a3}))
(asType<integer>(static_cast<int>(operator*(heapIs
heap_{funcstart\_1032.1}, this).p3)
\mathbf{asType} < \mathbf{integer} > (\mathbf{static\_cast} < \mathbf{int} > (\$ \mathbf{heap}_{funcstart\_1032,1}.\mathbf{a3}))) = =
asType<integer>(div3.quot)
(asType < integer > (static\_cast < int > (operator*(heapIs)))
heap_{funcstart\_1032,1}, this).p3)
```

```
asType < integer > (static\_cast < int > (\$heap_{funcstart\_1032.1}.a3))) = =
asType<integer>(div3.rem)
(\mathbf{asType}{<}\mathbf{integer}{>}(\mathbf{operator}^*(\mathbf{heapIs}\ \$\mathbf{heap}_{funcstart\_1032,1},\ \mathbf{this}).\mathrm{p3}) <
asType < integer > (\$heap_{funcstart\_1032,1}.a3)) = >
(asType<integer>(div3.rem) == asType<integer>(operator*(heapIs
heap_{funcstart\_1032,1}, this).p3)
(\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathsf{heap}_{funcstart\_1032,1}.\mathsf{a3}) \leq
asType<integer>(operator*(heapIs $heap_{tuncstart\_1032,1}, this).p3)) =>
!(0 == asType < integer > (div3.quot))
!(0 == asType < integer > (div3.rem)) || !(0 ==
asType<integer>(div3.quot))
temp1 == (\$heap_{funcstart\_1032,1}.r1 * static\_cast < signed int > (div1.rem)) -
(\text{sheap}_{funcstart\_1032,1}.\text{b1} * \text{static\_cast} < \text{signed int} > (\text{div1.quot}))
minof(signed int) \le temp1
temp1 \le maxof(signed int)
heap_{1032,1;1051,8} == heap_{funcstart\_1032,1}._replace(this.$r \rightarrow
operator*(heapIs heap_{funcstart\_1032,1}, this)._replace(p1 \rightarrow
asType<P1Type>(($heap_tuncstart_1032.1.M1 *
asType < int > (static\_cast < integer > (static\_cast < signed
int>(operator^*(heapIs \$heap_{funcstart\_1032,1}, this).p1) < (int)0))) +
temp1)))
temp2 == (\$heap_{1032.1:1051.8}.r2 * static\_cast < signed int > (div2.rem)) -
($heap<sub>1032,1;1051,8</sub>.b2 * static_cast<signed int>(div2.quot))
minof(signed\ int) \le temp2
temp2 < maxof(signed int)
Proof:
[Take given term]
[2.0] div1 == div(heapIs $heap<sub>funcstart_1032,1</sub>,
\mathbf{static\_cast} < \mathbf{int} > (\mathbf{operator}^*(\mathbf{heapIs} \ \$ \mathbf{heap}_{funcstart\_1032,1}, \ \mathbf{this}).\mathtt{p1}),
\mathbf{static\_cast}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_1032,1}.\mathrm{a1}))
→ [expand definition of operator '*' in class 'pointer' at built in declaration]
[2.1] \operatorname{div1} == \operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_1032,1},
static\_cast < int > (this. r.value(heapIs  heap_{funcstart\_1032,1}).p1),
static\_cast < int > (\$heap_{funcstart\_1032,1}.a1))
\rightarrow [simplify]
[2.2] \operatorname{div1} == \operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_1032,1}, \mathbf{this}.\$ r. \mathbf{value}(\mathbf{heapIs}))
\theta_{funcstart\_1032,1}.p1, \theta_{funcstart\_1032,1}.p1, \theta_{funcstart\_1032,1}.a1))
\rightarrow [const static or extern object]
```

```
[2.3] \operatorname{div1} == \operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_1032,1}, \mathbf{this}.\$ \mathbf{r.value}(\mathbf{heapIs})
\theta_{nit}.a1).p1, \theta_{nit}.a1
\rightarrow [expand definition of constant 'a1' at prang.cpp (30,26)]
[2.4] \text{ div1} == \text{div(heapIs } \text{$heap}_{funcstart\_1032,1}, \text{ this.} \text{$r.value(heapIs)}
\theta_{funcstart\_1032,1}.p1, \theta_{funcstart\_1032,1}.p1, \theta_{funcstart\_1032,1}.p1
\rightarrow [simplify]
[2.6] div1 == div(heapIs heap_{funcstart\_1032,1}, this.r.value(heapIs)
heap_{funcstart_{1032,1}}.p1, 177
[Assume known post-assertion, class invariant or type constraint for term 2.6]
[7.0] (0 < asType<integer>(this.$r.value(heapIs
\rho_{uncstart\_1032.1}.p1) && (asType<integer>(this.$r.value(heapIs)
\rho_{funcstart\_1032.1}.p1 < asType<integer>(\rho_{funcstart\_1032.1}.p1) < asType<integer>(\rho_{funcstart\_1032.1}.p1)
M1))
\rightarrow [simplify]
[7.2] (0 < this.\$r.value(heapIs \$heap_{funcstart_1032.1}).p1) &&
(this.r.value(heapIs $heap_{funcstart\_1032.1}).p1 <
asType<integer>($heap.class WHPrang ∈ M1))
\rightarrow [const static or extern object]
[7.3] (0 < this.$r.value(heap
Is \rho_{uncstart\_1032,1}.p1) \
(this.$r.value(heapIs heap_{funcstart\_1032,1}).p1 <
asType < integer > (\$heap_{init}.class WHPrang \in M1))
\rightarrow [expand definition of constant 'M1' at prang.cpp (28,26)]
[7.4] (0 < this.\$r.value(heapIs \$heap_{funcstart\_1032.1}).p1) &&
(this.r.value(heapIs $heap_{funcstart\_1032,1}).p1 <
asType < integer > ((int)30269))
\rightarrow [simplify]
[7.10] (-30269 < -this.$r.value(heapIs heap_{funcstart\_1032,1}).p1) \land (0 <
this.r.value(heapIs $heap_{funcstart\_1032,1}).p1)
[Work on sub-term 2 of conjunction in term 7.10]
[8.0] 0 < this.$r.value(heapIs \theta_{funcstart\_1032,1}).p1
[Take given term]
[18.0] div2 == div(heapIs heap_{funcstart\_1032,1},
\mathbf{static\_cast} < \mathbf{int} > (\mathbf{operator}^*(\mathbf{heapIs} \ \$ \mathbf{heap}_{funcstart\_1032,1}, \ \mathbf{this}).\mathtt{p2}),
static\_cast < int > (\$heap_{funcstart\_1032,1}.a2))
→ [expand definition of operator '*' in class 'pointer' at built in declaration]
[18.1] \operatorname{div2} == \operatorname{div}(\mathbf{heapIs} \ \text{$heap}_{funcstart\_1032,1},
static\_cast < int > (this. r.value(heapIs  heap_{funcstart\_1032,1}).p2),
```

```
\mathbf{static\_cast} {<} \mathbf{int} {>} (\$ \mathbf{heap}_{funcstart\_1032,1}.\mathbf{a2}))
\rightarrow [simplify]
[18.2] \operatorname{div2} == \operatorname{div}(\mathbf{heapIs} \ \mathbf{\$heap}_{funcstart\_1032,1}, \ \mathbf{this}.\mathbf{\$r.value}(\mathbf{heapIs})
\theta_{funcstart\_1032,1}.p2, \theta_{funcstart\_1032,1}.p2, \theta_{funcstart\_1032,1}.a2))
\rightarrow [const static or extern object]
[18.3] \operatorname{div2} == \operatorname{div}(\mathbf{heapIs} \ \text{$heap}_{funcstart\_1032,1}, \ \mathbf{this}.\text{$r.value}(\mathbf{heapIs})
\theta_{funcstart\_1032,1}.p2, \theta_{funcstart\_1032,1}.p3, \theta_{funcstart\_1032,1}.p2, \theta_{funcstart\_1032,1}.p3, \theta_{funcstart\_1032,1
\rightarrow [expand definition of constant 'a2' at prang.cpp (35,26)]
[18.4] \text{ div2} == \text{div}(\text{heapIs } \text{$heap}_{funcstart\_1032,1}, \text{this.}\text{$r.value}(\text{heapIs})
\theta_{tuncstart\_1032.1}.p2, \theta_{tuncstart} = \theta
\rightarrow [simplify]
 [18.6] div2 == div(heapIs $heap_{funcstart\_1032,1}, this.$r.value(heapIs)
heap_{funcstart_{-1032,1}}.p2, 176
[Assume known post-assertion, class invariant or type constraint for term 18.6]
[23.0] (0 < asType<integer>(this.$r.value(heapIs
\$ heap_{funcstart\_1032,1}).p2)) \ \&\& \ (\textbf{asType} < \textbf{integer} > (\textbf{this}.\$r.\textbf{value}(\textbf{heapIs}))) \ \&\& \ (\textbf{asType} < \textbf{integer} > (\textbf{this}.\$r.\textbf{value}))
\rho_{funcstart\_1032,1}.p2 < asType<integer>(\rho_{funcstart\_1032,1}.p2) < asType<integer>(\rho_{funcstart\_1032,1}.p2)
M2))
\rightarrow [simplify]
[23.2] (0 < this.$r.value(heap
Is \rho_{funcstart\_1032,1}).p2) &&
(this.$r.value(heapIs \rho_{funcstart\_1032,1}).p2 <
asType < integer > (\$heap.class WHPrang \in M2))
\rightarrow [const static or extern object]
[23.3] (0 < this.$r.value(heapIs heap_{funcstart\_1032,1}).p2) &&
(this.$r.value(heapIs \rho_{funcstart\_1032,1}).p2 <
asType < integer > (\$heap_{init}.class WHPrang \in M2))
\rightarrow [expand definition of constant 'M2' at prang.cpp (33,26)]
[23.4] (0 < this.$r.value(heapIs $heap_{funcstart\_1032,1}).p2) &&
(this.$r.value(heapIs \theta_{funcstart\_1032,1}).p2 <
asType < integer > ((int)30307))
\rightarrow [simplify]
[23.10] (-30307 < -this.$r.value(heapIs $heap_{funcstart\_1032,1}).p2) \land (0 <
this.r.value(heapIs $heap_{funcstart\_1032,1}).p2)
[Work on sub-term 2 of conjunction in term 23.10]
[24.0] 0 < this.$r.value(heapIs $heap_{funcstart\_1032,1}).p2
[Take given term]
```

```
[50.0] \; ((\$ heap_{funcstart\_1032,1}.r1 \; * \; \textbf{static\_cast} < \textbf{signed int} > (\text{div1.rem})) \; - \; \text{div1.rem})) \; - \; \text{div1.rem}) \; + \; \text{div
(\text{sheap}_{funcstart\_1032,1}.\text{b1} * \text{static\_cast} < \text{signed int} > (\text{div1.quot}))) == \text{temp1}
\rightarrow [const static or extern object]
[50.1] (($heap<sub>init</sub>.r1 * static_cast<signed int>(div1.rem)) -
(\text{sheap}_{funcstart\_1032,1}.\text{b1 * static\_cast} < \text{signed int} > (\text{div1.quot}))) == \text{temp1}
\rightarrow [expand definition of constant 'r1' at prang.cpp (29,26)]
[50.2] (((int)171 * static_cast<signed int>(div1.rem)) -
(\text{\$heap}_{funcstart\_1032,1}.\text{b1 * static\_cast} < \text{signed int} > (\text{div1.quot}))) == \text{temp1}
\rightarrow [simplify]
[50.3] ((171 * static_cast < signed int > (div1.rem)) - (\text{$heap_{funcstart\_1032,1}.b1}
* static_cast<signed int>(div1.quot))) == temp1
\rightarrow [from term 2.6, div1 is equal to div(heapIs $heap_{funcstart\_1032.1},
this.$r.value(heapIs $heap_{funcstart\_1032,1}).p1, 177)]
[50.4] ((171 * static_cast<signed int>(div(heapIs $heap_{tuncstart\_1032.1},
this.r.value(heapIs $heap_{funcstart\_1032,1}).p1, 177).rem)) -
(\text{sheap}_{funcstart\_1032.1}.\text{b1 * static\_cast} < \text{signed int} > (\text{div1.quot}))) == \text{temp1}
\rightarrow [simplify]
[50.5] ((171 * div(heapIs $heap<sub>funcstart_1032,1</sub>, this.$r.value(heapIs)
\text{Sheap}_{funcstart\_1032,1}.\text{p1}, 177).\text{rem} - (\text{Sheap}_{funcstart\_1032,1}.\text{b1} *
static_cast<signed int>(div1.quot))) == temp1
\rightarrow [const static or extern object]
[50.6] ((171 * div(heapIs $heap_{funcstart\_1032,1}, this.$r.value(heapIs)]
\rho_{uncstart\_1032,1}.p1, 177).rem – (\rho_{uncstart\_1032,1}.p1, 177).rem) – (\rho_{uncstart\_1032,1}.p1, 177).rem) – (\rho_{uncstart\_1032,1}.p1, 177).rem)
int>(div1.quot)) == temp1
\rightarrow [expand definition of constant 'b1' at prang.cpp (31,26)]
[50.7] ((171 * \mathrm{div}(\mathbf{heapIs}\ \$\mathrm{heap}_{funcstart\_1032,1},\ \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}
\theta_{uncstart\_1032,1}.p1, 177).rem - ((int)2 * static\_cast < signed)
int>(div1.quot)) == temp1
\rightarrow [simplify]
[50.8] ((171 * div(heapIs $heap_{funcstart\_1032,1}, this.$r.value(heapIs 
\theta_{funcstart\_1032,1}.p1, 177).rem - (2 * static\_cast < signed)
int>(div1.quot))) == temp1
\rightarrow [from term 2.6, div1 is equal to div(heapIs $heap_{funcstart\_1032.1},
this.r.value(heapIs \ heap_{funcstart\_1032.1}).p1, 177)
[50.9] ((171 * div(heapIs $heap_{funcstart\_1032,1}, this.$r.value(heapIs)]
\theta_{funcstart\_1032,1}.p1, 177).rem) - (2 * static_cast<signed)
int>(div(heapIs \$heap_{funcstart\_1032,1}, this.\$r.value(heapIs
\$heap_{funcstart\_1032,1}).p1,\,177).quot)))) == temp1
```

```
\rightarrow [simplify]
[50.14] 0 == (-\text{temp1} + (-2 * \text{div}(\text{heapIs } \text{\$heap}_{tuncstart\_1032.1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177).quot) + (171 *
div(\mathbf{heapIs} \$ heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
heap_{funcstart_{-1032.1}}.p1, 177).rem
[Take given term]
[53.0] heap_{1032,1;1051,8} == heap_{funcstart\_1032,1}._replace(this.r \rightarrow
operator*(heapIs heap_{funcstart\_1032,1}, this)._replace(p1 \rightarrow
\mathbf{asType}{<}P1\mathsf{Type}{>}((\$\mathsf{heap}_{funcstart\_1032,1}.\mathsf{M1}~*
asType<int>(static_cast<integer>(static_cast<signed
int>(operator*(heapIs $heap_{funcstart\_1032,1}, this).p1) < (int)0))) +
temp1)))
→ [expand definition of operator '*' in class 'pointer' at built in declaration]
[53.1] $heap<sub>1032,1:1051,8</sub> == $heap<sub>funcstart_1032,1</sub>._replace(this.$r \rightarrow
this.$r.value(heapIs \theta_{funcstart\_1032,1})._replace(p1 \rightarrow
asType<P1Type>(($heap<sub>funcstart_1032.1</sub>.M1 *
asType<int>(static_cast<integer>(static_cast<signed
int>(operator^*(heapIs \$heap_{funcstart\_1032,1}, this).p1) < (int)0))) +
temp1)))
\rightarrow [const static or extern object]
[53.2] heap_{1032,1;1051,8} == heap_{funcstart\_1032,1}._replace(this.r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow
asType<P1Type>(($heap<sub>init</sub>.M1 *
asType<int>(static_cast<integer>(static_cast<signed
int>(operator^*(heapIs \$heap_{funcstart\_1032,1}, this).p1) < (int)0))) +
temp1)))
\rightarrow [expand definition of constant 'M1' at prang.cpp (28,26)]
[53.3] $\text{heap}_{1032,1:1051.8} == \text{$heap}_{funcstart\_1032,1}._\text{replace}(\text{this}.\text{$r} \to \text{$}
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow
asType<P1Type>(((int)30269 *
asType<int>(static_cast<integer>(static_cast<signed
int>(operator^*(heapIs \$heap_{funcstart\_1032,1}, this).p1) < (int)0))) +
temp1)))
\rightarrow [simplify]
[53.4] heap_{1032,1;1051,8} == heap_{funcstart\_1032,1}._replace(this.r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow
asType<P1Type>((30269 *
asType < int > (static\_cast < integer > (static\_cast < signed)
int>(operator^*(heapIs \$heap_{funcstart\_1032,1}, this).p1) < (int)0))) +
temp1)))
→ [expand definition of operator '*' in class 'pointer' at built in declaration]
```

```
[53.5] heap_{1032,1;1051,8} == heap_{funcstart\_1032,1}._replace(this.r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow
asType<P1Type>((30269 *
as Type < int > (static\_cast < integer > (static\_cast < signed
int>(this.\$r.value(heapIs \$heap_{funcstart\_1032,1}).p1) < (int)0))) + temp1)))
\rightarrow [simplify]
[53.9] $heap<sub>1032,1;1051,8</sub> == $heap<sub>funcstart_1032,1</sub>._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow
asType<P1Type>((30269 * asType<int>(static_cast<integer>(0 <
-this.r.value(heapIs heap_{funcstart\_1032,1}.p1))) + temp1)))
\rightarrow [from term 8.0, literala < -this.$r.value(heapIs $heap_{funcstart\_1032.1}).p1
is false whenever -2 < (0 + literala)
    Proof of rule precondition:
    [53.9.0] - 2 < (0 + 0)
    \rightarrow [simplify]
    [53.9.2] true
[53.10] $\text{heap}_{1032,1;1051,8} == $\text{heap}_{funcstart\_1032,1}._\text{replace}(\text{this}.\text{$\frac{1}{2}r$})
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow
asType<P1Type>((30269 * asType<int>(static_cast<integer>(false)))
+ \text{temp1})))
\rightarrow [simplify]
[53.11] $\text{heap}_{1032,1;1051,8} == $\text{heap}_{funcstart\_1032,1}._\text{replace}(\text{this}.\text{$\frac{1}{2}r$})
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow
asType < P1Type > ((30269 * asType < int > (([false]: 1, []: 0))) + temp1)))
→ [explicitly assert falsehood of skipped guards in subsequent guards]
[53.12] $\text{heap}_{1032,1:1051.8} == $\text{heap}_{funcstart\_1032,1}.$\text{-replace}(\text{this}.$\text{$r} \to \text{
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow
asType<P1Type>((30269 * asType<int>(([false]: 1, [true]: 0))) +
temp1)))
\rightarrow [simplify]
[53.15] $\text{heap}_{1032,1;1051,8} == $\text{heap}_{funcstart\_1032,1}._\text{replace}(\text{this}.\text{$\frac{1}{2}r$})
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow
asType < P1Type > (0 + temp1))
\rightarrow [from term 50.14, temp1 is equal to (-2 * div(heapIs $heap_{funcstart\_1032,1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177).quot) + (171 * leapIs \ heap_{funcstart\_1032,1}).p1, 177).quot)
div(\mathbf{heapIs}\ \$heap_{funcstart\_1032,1},\ \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}
heap_{funcstart\_1032,1}.p1, 177).rem
[53.16] $heap<sub>1032.1:1051.8</sub> == $heap<sub>funcstart_1032.1</sub>._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow
```

```
asType < P1Type > (0 + ((-2 * div(heapIs $heap_{funcstart\_1032,1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177).quot) + (171 *
div(\mathbf{heapIs} \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
heap_{funcstart\_1032,1}.p1, 177.rem))))
\rightarrow [simplify]
[53.19] $heap<sub>1032,1;1051,8</sub> == $heap<sub>funcstart_1032,1</sub>._replace(this.$r \rightarrow
this.$r.value(heapIs \rho_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.} \text{\$r.value}(\text{heapIs}))
heap_{funcstart\_1032,1}.p1, 177.rem)))
[Take given term]
[54.0] (($heap<sub>1032.1:1051.8</sub>.r2 * static_cast<signed int>(div2.rem)) -
(\text{sheap}_{1032.1:1051.8}, \text{b2} * \text{static\_cast} < \text{signed int} > (\text{div2.quot}))) = = \text{temp2}
\rightarrow [from term 53.19, $heap<sub>1032,1;1051,8</sub> is equal to
$heap_{funcstart\_1032,1}.$_replace(this.$r \rightarrow this.$r.value(heapIs)
heap_{funcstart\_1032.1}._replace(p1 \rightarrow (-2 * div(heapIs p_{funcstart\_1032.1})
this.r.value(heapIs \ \ heap_{funcstart\_1032.1}).p1, \ 177).quot) + (171)^3
div(\mathbf{heapIs} \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
heap_{funcstart_{1032,1}}.p1, 177).rem)))
[54.1] \; ((\$ heap_{funcstart\_1032,1}.\_\mathbf{replace}(\mathbf{this}.\$r \to \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}))) \\
\rho_{tuncstart 1032.1}._replace(p1 \rightarrow ((-2 * div(heapIs $heap_{tuncstart 1032.1})).
this.r.value(heapIs \ heap_{funcstart\_1032.1}).p1, 177).quot) + (171)
div(\mathbf{heapIs} \$ heap_{funcstart\_1032.1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
\theta_{funcstart\_1032,1}.p1, 177).rem)))).r2 * static_cast < signed
int>(div2.rem)) - (\$heap_{1032,1:1051,8}.b2 * static\_cast < signed
int>(div2.quot)) == temp2
→ [const member of object with modified fields]
[54.2] \; ((\$heap_{funcstart\_1032,1}.r2 * \textbf{static\_cast} < \textbf{signed int} > (\text{div}2.rem)) \; - \\
(\text{\$heap}_{1032,1;1051,8}.\text{b2} * \textbf{static\_cast} < \textbf{signed int} > (\text{div2.quot}))) == \text{temp2}
\rightarrow [const static or extern object]
[54.3] (($heap_{init}.r2 * static_cast < signed int > (div2.rem)) -
(\text{sheap}_{1032,1;1051,8}.\text{b2} * \text{static\_cast} < \text{signed int} > (\text{div2.quot}))) == \text{temp2}
\rightarrow [expand definition of constant 'r2' at prang.cpp (34,26)]
[54.4] (((int)172 * static_cast<signed int>(div2.rem)) -
(\text{sheap}_{1032,1:1051,8}.\text{b2} * \text{static\_cast} < \text{signed int} > (\text{div2.quot}))) == \text{temp2}
\rightarrow [simplify]
[54.5] ((172 * static_cast < signed int > (div2.rem)) - ($heap_{1032,1:1051,8}.b2 *
static_cast<signed int>(div2.quot))) == temp2
\rightarrow [from term 18.6, div2 is equal to div(heapIs $heap_{funcstart\_1032,1},
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```
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p2, 176)]
[54.6] ((172 * static_cast<signed int>(div(heapIs \theta_{funcstart\_1032,1}),
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p2, 176).rem)) -
(\text{sheap}_{1032,1:1051.8}.\text{b2} * \text{static\_cast} < \text{signed int} > (\text{div2.quot}))) == \text{temp2}
\rightarrow [simplify]
[54.7] ((172 * div(heapIs $heap_{funcstart\_1032,1}, this.$r.value(heapIs
\text{Sheap}_{funcstart\_1032,1}.p2, 176).rem) - (\text{Sheap}_{1032,1:1051.8}.b2 *
static_cast<signed int>(div2.quot))) == temp2
\rightarrow [from term 53.19, $heap<sub>1032.1:1051.8</sub> is equal to
heap_{funcstart\_1032.1}._replace(this.r \rightarrow this.r.value(heapIs)
heap_{funcstart\_1032.1}._replace(p1 \rightarrow (-2 * div(heapIs heap_{funcstart\_1032.1})
this.$r.value(heapIs heap_{funcstart_{-1032,1}}).p1, 177).quot) + (171 *
div(heapIs $heap_funcstart_1032.1, this.$r.value(heapIs
\$heap_{funcstart\_1032,1}).p1,\ 177).rem)))]
[54.8] \; ((172 \; * \; \mathrm{div}(\mathbf{heapIs} \; \$ \mathrm{heap}_{funcstart\_1032,1}, \; \mathbf{this}.\$ r. \mathbf{value}(\mathbf{heapIs} \;
\rho_{tuncstart\_1032.1}.p2, 176).rem) - (\rho_{tuncstart\_1032.1}._replace(this.$r
\rightarrow this.$r.value(heapIs $heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 *
div(\mathbf{heapIs} \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
\text{Sheap}_{funcstart\_1032,1}.p1, 177).quot) + (171 * div(heapIs \text{Sheap}_{funcstart\_1032,1},
this.r.value(heapIs \ensuremath{\$}heap_{funcstart\_1032,1}).p1, 177).rem)))).b2 *
static_cast<signed int>(div2.quot))) == temp2
\rightarrow [const member of object with modified fields]
[54.9] ((172 * div(heapIs $heap_{funcstart\_1032,1}, this.$r.value(heapIs)
\text{Sheap}_{funcstart\_1032,1}.p2, 176).rem) - (\text{Sheap}_{funcstart\_1032,1}.b2 *
static_cast<signed int>(div2.quot))) == temp2
\rightarrow [const static or extern object]
[54.10] ((172 * div(heapIs $heap<sub>funcstart_1032.1</sub>, this.$r.value(heapIs)
\rho_{tuncstart\_1032.1}.p2, 176).rem) – (\rho_{tuncstart\_1032.1}.p2, 176).rem) – (\rho_{tuncstart\_1032.1}.p2, 176).rem)
int>(div2.quot)) == temp2
\rightarrow [expand definition of constant 'b2' at prang.cpp (36,26)]
[54.11] \ ((172 \ ^* \ \mathrm{div}(\mathbf{heapIs} \ \$ \mathrm{heap}_{funcstart\_1032,1}, \ \mathbf{this}.\$ r. \mathbf{value}(\mathbf{heapIs} \ 
\theta_{funcstart\_1032,1}.p2, 176).rem - ((int)35 * static\_cast < signed
int > (div2.quot))) == temp2
\rightarrow [simplify]
[54.12] ((172 * div(heapIs heap_{funcstart\_1032,1}, this.r.value(heapIs)
\rho_{funcstart\_1032,1}.p2, 176).rem - (35 * static\_cast < signed)
int>(div2.quot)) == temp2
\rightarrow [from term 18.6, div2 is equal to div(heapIs $heap_{funcstart\_1032,1},
this.r.value(heapIs \ heap_{funcstart=1032.1}).p2, 176)
```

```
[54.13] ((172 * div(heapIs \$heap_{funcstart\_1032,1}, this.\$r.value(heapIs
\rho_{funcstart\_1032,1}.p2, 176).rem - (35 * static_cast < signed)
int>(div(heapIs \$heap_{funcstart\_1032,1}, this.\$r.value(heapIs
\text{Sheap}_{funcstart\_1032,1}.p2, 176).quot))) == temp2
\rightarrow [simplify]
[54.18] 0 == (-\text{temp2} + (-35 * \text{div}(\text{heapIs} \$\text{heap}_{funcstart\_1032.1})]
this.$r.value(heapIs heap_{funcstart\_1032,1}).p2, 176).quot) + (172 *
div(\mathbf{heapIs} \$ heap_{funcstart\_1032.1}, \mathbf{this.}\$r.\mathbf{value}(\mathbf{heapIs})
heap_{funcstart_1032,1}.p2, 176).rem
[Take given term]
[55.0] minof(signed int) \leq temp2
\rightarrow [simplify]
[55.3] - 32769 < \text{temp2}
\rightarrow [from term 54.18, temp2 is equal to (-35 * div(heapIs $heap_{funcstart\_1032.1},
this.r.value(heapIs \ \ heap_{funcstart\_1032,1}).p2, \ 176).quot) + (172 \ \ *
div(heapIs $heap_{tuncstart\_1032.1}, this.$r.value(heapIs
heap_{funcstart\_1032,1}.p2, 176).rem
\textit{[55.4] -32769} < ((-35 * div(\textbf{heapIs} \$heap_{funcstart\_1032,1}, \textbf{this.}\$r.\textbf{value}(\textbf{heapIs} + \textbf{salue}))
\text{Sheap}_{funcstart\_1032.1}.p2, 176).quot) + (172 * div(heapIs \text{Sheap}_{funcstart\_1032.1},
this.r.value(heapIs $heap_{funcstart\_1032,1}).p2, 176).rem))
[Take goal term]
[1.0] minof(signed int) \leq (($heap_{1032.1:1051.8}.M2 *
asType < int > (static\_cast < integer > (static\_cast < signed)
int>(operator^*(heapIs $heap_{1032,1;1051,8}, this).p2) < (int)0))) + temp2)
\rightarrow [simplify]
[1.1] -32768 \leq (($heap<sub>1032,1;1051,8</sub>.M2 *
asType<int>(static_cast<integer>(static_cast<signed
int>(operator^*(heapIs \$heap_{1032.1:1051.8}, this).p2) < (int)(0))) + temp2)
\rightarrow [from term 53.19, $heap<sub>1032,1:1051,8</sub> is equal to
\$heap_{funcstart\_1032,1}.\_\textbf{replace}(\textbf{this}.\$r \rightarrow \textbf{this}.\$r.\textbf{value}(\textbf{heapIs}
heap_{funcstart\_1032.1}._replace(p1 \rightarrow (-2 * div(heapIs \$heap_{funcstart\_1032.1}, -2))
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177).quot) + (171 * leapIs \ heap_{funcstart\_1032,1}).p1, 177).quot)
div(\mathbf{heapIs} \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
heap_{funcstart\_1032,1}.p1, 177).rem)))
[1.2] -32768 \leq (($heap_funcstart_1032.1._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\$heap_{funcstart\_1032,1},\, \textbf{this.}\$r.\textbf{value}(\textbf{heapIs}\,\,\$heap_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
heap_{funcstart_{-1032,1}}.p1, 177).rem))).M2 *
asType<int>(static_cast<integer>(static_cast<signed
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int>(operator^*(heapIs \$heap_{1032.1:1051.8}, this).p2) < (int)(0))) + temp2)
\rightarrow [const member of object with modified fields]
[1.3] -32768 \leq (($heap_{funcstart\_1032,1}.M2 *
as Type < int > (static\_cast < integer > (static\_cast < signed))
int>(operator^*(heapIs \$heap_{1032,1;1051,8}, this).p2) < (int)0))) + temp2)
\rightarrow [const static or extern object]
[1.4] - 32768 \le ((\$heap_{init}.M2 *
asType<int>(static_cast<integer>(static_cast<signed
int>(operator^*(heapIs $heap_{1032,1;1051,8}, this).p2) < (int)0))) + temp2)
\rightarrow [expand definition of constant 'M2' at prang.cpp (33,26)]
[1.5] -32768 < (((int)30307 *
asType < int > (static\_cast < integer > (static\_cast < signed)
int>(operator^*(heapIs $heap_{1032,1;1051,8}, this).p2) < (int)0))) + temp2)
\rightarrow [simplify]
[1.6] -32768 < ((30307 *
asType<int>(static_cast<integer>(static_cast<signed
int>(operator^*(heapIs \$heap_{1032.1:1051.8}, this).p2) < (int)(0))) + temp2)
\rightarrow [from term 53.19, $heap<sub>1032,1:1051,8</sub> is equal to
$heap_{funcstart\_1032,1}.$_replace(this.$r \rightarrow this.$r.value(heapIs)
heap_{funcstart\_1032,1}._replace(p1 \rightarrow (-2 * div(heapIs $heap_{funcstart\_1032,1}, 
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177).quot) + (171 \ function for the first substitution of the first 
div(\mathbf{heapIs} \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
heap_{funcstart\_1032,1}.p1, 177).rem)))]
[1.7] -32768 < ((30307 *
asType<int>(static_cast<integer>(static_cast<signed
int>(operator^*(heapIs \$heap_{funcstart\_1032,1}.\_replace(this.\$r \rightarrow funcstart\_1032,1})
this.$r.value(heapIs heapIs ._replace(p1 \rightarrow (-2 * div(heapIs
\rho_{tuncstart=1032.1}, this.r.value(heapIs \rho_{tuncstart=1032.1}).p1,
177).quot) + (171 * div(\mathbf{heapIs} \ \$heap_{funcstart\_1032,1}, \ \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
\theta_{funcstart\_1032,1}.p1, 177).rem)), this).p2) < (int)0))) + temp2)
→ [expand definition of operator '*' in class 'pointer' at built in declaration]
[1.8] -32768 \le ((30307 *
asType < int > (static\_cast < integer > (static\_cast < signed)
int>(this.$r.value(heapIs \rho_{tyncstart\ 1032.1}.-replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
\text{Sheap}_{funcstart\_1032,1}.\text{p1}, 177).\text{rem})))).\text{p2}) < (int)0))) + \text{temp2})
\rightarrow [evaluate dereferenced pointer into modified heap]
[1.9] -32768 \le ((30307 *
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asType<int>(static_cast<integer>(static_cast<signed int>(([this.$r
== this.$r.value(heapIs heapIs _{funcstart\_1032,1})._replace(p1 \rightarrow (-2 *
div(\mathbf{heapIs} \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
\text{Sheap}_{funcstart\_1032,1}.p1, 177).quot) + (171 * div(heapIs \text{Sheap}_{funcstart\_1032,1},
this.r.value(heapIs \ heap_{funcstart\_1032.1}).p1, 177).rem)), []:
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p2) < (int)0)) + temp2)
→ [explicitly assert falsehood of skipped guards in subsequent guards]
[1.10] -32768 \le ((30307 *
asType < int > (static\_cast < integer > (static\_cast < signed int > (([this.$r
== this.$r]: this.$r.value(heapIs \rho_{tncstart 1032.1})._replace(p1 \rightarrow (-2 *
div(\mathbf{heapIs} \$ heap_{funcstart\_1032.1}, \mathbf{this.}\$r.\mathbf{value}(\mathbf{heapIs})
\text{Sheap}_{funcstart\_1032.1}.p1, 177).quot) + (171 * div(heapIs \text{Sheap}_{funcstart\_1032.1},
\mathbf{this.\$r.value(heapIs}\ \$heap_{funcstart\_1032,1}).p1,\ 177).rem)),\ [!(\mathbf{this.\$r}==
this.$r.value(heapIs \rho_{funcstart\_1032,1}).p2) < (int)0))) +
temp2)
\rightarrow [simplify]
[1.17] -32768 \leq ((30307 * asType<int>(static_cast<integer>(0 <
-\mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}\ \$\mathrm{heap}_{funcstart\_1032,1}).\mathrm{p2}))) + \mathrm{temp2})
\rightarrow [from term 24.0, literala < -this.$r.value(heapIs $heap_{funcstart\_1032.1}).p2
is false whenever -2 < (0 + literala)
   Proof of rule precondition:
   [1.17.0] - 2 < (0 + 0)
   \rightarrow [simplify]
   [1.17.2] true
[1.18] -32768 < ((30307 * asType<int>(static_cast<integer>(false))) +
temp2)
\rightarrow [simplify]
[1.19] -32768 \le ((30307 * asType < int > (([false]: 1, []: 0))) + temp2)
→ [explicitly assert falsehood of skipped guards in subsequent guards]
[1.20] -32768 \leq ((30307 * asType<int>(([false]: 1, [true]: 0))) + temp2)
\rightarrow [simplify]
[1.23] - 32768 \le (0 + \text{temp2})
\rightarrow [from term 54.18, temp2 is equal to (-35 * div(heapIs $heap_{funcstart\_1032.1},
this.$r.value(heapIs $heap_{funcstart\_1032.1}).p2, 176).quot) + (172 *
div(\mathbf{heapIs} \ \$heap_{funcstart\_1032,1}, \ \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
heap_{funcstart\_1032,1}.p2, 176).rem
[1.24] -32768 \leq (0 + ((-35 * div(heapIs $heap_{funcstart\_1032,1}, 
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p2, 176).quot) + (172 *
```

```
div(\mathbf{heapIs} \$ heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
heap_{funcstart\_1032,1}.p2, 176).rem)
\rightarrow [simplify]
[1.28] -32769 < ((-35 * div(heapIs $heap<sub>funcstart_1032,1</sub>, this.$r.value(heapIs)
\text{Sheap}_{funcstart\_1032,1}.p2, 176).quot) + (172 * div(heapIs \text{Sheap}_{funcstart\_1032,1},
this.r.value(heapIs $heap_{funcstart\_1032,1}).p2, 176).rem))
\rightarrow [from term 55.4, literala < ((-35 * div(heapIs $heap_{funcstart\_1032,1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p2, \ 176).quot) + (172 \ *funcstart\_1032,1)
div(\textbf{heapIs}~\$heap_{funcstart\_1032,1},~\textbf{this.}\$r.\textbf{value}(\textbf{heapIs}
heap_{funcstart\_1032,1}.p2, 176).rem is true whenever (-1 + literala) < -32769
   Proof of rule precondition:
   [1.28.0] (-32769 + -1) < -32769
   \rightarrow [simplify]
   [1.28.2] true
[1.29] true
Proof of verification condition: Type constraint satisfied in implicit
conversion from 'signed int' to 'P2Type'
In the context of class: WHPrang, declared at:
C:\Escher\Customers\prang-cpp\prang.cpp (18,1)
Condition generated at: C:\Escher\Customers\prang-cpp\prang.cpp
(78,16)
Condition defined at:
To prove: (($heap<sub>1032,1:1051,8</sub>.M2 *
asType < int > (static\_cast < integer > (static\_cast < signed)
int>(operator^*(heapIs \$heap_{1032,1;1051,8}, this).p2) < (int)(0))) + temp(2) \le int>(operator^*(heapIs \$heap_{1032,1;1051,8}, this).p2) < (int)(0))) + temp(0)
maxof(signed int)
Given:
heap_{init}.LIMIT == (int)80
heap_{init}.class WHPrang \in M1 == (int)30269
heap_{init}.class WHPrang \in r1 == (int)171
heap_{init}.class WHPrang \in a1 == (int)177
heap_{init}.class WHPrang \in b1 == (int)2
\text{$heap}_{init}.\mathbf{class} \text{ WHPrang} \in M2 == (\mathbf{int})30307
heap_{init}.class WHPrang \in r2 == (int)172
heap_{init}.class WHPrang \in a2 == (int)176
```

```
heap_{init}.class WHPrang \in b2 == (int)35
heap_{init}.class WHPrang \in M3 == (int)30323
heap_{init}.class WHPrang \in r3 == (int)170
heap_{init}.class WHPrang \in a3 == (int)178
heap_{init}.class WHPrang \in b3 == (int)63
\operatorname{div1} == \operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_1032,1},
static_cast<int>(operator*(heapIs $heap_{funcstart\_1032.1}, this).p1),
\mathbf{static\_cast} < \mathbf{int} > (\$ \mathbf{heap}_{funcstart\_1032,1}.\mathbf{a1}))
(asType < integer > (static\_cast < int > (operator*(heapIs)))
heap_{funcstart = 1032.1}, this .p1)
\mathbf{asType} {<} \mathbf{integer} {>} (\mathbf{static\_cast} {<} \mathbf{int} {>} (\$ \mathbf{heap}_{funcstart\_1032,1}.\mathbf{a1}))) = =
asType<integer>(div1.quot)
(asType < integer > (static\_cast < int > (operator*(heapIs)))
heap_{funcstart\_1032,1}, this).p1) %
asType < integer > (static\_cast < int > (\$heap_{funcstart\_1032.1}.a1))) = =
asType<integer>(div1.rem)
(asType < integer > (operator*(heapIs $heap_{funcstart\_1032,1}, this).p1) < footnote{the content of the conte
asType < integer > (\$heap_{funcstart\_1032,1}.a1)) = >
(asType<integer>(div1.rem) == asType<integer>(operator*(heapIs
heap_{funcstart\_1032,1}, this).p1)
(\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathsf{heap}_{funcstart\_1032,1}.\mathsf{a1}) \leq
\mathbf{asType}{<}\mathbf{integer}{>}(\mathbf{operator*}(\mathbf{heapIs}\ \$\mathbf{heap}_{funcstart\_1032,1},\ \mathbf{this}).\mathbf{p1})) =>
!(0 == asType < integer > (div1.quot))
!(0 == asType < integer > (div1.rem)) || !(0 ==
asType<integer>(div1.quot))
\operatorname{div2} == \operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_1032,1},
\mathbf{static\_cast} {<} \mathbf{int} {>} (\mathbf{operator^*(heapIs}\ \$heap_{funcstart\_1032,1},\ \mathbf{this}).p2),
\mathbf{static\_cast}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_1032,1}.\mathrm{a2}))
(asType<integer>(static_cast<int>(operator*(heapIs
heap_{funcstart\_1032.1}, this).p2)
asType < integer > (static\_cast < int > (\$heap_{funcstart\_1032,1}.a2))) = =
asType<integer>(div2.quot)
(asType<integer>(static_cast<int>(operator*(heapIs
heap_{funcstart\_1032,1}, this).p2)
asType < integer > (static\_cast < int > (\$heap_{funcstart\_1032,1}.a2))) = =
asType<integer>(div2.rem)
(\mathbf{asType}{<}\mathbf{integer}{>}(\mathbf{operator}^*(\mathbf{heapIs}\ \$\mathbf{heap}_{funcstart\_1032,1},\ \mathbf{this}).\mathbf{p2})<
asType < integer > (\$heap_{funcstart\_1032,1}.a2)) = >
(asType<integer>(div2.rem) == asType<integer>(operator*(heapIs
heap_{funcstart\_1032,1}, this).p2)
```

```
(asType < integer > (\$heap_{funcstart\_1032,1}.a2) \le
asType < integer > (operator*(heapIs $heap_{funcstart\_1032,1}, this).p2)) = >
!(0 == asType < integer > (div2.quot))
!(0 == asType < integer > (div2.rem)) || !(0 ==
asType<integer>(div2.quot))
div3 == div(\mathbf{heapIs} \$ heap_{funcstart\_1032,1},
static\_cast < int > (operator*(heapIs $heap_{funcstart\_1032,1}, this).p3),
\mathbf{static\_cast}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_1032,1}.\mathrm{a3}))
(asType < integer > (static\_cast < int > (operator*(heapIs
heap_{funcstart\_1032,1}, this).p3) /
asType < integer > (static\_cast < int > (\$heap_{funcstart\_1032.1}.a3))) = =
asType<integer>(div3.quot)
(asType<integer>(static_cast<int>(operator*(heapIs
heap_{funcstart\_1032,1}, this).p3)
asType < integer > (static\_cast < int > (\$heap_{funcstart\_1032,1}.a3))) = =
asType<integer>(div3.rem)
(asType<integer>(operator*(heapIs $heap_{tuncstart\_1032.1}, this).p3) <
asType < integer > (\$heap_{funcstart\_1032,1}.a3)) = >
(asType<integer>(div3.rem) == asType<integer>(operator*(heapIs
heap_{funcstart\_1032.1}, this).p3)
(asType < integer > (\$heap_{funcstart\_1032,1}.a3) \le
\mathbf{asType} < \mathbf{integer} > (\mathbf{operator}^*(\mathbf{heapIs} \ \$ \mathbf{heap}_{funcstart\_1032,1}, \ \mathbf{this}).\mathrm{p3})) = >
!(0 == asType < integer > (div3.quot))
!(0 == asType < integer > (div3.rem)) || !(0 ==
asType<integer>(div3.quot))
temp1 == (\$heap_{funcstart\_1032,1}.r1 * static\_cast < signed int > (div1.rem)) -
($heap_tuncstart_1032.1.b1 * static_cast<signed int>(div1.quot))
minof(signed int) < temp1
temp1 \le maxof(signed int)
\$ heap_{1032,1;1051,8} == \$ heap_{funcstart\_1032,1}.\_\mathbf{replace}(\mathbf{this}.\$r \rightarrow \texttt{prop})
\mathbf{operator}^*(\mathbf{heapIs}~\$ \mathrm{heap}_{funcstart\_1032,1},~\mathbf{this}).\_\mathbf{replace}(\mathrm{p1} \rightarrow
asType < P1Type > ((\$heap_{funcstart\_1032,1}.M1 *
asType<int>(static_cast<integer>(static_cast<signed
int>(operator^*(heapIs \$heap_{funcstart\_1032,1}, this).p1) < (int)0))) +
temp1)))
temp2 == (\$heap_{1032,1;1051,8}.r2 * static\_cast < signed int > (div2.rem)) -
(\text{\$heap}_{1032,1;1051,8}.\text{b2} * \textbf{static\_cast} < \textbf{signed int} > (\text{div}2.\text{quot}))
minof(signed\ int) \le temp2
temp2 \le maxof(signed int)
```

Proof:

```
[Take given term]
[2.0] div1 == div(heapIs $heap<sub>funcstart_1032,1</sub>,
static_cast<int>(operator*(heapIs $heap_{funcstart\_1032,1}, this).p1),
\mathbf{static\_cast}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_1032,1}.\mathrm{a1}))
→ [expand definition of operator '*' in class 'pointer' at built in declaration]
[2.1] \operatorname{div1} == \operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_1032,1},
static\_cast < int > (this. r.value(heapIs  heap_{funcstart\_1032,1}).p1),
static\_cast < int > (\$heap_{funcstart\_1032.1}.a1))
\rightarrow [simplify]
[2.2] \text{ div1} == \text{div(heapIs } \text{$heap}_{funcstart\_1032,1}, \text{this.} \text{$r.value(heapIs)}
\theta_{funcstart\_1032,1}, p1, static_cast<int>(\theta_{funcstart\_1032,1})
\rightarrow [const static or extern object]
[2.3] \text{ div1} == \text{div(heapIs } \text{$heap}_{funcstart\_1032,1}, \text{this.} \text{$r.value(heapIs)$}
\theta_{uncstart\_1032.1}.p1, static_cast<int>(\theta_{unit}.a1))
\rightarrow [expand definition of constant 'a1' at prang.cpp (30,26)]
[2.4] \text{ div1} == \text{div}(\text{heapIs } \text{$heap}_{funcstart\_1032,1}, \text{this.}\text{$r.value}(\text{heapIs})
\theta_{funcstart\_1032,1}.p1, \theta_{funcstart\_1032,1}.p1, \theta_{funcstart\_1032,1}.p1, \theta_{funcstart\_1032,1}.p1, \theta_{funcstart\_1032,1}.p1, \theta_{funcstart\_1032,1}.p2, \theta_{funcstart\_1032,1}.p2, \theta_{funcstart\_1032,1}.p2, \theta_{funcstart\_1032,1}.p2, \theta_{funcstart\_1032,1}.p2, \theta_{funcstart\_1032,1}.p3, \theta_{funcstart\_1032,1}.p4, \theta_{funcstart\_1032,1}.p4, \theta_{funcstart\_1032,1}.p4, \theta_{funcstart\_1032,1}.p4, \theta_{funcstart\_1032,1}.p4, \theta_{funcstart\_1032,1}.p5, \theta_{funcstart\_1032,1
\rightarrow [simplify]
[2.6] \operatorname{div1} == \operatorname{div}(\mathbf{heapIs} \ \mathbf{\$heap}_{funcstart\_1032,1}, \ \mathbf{this}.\mathbf{\$r.value}(\mathbf{heapIs})
heap_{funcstart_{-1032,1}}.p1, 177
[Assume known post-assertion, class invariant or type constraint for term 2.6]
[7.0] (0 < asType<integer>(this.$r.value(heapIs
\verb§heap$_{funcstart\_1032,1}).p1)) \&\& (\mathbf{asType} < \mathbf{integer} > (\mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}))) \&\& (\mathbf{asType} < \mathbf{integer} > (\mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})))) \&\& (\mathbf{asType} < \mathbf{integer} > (\mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})))) \&\& (\mathbf{asType} < \mathbf{integer} > (\mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})))) \&\& (\mathbf{asType} < \mathbf{integer} > (\mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}))))) \&\& (\mathbf{asType} < \mathbf{integer} > (\mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})))) \&\& (\mathbf{asType} < \mathbf{integer} > (\mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}))))) \&\& (\mathbf{asType} < \mathbf{integer} > (\mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}))))) \&\& (\mathbf{asType} < \mathbf{integer} > (\mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})))) \&\& (\mathbf{asType} < \mathbf{integer} > (\mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}))))) \&\& (\mathbf{asType} < \mathbf{integer} > (\mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}))))) \&\& (\mathbf{asType} < \mathbf{integer} > (\mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})))))) \&\& (\mathbf{asType} < \mathbf{integer} > (\mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}))))))
\$ heap_{funcstart\_1032,1}).p1) < \mathbf{asType} < \mathbf{integer} > (\$ heap.\mathbf{class} \ WHPrang \in \texttt{Constart} = \texttt{Constart}
M1))
\rightarrow [simplify]
[7.2] (0 < this.$r.value(heapIs \rho_{funcstart\_1032,1}).p1) &&
(this.$r.value(heapIs \theta_{funcstart\_1032,1}).p1 <
asType < integer > (\$heap.class WHPrang \in M1))
\rightarrow [const static or extern object]
[7.3] (0 < this.$r.value(heapIs heap_{funcstart\_1032,1}).p1) &&
(this.r.value(heapIs $heap_{funcstart\_1032,1}).p1 <
asType < integer > (\$heap_{init}.class WHPrang \in M1))
\rightarrow [expand definition of constant 'M1' at prang.cpp (28,26)]
[7.4] (0 < this.$r.value(heapIs \theta_{funcstart\_1032,1}).p1) &&
(this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1 <
```

```
asType < integer > ((int)30269))
\rightarrow [simplify]
[7.10] (-30269 < -this.$r.value(heap
Is \rho_{funcstart\_1032,1}).p1) <math display="inline">\land (0 <
this.r.value(heapIs $heap_{funcstart\_1032,1}).p1)
[Work on sub-term 2 of conjunction in term 7.10]
[8.0] 0 < this.$r.value(heapIs $heap<sub>funcstart_1032,1</sub>).p1
[Take given term]
[18.0] \operatorname{div2} == \operatorname{div}(\mathbf{heapIs} \ \operatorname{\$heap}_{funcstart\_1032,1},
static_cast<int>(operator*(heapIs $heap_{funcstart\_1032,1}, this).p2),
static\_cast < int > (\$heap_{funcstart\_1032,1}.a2))
→ [expand definition of operator '*' in class 'pointer' at built in declaration]
[18.1] div2 == div(heapIs heap_{funcstart\_1032,1},
static_cast<int>(this.$r.value(heapIs $heap_{funcstart\_1032,1}).p2),
\mathbf{static\_cast}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_1032,1}.\mathrm{a2}))
\rightarrow [simplify]
[18.2] \text{ div2} == \text{div}(\text{heapIs } \text{$heap}_{funcstart\_1032,1}, \text{this.}\text{$r.value}(\text{heapIs})
\theta_{funcstart\_1032,1}.p2, \theta_{funcstart\_1032,1}.p2, \theta_{funcstart\_1032,1}.a2))
\rightarrow [const static or extern object]
[18.3] div2 == div(\mathbf{heapIs} \ \hat{\mathbf{s}}_{heap} \mathbf{I}_{sat}, \mathbf{this.} \hat{\mathbf{s}}_{r.} \mathbf{value}(\mathbf{heapIs})
\$ heap_{funcstart\_1032,1}).p2, \ \mathbf{static\_cast} < \mathbf{int} > (\$ heap_{init}.a2))
\rightarrow [expand definition of constant 'a2' at prang.cpp (35,26)]
[18.4] \text{ div2} == \text{div}(\mathbf{heapIs} \$ \mathbf{heap}_{funcstart\_1032,1}, \mathbf{this.\$r.value}(\mathbf{heapIs}))
\theta_{funcstart\_1032,1}.p2, \theta_{funcstart\_1032,1
\rightarrow [simplify]
[18.6] div2 == div(heapIs $heap<sub>funcstart_1032,1</sub>, this.$r.value(heapIs)
heap_{funcstart\_1032,1}.p2, 176)
[Assume known post-assertion, class invariant or type constraint for term 18.6]
[23.0] (0 < asType<integer>(this.$r.value(heapIs
\verb§heap$_{funcstart\_1032,1}).p2)) \&\& (\mathbf{asType} < \mathbf{integer} > (\mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}))) \&\& (\mathbf{asType} < \mathbf{integer} > (\mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})))) \&\& (\mathbf{asType} < \mathbf{integer} > (\mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})))) \&\& (\mathbf{asType} < \mathbf{integer} > (\mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})))) \&\& (\mathbf{asType} < \mathbf{integer} > (\mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})))))
\label{eq:continuous_function} \$ \operatorname{heap}_{funcstart\_1032,1}).p2) < \mathbf{asType} < \mathbf{integer} > (\$ \operatorname{heap}.\mathbf{class} \ \mathrm{WHPrang} \in \mathbb{R}^{n})
M2))
\rightarrow [simplify]
[23.2] (0 < this.$r.value(heap
Is \rho_{uncstart\_1032,1}).p2) &&
(this.r.value(heapIs $heap_{funcstart\_1032,1}).p2 <
asType < integer > (\text{$heap.class WHPrang} \in M2))
\rightarrow [const static or extern object]
```

```
[23.3] (0 < this.$r.value(heap
Is \rho_{uncstart\_1032,1}).p2) &&
(this.$r.value(heapIs \theta_{funcstart\_1032,1}).p2 <
asType < integer > (\$heap_{init}.class WHPrang \in M2))
\rightarrow [expand definition of constant 'M2' at prang.cpp (33,26)]
[23.4] (0 < this.$r.value(heapIs heap_{funcstart\_1032,1}).p2) &&
(this.r.value(heapIs $heap_{funcstart\_1032,1}).p2 <
asType < integer > ((int)30307))
\rightarrow [simplify]
[23.10] (-30307 < -this.$r.value(heapIs $heap_{funcstart\_1032.1}).p2) \land (0 <
this.r.value(heapIs $heap_{funcstart\_1032,1}).p2)
[Work on sub-term 2 of conjunction in term 23.10]
[24.0] 0 < this.$r.value(heapIs $heap_{tuncstart\_1032.1}).p2
[Take given term]
[50.0]\;((\$heap_{funcstart\_1032,1}.r1\;*\;\textbf{static\_cast}{<}\textbf{signed int}{>}(\text{div}1.rem))\;-
($heap_tuncstart_1032.1.b1 * static_cast<signed int>(div1.quot))) == temp1
\rightarrow [const static or extern object]
[50.1] (($heap<sub>init</sub>.r1 * static_cast<signed int>(div1.rem)) -
(\text{sheap}_{funcstart\_1032,1}.\text{b1} * \text{static\_cast} < \text{signed int} > (\text{div1.quot}))) == \text{temp1}
\rightarrow [expand definition of constant 'r1' at prang.cpp (29,26)]
[50.2] (((int)171 * static_cast<signed int>(div1.rem)) -
(\$heap_{funcstart\_1032,1}.b1 * \textbf{static\_cast} < \textbf{signed int} > (div1.quot))) == temp1
\rightarrow [simplify]
[50.3] ((171 * static_cast < signed int > (div1.rem)) - ($heap_{funcstart\_1032,1}.b1
* static_cast<signed int>(div1.quot))) == temp1
\rightarrow [from term 2.6, div1 is equal to div(heapIs $heap_{funcstart\_1032,1},
\mathbf{this.}\$r.\mathbf{value}(\mathbf{heapIs}~\$heap_{funcstart\_1032,1}).p1,~177)]
[50.4] ((171 * static_cast<signed int>(div(heapIs heap_{funcstart\_1032,1},
this.r.value(heapIs \$heap_{funcstart\_1032,1}).p1, 177).rem)) -
(\text{sheap}_{funcstart\_1032,1}.\text{b1} * \text{static\_cast} < \text{signed int} > (\text{div1.quot}))) == \text{temp1}
\rightarrow [simplify]
[50.5] ((171 * div(heapIs $heap_{funcstart\_1032,1}, this.$r.value(heapIs)
\text{Sheap}_{funcstart\_1032,1}.p1, 177).rem) - (\text{Sheap}_{funcstart\_1032,1}.b1 *
static_cast<signed int>(div1.quot))) == temp1
\rightarrow [const static or extern object]
[50.6] ((171 * \mathrm{div}(\mathbf{heapIs}\ \$\mathrm{heap}_{funcstart\_1032,1},\ \mathbf{this}.\$\mathrm{r.value}(\mathbf{heapIs}
\theta_{funcstart\_1032,1}.p1, 177).rem – (\theta_{funcstart\_1032,1}.p1, 177).rem) – (\theta_{funcstart\_1032,1}.p1, 177).rem)
int>(div1.quot))) == temp1
```

```
\rightarrow [expand definition of constant 'b1' at prang.cpp (31,26)]
[50.7] ((171 * div(heapIs $heap<sub>funcstart_1032.1</sub>, this.$r.value(heapIs
\theta_{funcstart\_1032,1}.p1, 177).rem) - ((int)2 * static_cast<signed
int>(div1.quot))) == temp1
\rightarrow [simplify]
[50.8] ((171 * div(heapIs $heap_{funcstart\_1032,1}, this.$r.value(heapIs)]
\theta_{funcstart\_1032,1}.p1, 177).rem – (2 * static_cast<signed)
int>(div1.quot)) == temp1
\rightarrow [from term 2.6, div1 is equal to div(heapIs $heap_{funcstart\_1032,1},
this.$r.value(heapIs $heap_{funcstart\_1032,1}).p1, 177)]
[50.9] ((171 * div(heapIs \$heap_{funcstart\_1032,1}, this.\$r.value(heapIs
\theta_{funcstart\_1032,1}.p1, 177).rem) - (2 * static_cast<signed
int>(div(heapIs \$heap_{funcstart\_1032,1}, this.\$r.value(heapIs
\text{Sheap}_{funcstart\_1032,1}.\text{p1}, 177).\text{quot}))) == \text{temp1}
\rightarrow [simplify]
[50.14] 0 == (-\text{temp1} + (-2 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177).quot) + (171 *
div(\mathbf{heapIs} \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
heap_{funcstart_{-1032,1}}.p1, 177).rem
[Take given term]
[53.0] \rho_{1032,1;1051,8} == \rho_{1032,1;1051,8} == \rho_{1032,1}.replace(this.$r \to
operator*(heapIs heap_{funcstart\_1032,1}, this)._replace(p1 \rightarrow
asType<P1Type>(($heap_funcstart_1032,1.M1 *
asType<int>(static_cast<integer>(static_cast<signed
int>(operator^*(heapIs \$heap_{funcstart\_1032,1}, this).p1) < (int)0))) +
temp1)))
→ [expand definition of operator '*' in class 'pointer' at built in declaration]
[53.1] \theta_{1032,1;1051,8} == \theta_{1032,1;1051,8} = \theta_{1032,1;1051,8} == \theta
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow
\mathbf{asType}{<}P1\mathsf{Type}{>}((\$\mathsf{heap}_{funcstart\_1032,1}.\mathsf{M1}~*
asType<int>(static_cast<integer>(static_cast<signed
int>(operator^*(heapIs \$heap_{funcstart\_1032,1}, this).p1) < (int)0))) +
temp1)))
\rightarrow [const static or extern object]
[53.2] heap_{1032,1;1051,8} == heap_{funcstart\_1032,1}._replace(this.$r \rightarrow
\textbf{this.}\$r.\textbf{value}(\textbf{heapIs}~\$heap_{funcstart\_1032,1}).\_\textbf{replace}(p1 \rightarrow
asType < P1Type > ((\$heap_{init}.M1 *
asType < int > (static\_cast < integer > (static\_cast < signed
int>(operator^*(heapIs \$heap_{funcstart\_1032,1}, this).p1) < (int)0))) +
temp1)))
```

```
\rightarrow [expand definition of constant 'M1' at prang.cpp (28,26)]
[53.3] $heap<sub>1032,1;1051,8</sub> == $heap<sub>funcstart_1032,1</sub>._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow
asType<P1Type>(((int)30269 *
asType < int > (static\_cast < integer > (static\_cast < signed)
int>(operator^*(heapIs \$heap_{funcstart\_1032,1}, this).p1) < (int)0))) +
temp1)))
\rightarrow [simplify]
[53.4] \theta_{1032,1;1051,8} == \theta_{1032,1;1051,8} = \theta_{1032,1;1051,8} == \theta
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow
asType<P1Type>((30269 *
asType < int > (static\_cast < integer > (static\_cast < signed)
int>(operator*(heapIs $heap_{funcstart\_1032,1}, this).p1) < (int)0))) +
temp1)))
→ [expand definition of operator '*' in class 'pointer' at built in declaration]
[53.5] $heap<sub>1032,1;1051,8</sub> == $heap<sub>funcstart_1032,1</sub>._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow
asType<P1Type>((30269 *
asType{<}int{>}(static\_cast{<}integer{>}(static\_cast{<}signed
int>(this.\$r.value(heapIs \$heap_{funcstart\_1032.1}).p1) < (int)0))) + temp1)))
\rightarrow [simplify]
[53.9] $heap<sub>1032,1;1051,8</sub> == $heap<sub>funcstart_1032,1</sub>._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow
asType<P1Type>((30269 * asType<int>(static_cast<integer>(0 <
-\mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}\ \$\mathrm{heap}_{funcstart\_1032,1}).\mathrm{p1}))) + \mathrm{temp1})))
\rightarrow [from term 8.0, literala < -this.$r.value(heapIs $heap_{funcstart\_1032,1}).p1
is false whenever -2 < (0 + literala)
        Proof of rule precondition:
        [53.9.0] - 2 < (0 + 0)
        \rightarrow [simplify]
        [53.9.2] true
[53.10] $heap<sub>1032,1;1051,8</sub> == $heap<sub>funcstart_1032,1</sub>._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow
asType<P1Type>((30269 * asType<int>(static_cast<integer>(false)))
+ \text{ temp1}))
\rightarrow [simplify]
[53.11] $\text{heap}_{1032,1;1051,8} == $\text{heap}_{funcstart\_1032,1}._\text{replace}(\text{this}.\text{$\frac{1}{2}r$})
\mathbf{this.\$r.value}(\mathbf{heapIs}~\$ \mathrm{heap}_{funcstart\_1032,1}).\_\mathbf{replace}(\mathrm{p1} \rightarrow
asType < P1Type > ((30269 * asType < int > (([false]: 1, []: 0))) + temp1)))
```

```
→ [explicitly assert falsehood of skipped guards in subsequent guards]
[53.12] $heap<sub>1032,1;1051,8</sub> == $heap<sub>funcstart_1032,1</sub>._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow
asType<P1Type>((30269 * asType<int>(([false]: 1, [true]: 0))) +
temp1)))
\rightarrow [simplify]
[53.15] $heap<sub>1032,1;1051,8</sub> == $heap<sub>funcstart_1032,1</sub>._replace(this.$r \rightarrow
\textbf{this.}\$r.\textbf{value}(\textbf{heapIs}~\$heap_{funcstart\_1032,1}).\_\textbf{replace}(p1 \rightarrow
asType < P1Type > (0 + temp1))
\rightarrow [from term 50.14, temp1 is equal to (-2 * div(heapIs $heap_{funcstart\_1032.1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177).quot) + (171 *
div(heapIs $heap_{funcstart_1032.1}, this.$r.value(heapIs
heap_{funcstart\_1032,1}.p1, 177).rem
[53.16] $heap<sub>1032,1;1051,8</sub> == $heap<sub>funcstart_1032,1</sub>._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow
asType<P1Type>(0 + ((-2 * div(heapIs $heap_{funcstart\_1032,1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177).quot) + (171 *
div(\mathbf{heapIs} \$ heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
heap_{funcstart_{1032,1}}.p1, 177).rem))))
\rightarrow [simplify]
[53.19] \theta_{1032,1;1051,8} == \theta_{1032,1;1051,8} == \theta_{1032,1}.replace(this.$r \to
this.$r.value(heapIs \rho_{tuncstart\_1032.1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.} \text{\$r.value}(\text{heapIs}))
heap_{funcstart\_1032,1}.p1, 177.rem)))
[Take given term]
[54.0] (($heap<sub>1032.1:1051.8</sub>.r2 * static_cast<signed int>(div2.rem)) -
(\text{sheap}_{1032,1;1051,8}.\text{b2} * \text{static\_cast} < \text{signed int} > (\text{div2.quot}))) = = \text{temp2}
\rightarrow [from term 53.19, $heap<sub>1032,1;1051,8</sub> is equal to
\$heap_{funcstart\_1032,1}.\_\textbf{replace}(\textbf{this}.\$r \rightarrow \textbf{this}.\$r.\textbf{value}(\textbf{heapIs}
heap_{funcstart\_1032,1}._replace(p1 \rightarrow (-2 * div(heapIs \$heap_{funcstart\_1032,1},
this.r.value(heapIs \ \ heap_{funcstart\_1032,1}).p1, \ 177).quot) + (171 \ \ *
div(heapIs $heap_funcstart_1032.1, this.$r.value(heapIs
heap_{funcstart\_1032,1}.p1, 177).rem)))
[54.1] ((\text{\$heap}_{funcstart\_1032,1}._replace(this.\text{\$r} \to \text{this}.\text{\$r.value}(\text{heapIs})
\text{Sheap}_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs \text{Sheap}_{funcstart\_1032,1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177).quot) + (171 *
div(\mathbf{heapIs} \$ heap_{funcstart\_1032.1}, \mathbf{this.}\$ r. \mathbf{value}(\mathbf{heapIs})
\rho_{tuncstart_1032,1}.p1, 177).rem))).r2 * static_cast < signed
int>(div2.rem)) - (\$heap_{1032.1:1051.8}.b2 * static\_cast < signed)
int>(div2.quot)) = temp2
```

```
\rightarrow [const member of object with modified fields]
[54.2] \; ((\$heap_{funcstart\_1032,1}.r2 * \textbf{static\_cast} < \textbf{signed int} > (\text{div}2.rem)) \; - \\
(\text{sheap}_{1032,1:1051,8}.\text{b2} * \text{static\_cast} < \text{signed int} > (\text{div2.quot}))) == \text{temp2}
\rightarrow [const static or extern object]
[54.3] \; ((\$ heap_{init}.r2 \; * \; \textbf{static\_cast} < \textbf{signed int} > (div2.rem)) \; - \;
(\text{sheap}_{1032,1;1051,8}.\text{b2} * \text{static\_cast} < \text{signed int} > (\text{div2.quot}))) == \text{temp2}
\rightarrow [expand definition of constant 'r2' at prang.cpp (34,26)]
[54.4] (((int)172 * static_cast<signed int>(div2.rem)) -
(\text{sheap}_{1032,1;1051,8}.\text{b2} * \text{static\_cast} < \text{signed int} > (\text{div2.quot}))) == \text{temp2}
\rightarrow [simplify]
[54.5] ((172 * static_cast < signed int > (div2.rem)) - ($heap_{1032.1:1051.8}.b2 *
static_cast<signed int>(div2.quot))) == temp2
\rightarrow [from term 18.6, div2 is equal to div(heapIs $heap_{funcstart\_1032,1},
this.r.value(heapIs $heap_{funcstart\_1032,1}).p2, 176)]
[54.6] ((172 * static_cast<signed int>(div(heapIs $heap_{tuncstart\_1032.1})
this.r.value(heapIs $heap_{funcstart\_1032,1}).p2, 176).rem)) -
(\text{sheap}_{1032,1:1051.8}.\text{b2} * \text{static\_cast} < \text{signed int} > (\text{div2.quot}))) == \text{temp2}
\rightarrow [simplify]
[54.7] ((172 * div(heapIs $heap_{funcstart\_1032,1}, this.$r.value(heapIs
\text{heap}_{funcstart\_1032.1}.p2, 176).rem) - (\text{heap}_{1032.1:1051.8}.b2 *
\mathbf{static\_cast} < \mathbf{signed\ int} > (\mathbf{div2.quot}))) == \mathbf{temp2}
\rightarrow [from term 53.19, $heap<sub>1032,1;1051,8</sub> is equal to
\$heap_{funcstart\_1032,1}.\_\textbf{replace}(\textbf{this}.\$r \rightarrow \textbf{this}.\$r.\textbf{value}(\textbf{heapIs}
heap_{funcstart\_1032,1}._replace(p1 \rightarrow (-2 * div(heapIs p_{funcstart\_1032,1}).
this.$r.value(heapIs $heap_{funcstart\_1032,1}).p1, 177).quot) + (171)^{3}
div(heapIs $heap_{tuncstart\_1032.1}, this.$r.value(heapIs
heap_{funcstart\_1032,1}.p1, 177).rem)))]
[54.8] ((172 * div(heapIs $heap_{funcstart\_1032,1}, this.$r.value(heapIs)]
\rho_{tuncstart\_1032,1}.p2, 176).rem – (\rho_{tuncstart\_1032,1}.peplace(this.r
\rightarrow this.$r.value(heapIs $heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 *
div(\mathbf{heapIs} \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
\text{Sheap}_{funcstart\_1032,1}.p1, 177).quot) + (171 * div(heapIs \text{Sheap}_{funcstart\_1032,1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177).rem)))).b2 *
static_cast<signed int>(div2.quot))) == temp2
\rightarrow [const member of object with modified fields]
[54.9] ((172 * div(heapIs $heap<sub>funcstart_1032,1</sub>, this.$r.value(heapIs)
\text{Sheap}_{funcstart\_1032,1}.p2, 176).rem) - (\text{Sheap}_{funcstart\_1032,1}.b2 *
static_cast<signed int>(div2.quot))) == temp2
\rightarrow [const static or extern object]
```

```
[54.10] ((172 * div(heapIs $heap<sub>funcstart=1032,1</sub>, this.$r.value(heapIs)
\rho_{funcstart\_1032,1}.p2, 176).rem – (\rho_{init}.b2 * static\_cast < signed
\mathbf{int}{>}(\mathrm{div2.quot}))) == \mathrm{temp2}
\rightarrow [expand definition of constant 'b2' at prang.cpp (36,26)]
[54.11] ((172 * div(heapIs $heap_{funcstart\_1032,1}, this.$r.value(heapIs
\rho_{tuncstart=1032.1}.p2, 176).rem - ((int)35 * static_cast < signed)
int>(div2.quot))) == temp2
\rightarrow [simplify]
[54.12] ((172 * div(heapIs $heap_{funcstart\_1032,1}, this.$r.value(heapIs)]
\rho_{tuncstart\_1032.1}, p2, 176).rem) - (35 * static_cast<signed)
int>(div2.quot)) = temp2
\rightarrow [from term 18.6, div2 is equal to div(heapIs $heap_{funcstart\_1032,1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p2, 176)]
[54.13] ((172 * div(heapIs $heap<sub>funcstart_1032,1</sub>, this.$r.value(heapIs
\theta_{funcstart\_1032,1}.p2, 176).rem - (35 * static\_cast < signed)
int>(div(heapIs \$heap_{funcstart\_1032,1}, this.\$r.value(heapIs
heap_{funcstart_1032,1}.p2, 176).quot)) = temp2
\rightarrow [simplify]
[54.18] 0 == (-\text{temp2} + (-35 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1},
this.r.value(heapIs \ensuremath{\$}heap_{funcstart\_1032,1}).p2, 176).quot) + (172 *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_1032,1}, \ \mathbf{this}.\$ r. \mathbf{value}(\mathbf{heapIs}
heap_{funcstart_{-1032.1}}.p2, 176).rem
[Take given term]
[56.0] temp2 \leq maxof(signed int)
\rightarrow [simplify]
[56.9] - 32768 < -\text{temp}2
\rightarrow [from term 54.18, temp2 is equal to (-35 * div(heapIs $heap_{funcstart\_1032,1},
div(heapIs $heap_{funcstart\_1032.1}, this.$r.value(heapIs
heap_{funcstart\_1032,1}.p2, 176).rem
[56.10] -32768 < -((-35 * div(heapIs $heap_{funcstart\_1032,1},
this.$r.value(heapIs heap_{funcstart\_1032,1}).p2, 176).quot) + (172 *
div(\mathbf{heapIs} \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
heap_{funcstart_{1032,1}}.p2, 176).rem)
\rightarrow [simplify]
[56.13] -32768 < ((35 * div(heapIs $heap_{funcstart\_1032,1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p2, 176).quot) + (-172 *
div(\mathbf{heapIs} \$heap_{funcstart\_1032.1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
heap_{funcstart_{1032,1}}.p2, 176).rem
```

```
[Take goal term]
[1.0] (($heap<sub>1032.1:1051.8</sub>.M2 *
asType<int>(static_cast<integer>(static_cast<signed
int>(operator^*(heapIs $heap_{1032.1:1051.8}, this).p2) < (int)0))) + temp2) \le
maxof(signed int)
\rightarrow [from term 53.19, $heap<sub>1032.1:1051.8</sub> is equal to
\$heap_{funcstart\_1032,1}.\_\textbf{replace}(\textbf{this}.\$r \rightarrow \textbf{this}.\$r.\textbf{value}(\textbf{heapIs}
heap_{funcstart\_1032,1}._replace(p1 \rightarrow (-2 * div(heapIs \$heap_{funcstart\_1032,1}, -2))
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177).quot) + (171 *
div(heapIs $heap_{tuncstart\_1032,1}, this.$r.value(heapIs)
heap_{funcstart\_1032,1}.p1, 177).rem)))
[1.1] \; ((\$ heap_{funcstart\_1032,1}.\_\textbf{replace}(\textbf{this}.\$r \rightarrow \textbf{this}.\$r.\textbf{value}(\textbf{heapIs}
\text{Sheap}_{funcstart\_1032.1})._replace(p1 \rightarrow ((-2 * div(heapIs \text{Sheap}_{funcstart\_1032.1}),
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177).quot) + (171 * funcstart\_1032,1).p1
div(heapIs $heap<sub>funcstart_1032.1</sub>, this.$r.value(heapIs
heap_{funcstart\_1032,1}.p1, 177).rem))).M2 *
asType < int > (static\_cast < integer > (static\_cast < signed
\mathbf{int} > (\mathbf{operator}^*(\mathbf{heapIs}\ \$ \mathrm{heap}_{1032,1;1051,8},\ \mathbf{this}).\mathrm{p2}) < (\mathbf{int})0))) + \mathrm{temp2}) \leq
maxof(signed int)
\rightarrow [const member of object with modified fields]
[1.2] (($heap<sub>funcstart_1032,1</sub>.M2 *
asType<int>(static_cast<integer>(static_cast<signed
int>(operator^*(heapIs \$heap_{1032,1;1051,8}, this).p2) < (int)(0))) + temp(2) \le int>(operator^*(heapIs \$heap_{1032,1;1051,8}, this).p2) < (int)(0)))
maxof(signed int)
\rightarrow [const static or extern object]
[1.3] (($heap<sub>init</sub>.M2 *
asType<int>(static_cast<integer>(static_cast<signed
int>(operator^*(heapIs $heap_{1032.1:1051.8}, this).p2) < (int)0))) + temp2) \le
maxof(signed int)
\rightarrow [expand definition of constant 'M2' at prang.cpp (33,26)]
[1.4] (((int)30307 *
asType<int>(static_cast<integer>(static_cast<signed
int>(operator^*(heapIs \$heap_{1032,1;1051,8}, this).p2) < (int)(0))) + temp(2) \le int>(operator^*(heapIs \$heap_{1032,1;1051,8}, this).p2) < (int)(0)))
maxof(signed int)
\rightarrow [simplify]
[1.5] ((30307 * asType<int>(static_cast<integer>(static_cast<signed)
int>(operator^*(heapIs $heap_{1032,1:1051.8}, this).p2) < (int)0))) + temp2) \le
maxof(signed int)
\rightarrow [from term 53.19, heap_{1032,1;1051,8} is equal to
heap_{funcstart\_1032,1}._replace(this.r \rightarrow this.r.value(heapIs)
heap_{funcstart\_1032,1}._replace(p1 \rightarrow (-2 * div(heapIs $heap_{funcstart\_1032,1},
```

```
div(\mathbf{heapIs} \ \$heap_{funcstart\_1032,1}, \ \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
heap_{funcstart\_1032,1}.p1, 177).rem)))]
{\it [1.6]}~((30307~* {\it asType}{<} {\it int}{>} ({\it static\_cast}{<} {\it integer}{>} ({\it static\_cast}{<} {\it signed}
\mathbf{int}{>}(\mathbf{operator^*}(\mathbf{heapIs}\ \$\mathbf{heap}_{funcstart\_1032,1}.\_\mathbf{replace}(\mathbf{this}.\$\mathbf{r}\rightarrow
this.$r.value(heapIs \theta_{funcstart\_1032,1})._replace(p1 \rightarrow (-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.} \text{\$r.value}(\text{heapIs}))
\text{Sheap}_{funcstart\_1032,1}.\text{p1}, 177).\text{rem})), \text{this}.\text{p2}) < (\text{int})0))) + \text{temp2}) \le
maxof(signed int)
→ [expand definition of operator '*' in class 'pointer' at built in declaration]
[1.7] ((30307 * asType<int>(static_cast<integer>(static_cast<signed
\mathbf{int}{>}(\mathbf{this.\$r.value}(\mathbf{heapIs}\ \$\mathbf{heap}_{funcstart\_1032,1}.\_\mathbf{replace}(\mathbf{this.\$r}\ \rightarrow\ 
this.$r.value(heapIs \rho_{tuncstart\_1032.1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{tuncstart\_1032.1}, this.r.value(heapIs \rho_{tuncstart\_1032.1}).p1,
177).quot) + (171 * div(heapIs \rho_{funcstart\_1032,1}, this.r.value(heapIs)
\text{Sheap}_{funcstart_{-1032.1}}.p1, 177).rem))))).p2) < (int)0))) + temp2) \leq
maxof(signed int)
→ [evaluate dereferenced pointer into modified heap]
[1.8] ((30307 * asType<int>(static_cast<integer>(static_cast<signed
int>(([this.$r == this.$r]: this.$r.value(heapIs
heap_{funcstart\_1032,1}._replace(p1 \rightarrow (-2 * div(heapIs heap_{funcstart\_1032,1}),
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177).quot) + (171 * 
div(\mathbf{heapIs} \$ heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
\theta_{funcstart\_1032,1}.p1, 177).rem), [: this.\$r.value(heapIs)
\{\text{heap}_{funcstart\_1032,1})\}.p2) < (\text{int})0))) + temp2) \leq \text{maxof}(\text{signed int})
→ [explicitly assert falsehood of skipped guards in subsequent guards]
[1.9] ((30307 * asType<int>(static_cast<integer>(static_cast<signed
int > (([this.\$r == this.\$r]: this.\$r.value(heapIs)))
\text{Sheap}_{funcstart\_1032.1})._replace(p1 \rightarrow (-2 * div(heapIs \text{Sheap}_{funcstart\_1032.1}),
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177).quot) + (171 *
div(\mathbf{heapIs} \$ heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
\text{Sheap}_{funcstart\_1032,1}.\text{p1}, 177).\text{rem}), [!(this.\$r == this.\$r)]:
this.$r.value(heapIs heap_{funcstart\_1032,1}).p2) < (int)0))) + temp2) \leq
maxof(signed int)
\rightarrow [simplify]
[1.16] ((30307 * asType<int>(static_cast<integer>(0 <
-this.$r.value(heapIs \theta_{tuncstart\_1032,1}).p2))) + temp2) \leq
maxof(signed int)
\rightarrow [from term 24.0, literala < -this.$r.value(heapIs $heap_{funcstart\_1032.1}).p2
is false whenever -2 < (0 + literala)
```

this. $r.value(heapIs \ \ heap_{funcstart_1032,1}).p1, \ 177).quot) + (171 *$

```
Proof of rule precondition:
   [1.16.0] - 2 < (0 + 0)
   \rightarrow [simplify]
   [1.16.2] true
[1.17] ((30307 * asType<int>(static_cast<integer>(false))) + temp2) \leq
maxof(signed int)
\rightarrow [simplify]
[1.18] ((30307 * asType<int>(([false]: 1, []: 0))) + temp2) \leq maxof(signed)
→ [explicitly assert falsehood of skipped guards in subsequent guards]
[1.19] ((30307 * asType<int>(([false]: 1, [true]: 0))) + temp2) <
maxof(signed int)
\rightarrow [simplify]
[1.22] (0 + \text{temp2}) \le \text{maxof(signed int)}
\rightarrow [from term 54.18, temp2 is equal to (-35 * div(heapIs $heap_{funcstart\_1032,1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p2, 176).quot) + (172 *
div(heapIs $heap_{tuncstart\_1032.1}, this.$r.value(heapIs
heap_{funcstart\_1032.1}.p2, 176).rem)
[1.23] (0 + ((-35 * div(heap
Is \rho_{funcstart\_1032,1}, this.\r.value(heap
Is
\text{Sheap}_{funcstart\_1032,1}.p2, 176).quot) + (172 * div(heapIs \text{Sheap}_{funcstart\_1032,1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p2, 176).rem))) \le maxof(signed)
int)
\rightarrow [simplify]
[1.39] -32768 < ((-172 * div(heapIs $heap<sub>funcstart_1032,1</sub>,
this.$r.value(heapIs $heap_{funcstart\_1032,1}).p2, 176).rem) + (35 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p2,
176).quot))
\rightarrow [from term 56.13, literala < ((-172 * div(heapIs $heap_{funcstart\_1032,1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p2, 176).rem) + (35 * div(heapIs)
heap_{funcstart\_1032.1}, this.r.value(heapIs heap_{funcstart\_1032.1}).p2,
176).quot)) is true whenever (-1 + literala) < -32768
   Proof of rule precondition:
   [1.39.0] (-32768 + -1) < -32768
   \rightarrow [simplify]
```

[1.39.2] **true**

[1.40] **true**

```
Proof of verification condition: Arithmetic result of operator '*' is within limit of type 'signed int'
```

In the context of class: WHPrang, declared at: C:\Escher\Customers\prang-cpp\prang.cpp (18,1)

Condition generated at: C:\Escher\Customers\prang-cpp\prang.cpp (80,30)

Condition defined at:

To prove: minof(signed int) \leq (\$heap_{1032,1;1054,8}.r3 * static_cast < signed int > (div3.rem))

Given:

```
heap_{init}.LIMIT == (int)80
heap_{init}.class WHPrang \in M1 == (int)30269
heap_{init}.class WHPrang \in r1 == (int)171
heap_{init}.class WHPrang \in a1 == (int)177
heap_{init}.class WHPrang \in b1 == (int)2
heap_{init}.class WHPrang \in M2 == (int)30307
heap_{init}.class WHPrang \in r2 == (int)172
heap_{init}.class WHPrang \in a2 == (int)176
heap_{init}.class WHPrang \in b2 == (int)35
heap_{init}.class WHPrang \in M3 == (int)30323
heap_{init}.class WHPrang \in r3 == (int)170
heap_{init}.class WHPrang \in a3 == (int)178
heap_{init}.class WHPrang \in b3 == (int)63
\operatorname{div1} == \operatorname{div}(\mathbf{heapIs} \ \operatorname{heap}_{funcstart\_1032.1},
\mathbf{static\_cast} {<} \mathbf{int} {>} (\mathbf{operator*}(\mathbf{heapIs}\ \$ \mathbf{heap}_{funcstart\_1032,1},\ \mathbf{this}). \mathbf{p1}),
static\_cast < int > (\$heap_{funcstart\_1032,1}.a1))
(asType<integer>(static_cast<int>(operator*(heapIs
heap_{funcstart\_1032,1}, this).p1) /
asType < integer > (static\_cast < int > (\$heap_{funcstart\_1032,1}.a1))) = =
asType<integer>(div1.quot)
(asType<integer>(static_cast<int>(operator*(heapIs
heap_{funcstart\_1032,1}, this).p1) %
asType < integer > (static\_cast < int > (\$heap_{funcstart\_1032.1}.a1))) = =
asType<integer>(div1.rem)
(\mathbf{asType}{<}\mathbf{integer}{>}(\mathbf{operator}^*(\mathbf{heapIs}\ \$\mathbf{heap}_{funcstart\_1032,1},\ \mathbf{this}).\mathbf{p1}) <
asType < integer > ($heap_{funcstart\_1032,1}.a1)) = >
```

```
(asType<integer>(div1.rem) == asType<integer>(operator*(heapIs
heap_{funcstart\_1032,1}, this).p1)
(asType < integer > (\$heap_{funcstart\_1032,1}.a1) \le
\mathbf{asType} < \mathbf{integer} > (\mathbf{operator}^*(\mathbf{heapIs} \ \$ \mathbf{heap}_{funcstart\_1032,1}, \ \mathbf{this}).\mathtt{p1})) = >
!(0 == asType < integer > (div1.quot))
!(0 == asType < integer > (div1.rem)) || !(0 ==
asType<integer>(div1.quot))
div2 == div(\mathbf{heapIs} \$heap_{funcstart\_1032,1},
\mathbf{static\_cast} < \mathbf{int} > (\mathbf{operator}^*(\mathbf{heapIs}\ \$ \mathbf{heap}_{funcstart\_1032,1},\ \mathbf{this}).\mathbf{p2}),
\mathbf{static\_cast}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_1032,1}.\mathrm{a2}))
(\mathbf{asType} {<} \mathbf{integer} {>} (\mathbf{static\_cast} {<} \mathbf{int} {>} (\mathbf{operator}^* (\mathbf{heapIs}
heap_{funcstart_1032,1}, this).p2) /
asType < integer > (static\_cast < int > (\$heap_{funcstart\_1032,1}.a2))) = =
asType<integer>(div2.quot)
(asType < integer > (static\_cast < int > (operator*(heapIs)))
heap_{funcstart\_1032.1}, this).p2)
asType < integer > (static\_cast < int > (\$heap_{funcstart\_1032.1}.a2))) = =
asType<integer>(div2.rem)
(\mathbf{asType}{<}\mathbf{integer}{>}(\mathbf{operator}^*(\mathbf{heapIs}\ \$\mathbf{heap}_{funcstart\_1032,1},\ \mathbf{this}).\mathtt{p2}) <
asType < integer > ($heap_{funcstart\_1032,1}.a2)) = >
(asType<integer>(div2.rem) == asType<integer>(operator*(heapIs
heap_{funcstart\_1032,1}, this).p2)
(asType < integer > (\$heap_{funcstart\_1032,1}.a2) \le
\mathbf{asType} < \mathbf{integer} > (\mathbf{operator}^*(\mathbf{heapIs} \ \$ \mathbf{heap}_{funcstart\_1032,1}, \ \mathbf{this}).\mathtt{p2})) = >
!(0 == asType < integer > (div2.quot))
!(0 == asType < integer > (div2.rem)) || !(0 ==
asType<integer>(div2.quot))
div3 == div(\mathbf{heapIs} \$ heap_{funcstart\_1032,1},
\mathbf{static\_cast} < \mathbf{int} > (\mathbf{operator}^*(\mathbf{heapIs}\ \$ \mathbf{heap}_{funcstart\_1032,1},\ \mathbf{this}).\mathbf{p3}),
\mathbf{static\_cast}{<}\mathbf{int}{>}(\$\mathbf{heap}_{funcstart\_1032,1}.\mathbf{a3}))
(asType < integer > (static\_cast < int > (operator^*(heapIs))) \\
heap_{funcstart\_1032,1}, this).p3)
asType<integer>(static_cast<int>($heap_{funcstart_1032.1}.a3))) ==
asType<integer>(div3.quot)
(asType < integer > (static\_cast < int > (operator*(heapIs)))
heap_{funcstart\_1032,1}, this).p3)
\mathbf{asType} \small{<} \mathbf{integer} \small{>} (\mathbf{static\_cast} \small{<} \mathbf{int} \small{>} (\$ \mathbf{heap}_{funcstart\_1032,1}.\mathbf{a3}))) = =
asType<integer>(div3.rem)
(\mathbf{asType}{<}\mathbf{integer}{>}(\mathbf{operator}^*(\mathbf{heapIs}\ \$\mathbf{heap}_{funcstart\_1032,1},\ \mathbf{this}).\mathrm{p3}) <
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathrm{heap}_{funcstart\_1032,1}.\mathrm{a3})) =>
(asType<integer>(div3.rem) == asType<integer>(operator*(heapIs
```

```
heap_{funcstart_1032,1}, this).p3)
(asType < integer > (\$heap_{funcstart\_1032,1}.a3) \le
asType<integer>(operator*(heapIs $heap_{funcstart\_1032,1}, this).p3)) =>
!(0 == asType < integer > (div3.quot))
!(0 == asType < integer > (div3.rem)) || !(0 ==
asType<integer>(div3.quot))
temp1 == (\$heap_{funcstart\_1032,1}.r1 * \textbf{static\_cast} < \textbf{signed int} > (div1.rem)) - (div1.rem) + (div1.r
(\text{sheap}_{funcstart\_1032,1}.\text{b1 * static\_cast} < \text{signed int} > (\text{div1.quot}))
minof(signed int) < temp1
temp1 \le maxof(signed int)
heap_{1032,1;1051,8} == heap_{funcstart\_1032,1}._replace(this.r \rightarrow replace)
operator*(heapIs heap_{funcstart\_1032,1}, this)._replace(p1 \rightarrow
asType<P1Type>(($heap_tuncstart_1032,1.M1 *
asType<int>(static_cast<integer>(static_cast<signed
int>(operator^*(heapIs \$heap_{funcstart\_1032,1}, this).p1) < (int)0))) +
temp1)))
temp2 == (\$heap_{1032,1:1051,8}.r2 * static\_cast < signed int > (div2.rem)) -
(\text{sheap}_{1032,1:1051.8}.\text{b2} * \text{static\_cast} < \text{signed int} > (\text{div}2.\text{quot}))
minof(signed\ int) \le temp2
temp2 \le maxof(signed int)
heap_{1032,1;1054,8} == heap_{1032,1;1051,8}._replace(this.$r \rightarrow
operator*(heapIs heap_{1032,1;1051,8}, this)._replace(p2 \rightarrow
asType<P2Type>(($heap<sub>1032.1:1051.8</sub>.M2 *
asType<int>(static_cast<integer>(static_cast<signed
int>(operator^*(heapIs \$heap_{1032,1;1051,8}, this).p2) < (int)(0))) + temp(2)))
Proof:
[Take given term]
[2.0] div1 == div(heapIs heap_{funcstart\_1032,1},
\mathbf{static\_cast} < \mathbf{int} > (\mathbf{operator}^*(\mathbf{heapIs} \ \$ \mathbf{heap}_{funcstart\_1032,1}, \ \mathbf{this}).\mathtt{p1}),
\mathbf{static\_cast}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_1032,1}.\mathrm{a1}))
→ [expand definition of operator '*' in class 'pointer' at built in declaration]
[2.1] \operatorname{div1} == \operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_1032,1},
static\_cast < int > (this. r.value(heapIs  heap_{funcstart\_1032,1}).p1),
static\_cast < int > (\$heap_{funcstart\_1032,1}.a1))
\rightarrow [simplify]
[2.2]~{\rm div1} == {\rm div}(\mathbf{heapIs}~\$ \mathrm{heap}_{funcstart\_1032,1},~\mathbf{this}.\$ \mathrm{r.value}(\mathbf{heapIs}
\theta_{funcstart\_1032,1}.p1, \theta_{funcstart\_1032,1}.p1, \theta_{funcstart\_1032,1}.a1))
\rightarrow [const static or extern object]
```

```
[2.3] \operatorname{div1} == \operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_1032,1}, \mathbf{this}.\$ \mathbf{r.value}(\mathbf{heapIs})
\theta_{nit}.a1).p1, \theta_{nit}.a1
\rightarrow [expand definition of constant 'a1' at prang.cpp (30,26)]
[2.4] \text{ div1} == \text{div(heapIs } \text{$heap}_{funcstart\_1032,1}, \text{ this.} \text{$r.value(heapIs)}
\theta_{funcstart\_1032,1}.p1, \theta_{funcstart\_1032,1}.p1, \theta_{funcstart\_1032,1}.p1
\rightarrow [simplify]
[2.6] div1 == div(heapIs heap_{funcstart\_1032,1}, this.r.value(heapIs)
heap_{funcstart_{1032,1}}.p1, 177
[Assume known post-assertion, class invariant or type constraint for term 2.6]
[7.0] (0 < asType<integer>(this.$r.value(heapIs
\theta_{funcstart\_1032.1}.p1) && (asType<integer>(this.$r.value(heapIs)
\rho_{funcstart\_1032.1}.p1 < asType<integer>(\rho_{funcstart\_1032.1}.p1) < asType<integer>(\rho_{funcstart\_1032.1}.p1)
M1))
\rightarrow [simplify]
[7.2] (0 < this.\$r.value(heapIs \$heap_{funcstart_1032.1}).p1) &&
(this.r.value(heapIs $heap_{funcstart\_1032.1}).p1 <
asType<integer>($heap.class WHPrang ∈ M1))
\rightarrow [const static or extern object]
[7.3] (0 < this.$r.value(heap
Is \rho_{uncstart\_1032,1}.p1) \
(this.$r.value(heapIs heap_{funcstart\_1032,1}).p1 <
asType < integer > (\$heap_{init}.class WHPrang \in M1))
\rightarrow [expand definition of constant 'M1' at prang.cpp (28,26)]
[7.4] (0 < this.$r.value(heapIs \rho_{funcstart\_1032,1}).p1) &&
(this.r.value(heapIs $heap_{funcstart\_1032,1}).p1 <
asType < integer > ((int)30269))
\rightarrow [simplify]
[7.10] (-30269 < -this.$r.value(heapIs heap_{funcstart\_1032,1}).p1) \land (0 <
this.r.value(heapIs $heap_{funcstart\_1032,1}).p1)
[Work on sub-term 2 of conjunction in term 7.10]
[8.0] 0 < this.$r.value(heapIs \theta_{funcstart\_1032,1}).p1
[Take given term]
[18.0] div2 == div(heapIs heap_{funcstart\_1032,1},
\mathbf{static\_cast} < \mathbf{int} > (\mathbf{operator}^*(\mathbf{heapIs} \ \$ \mathbf{heap}_{funcstart\_1032,1}, \ \mathbf{this}).\mathtt{p2}),
static\_cast < int > (\$heap_{funcstart\_1032,1}.a2))
→ [expand definition of operator '*' in class 'pointer' at built in declaration]
[18.1] \operatorname{div2} == \operatorname{div}(\mathbf{heapIs} \ \text{$heap}_{funcstart\_1032,1},
static\_cast < int > (this.\$r.value(heapIs \$heap_{funcstart\_1032,1}).p2),
```

```
\mathbf{static\_cast} {<} \mathbf{int} {>} (\$ \mathbf{heap}_{funcstart\_1032,1}.\mathbf{a2}))
\rightarrow [simplify]
[18.2] \operatorname{div2} == \operatorname{div}(\mathbf{heapIs} \ \mathbf{\$heap}_{funcstart\_1032,1}, \ \mathbf{this}.\mathbf{\$r.value}(\mathbf{heapIs})
\theta_{funcstart\_1032,1}.p2, \theta_{funcstart\_1032,1}.p2, \theta_{funcstart\_1032,1}.a2))
\rightarrow [const static or extern object]
[18.3] \operatorname{div2} == \operatorname{div}(\mathbf{heapIs} \ \text{$heap}_{funcstart\_1032,1}, \ \mathbf{this}.\text{$r.value}(\mathbf{heapIs})
\theta_{funcstart\_1032,1}.p2, \theta_{funcstart\_1032,1
\rightarrow [expand definition of constant 'a2' at prang.cpp (35,26)]
[18.4] \text{ div2} == \text{div}(\text{heapIs } \text{$heap}_{funcstart\_1032,1}, \text{this.}\text{$r.value}(\text{heapIs})
\theta_{tuncstart\_1032.1}.p2, \theta_{tuncstart} = \theta
\rightarrow [simplify]
 [18.6] div2 == div(heapIs $heap_{funcstart\_1032,1}, this.$r.value(heapIs)
heap_{funcstart_{-1032,1}}.p2, 176
[Assume known post-assertion, class invariant or type constraint for term 18.6]
[23.0] (0 < asType<integer>(this.$r.value(heapIs
\$ heap_{funcstart\_1032,1}).p2)) \ \&\& \ (\textbf{asType} < \textbf{integer} > (\textbf{this}.\$r.\textbf{value}(\textbf{heapIs}))) \ \&\& \ (\textbf{asType} < \textbf{integer} > (\textbf{this}.\$r.\textbf{value}))
\rho_{funcstart\_1032,1}.p2 < asType<integer>(\rho_{funcstart\_1032,1}.p2) < asType<integer>(\rho_{funcstart\_1032,1}.p2)
M2))
\rightarrow [simplify]
[23.2] (0 < this.$r.value(heap
Is \rho_{funcstart\_1032,1}).p2) &&
(this.$r.value(heap
Is \rho_{funcstart\_1032,1}).p2 <
asType < integer > (\$heap.class WHPrang \in M2))
\rightarrow [const static or extern object]
[23.3] (0 < this.$r.value(heapIs heap_{funcstart\_1032,1}).p2) &&
(this.$r.value(heapIs \rho_{funcstart\_1032,1}).p2 <
asType < integer > (\$heap_{init}.class WHPrang \in M2))
\rightarrow [expand definition of constant 'M2' at prang.cpp (33,26)]
[23.4] (0 < this.$r.value(heapIs $heap_{funcstart\_1032,1}).p2) &&
(this.$r.value(heapIs \theta_{funcstart\_1032,1}).p2 <
asType < integer > ((int)30307))
\rightarrow [simplify]
[23.10] (-30307 < -this.$r.value(heapIs $heap_{funcstart\_1032,1}).p2) \land (0 <
this.r.value(heapIs $heap_{funcstart\_1032,1}).p2)
[Work on sub-term 2 of conjunction in term 23.10]
[24.0] 0 < this.$r.value(heapIs $heap_{funcstart\_1032,1}).p2
[Take given term]
```

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[34.0] div3 == div(heapIs $heap_{funcstart\_1032,1},
\mathbf{static\_cast} < \mathbf{int} > (\mathbf{operator}^*(\mathbf{heapIs} \ \$ \mathbf{heap}_{funcstart\_1032,1}, \ \mathbf{this}).\mathbf{p3}),
\mathbf{static\_cast}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_1032,1}.\mathrm{a3}))
→ [expand definition of operator '*' in class 'pointer' at built in declaration]
[34.1] \operatorname{div3} == \operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_1032,1},
static\_cast < int > (this. r.value(heapIs  heap_{funcstart\_1032,1}).p3),
\mathbf{static\_cast}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_1032,1}.\mathrm{a3}))
\rightarrow [simplify]
[34.2] div3 == div(heapIs $heap<sub>funcstart_1032,1</sub>, this.$r.value(heapIs)
\label{eq:cast_int} $$ \theta_{funcstart\_1032,1}.p3, \ \mathbf{static\_cast} < \mathbf{int} > (\$ \theta_{funcstart\_1032,1}.a3)) $$
\rightarrow [const static or extern object]
[34.3] div3 == div(heapIs $heap<sub>funcstart_1032,1</sub>, this.$r.value(heapIs)
\label{eq:cast} $$ \theta_{funcstart\_1032,1}.p3, \ \mathbf{static\_cast} < \mathbf{int} > (\theta_{init}.a3))$ 
\rightarrow [expand definition of constant 'a3' at prang.cpp (40,26)]
[34.4] div3 == div(heapIs $heap_{tuncstart\_1032.1}, this.$r.value(heapIs)
\theta_{funcstart\_1032,1}.p3, \theta_{funcstart\_1032,1}.p4, \theta_{funcstart\_1032,1}.p4, \theta_{funcstart\_1032,1}.p4, \theta_{funcstart\_1032,1}.p5, \theta_{funcstart\_1032,1}.p5, \theta_{funcstart\_1032,1}.p5, \theta_{funcstart\_1032,1}.p5, \theta_{funcstart\_1032,1}.p5, \theta_{funcstart\_1032,1}.p5, \theta_{funcstart\_1032,1}.p5, \theta_{funcstart\_1032,1}.p5, \theta_{funcstart\_1032,1
\rightarrow [simplify]
[34.6] div3 == div(heapIs heapIs  heap_{funcstart\_1032,1}, this.r.value(heapIs)
heap_{funcstart_{1032,1}}.p3, 178
[Assume known post-assertion, class invariant or type constraint for term 34.6]
[39.0] (0 < asType<integer>(this.$r.value(heapIs
$heap_funcstart_1032.1).p3)) && (asType<integer>(this.$r.value(heapIs
\$heap_{funcstart\_1032,1}).p3) < \mathbf{asType} < \mathbf{integer} > (\$heap.\mathbf{class} \ WHPrang \in \texttt{Constart} = \texttt{Constart} =
M3))
\rightarrow [simplify]
[39.2] (0 < this.$r.value(heap
Is $heap_{funcstart\_1032,1}).p3) &&
(this.$r.value(heapIs \theta_{funcstart\_1032,1}).p3 <
asType < integer > (\text{$heap.class WHPrang} \in M3))
\rightarrow [const static or extern object]
[39.3] (0 < this.$r.value(heap
Is \rho_{uncstart\_1032,1}).p3) &&
(this.$r.value(heapIs heap_{funcstart\_1032,1}).p3 <
asType < integer > (\$heap_{init}.class WHPrang \in M3))
\rightarrow [expand definition of constant 'M3' at prang.cpp (38,26)]
[39.4] (0 < this.$r.value(heap
Is \rho_{uncstart\_1032,1}).p3) &&
(this.$r.value(heapIs \theta_{funcstart\_1032,1}).p3 <
asType < integer > ((int)30323))
\rightarrow [simplify]
```

```
[39.10] (-30323 < -this.$r.value(heap
Is \rho_{uncstart\_1032,1}).p3) <math display="inline">\land (0 <
this.r.value(heapIs $heap_{funcstart\_1032,1}).p3)
[Work on sub-term 2 of conjunction in term 39.10]
[40.0]~0 < {\bf this.\$r.value(heap Is}~\$heap_{funcstart\_1032,1}).p3
[Assume known post-assertion, class invariant or type constraint for term 34.6]
[42.0] (asType<integer>(this.$r.value(heapIs $heap_{funcstart\_1032,1}).p3) \%
asType<integer>(178)) == asType<integer>(div(heapIs
\rho_{funcstart\_1032.1}, this.r.value(heapIs \rho_{funcstart\_1032.1}).p3,
178).rem)
\rightarrow [simplify]
[42.2] (this.$r.value(heapIs heap_{funcstart\_1032,1}).p3 % 178) ==
\mathbf{asType}{<}\mathbf{integer}{>}(\text{div}(\mathbf{heapIs}\ \$\text{heap}_{funcstart\_1032,1},\ \mathbf{this}.\$\mathbf{r}.\mathbf{value}(\mathbf{heapIs}\ \texttt{heap})
heap_{funcstart\_1032,1}.p3, 178).rem
\rightarrow [expand definition of operator '.%' in class 'int' at built in declaration]
[42.3] ([asType<integer>(this.$r.value(heapIs $heap_{tuncstart\_1032.1}).p3) <
0]: -(-asType<integer>(this.$r.value(heapIs \rho_{funcstart\_1032,1}).p3) %
178), []: asType<integer>(this.$r.value(heapIs $heap_{funcstart\_1032,1}).p3)
\% 178) == asType<integer>(div(heapIs $heap_{funcstart\_1032,1},)
this.r.value(heapIs $heap_{funcstart\_1032,1}).p3, 178).rem)
→ [explicitly assert falsehood of skipped guards in subsequent guards]
[42.4] \; ([\mathbf{asType} < \mathbf{integer} > (\mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs} \; \$ \mathbf{heap}_{funcstart\_1032,1}).\mathbf{p3}) < \mathbf{page}) \\
0]: -(-asType < integer > (this.\$r.value(heapIs \$heap_{funcstart\_1032,1}).p3) \%
178), [!(asType<integer>(this.$r.value(heapIs \rho_{tart_1032,1}).p3) <
0)]: asType<integer>(this.$r.value(heapIs $heap_{funcstart\_1032.1}).p3) %
178) == asType < integer > (div(heapIs $heap_{funcstart\_1032,1},
this.r.value(heapIs $heap_{funcstart\_1032,1}).p3, 178).rem)
\rightarrow [simplify]
[42.7] ([0 < -this.$r.value(heapIs \rho_{funcstart\_1032,1}).p3]:
-(-asType < integer > (this.\$r.value(heapIs \$heap_{funcstart\_1032,1}).p3) \%
178), [!(asType<integer>(this.r.value(heapIs \heap_{funcstart\_1032,1}).p3) <
0)]: asType<integer>(this.$r.value(heapIs \rho_{uncstart\_1032,1}).p3) %
178) == asType < integer > (div(heapIs $heap_{funcstart\_1032,1},
this.r.value(heapIs $heap_{funcstart\_1032.1}).p3, 178).rem)
\rightarrow [from term 40.0, literala < -this.$r.value(heapIs $heap_{funcstart\_1032.1}).p3
is false whenever -2 < (0 + literala)
   Proof of rule precondition:
   [42.7.0] - 2 < (0 + 0)
   \rightarrow [simplify]
```

```
[42.7.2] true
[42.8] ([false]: -(-asType<integer>(this.$r.value(heapIs
$heap_funcstart_1032,1).p3) % 178), [!(asType<integer>(this.$r.value(heapIs
\verb§heap$_{funcstart\_1032,1}).p3) < 0)]: \textbf{ asType} < \textbf{integer} > (\textbf{this}.\$r.\textbf{value}(\textbf{heapIs})))
\theta_{funcstart\_1032.1}.p3) % 178) == asType<integer>(div(heapIs
\rho_{tuncstart\_1032.1}, this.r.value(heapIs \rho_{tuncstart\_1032.1}).p3,
178).rem)
\rightarrow [simplify]
[42.11] ([false]: -(-asType<integer>(this.$r.value(heapIs
\theta_{funcstart\_1032,1}).p3)~\%~178),~[!(0<-{\bf this}.\r.value({\bf heapIs})]
[heap_{funcstart\_1032.1}]: asType<integer>(this.r.value(heapIs)
\theta_{funcstart\_1032,1}.p3) \% 178 = asType < integer > (div(heapIs))
\rho_{tuncstart\_1032.1}, this.r.value(heapIs \rho_{tuncstart\_1032.1}).p3,
178).rem)
\rightarrow [from term 40.0, literala < -this.$r.value(heapIs $heap_{funcstart\_1032.1}).p3
is false whenever -2 < (0 + literala)
   Proof of rule precondition:
   [42.11.0] - 2 < (0 + 0)
   \rightarrow [simplify]
   [42.11.2] true
[42.12] ([false]: -(-asType<integer>(this.$r.value(heapIs
\rho_{funcstart\_1032,1}.p3)~\%~178), [!false]:
asType<integer>(this.$r.value(heapIs $heap_{funcstart\_1032,1}).p3) % 178)
== asType < integer > (div(heapIs $heap_{funcstart\_1032,1},
this.r.value(heapIs $heap_{funcstart\_1032,1}).p3, 178).rem)
\rightarrow [simplify]
[42.17] 0 == (-\text{div}(\mathbf{heapIs} \$ \mathbf{heap}_{funcstart\_1032,1}, \mathbf{this}.\$ \mathbf{r.value}(\mathbf{heapIs}))
\$heap_{funcstart\_1032,1}).p3,\ 178).rem + (\textbf{this}.\$r.\textbf{value}(\textbf{heapIs}
heap_{funcstart_{1032,1}}.p3 \% 178)
[Take given term]
[50.0] (({\rm sheap}_{funcstart\_1032,1}.r1 * static\_cast < signed int > (div1.rem)) -
(\text{sheap}_{funcstart\_1032,1}.\text{b1 * static\_cast} < \text{signed int} > (\text{div1.quot}))) = \text{temp1}
\rightarrow [const static or extern object]
[50.1] (($heap<sub>init</sub>.r1 * static_cast<signed int>(div1.rem)) -
(\$heap_{funcstart\_1032,1}.b1 * \mathbf{static\_cast} < \mathbf{signed\ int} > (\text{div1.quot}))) == \text{temp1}
\rightarrow [expand definition of constant 'r1' at prang.cpp (29,26)]
[50.2] (((int)171 * static_cast<signed int>(div1.rem)) -
(\text{sheap}_{funcstart\_1032.1}.\text{b1 * static\_cast} < \text{signed int} > (\text{div1.quot}))) == \text{temp1}
```

```
\rightarrow [simplify]
[50.3] ((171 * static_cast < signed int > (div1.rem)) - (partial = 1000) - (partial = 1000)
* static_cast < signed int > (div1.quot))) == temp1
\rightarrow [from term 2.6, div1 is equal to div(heapIs $heap_{funcstart\_1032,1},
this.r.value(heapIs $heap_{funcstart\_1032,1}).p1, 177)]
[50.4] ((171 * static_cast<signed int>(div(heapIs \theta_{funcstart\_1032,1}),
this.r.value(heapIs $heap_{funcstart\_1032,1}).p1, 177).rem)) -
(\text{sheap}_{funcstart\_1032,1}.\text{b1} * \text{static\_cast} < \text{signed int} > (\text{div1.quot}))) == \text{temp1}
\rightarrow [simplify]
[50.5] ((171 * \mathrm{div}(\mathbf{heapIs}\ \$\mathrm{heap}_{funcstart\_1032,1},\ \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}\ 
\text{Sheap}_{funcstart\_1032,1}.p1, 177).rem) - (\text{Sheap}_{funcstart\_1032,1}.b1 *
static_cast<signed int>(div1.quot))) == temp1
\rightarrow [const static or extern object]
[50.6] ((171 * div(heapIs $heap<sub>funcstart_1032,1</sub>, this.$r.value(heapIs)
\rho_{uncstart\_1032,1}.p1, 177).rem – (\rho_{uncstart\_1032,1}.p1, 177).rem) – (\rho_{uncstart\_1032,1}.p1, 177).rem) – (\rho_{uncstart\_1032,1}.p1, 177).rem)
int>(div1.quot)) == temp1
\rightarrow [expand definition of constant 'b1' at prang.cpp (31,26)]
[50.7] ((171 * div(heapIs \rho_{funcstart\_1032,1}, this.r.value(heapIs)
\theta_{uncstart\_1032,1}.p1, 177).rem - ((int)2 * static\_cast < signed)
int>(div1.quot)) == temp1
\rightarrow [simplify]
[50.8] ((171 * \operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_1032,1}, \ \mathbf{this}.\$ r. \mathbf{value}(\mathbf{heapIs})
\theta_{funcstart\_1032,1}.p1, 177).rem) - (2 * static_cast<signed)
int>(div1.quot))) == temp1
\rightarrow [from term 2.6, div1 is equal to div(heapIs $heap_{funcstart\_1032,1},
this.r.value(heapIs \ heap_{funcstart\_1032.1}).p1, 177)
[50.9] ((171 * div(heapIs $heap<sub>funcstart_1032,1</sub>, this.$r.value(heapIs)
\theta_{funcstart\_1032,1}.p1, 177).rem) - (2 * static_cast<signed)
int>(div(heapIs \$heap_{tuncstart\_1032.1}, this.\$r.value(heapIs
\text{Sheap}_{funcstart\_1032,1}).p1, 177).quot))) == temp1
\rightarrow [simplify]
[50.14] 0 == (-\text{temp1} + (-2 * \text{div}(\text{heapIs } \text{$heap}_{funcstart\_1032.1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177).quot) + (171 *
div(\mathbf{heapIs} \$ heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
heap_{funcstart\_1032,1}.p1, 177).rem
[Take given term]
[53.0] $\text{heap}_{1032,1;1051,8} == $\text{heap}_{funcstart\_1032,1}._\text{replace}(\text{this}.\text{$\frac{1}{2}r$})
```

operator*(heapIs $heap_{funcstart_1032,1}$, this)._replace(p1 \rightarrow

```
asType<P1Type>(($heap<sub>funcstart_1032.1</sub>.M1 *
asType<int>(static_cast<integer>(static_cast<signed
int>(operator^*(heapIs \$heap_{funcstart\_1032,1}, this).p1) < (int)0))) +
temp1)))
→ [expand definition of operator '*' in class 'pointer' at built in declaration]
[53.1] \theta_{1032,1;1051,8} == \theta_{1032,1;1051,8} = \theta_{1032,1;1051,8} == \theta
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow
asType < P1Type > ((\$heap_{funcstart\_1032,1}.M1 *
asType<int>(static_cast<integer>(static_cast<signed
int>(operator^*(heapIs \$heap_{tuncstart 1032.1}, this).p1) < (int)0))) +
temp1)))
\rightarrow [const static or extern object]
[53.2] heap_{1032,1;1051,8} == heap_{funcstart\_1032,1}.\_replace(this.\$r \rightarrow this)
\textbf{this.}\$r.\textbf{value}(\textbf{heapIs}~\$heap_{funcstart\_1032,1}).\_\textbf{replace}(p1 \rightarrow
asType < P1Type > ((\$heap_{init}.M1 *
asType<int>(static_cast<integer>(static_cast<signed
int>(operator*(heapIs $heap_{funcstart\_1032,1}, this).p1) < (int)0))) +
temp1)))
\rightarrow [expand definition of constant 'M1' at prang.cpp (28,26)]
[53.3] heap_{1032,1;1051,8} == heap_{funcstart\_1032,1}._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow
asType<P1Type>(((int)30269 *
asType<int>(static_cast<integer>(static_cast<signed
int>(operator^*(heapIs \$heap_{funcstart\_1032,1}, this).p1) < (int)0))) +
temp1)))
\rightarrow [simplify]
[53.4] heap_{1032,1;1051,8} == heap_{funcstart\_1032,1}._replace(this.r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow
asType<P1Type>((30269 *
as Type < int > (static\_cast < integer > (static\_cast < signed))
int>(operator^*(heapIs \$heap_{funcstart\_1032,1}, this).p1) < (int)0))) +
temp1)))
→ [expand definition of operator '*' in class 'pointer' at built in declaration]
[53.5] heap_{1032,1;1051,8} == heap_{funcstart\_1032,1}._replace(this.$r \rightarrow
\mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}~\$heap_{funcstart\_1032,1}).\_\mathbf{replace}(p1 \rightarrow
asType<P1Type>((30269 *
asType<int>(static_cast<integer>(static_cast<signed
int>(this.\$r.value(heapIs \$heap_{funcstart\_1032,1}).p1) < (int)0))) + temp1)))
\rightarrow [simplify]
[53.9] heap_{1032,1;1051,8} == heap_{funcstart\_1032,1}._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow
```

```
asType<P1Type>((30269 * asType<int>(static_cast<integer>(0 <
-\mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}\ \$\mathrm{heap}_{funcstart\_1032,1}).\mathrm{p1}))) + \mathrm{temp1})))
\rightarrow [from term 8.0, literala < -this.$r.value(heapIs $heap_{funcstart\_1032.1}).p1
is false whenever -2 < (0 + literala)
    Proof of rule precondition:
    [53.9.0] - 2 < (0 + 0)
    \rightarrow [simplify]
    [53.9.2] true
[53.10] $heap<sub>1032,1;1051,8</sub> == $heap<sub>funcstart_1032,1</sub>._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow
\mathbf{asType} \hspace{-0.05cm} < \hspace{-0.05cm} \text{P1Type} \hspace{-0.05cm} > \hspace{-0.05cm} ((30269 * \mathbf{asType} \hspace{-0.05cm} < \hspace{-0.05cm} \mathbf{int} \hspace{-0.05cm} > \hspace{-0.05cm} (\mathbf{static\_cast} \hspace{-0.05cm} < \hspace{-0.05cm} \mathbf{integer} \hspace{-0.05cm} > \hspace{-0.05cm} (\mathbf{false})))
+ temp1)))
\rightarrow [simplify]
[53.11] \theta_{1032,1;1051,8} == \theta_{1032,1;1051,8} == \theta_{1032,1}.replace(this.$r \to
this.$r.value(heapIs heap_{funcstart\_1032.1})._replace(p1 \rightarrow
asType < P1Type > ((30269 * asType < int > (([false]: 1, []: 0))) + temp1)))
→ [explicitly assert falsehood of skipped guards in subsequent guards]
[53.12] \$ heap_{1032,1;1051,8} == \$ heap_{funcstart\_1032,1}.\_\mathbf{replace}(\mathbf{this}.\$ r \rightarrow \texttt{replace})
\mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}~\$\mathrm{heap}_{funcstart\_1032,1}).\_\mathbf{replace}(\mathrm{p1}\to
temp1)))
\rightarrow [simplify]
[53.15] $heap<sub>1032,1;1051,8</sub> == $heap<sub>funcstart_1032,1</sub>._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow
asType < P1Type > (0 + temp1))
\rightarrow [from term 50.14, temp1 is equal to (-2 * div(heapIs $heap_{funcstart\_1032,1},
this.r.value(heapIs \ heap_{funcstart\_1032.1}).p1, 177).quot) + (171 *
div(\mathbf{heapIs} \ \$heap_{funcstart\_1032,1}, \ \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
heap_{funcstart_{1032,1}}.p1, 177).rem
[53.16] \ \$ heap_{1032,1;1051,8} == \$ heap_{funcstart\_1032,1}.\_\mathbf{replace}(\mathbf{this}.\$ r \rightarrow \texttt{replace})
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow
asType < P1Type > (0 + ((-2 * div(heapIs $heap_{funcstart\_1032,1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177).quot) + (171 *
div(\mathbf{heapIs} \$ heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
heap_{funcstart_{1032.1}}.p1, 177).rem))))
\rightarrow [simplify]
[53.19] $heap<sub>1032.1:1051.8</sub> == $heap<sub>funcstart_1032.1</sub>._replace(this.$r \rightarrow
this.$r.value(heapIs \rho_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{tuncstart\_1032.1}, this.r.value(heapIs \rho_{tuncstart\_1032.1}).p1,
```

```
177).quot) + (171 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.} \text{\$r.value}(\text{heapIs}))
heap_{funcstart\_1032,1}.p1, 177.rem)))
[Take given term]
[54.0] \; ((\$ heap_{1032,1;1051,8}.r2 \; * \; \textbf{static\_cast} < \textbf{signed int} > (\text{div}2.rem)) \; - \;
(\text{sheap}_{1032,1:1051.8}.\text{b2} * \text{static\_cast} < \text{signed int} > (\text{div2.quot}))) == \text{temp2}
\rightarrow [from term 53.19, $heap<sub>1032,1;1051,8</sub> is equal to
\$heap_{funcstart\_1032,1}.\_\textbf{replace}(\textbf{this}.\$r \rightarrow \textbf{this}.\$r.\textbf{value}(\textbf{heapIs}
$\text{heap}_{funcstart_1032,1}$._\text{replace}(p1 \to (-2 * \div(\text{heapIs} $\text{sheap}_{funcstart_1032,1}).
this.r.value(heapIs\ \$heap_{funcstart\_1032,1}).p1,\ 177).quot) + (171 *
div(\mathbf{heapIs} \ \$heap_{funcstart\_1032,1}, \ \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
heap_{funcstart\_1032.1}.p1, 177).rem)))]
[54.1] ((\text{heap}_{funcstart\_1032.1}._replace(this.\text{r} \to \text{this}.\text{r.value}(\text{heapIs})
\text{Sheap}_{funcstart\_1032,1}._replace(p1 \rightarrow ((-2 * div(heapIs \text{Sheap}_{funcstart\_1032,1},
\mathbf{this.\$r.value(heapIs}\ \$heap_{funcstart\_1032,1}).p1,\ 177).quot) + (171\ *
div(\mathbf{heapIs} \$ heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
\theta_{funcstart\_1032,1}.p1, 177).rem))).r2 * static_cast < signed
int>(div2.rem)) - (\$heap_{1032,1;1051,8}.b2 * static\_cast < signed
int > (div2.quot))) == temp2
\rightarrow [const member of object with modified fields]
[54.2]\;((\$heap_{funcstart\_1032,1}.r2\;*\;\textbf{static\_cast} < \textbf{signed int} > (\text{div}2.rem))\;-
(\text{sheap}_{1032,1:1051,8}.\text{b2} * \text{static\_cast} < \text{signed int} > (\text{div2.quot}))) == \text{temp2}
\rightarrow [const static or extern object]
[54.3] (($heap<sub>init</sub>.r2 * static_cast<signed int>(div2.rem)) -
(\text{sheap}_{1032,1:1051,8}.\text{b2} * \text{static\_cast} < \text{signed int} > (\text{div2.quot}))) == \text{temp2}
\rightarrow [expand definition of constant 'r2' at prang.cpp (34,26)]
[54.4] (((int)172 * static_cast<signed int>(div2.rem)) -
(\text{sheap}_{1032,1:1051.8}.\text{b2} * \text{static\_cast} < \text{signed int} > (\text{div2.quot}))) == \text{temp2}
\rightarrow [simplify]
[54.5] ((172 * static_cast<signed int>(div2.rem)) - ($heap_{1032.1:1051.8}.b2 *
static_cast<signed int>(div2.quot))) == temp2
\rightarrow [from term 18.6, div2 is equal to div(heapIs $heap_{funcstart\_1032,1},
this.r.value(heapIs $heap_{funcstart\_1032,1}).p2, 176)
[54.6] ((172 * static_cast<signed int>(div(heapIs $heap_{funcstart\_1032,1},
this.r.value(heapIs $heap_{funcstart\_1032,1}).p2, 176).rem)) -
(\text{sheap}_{1032,1;1051,8}.\text{b2} * \text{static\_cast} < \text{signed int} > (\text{div2.quot}))) == \text{temp2}
\rightarrow [simplify]
[54.7] ((172 * div(heapIs \$heap_{funcstart\_1032,1}, this.\$r.value(heapIs
\text{Sheap}_{funcstart\ 1032\ 1}.p2, 176).rem) - (\text{Sheap}_{1032\ 1\cdot1051\ 8}.b2 *
static_cast<signed int>(div2.quot))) == temp2
```

```
\rightarrow [from term 53.19, $heap<sub>1032.1:1051.8</sub> is equal to
\$heap_{funcstart\_1032,1}.\_\textbf{replace}(\textbf{this}.\$r \rightarrow \textbf{this}.\$r.\textbf{value}(\textbf{heapIs}
heap_{funcstart\_1032,1}._replace(p1 \rightarrow (-2 * div(heapIs p_{funcstart\_1032,1}).
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, \ 177).quot) + (171)
div(heapIs $heap_funcstart_1032.1, this.$r.value(heapIs
heap_{funcstart\_1032,1}.p1, 177).rem)))
[54.8] ((172 * \mathrm{div}(\mathbf{heapIs}\ \$\mathrm{heap}_{funcstart\_1032,1},\ \mathbf{this}.\$\mathrm{r.value}(\mathbf{heapIs}
\rho_{uncstart\_1032,1}.p2, 176).rem – (\rho_{uncstart\_1032,1}.p2).rem
\rightarrow this.$r.value(heapIs $heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 *
div(\mathbf{heapIs} \$ heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
\text{Sheap}_{funcstart\_1032,1}.p1, 177).quot) + (171 * div(heapIs \text{Sheap}_{funcstart\_1032,1},
this.$r.value(heapIs $heap_{tuncstart_1032.1}).p1, 177).rem)))).b2 *
static_cast<signed int>(div2.quot))) == temp2
\rightarrow [const member of object with modified fields]
[54.9] ((172 * div(heapIs heapIs funcstart_{1032,1}, this.r.value(heapIs funcstart_{1032,1})
\text{Sheap}_{funcstart\_1032,1}.p2, 176).rem) - (\text{Sheap}_{funcstart\_1032,1}.b2 *
static_cast<signed int>(div2.quot))) == temp2
\rightarrow [const static or extern object]
[54.10] ((172 * div(heapIs $heap_{funcstart\_1032,1}, this.$r.value(heapIs
\rho_{tuncstart\_1032.1}.p2, 176).rem) – (\rho_{tuncstart\_1032.1}.p2, 176).rem) – (\rho_{tuncstart\_1032.1}.p2, 176).rem)
int>(div2.quot)) = temp2
\rightarrow [expand definition of constant 'b2' at prang.cpp (36.26)]
[54.11] ((172 * div(heapIs \$heap_{funcstart\_1032,1}, this.\$r.value(heapIs
\rho_{funcstart\_1032,1}.p2, 176).rem - ((int)35 * static\_cast < signed)
int>(div2.quot)) == temp2
\rightarrow [simplify]
[54.12] ((172 * div(heapIs $heap<sub>funcstart_1032.1</sub>, this.$r.value(heapIs)
\theta_{funcstart\_1032,1}.p2, 176).rem - (35 * static\_cast < signed)
int>(div2.quot)) == temp2
\rightarrow [from term 18.6, div2 is equal to div(heapIs $heap_{funcstart\_1032,1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p2, 176)]
[54.13] ((172 * div(heapIs $heap<sub>funcstart_1032,1</sub>, this.$r.value(heapIs
\theta_{tuncstart\_1032.1}.p2, 176).rem) - (35 * static_cast<signed)
int>(div(heapIs \$heap_{funcstart\_1032,1}, this.\$r.value(heapIs
\text{Sheap}_{funcstart\_1032,1}.p2, 176).quot))) == temp2
\rightarrow [simplify]
[54.18] 0 == (-\text{temp2} + (-35 * \text{div}(\text{heapIs } \text{$heap}_{funcstart\_1032,1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p2, 176).quot) + (172 *
div(\mathbf{heapIs} \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
heap_{funcstart\_1032,1}.p2, 176).rem
```

```
[Take given term]
[57.0] $\text{heap}_{1032,1;1054,8} == $\text{heap}_{1032,1;1051,8}._\text{replace}(\text{this}.$\text{$r} \to \text{
operator*(heapIs heap_{1032,1;1051,8}, this)._replace(p2 \rightarrow
asType<P2Type>(($heap<sub>1032,1:1051.8</sub>.M2 *
asType{<}int{>}(static\_cast{<}integer{>}(static\_cast{<}signed
int>(operator^*(heapIs \$heap_{1032,1;1051,8}, this).p2) < (int)(0))) + temp(2)))
\rightarrow [from term 53.19, $heap<sub>1032,1:1051,8</sub> is equal to
$heap_{funcstart\_1032,1}.$_replace(this.$r \rightarrow this.$r.value(heapIs)
heap_{funcstart\_1032.1}._replace(p1 \rightarrow (-2 * div(heapIs p_{funcstart\_1032.1})
this.r.value(heapIs \ \ heap_{funcstart\_1032,1}).p1, \ 177).quot) + (171 \ \ *
div(\mathbf{heapIs}\ \$heap_{funcstart\_1032,1},\ \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}
heap_{funcstart\_1032,1}.p1, 177).rem)))
[57.2] heap_{1032,1;1054,8} == heap_{funcstart\_1032,1}._replace(this.$r \rightarrow
this.$r.value(heapIs $heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{tuncstart\_1032.1}, this.r.value(heapIs \rho_{tuncstart\_1032.1}).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.} \text{\$r.value}(\text{heapIs}))
\rho_{tuncstart\_1032.1}, p_1, 177, p_1, 177).
\theta_{funcstart\_1032,1}._replace(this.r \to this.r.value(heapIs)
heap_{funcstart\_1032,1}._replace(p1 \rightarrow (-2 * div(heapIs p_{funcstart\_1032,1})
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177).quot) + (171 *
div(\mathbf{heapIs} \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
\theta_{tuncstart_{1032,1}}.p1, 177).rem)), this).replace(p2 \rightarrow
asType<P2Type>(($heap<sub>1032,1;1051,8</sub>.M2 *
asType<int>(static_cast<integer>(static_cast<signed
int > (operator^*(heapIs \$heap_{1032,1;1051,8}, this).p2) < (int)0))) + temp2)))
→ [expand definition of operator '*' in class 'pointer' at built in declaration]
[57.3] \theta_{1032,1;1054,8} == \theta_{1032,1;1054,8} = \theta_{1032,1;1054,8} == \theta
this.$r.value(heapIs $heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\$heap_{funcstart\_1032,1},\, \textbf{this}.\$r.\textbf{value}(\textbf{heapIs}\,\,\$heap_{funcstart\_1032,1}).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.}\text{\$r.value}(\text{heapIs}))
\theta_{funcstart\_1032,1}.p1, 177).rem)))).\_replace(this.$r \rightarrow 0
this.$r.value(heapIs heap_{funcstart\_1032,1}._replace(this.$r \rightarrow
\textbf{this.\$r.value}(\textbf{heapIs}~\$\text{heap}_{funcstart\_1032,1}).\_\textbf{replace}(\text{p1} \rightarrow ((-2~*\text{div}(\textbf{heapIs}))))))
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(\mathbf{heapIs} \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}))
\theta_{tuncstart = 1032.1}, p1, 177).rem))))._replace(p2 \rightarrow
asType<P2Type>(($heap<sub>1032,1:1051,8</sub>.M2 *
asType < int > (static\_cast < integer > (static\_cast < signed
int>(operator^*(heapIs \$heap_{1032,1;1051,8}, this).p2) < (int)(0))) + temp(2)))
\rightarrow [evaluate dereferenced pointer into modified heap]
[57.4] $\text{heap}_{1032,1:1054.8} == \text{$heap}_{funcstart\_1032,1}._\text{replace}(\text{this}.\text{$r} \to \text{$}
\textbf{this.}\$r.\textbf{value}(\textbf{heapIs}~\$heap_{funcstart\_1032,1}).\_\textbf{replace}(p1 \rightarrow ((-2~*div(\textbf{heapIs})))))
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
```

```
177).quot) + (171 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.} \text{\$r.value}(\text{heapIs}))
\theta_{uncstart\_1032,1}.p1, 177).rem))))._replace(this.$r \rightarrow ([this.$r == 1]))
this.$r]: this.$r.value(heapIs \rho_{funcstart\_1032,1})._replace(p1 \rightarrow (-2 *
div(\mathbf{heapIs} \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
\text{Sheap}_{funcstart\_1032,1}.p1, 177).quot) + (171 * div(heapIs \text{Sheap}_{funcstart\_1032,1},
this.r.value(heapIs \ heap_{funcstart\_1032.1}).p1, 177).rem)), []:
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p2 \rightarrow
asType<P2Type>(($heap<sub>1032,1:1051,8</sub>.M2 *
asType<int>(static_cast<integer>(static_cast<signed
int>(operator^*(heapIs $heap_{1032,1;1051,8}, this).p2) < (int)(0))) + temp(2)))
→ [explicitly assert falsehood of skipped guards in subsequent guards]
[57.5] heap_{1032,1;1054,8} == heap_{funcstart\_1032,1}._replace(this.$r \rightarrow
this.$r.value(heapIs \frac{1}{2} heap\frac{1}{2} line \frac{1}{2} heap\frac{1}{2} heap\frac{1}{2
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
\hat{r} = \frac{1032,1}{1032,1}.p1, 177.rem)...-replace(this.$r \rightarrow ([this.$r ==
this.$r]: this.$r.value(heapIs \rho_{funcstart\_1032,1})._replace(p1 \rightarrow (-2 *
div(\mathbf{heapIs} \$heap_{funcstart\_1032.1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
\text{Sheap}_{funcstart\_1032,1}.\text{p1}, 177).\text{quot} + (171 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_1032,1},
this.r.value(heapIs \ensuremath{\$}heap_{funcstart\_1032,1}).p1, 177).rem)), [!(this.\ensuremath{\$}r ==
this.$r)]: this.$r.value(heapIs heap_{funcstart\_1032.1}))._replace(p2 \rightarrow
asType<P2Type>(($heap<sub>1032,1:1051,8</sub>.M2 *
asType < int > (static\_cast < integer > (static\_cast < signed)
int > (operator^*(heapIs \$heap_{1032,1;1051,8}, this).p2) < (int)0))) + temp2)))
\rightarrow [simplify]
[57.7] heap_{1032,1;1054,8} == heap_{funcstart\_1032,1}._replace(this.$r \rightarrow
this.$r.value(heapIs \rho_{uncstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.} \text{\$r.value}(\text{heapIs}))
\theta_{funcstart\_1032,1}.p1, 177).rem))))._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\$heap_{funcstart\_1032,1},\, \textbf{this}.\$r.\textbf{value}(\textbf{heapIs}\,\,\$heap_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(\mathbf{heapIs} \ \$heap_{funcstart\_1032,1}, \ \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
heap_{funcstart\_1032,1}.p1, 177).rem)))._replace(p2 \rightarrow
asType<P2Type>(($heap<sub>1032.1:1051.8</sub>.M2 *
asType{<}int{>}(static\_cast{<}integer{>}(static\_cast{<}signed
int>(operator^*(heapIs $heap_{1032,1;1051,8}, this).p2) < (int)(0))) + temp(2)))
\rightarrow [from term 53.19, $heap<sub>1032.1:1051.8</sub> is equal to
$heap_{funcstart\_1032,1}.$_replace(this.$r \rightarrow this.$r.value(heapIs)
heap_{funcstart\_1032,1}._replace(p1 \rightarrow (-2 * div(heapIs heap_{funcstart\_1032,1}),
this.r.value(heapIs heap_{funcstart\_1032,1}).p1, 177).quot) + (171 *
div(\mathbf{heapIs} \ \$heap_{funcstart\_1032,1}, \ \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
heap_{funcstart_{-1032,1}}.p1, 177).rem)))]
```

```
[57.8] heap_{1032,1;1054,8} == heap_{funcstart\_1032,1}._replace(this.r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs \theta_{funcstart\_1032,1}, this.r.value(heapIs)
\theta_{tuncstart\_1032,1}.p1, 177).rem)))).\_replace(this.\$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs heapIs = f_{uncstart_1032,1}, this.r.value(heapIs)
\theta_{funcstart\_1032,1}.p1, 177).rem))._replace(p2 \rightarrow
asType < P2Type > ((\$heap_{funcstart\_1032,1}.\_replace(this.\$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032.1}, this.r.value(heapIs \rho_{funcstart\_1032.1}).p1,
177).quot) + (171 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
heap_{funcstart\_1032,1}.p1, 177).rem))).M2 *
asType<int>(static_cast<integer>(static_cast<signed
int>(operator^*(heapIs $heap_{1032.1:1051.8}, this).p2) < (int)(0))) + temp(2)))
\rightarrow [const member of object with modified fields]
[57.9] heap_{1032,1;1054,8} == heap_{funcstart\_1032,1}._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.\r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs $heap<sub>funcstart_1032.1</sub>, this.$r.value(heapIs
\theta_{funcstart\_1032,1}.p1, 177).rem)))).\_replace(this.\$r \rightarrow 0
\textbf{this.\$r.value}(\textbf{heapIs}~\$ heap_{funcstart\_1032,1}).\_\textbf{replace}(p1 \rightarrow ((-2~*div(\textbf{heapIs}
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{heap}_{funcstart\_1032.1}, \text{this.} \text{$r.value}(\text{heapIs}))
\theta_{funcstart\_1032,1}.p1, 177).rem)))._replace(p2 \rightarrow
asType < P2Type > ((\$heap_{funcstart\_1032,1}.M2 *
asType{<}int{>}(static\_cast{<}integer{>}(static\_cast{<}signed
int>(operator^*(heapIs $heap_{1032,1:1051.8}, this).p2) < (int)(0))) + temp(2)))
\rightarrow [const static or extern object]
[57.10] $heap<sub>1032,1;1054,8</sub> == $heap<sub>funcstart_1032,1</sub>._replace(this.$r \rightarrow
\textbf{this.\$r.value}(\textbf{heapIs}~\$ heap_{funcstart\_1032,1}).\_\textbf{replace}(p1 \rightarrow ((-2~*div(\textbf{heapIs})))))
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
\theta_{funcstart\_1032,1}.p1, 177).rem)))).\_replace(this.\$r \rightarrow 0
\textbf{this.\$r.value}(\textbf{heapIs}~\$ heap_{funcstart\_1032,1}).\_\textbf{replace}(p1 \rightarrow ((-2~*div(\textbf{heapIs})))))
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs $heap<sub>funcstart_1032,1</sub>, this.$r.value(heapIs
\theta_{funcstart\_1032,1}.p1, 177).rem))).\_replace(p2 \rightarrow
asType<P2Type>(($heap<sub>init</sub>.M2 *
asType < int > (static\_cast < integer > (static\_cast < signed
int>(operator^*(heapIs $heap_{1032,1;1051,8}, this).p2) < (int)0))) + temp2)))
\rightarrow [expand definition of constant 'M2' at prang.cpp (33,26)]
```

```
[57.11] $\text{heap}_{1032,1;1054,8} == $\text{heap}_{funcstart\_1032,1}._\text{replace}(\text{this.}\text{$\frac{1}{2}}\text{$\text{constart}_{-1032,1}._\text{$\text{replace}}(\text{this}.\text{$\text{$\text{constart}_{-1032,1}._\text{$\text{constart}_{-1032,1}._\text{$\text{constart}_{-1032,1}._\text{$\text{constart}_{-1032,1}._\text{$\text{constart}_{-1032,1}._\text{$\text{constart}_{-1032,1}._\text{$\text{constart}_{-1032,1}._\text{$\text{constart}_{-1032,1}._\text{$\text{constart}_{-1032,1}._\text{$\text{constart}_{-1032,1}._\text{$\text{constart}_{-1032,1}._\text{$\text{constart}_{-1032,1}._\text{$\text{constart}_{-1032,1}._\text{$\text{constart}_{-1032,1}._\text{$\text{constart}_{-1032,1}._\text{$\text{constart}_{-1032,1}._\text{$\text{constart}_{-1032,1}._\text{$\text{constart}_{-1032,1}._\text{$\text{constart}_{-1032,1}._\text{$\text{constart}_{-1032,1}._\text{$\text{constart}_{-1032,1}._\text{$\text{constart}_{-1032,1}._\text{$\text{constart}_{-1032,1}._\text{$\text{constart}_{-1032,1}._\text{$\text{constart}_{-1032,1}._\text{$\text{constart}_{-1032,1}._\text{$\text{constart}_{-1032,1}._\text{$\text{constart}_{-1032,1}._\text{$\text{constart}_{-1032,1}._\text{$\text{constart}_{-1032,1}._\text{$\text{constart}_{-1032,1}._\text{$\text{constart}_{-1032,1}._\text{$\text{constart}_{-1032,1}._\text{$\text{constart}_{-1032,1}._\text{$\text{constart}_{-1032,1}._\text{$\text{constart}_{-1032,1}._\text{$\text{constart}_{-1032,1}._\text{$\text{constart}_{-1032,1}._\text{$\text{constart}_{-1032,1}._\text{$\text{constart}_{-1032,1}._\text{$\text{constart}_{-1032,1}._\text{$\text{constart}_{-1032,1}._\text{$\text{constart}_{-1032,1}._\text{$\text{constart}_{-1032,1}._\text{$\text{constart}_{-1032,1}._\text{$\text{constart}_{-1032,1}._\text{$\text{constart}_{-1032,1}._\text{$\text{constart}_{-1032,1}._\text{$\text{constart}_{-1032,1}._\text{$\text{constart}_{-1032,1}._\text{$\text{constart}_{-1032,1}._\text{$\text{constart}_{-1032,1}._\text{$\text{constart}_{-1032,1}._\text{$\text{constart}_{-1032,1}._\text{$\text
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs \theta_{funcstart\_1032,1}, this.r.value(heapIs)
\theta_{tuncstart\_1032,1}.p1, 177).rem)))).\_replace(this.\$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs heapIs = f_{uncstart_1032,1}, this.r.value(heapIs)
\theta_{funcstart\_1032,1}.p1, 177).rem))).\_replace(p2 \rightarrow
\mathbf{asType}{<}\mathrm{P2Type}{>}(((\mathbf{int})30307\ ^*
asType < int > (static\_cast < integer > (static\_cast < signed
int>(operator^*(heapIs \$heap_{1032,1:1051.8}, this).p2) < (int)0))) + temp2)))
\rightarrow [simplify]
[57.12] heap_{1032,1;1054,8} == heap_{funcstart\_1032,1}._replace(this.r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart_1032,1}, this.r.value(heapIs \rho_{funcstart_1032,1}).p1,
177).quot) + (171 * div(heapIs \$heap_{funcstart\_1032,1}, this.\$r.value(heapIs
\theta_{funcstart\_1032,1}.p1, 177).rem))))._replace(this.$r \rightarrow
this.$r.value(heapIs \rho_{tuncstart\_1032.1})._replace(p1 \rightarrow ((-2 * div(heapIs
\$heap_{funcstart\_1032,1},\, \textbf{this.}\$r.\textbf{value}(\textbf{heapIs}\,\,\$heap_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs $heap<sub>funcstart_1032,1</sub>, this.$r.value(heapIs
\theta_{funcstart\_1032,1}.p1, 177).rem))).\_replace(p2 \rightarrow
asType<P2Type>((30307 *
asType < int > (static\_cast < integer > (static\_cast < signed
int>(operator^*(heapIs $heap_{1032.1:1051.8}, this).p2) < (int)(0))) + temp(2)))
\rightarrow [from term 53.19, $heap<sub>1032,1:1051,8</sub> is equal to
\$heap_{funcstart\_1032,1}.\_\textbf{replace}(\textbf{this}.\$r \rightarrow \textbf{this}.\$r.\textbf{value}(\textbf{heapIs}
heap_{funcstart\_1032,1}._replace(p1 \rightarrow (-2 * div(heapIs $heap_{funcstart\_1032,1}).
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177).quot) + (171)
div(heapIs $heap_{tuncstart\_1032.1}, this.$r.value(heapIs
heap_{funcstart\_1032,1}.p1, 177.rem)))
[57.13] \rho_{1032,1;1054,8} == \rho_{1032,1;1054,8} = \rho_{1032,1;1054,
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{heap}_{funcstart\_1032,1}, \text{this.}\text{$r.value}(\text{heapIs}))
\theta_{funcstart\_1032,1}.p1, 177).rem)))).\_replace(this.\$r \rightarrow 0
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.}\text{\$r.value}(\text{heapIs}))
heap_{funcstart\_1032,1}.p1, 177).rem))).\_replace(p2 \rightarrow
asType<P2Type>((30307 *
as Type < int > (static\_cast < integer > (static\_cast < signed
int>(operator^*(heapIs \$heap_{funcstart\_1032.1}.\_replace(this.\$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow (-2 * div(heapIs
```

```
\rho_{tuncstart=1032.1}, this.r.value(heapIs \rho_{tuncstart=1032.1}).p1,
177).quot) + (171 * div(heapIs \theta_{funcstart\_1032,1}, this.r.value(heapIs)
\text{Sheap}_{funcstart\_1032,1}.\text{p1}, 177).\text{rem})), \text{this}.\text{p2}) < (\text{int})0)) + \text{temp2}))
→ [expand definition of operator '*' in class 'pointer' at built in declaration]
[57.14] $\text{heap}_{1032,1;1054,8} == $\text{heap}_{funcstart\_1032,1}._\text{replace}(\text{this.}\text{$\frac{1}{2}}\text{$\text{constart}_{-1032,1}._\text{$\text{replace}}(\text{this}.\text{$\text{$\text{constart}_{-1032,1}._\text{$\text{constart}_{-1032,1}._\text{$\text{constart}_{-1032,1}._\text{$\text{constart}_{-1032,1}._\text{$\text{constart}_{-1032,1}._\text{$\text{constart}_{-1032,1}._\text{$\text{constart}_{-1032,1}._\text{$\text{constart}_{-1032,1}._\text{$\text{constart}_{-1032,1}._\text{$\text{constart}_{-1032,1}._\text{$\text{constart}_{-1032,1}._\text{$\text{constart}_{-1032,1}._\text{$\text{constart}_{-1032,1}._\text{$\text{constart}_{-1032,1}._\text{$\text{constart}_{-1032,1}._\text{$\text{constart}_{-1032,1}._\text{$\text{constart}_{-1032,1}._\text{$\text{constart}_{-1032,1}._\text{$\text{constart}_{-1032,1}._\text{$\text{constart}_{-1032,1}._\text{$\text{constart}_{-1032,1}._\text{$\text{constart}_{-1032,1}._\text{$\text{constart}_{-1032,1}._\text{$\text{constart}_{-1032,1}._\text{$\text{constart}_{-1032,1}._\text{$\text{constart}_{-1032,1}._\text{$\text{constart}_{-1032,1}._\text{$\text{constart}_{-1032,1}._\text{$\text{constart}_{-1032,1}._\text{$\text{constart}_{-1032,1}._\text{$\text{constart}_{-1032,1}._\text{$\text{constart}_{-1032,1}._\text{$\text{constart}_{-1032,1}._\text{$\text{constart}_{-1032,1}._\text{$\text{constart}_{-1032,1}._\text{$\text{constart}_{-1032,1}._\text{$\text{constart}_{-1032,1}._\text{$\text{constart}_{-1032,1}._\text{$\text{constart}_{-1032,1}._\text{$\text{constart}_{-1032,1}._\text{$\text{constart}_{-1032,1}._\text{$\text{constart}_{-1032,1}._\text{$\text{constart}_{-1032,1}._\text{$\text{constart}_{-1032,1}._\text{$\text{constart}_{-1032,1}._\text{$\text{constart}_{-1032,1}._\text{$\text{constart}_{-1032,1}._\text{$\text{constart}_{-1032,1}._\text{$\text{constart}_{-1032,1}._\text{$\text{constart}_{-1032,1}._\text{$\text{constart}_{-1032,1}._\text{$\text{constart}_{-1032,1}._\text{$\text{constart}_{-1032,1}._\text{$\text{constart}_{-1032,1}._\text{$\text
this.$r.value(heapIs \rho_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032.1}, \text{this.} \text{\$r.value}(\text{heapIs}))
\label{eq:continuous_function} $ \text{heap}_{funcstart\_1032,1} . \text{p1}, 177).rem)))).\_\textbf{replace}(\textbf{this}.\$r \rightarrow
this.$r.value(heapIs heap_{funcstart\ 1032.1}).replace(p1 \rightarrow ((-2 * div(heapIs
\$heap_{funcstart\_1032,1},\, \textbf{this}.\$r.\textbf{value}(\textbf{heapIs}\,\,\$heap_{funcstart\_1032.1}).p1,
177).quot) + (171 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
heap_{funcstart\_1032,1}.p1, 177).rem)))._replace(p2 \rightarrow
asType<P2Type>((30307 *
asType<int>(static_cast<integer>(static_cast<signed
\mathbf{int}{>}(\mathbf{this.\$r.value}(\mathbf{heapIs}\ \$\mathbf{heap}_{funcstart\_1032,1}.\_\mathbf{replace}(\mathbf{this.\$r} \to \mathbf{funcstart}))
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
$\text{heap}_{funcstart_1032.1}$, this.$\text{r.value}(\text{heapIs} \text{$heap}_{funcstart_1032.1}).p1,
177).quot) + (171 * div(\mathbf{heapIs} \ \$heap_{funcstart\_1032,1}, \ \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
\text{Sheap}_{funcstart\_1032.1}.\text{p1}, 177).\text{rem})))).\text{p2}) < (int)0))) + \text{temp2}))
→ [evaluate dereferenced pointer into modified heap]
[57.15] $heap<sub>1032,1;1054,8</sub> == $heap<sub>funcstart_1032,1</sub>._replace(this.$r \rightarrow
this.$r.value(heapIs $heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{tuncstart\_1032.1}, this.r.value(heapIs \rho_{tuncstart\_1032.1}).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.} \text{\$r.value}(\text{heapIs}))
\theta_{funcstart\_1032,1}.p1, 177).rem)))).\_replace(this.\$r \rightarrow 0
this.$r.value(heapIs heap_{funcstart\_1032.1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.\r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(\mathbf{heapIs} \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}))
\theta_{funcstart\_1032.1}.p1, 177).rem))._replace(p2 \rightarrow
asType<P2Type>((30307 *
asType<int>(static_cast<integer>(static_cast<signed int>(([this.$r
== this.$r.value(heapIs \rho_{funcstart\_1032,1})._replace(p1 \rightarrow (-2 *
{\rm div}(\textbf{heapIs} \ \$ heap_{funcstart\_1032,1}, \ \textbf{this}.\$ r. \textbf{value}(\textbf{heapIs}
\text{Sheap}_{funcstart\_1032,1}.p1, 177).quot) + (171 * div(heapIs \text{Sheap}_{funcstart\_1032,1},
\mathbf{this.\$r.value(heapIs}\ \$heap_{funcstart\_1032,1}).p1,\ 177).rem)),\ []:
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p2) < (int)0))) + temp2)))
→ [explicitly assert falsehood of skipped guards in subsequent guards]
[57.16] $\text{heap}_{1032,1;1054,8} == $\text{heap}_{funcstart\_1032,1}._\text{replace}(\text{this.}\text{$\frac{1}{2}}\text{$\frac{1}{2}}$
this.$r.value(heapIs \rho_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
\theta_{funcstart\_1032,1}.p1, 177).rem)))).replace(this.r \rightarrow 0
```

```
this.$r.value(heapIs \rho_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
\theta_{funcstart\_1032,1}.p1, 177).rem))).\_replace(p2 \rightarrow
asType<P2Type>((30307 *
\mathbf{asType} < \mathbf{int} > (\mathbf{static\_cast} < \mathbf{integer} > (\mathbf{static\_cast} < \mathbf{signed\ int} > (([\mathbf{this.\$r}
== this.$r]: this.$r.value(heapIs \rho_{tuncstart\_1032.1})._replace(p1 \rightarrow (-2 *
div(heapIs $heap_tuncstart_1032.1, this.$r.value(heapIs
\text{Sheap}_{funcstart\_1032.1}, p1, 177).quot) + (171 * div(heapIs \text{Sheap}_{funcstart\_1032.1},
this.r.value(heapIs \heap_{funcstart\_1032.1}).p1, 177).rem)), [!(this.<math>r = 
\mathbf{this.\$r.value}(\mathbf{heapIs}~\$ \mathrm{heap}_{funcstart\_1032,1})).\mathrm{p2}) < (\mathbf{int})0))) + \\
temp2)))
\rightarrow [simplify]
[57.23] $\text{heap}_{1032,1;1054,8} == $\text{heap}_{funcstart\_1032,1}._\text{replace}(\text{this}.\text{$\frac{1}{2}r$})
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart_1032,1}, this.r.value(heapIs \rho_{funcstart_1032,1}).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.} \text{\$r.value}(\text{heapIs}))
\theta_{funcstart\_1032,1}.p1, 177).rem))))._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this. r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs $heap<sub>funcstart_1032.1</sub>, this.$r.value(heapIs
\theta_{funcstart\_1032,1}.p1, 177).rem))).\_replace(p2 \rightarrow
\mathbf{asType} {<} P2Type {>} ((30307 \ * \ \mathbf{asType} {<} \mathbf{int} {>} (\mathbf{static\_cast} {<} \mathbf{integer} {>} (0 <
-this.r.value(heapIs heap_{funcstart\_1032,1}.p2))) + temp2)))
\rightarrow [from term 24.0, literala < -this.$r.value(heapIs $heap_{funcstart\_1032.1}).p2
is false whenever -2 < (0 + literala)
    Proof of rule precondition:
    [57.23.0] - 2 < (0 + 0)
    \rightarrow [simplify]
    [57.23.2] true
[57.24] $heap<sub>1032,1;1054,8</sub> == $heap<sub>funcstart_1032,1</sub>._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
$\text{heap}_{funcstart_1032.1}$, this.$\text{r.value}(\text{heapIs} \text{$heap}_{funcstart_1032.1}).p1,
177).quot) + (171 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
\theta_{funcstart\_1032,1}.p1, 177).rem)))).\_replace(this.\$r \rightarrow 0
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs))
\rho_{funcstart\_1032,1}, this.\r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs \rho_{funcstart\_1032,1}, this.r.value(heapIs)
\label{eq:place} $\operatorname{heap}_{funcstart\_1032,1}).p1,\ 177).rem))).\_\mathbf{replace}(p2 \to
asType<P2Type>((30307 * asType<int>(static_cast<integer>(false)))
+ \text{temp2})))
\rightarrow [simplify]
```

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[57.25] $heap<sub>1032,1;1054,8</sub> == $heap<sub>funcstart_1032,1</sub>._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs $heap<sub>funcstart_1032,1</sub>, this.$r.value(heapIs
\theta_{tuncstart\_1032,1}.p1, 177).rem)))).\_replace(this.\$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs heap_{funcstart_1032,1}, this.r.value(heapIs)
\theta_{funcstart\_1032,1}.p1, 177).rem))).\_replace(p2 \rightarrow
asType<P2Type>((30307 * asType<int>(([false]: 1, []: 0))) + temp2)))
→ [explicitly assert falsehood of skipped guards in subsequent guards]
[57.26] $heap<sub>1032,1;1054,8</sub> == $heap<sub>funcstart_1032,1</sub>._replace(this.$r \rightarrow
this.$r.value(heapIs \rho_{uncstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs)
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
\theta_{funcstart\_1032,1}.p1, 177).rem)))).\_replace(this.\$r \rightarrow 0
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\theta_{funcstart\_1032,1}, this.r.value(heapIs \theta_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs \rho_{funcstart\_1032,1}, this.r.value(heapIs)
\theta_{funcstart\_1032.1}.p1, 177).rem)))._replace(p2 \rightarrow
asType < P2Type > ((30307 * asType < int > (([false]: 1, [true]: 0))) +
temp2)))
\rightarrow [simplify]
[57.29] $\text{heap}_{1032,1;1054,8} == $\text{heap}_{funcstart\_1032,1}._\text{replace}(\text{this}.\text{$\frac{1}{2}r$})
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(\mathbf{heapIs} \$ heap_{funcstart\_1032,1}, \mathbf{this}.\$ r. \mathbf{value}(\mathbf{heapIs})
\theta_{funcstart\_1032,1}.p1, 177).rem)))).\_replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
$heap_funcstart_1032.1, this.$r.value(heapIs $heap_funcstart_1032.1).p1,
177).quot) + (171 * div(heapIs $heap<sub>funcstart_1032,1</sub>, this.$r.value(heapIs
\rho_{funcstart\_1032,1}.p1, 177).rem))._replace(p2 \rightarrow asType<P2Type>(0 +
temp2)))
\rightarrow [from term 54.18, temp2 is equal to (-35 * div(heapIs $heap_{funcstart\_1032,1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p2, 176).quot) + (172 *
div(heapIs $heap_{funcstart_1032.1}, this.$r.value(heapIs
heap_{funcstart_{1032,1}}.p2, 176).rem
[57.30] $\text{heap}_{1032,1;1054,8} == $\text{heap}_{funcstart\_1032,1}._\text{replace}(\text{this}.\text{$\frac{1}{2}r$})
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.} \text{\$r.value}(\text{heapIs}))
this.$r.value(heapIs \rho_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
```

```
\rho_{funcstart=1032,1}, this.r.value(heapIs \rho_{funcstart=1032,1}).p1,
177).quot) + (171 * div(heapIs $heap_{funcstart\_1032,1}, this.$r.value(heapIs
\label{eq:posterior} $\operatorname{heap}_{funcstart\_1032,1}).p1,\ 177).rem))).$\tt-replace(p2 \to asType < P2Type > (0 + p)).$\tt-replace(p2 \to p) = (p) =
((-35 * div(heapIs \$heap_{funcstart\_1032,1}, this.\$r.value(heapIs
\text{Sheap}_{funcstart\_1032.1}.p2, 176).quot) + (172 * div(heapIs \text{Sheap}_{funcstart\_1032.1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p2, 176).rem)))))
\rightarrow [simplify]
[57.33] $heap<sub>1032,1;1054,8</sub> == $heap<sub>funcstart_1032,1</sub>._replace(this.$r \rightarrow
this.$r.value(heapIs $heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.}\text{\$r.value}(\text{heapIs}))
\theta_{tuncstart\_1032,1}.p1, 177).rem)))).\_replace(this.\$r \rightarrow
this.$r.value(heapIs \frac{1}{2} heap\frac{1}{2} line \frac{1}{2} heap\frac{1}{2} heap\frac{1}{2
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
\rho_{funcstart\_1032,1}.p1, 177).rem))._replace(p2 \rightarrow ((-35 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p2,
176).quot) + (172 * div(\mathbf{heapIs} \ \$heap_{funcstart\_1032,1}, \ \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
heap_{funcstart_{1032,1}}.p2, 176).rem)))
[Take goal term]
[1.0] minof(signed int) \leq ($heap<sub>1032.1:1054.8</sub>.r3 * static_cast<signed
int>(div3.rem))
\rightarrow [simplify]
\textit{[1.1] -32768} \leq (\$ heap_{1032,1:1054,8}.r3 * \textbf{static\_cast} < \textbf{signed int} > (\texttt{div3.rem}))
\rightarrow [from term 57.33, $heap<sub>1032,1;1054,8</sub> is equal to
$heap_{funcstart\_1032,1}.$_replace(this.$r \rightarrow this.$r.value(heapIs)
heap_{funcstart\_1032,1}._replace(p1 \rightarrow ((-2 * div(heapIs heap_{funcstart\_1032,1}),
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177).quot) + (171 *
div(heapIs $heap_{funcstart_1032.1}, this.$r.value(heapIs
\theta_{tuncstart\ 1032.1}).p1, 177).rem))))._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs))
heap_{funcstart\_1032,1}, this.r.value(heapIs heap_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs \$heap_{funcstart\_1032,1}, this.\$r.value(heapIs))
heap_{funcstart\_1032,1}.p1, 177).rem))).\_replace(p2 \rightarrow (-35 * div(heapIs))).
heap_{funcstart\_1032,1}, this.r.value(heapIs heap_{funcstart\_1032,1}).p2,
176).quot) + (172 * div(heapIs $heap_{funcstart\_1032,1}, this.$r.value(heapIs
$heap_tuncstart_1032.1).p2, 176).rem)))]
[1.2] -32768 \le (\$heap_{funcstart\_1032,1}.\_replace(this.\$r \rightarrow this.\$r.value(heapIs))
\text{Sheap}_{funcstart\_1032.1}._replace(p1 \rightarrow ((-2 * div(heapIs \text{Sheap}_{funcstart\_1032.1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177).quot) + (171 *
div(\mathbf{heapIs} \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
\theta_{funcstart\_1032,1}.p1, 177).rem)))).\_replace(this.\$r \rightarrow 0
```

```
this.$r.value(heapIs \rho_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs \theta_{funcstart\_1032,1}, this.r.value(heapIs)
\rho_{funcstart\_1032,1}.p1, 177).rem))._replace(p2 \rightarrow ((-35 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p2,
176).quot) + (172 * div(heapIs $heap<sub>funcstart_1032,1</sub>, this.$r.value(heapIs
\theta_{funcstart\_1032,1}.p2, 176).rem)))).r3*static_cast<signed
int>(div3.rem)
\rightarrow [const member of object with modified fields]
[1.4] -32768 \leq ($heap<sub>funcstart 1032.1</sub>.r3 * static_cast\leqsigned int\geq(div3.rem))
\rightarrow [const static or extern object]
[1.5] -32768 < ($heap<sub>init</sub>.r3 * static_cast<signed int>(div3.rem))
\rightarrow [expand definition of constant 'r3' at prang.cpp (39,26)]
[1.6] -32768 < ((int)170 * static_cast<signed int>(div3.rem))
\rightarrow [simplify]
[1.7] -32768 < (170 * static\_cast < signed int > (div3.rem))
\rightarrow [from term 34.6, div3 is equal to div(heapIs $heap_{funcstart\_1032,1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p3, 178)]
[1.8] -32768 \leq (170 * static_cast<signed int>(div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p3,
178).rem))
\rightarrow [simplify]
[1.11] -32769 < (170 * div(heapIs $heap_{funcstart\_1032,1}, this.$r.value(heapIs)]
heap_{funcstart_{-1032,1}}.p3, 178).rem
\rightarrow [literal comparison of product]
[1.12] ([170 < 0]: (-32769 / -170) < -\text{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_1032.1},
this.$r.value(heapIs \frac{1}{100}).p3, 178).rem, [0 < 170]: (-32769 /
170) < div(heapIs heap_{funcstart\_1032,1}, this.r.value(heapIs)
\text{Sheap}_{funcstart\_1032,1}.p3, 178).rem, [0 == 170]: -32769 < 0)
→ [explicitly assert falsehood of skipped guards in subsequent guards]
[1.13] ([170 < 0]: (-32769 / -170) < -\text{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_1032,1},
this.$r.value(heapIs heap_{funcstart\_1032,1}).p3, 178).rem, [(0 < 170) \land !(170 <
0)]: (-32769 / 170) < \text{div}(\text{heapIs } \text{$heap}_{funcstart\_1032,1}, \text{this.}\text{$r.value}(\text{heapIs})
\text{Sheap}_{funcstart\_1032,1}).p3, 178).rem, [(0 == 170) \land !(0 < 170) \land !(170 < 0)]:
-32769 < 0
\rightarrow [simplify]
[1.21] -193 < div(heapIs heapIs heapIs, this.r.value(heapIs
heap_{funcstart\_1032,1}.p3, 178).rem
```

```
\rightarrow [negate goal and search for contradiction] [1.22] !(-193 < div(heapIs $heap_{funcstart\_1032,1}, this.$r.value(heapIs $heap_{funcstart\_1032,1}).p3, 178).rem) 

\rightarrow [simplify] [1.24] 192 < −div(heapIs $heap_{funcstart\_1032,1}, this.$r.value(heapIs $heap_{funcstart\_1032,1}).p3, 178).rem [Create new term from terms 1.24, 42.17 using rule: transitivity 15] [78.0] (0 + 192) < −(this.$r.value(heapIs $heap_{funcstart\_1032,1}).p3 % 178) 

\rightarrow [simplify] [78.2] false
```

Proof of verification condition: Arithmetic result of operator '*' is within limit of type 'signed int'

In the context of class: WHPrang, declared at: C:\Escher\Customers\prang-cpp\prang.cpp (18,1)

Condition generated at: C:\Escher\Customers\prang-cpp\prang.cpp (80,30)

Condition defined at:

To prove: $(\text{heap}_{1032,1;1054,8}.r3 * \text{static_cast} < \text{signed int} > (\text{div}3.rem)) \le \max of(\text{signed int})$

Given:

```
Sheap<sub>init</sub>.class WHPrang \in M1 == (int)30269
Sheap<sub>init</sub>.class WHPrang \in M1 == (int)171
Sheap<sub>init</sub>.class WHPrang \in a1 == (int)177
Sheap<sub>init</sub>.class WHPrang \in a1 == (int)177
Sheap<sub>init</sub>.class WHPrang \in b1 == (int)2
Sheap<sub>init</sub>.class WHPrang \in M2 == (int)30307
Sheap<sub>init</sub>.class WHPrang \in r2 == (int)172
Sheap<sub>init</sub>.class WHPrang \in a2 == (int)176
Sheap<sub>init</sub>.class WHPrang \in b2 == (int)35
Sheap<sub>init</sub>.class WHPrang \in M3 == (int)30323
Sheap<sub>init</sub>.class WHPrang \in r3 == (int)170
Sheap<sub>init</sub>.class WHPrang \in a3 == (int)178
Sheap<sub>init</sub>.class WHPrang \in b3 == (int)63
```

```
\operatorname{div1} == \operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_1032,1},
\mathbf{static\_cast} {<} \mathbf{int} {>} (\mathbf{operator}^*(\mathbf{heapIs}\ \$ \mathbf{heap}_{funcstart\_1032,1},\ \mathbf{this}).\mathtt{p1}),
\mathbf{static\_cast}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_1032,1}.\mathrm{a1}))
(\mathbf{asType} {<} \mathbf{integer} {>} (\mathbf{static\_cast} {<} \mathbf{int} {>} (\mathbf{operator}^* (\mathbf{heapIs}
heap_{funcstart\_1032,1}, this).p1) /
asType < integer > (static\_cast < int > (\$heap_{funcstart\_1032,1}.a1))) = =
asType<integer>(div1.quot)
(\mathbf{asType} {<} \mathbf{integer} {>} (\mathbf{static\_cast} {<} \mathbf{int} {>} (\mathbf{operator^*} (\mathbf{heapIs}
\theta_{funcstart\_1032,1},\,\mathbf{this}).p1)) %
asType<integer>(static_cast<int>($heap_{funcstart_1032.1}.a1))) ==
asType<integer>(div1.rem)
(\mathbf{asType}{<}\mathbf{integer}{>}(\mathbf{operator}^*(\mathbf{heapIs}\ \$\mathbf{heap}_{funcstart\_1032,1},\ \mathbf{this}).\mathtt{p1}) <
asType < integer > ($heap_{funcstart\_1032,1}.a1)) = >
(asType<integer>(div1.rem) == asType<integer>(operator*(heapIs
heap_{funcstart\_1032,1}, this).p1)
(\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathsf{heap}_{funcstart\_1032,1}.\mathsf{a1}) \leq
\mathbf{asType} < \mathbf{integer} > (\mathbf{operator}^*(\mathbf{heapIs} \ \$ \mathbf{heap}_{funcstart\_1032,1}, \ \mathbf{this}).\mathtt{p1})) = >
!(0 == asType < integer > (div1.quot))
!(0 == asType < integer > (div1.rem)) || !(0 ==
asType<integer>(div1.quot))
div2 == div(\mathbf{heapIs} \$ heap_{funcstart\_1032,1},
\mathbf{static\_cast} {<} \mathbf{int} {>} (\mathbf{operator*}(\mathbf{heapIs}\ \$\mathbf{heap}_{funcstart\_1032,1},\ \mathbf{this}).\mathtt{p2}),
\mathbf{static\_cast}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_1032,1}.\mathrm{a2}))
(asType < integer > (static\_cast < int > (operator*(heapIs)))
heap_{funcstart\_1032,1}, this).p2) /
\mathbf{asType} < \mathbf{integer} > (\mathbf{static\_cast} < \mathbf{int} > (\$ \mathbf{heap}_{funcstart\_1032,1}.\mathbf{a2}))) = =
asType<integer>(div2.quot)
(asType < integer > (static\_cast < int > (operator*(heapIs)))
\theta_{funcstart_{1032,1}}, this).p2))
asType < integer > (static\_cast < int > (\$heap_{funcstart\_1032.1}.a2))) = =
asType<integer>(div2.rem)
(\mathbf{asType}{<}\mathbf{integer}{>}(\mathbf{operator}^*(\mathbf{heapIs}\ \$\mathbf{heap}_{funcstart\_1032,1},\ \mathbf{this}).\mathtt{p2}) <
asType < integer > (\$heap_{funcstart\_1032,1}.a2)) = >
(asType<integer>(div2.rem) == asType<integer>(operator*(heapIs
heap_{funcstart_1032.1}, this).p2)
(asType < integer > (\$heap_{funcstart\_1032,1}.a2) \le
\mathbf{asType}{<}\mathbf{integer}{>}(\mathbf{operator*}(\mathbf{heapIs}\ \$\mathbf{heap}_{funcstart\_1032,1},\ \mathbf{this}).\mathtt{p2})) =>
!(0 == asType < integer > (div2.quot))
!(0 == asType < integer > (div2.rem)) || !(0 ==
asType<integer>(div2.quot))
div3 == div(\mathbf{heapIs} \$ heap_{funcstart\_1032,1},
```

```
\mathbf{static\_cast} < \mathbf{int} > (\mathbf{operator}^*(\mathbf{heapIs}\ \$ \mathbf{heap}_{funcstart\_1032,1},\ \mathbf{this}).\mathbf{p3}),
static\_cast < int > (\$heap_{funcstart\_1032,1}.a3))
(asType < integer > (static\_cast < int > (operator*(heapIs
heap_{funcstart\_1032.1}, this).p3) /
asType < integer > (static\_cast < int > (\$heap_{funcstart\_1032.1}.a3))) = =
asType<integer>(div3.quot)
(asType<integer>(static_cast<int>(operator*(heapIs
heap_{funcstart\_1032,1}, this).p3)
\mathbf{asType} < \mathbf{integer} > (\mathbf{static\_cast} < \mathbf{int} > (\$ \mathbf{heap}_{funcstart\_1032,1}.\mathbf{a3}))) = =
asType<integer>(div3.rem)
(\mathbf{asType} < \mathbf{integer} > (\mathbf{operator}^*(\mathbf{heapIs} \ \$ \mathbf{heap}_{funcstart\_1032,1}, \ \mathbf{this}).\mathbf{p3}) <
asType < integer > ($heap_{funcstart\_1032,1}.a3)) = >
(asType<integer>(div3.rem) == asType<integer>(operator*(heapIs
heap_{funcstart\_1032.1}, this).p3)
(asType < integer > (\$heap_{funcstart\_1032,1}.a3) \le
\mathbf{asType} < \mathbf{integer} > (\mathbf{operator}^*(\mathbf{heapIs} \ \$ \mathbf{heap}_{funcstart\_1032,1}, \ \mathbf{this}).\mathrm{p3})) = >
!(0 == asType < integer > (div3.quot))
!(0 == asType < integer > (div3.rem)) || !(0 ==
asType<integer>(div3.quot))
temp1 == (\$heap_{funcstart\_1032,1}.r1 * \textbf{static\_cast} < \textbf{signed int} > (div1.rem)) -
($heap_tuncstart_1032.1.b1 * static_cast<signed int>(div1.quot))
minof(signed\ int) \le temp1
temp1 < maxof(signed int)
heap_{1032,1;1051,8} == heap_{funcstart\_1032,1}._replace(this.$r \rightarrow
operator*(heapIs heap_{funcstart\_1032,1}, this)._replace(p1 \rightarrow
asType < P1Type > ((\$heap_{funcstart\_1032,1}.M1 *
asType<int>(static_cast<integer>(static_cast<signed
int>(operator^*(heapIs $heap_{funcstart\_1032.1}, this).p1) < (int)0))) +
temp1)))
temp2 == (\$heap_{1032,1;1051,8}.r2 * \mathbf{static\_cast} < \mathbf{signed\ int} > (div2.rem)) -
(\text{sheap}_{1032,1;1051,8}.\text{b2} * \text{static\_cast} < \text{signed int} > (\text{div}2.\text{quot}))
minof(signed int) \le temp2
temp2 \le maxof(signed int)
heap_{1032,1;1054,8} == heap_{1032,1;1051,8}._replace(this.$r \rightarrow
operator*(heapIs heap_{1032,1;1051,8}, this)._replace(p2 \rightarrow
asType<P2Type>(($heap<sub>1032,1:1051,8</sub>.M2 *
as Type < int > (static\_cast < integer > (static\_cast < signed))
int>(operator^*(heapIs $heap_{1032,1;1051,8}, this).p2) < (int)0))) + temp2)))
Proof:
```

```
[Take given term]
[2.0] div1 == div(heapIs heap_{funcstart\_1032,1},
\mathbf{static\_cast} < \mathbf{int} > (\mathbf{operator}^*(\mathbf{heapIs} \ \$ \mathbf{heap}_{funcstart\_1032,1}, \ \mathbf{this}).\mathtt{p1}),
\mathbf{static\_cast}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_1032,1}.\mathrm{a1}))
→ [expand definition of operator '*' in class 'pointer' at built in declaration]
[2.1] \operatorname{div1} == \operatorname{div}(\mathbf{heapIs} \ \text{$heap}_{funcstart\_1032,1},
static\_cast < int > (this. r.value(heapIs  heap_{funcstart\_1032,1}).p1),
static\_cast < int > (\$heap_{funcstart\_1032,1}.a1))
\rightarrow [simplify]
[2.2]~{\rm div1} == {\rm div}(\mathbf{heapIs}~\$ \mathrm{heap}_{funcstart\_1032,1},~\mathbf{this}.\$ \mathrm{r.value}(\mathbf{heapIs}
\theta_{funcstart\_1032,1}.p1, \theta_{funcstart\_1032,1}.p1, \theta_{funcstart\_1032,1}.a1))
\rightarrow [const static or extern object]
[2.3]~{\rm div1} == {\rm div}(\mathbf{heapIs}~\$ \mathrm{heap}_{funcstart\_1032,1},~\mathbf{this}.\$ \mathrm{r.value}(\mathbf{heapIs}
\theta_{tuncstart\_1032,1}.p1, \theta_{tuncstart\_1032,1}.p2, \theta_{tuncstart\_1032,1}.p2, \theta_{tuncstart\_1032,1}.p2, \theta_{tuncstart\_1032,1}.p2, \theta_{tuncstart\_1032,1}.p2, \theta_{tuncstart\_1032,1}.p2, \theta_{tuncstart\_1032,1}.p2, \theta_{tuncstart\_1032,1}.p3, \theta_{tuncstart\_1032,1}.p4, \theta_{tuncstart\_1032,1}.p4, \theta_{tuncstart\_1032,1
\rightarrow [expand definition of constant 'a1' at prang.cpp (30,26)]
[2.4] div1 == div(heapIs $heap<sub>funcstart_1032,1</sub>, this.$r.value(heapIs)
\theta_{funcstart\_1032,1}.p1, \theta_{funcstart\_1032,1}.p1, \theta_{funcstart\_1032,1}.p1, \theta_{funcstart\_1032,1}.p1, \theta_{funcstart\_1032,1}.p1, \theta_{funcstart\_1032,1}.p1, \theta_{funcstart\_1032,1}.p2, \theta_{funcstart\_1032,1}.p2, \theta_{funcstart\_1032,1}.p2, \theta_{funcstart\_1032,1}.p2, \theta_{funcstart\_1032,1}.p2, \theta_{funcstart\_1032,1}.p3, \theta_{funcstart\_1032,1}.p4, \theta_{funcstart\_1032,1}.p4, \theta_{funcstart\_1032,1}.p4, \theta_{funcstart\_1032,1}.p5, \theta_{funcstart\_1032,1
\rightarrow [simplify]
[2.6] div1 == div(heapIs $heap_{funcstart\_1032,1}, this.$r.value(heapIs)
heap_{funcstart_{-1032,1}}.p1, 177
[Assume known post-assertion, class invariant or type constraint for term 2.6]
[7.0] (0 < asType<integer>(this.$r.value(heapIs
$\text{heap}_{funcstart_1032.1}\text{).p1})\text{\&&} (asType<integer>(this.\frac{\text{sr.value}(heapIs)}{\text{heap}}\text{\text{sr.value}(heapIs)}
\rho_{tuncstart_{1032.1}, p1} < asType < integer > (\rho_{tuncstart_{1032.1}, p1}) < asType < intege
M1))
\rightarrow [simplify]
[7.2] (0 < this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1) \&\&
(this.$r.value(heapIs \theta_{funcstart\_1032,1}).p1 <
asType < integer > (\$heap.class WHPrang \in M1))
\rightarrow [const static or extern object]
[7.3] (0 < this.$r.value(heapIs \rho_{uncstart\_1032,1}).p1) &&
(this.$r.value(heapIs heap_{funcstart\_1032,1}).p1 <
asType < integer > (\$heap_{init}.class WHPrang \in M1))
\rightarrow [expand definition of constant 'M1' at prang.cpp (28,26)]
[7.4] (0 < this.$r.value(heap
Is \rho_{funcstart\_1032,1}).p1) &&
(this.r.value(heapIs $heap_{funcstart\_1032.1}).p1 <
asType < integer > ((int)30269))
```

```
\rightarrow [simplify]
[7.10] (-30269 < -this.$r.value(heapIs $heap_{tuncstart_1032.1}).p1) \land (0 <
\textbf{this.\$r.value}(\textbf{heapIs}~\$\text{heap}_{funcstart\_1032,1}).\text{p1})
[Work on sub-term 2 of conjunction in term 7.10]
[8.0] 0 < this.$r.value(heapIs $heap_{tuncstart\_1032,1}).p1
[Take given term]
[18.0] \operatorname{div2} == \operatorname{div}(\mathbf{heapIs} \ \operatorname{\$heap}_{funcstart\_1032,1},
static_cast<int>(operator*(heapIs $heap_{funcstart\_1032,1}, this).p2),
\mathbf{static\_cast}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_1032,1}.\mathrm{a2}))
→ [expand definition of operator '*' in class 'pointer' at built in declaration]
[18.1] \operatorname{div2} == \operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_1032,1},
\mathbf{static\_cast} < \mathbf{int} > (\mathbf{this.\$r.value}(\mathbf{heapIs} \ \$ \mathbf{heap}_{funcstart\_1032,1}).\mathbf{p2}),
\mathbf{static\_cast}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_1032,1}.\mathrm{a2}))
\rightarrow [simplify]
[18.2] div2 == div(\mathbf{heapIs} \$ \mathbf{heap}_{funcstart\_1032,1}, \mathbf{this}.\$ \mathbf{r.value}(\mathbf{heapIs})
\theta_{funcstart=1032.1}, p2, static_cast<int>(\theta_{funcstart=1032.1})
\rightarrow [const static or extern object]
[18.3] div2 == div(\mathbf{heapIs} \$ \mathbf{heap}_{funcstart\_1032.1}, \mathbf{this}.\$ \mathbf{r.value}(\mathbf{heapIs})
\$heap_{funcstart\_1032,1}).p2,\, \textbf{static\_cast} < \textbf{int} > (\$heap_{init}.a2))
\rightarrow [expand definition of constant 'a2' at prang.cpp (35,26)]
[18.4] \text{ div2} == \text{div}(\text{heapIs } \text{$heap}_{funcstart\_1032,1}, \text{this.}\text{$r.value}(\text{heapIs})
\theta_{funcstart\_1032,1}.p2, \theta_{funcstart\_1032,1}.p2, \theta_{funcstart\_1032,1}.p2, \theta_{funcstart\_1032,1}.p2
\rightarrow [simplify]
[18.6] div2 == div(heapIs $heap<sub>funcstart_1032,1</sub>, this.$r.value(heapIs)
heap_{funcstart_{1032.1}}.p2, 176
[Assume known post-assertion, class invariant or type constraint for term 18.6]
[23.0] (0 < asType<integer>(this.$r.value(heapIs
$heap_funcstart_1032.1).p2)) && (asType<integer>(this.$r.value(heapIs
\theta_{funcstart\_1032,1}.p2 < asType<integer>(\theta_{funcstart\_1032,1}.p2) < asType<integer>(\theta_{funcstart\_1032,1}.p2)
M2))
\rightarrow [simplify]
[23.2] (0 < this.$r.value(heapIs heap_{funcstart\_1032,1}).p2) &&
(this.r.value(heapIs \ heap_{funcstart\_1032.1}).p2 <
asType < integer > (\$heap.class WHPrang \in M2))
\rightarrow [const static or extern object]
[23.3] (0 < this.$r.value(heapIs heap_{funcstart\_1032,1}).p2) &&
(this.r.value(heapIs \ heap_{funcstart\_1032,1}).p2 <
```

```
asType < integer > (\$heap_{init}.class WHPrang \in M2))
\rightarrow [expand definition of constant 'M2' at prang.cpp (33,26)]
[23.4] (0 < this.$r.value(heapIs heap_{funcstart\_1032,1}).p2) &&
(this.r.value(heapIs $heap_{funcstart\_1032,1}).p2 <
asType < integer > ((int)30307))
\rightarrow [simplify]
[23.10] (-30307 < -this.$r.value(heapIs $heap_{funcstart\_1032,1}).p2) \land (0 <
this.r.value(heapIs $heap_{funcstart\_1032,1}).p2)
[Work on sub-term 2 of conjunction in term 23.10]
[24.0] 0 < this.$r.value(heapIs $heap_{funcstart\_1032,1}).p2
[Take given term]
[34.0] div3 == div(heapIs $heap<sub>funcstart_1032,1</sub>,
\mathbf{static\_cast} < \mathbf{int} > (\mathbf{operator}^*(\mathbf{heapIs} \ \$ \mathbf{heap}_{funcstart\_1032,1}, \ \mathbf{this}).\mathbf{p3}),
\mathbf{static\_cast}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_1032,1}.\mathrm{a3}))
→ [expand definition of operator '*' in class 'pointer' at built in declaration]
[34.1] div3 == div(heapIs $heap_{funcstart\_1032.1},
static_cast<int>(this.$r.value(heapIs $heap_{funcstart\_1032.1}).p3),
static\_cast < int > (\$heap_{funcstart\_1032,1}.a3))
\rightarrow [simplify]
[34.2] \text{ div3} == \text{div(heapIs $heap}_{funcstart\_1032,1}, \text{ this.} \$r. value(heapIs)
\theta_{funcstart\_1032,1}.p3, \theta_{funcstart\_1032,1}.p3, \theta_{funcstart\_1032,1}.a3))
\rightarrow [const static or extern object]
[34.3] \text{ div3} == \text{div(heapIs $heap}_{funcstart\_1032,1}, \text{ this.} \$r. value(heapIs)
\theta_{funcstart\_1032,1}.p3, static_cast<int>(\theta_{init}.a3))
\rightarrow [expand definition of constant 'a3' at prang.cpp (40,26)]
[34.4] div3 == div(heapIs $heap<sub>funcstart_1032,1</sub>, this.$r.value(heapIs)
\theta_{funcstart\_1032,1}.p3, \theta_{funcstart\_1032,1}.p3, \theta_{funcstart\_1032,1}.p3
\rightarrow [simplify]
[34.6] div3 == div(heapIs heapIs  heap_{funcstart\_1032,1}, this.r.value(heapIs)
heap_{funcstart_{-1032,1}}.p3, 178)
[Assume known post-assertion, class invariant or type constraint for term 34.6]
[39.0] (0 < asType<integer>(this.$r.value(heapIs
\theta_{uncstart\_1032,1}.p3 < asType < integer > (\theta_{uncstart\_1032,1}.p3) < asType < integer > (\theta_{uncstart\_1032,1}.p
M3))
\rightarrow [simplify]
```

```
[39.2] (0 < this.$r.value(heap
Is \rho_{uncstart\_1032,1}).p3) &&
(this.$r.value(heapIs heap_{funcstart\_1032,1}).p3 <
asType < integer > (\$heap.class WHPrang \in M3))
\rightarrow [const static or extern object]
[39.3] (0 < this.\$r.value(heapIs \$heap_{funcstart_{-1032,1}}).p3) &&
(this.r.value(heapIs $heap_{funcstart\_1032.1}).p3 <
asType < integer > (\$heap_{init}.class WHPrang \in M3))
\rightarrow [expand definition of constant 'M3' at prang.cpp (38,26)]
[39.4] (0 < this.$r.value(heap
Is \rho_{uncstart\_1032,1}).p3) &&
(this.$r.value(heapIs heap_{funcstart\_1032,1}).p3 <
asType < integer > ((int)30323))
\rightarrow [simplify]
[39.10] (-30323 < -this.$r.value(heapIs $heap_{funcstart\_1032.1}).p3) \land (0 <
this.$r.value(heapIs $heap_{funcstart_1032.1}).p3)
[Work on sub-term 2 of conjunction in term 39.10]
[40.0]~0 < {\bf this.\$r.value(heap Is}~\$heap_{funcstart\_1032,1}).p3
[Take given term]
[50.0] (($heap<sub>funcstart_1032,1</sub>.r1 * static_cast<signed int>(div1.rem)) -
(\text{sheap}_{funcstart\_1032,1}.\text{b1 * static\_cast} < \text{signed int} > (\text{div1.quot}))) == \text{temp1}
\rightarrow [const static or extern object]
[50.1] (($heap<sub>init</sub>.r1 * static_cast<signed int>(div1.rem)) -
(\text{sheap}_{funcstart\_1032,1}.\text{b1 * static\_cast} < \text{signed int} > (\text{div1.quot}))) == \text{temp1}
\rightarrow [expand definition of constant 'r1' at prang.cpp (29,26)]
[50.2] (((int)171 * static_cast<signed int>(div1.rem)) -
(\text{sheap}_{funcstart\_1032,1}.\text{b1} * \text{static\_cast} < \text{signed int} > (\text{div1.quot}))) == \text{temp1}
\rightarrow [simplify]
[50.3] ((171 * static_cast<signed int>(div1.rem)) - ($heap_tuncstart_1032.1.b1
* static_cast<signed int>(div1.quot))) == temp1
\rightarrow [from term 2.6, div1 is equal to div(heapIs $heap_{funcstart\_1032,1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177)]
[50.4] ((171 * static_cast<signed int>(div(heapIs $heap_{tuncstart_1032.1})
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177).rem)) -
(\text{sheap}_{funcstart\_1032,1}.\text{b1 * static\_cast} < \text{signed int} > (\text{div1.quot}))) == \text{temp1}
\rightarrow [simplify]
[50.5] ((171 * div(\mathbf{heapIs} \ \$heap_{funcstart\_1032,1}, \ \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
heap_{funcstart\_1032,1}.p1, 177).rem - (heap_{funcstart\_1032,1}.b1 *
static_cast<signed int>(div1.quot))) == temp1
```

```
\rightarrow [const static or extern object]
[50.6] ((171 * div(heapIs $heap_{funcstart\_1032,1}, this.$r.value(heapIs)
\rho_{uncstart\_1032,1}.p1, 177).rem – (\rho_{uncstart\_1032,1}.p1, 177).rem) – (\rho_{uncstart\_1032,1}.p1, 177).rem) – (\rho_{uncstart\_1032,1}.p1, 177).rem)
int>(div1.quot)) == temp1
\rightarrow [expand definition of constant 'b1' at prang.cpp (31,26)]
[50.7] ((171 * div(heapIs \rho_{funcstart\_1032,1}, this.\rho_{funcstart\_1032,1})
\theta_{uncstart\_1032,1}.p1, 177).rem - ((int)2 * static\_cast < signed)
int>(div1.quot)) == temp1
\rightarrow [simplify]
[50.8] ((171 * \mathrm{div}(\mathbf{heapIs}\ \$\mathrm{heap}_{funcstart\_1032,1},\ \mathbf{this}.\$\mathrm{r.value}(\mathbf{heapIs}
\theta_{funcstart\_1032,1}.p1, 177).rem - (2 * static\_cast < signed)
int>(div1.quot)) == temp1
\rightarrow [from term 2.6, div1 is equal to div(heapIs $heap_{funcstart\_1032,1},
this.r.value(heapIs \ heap_{funcstart\_1032.1}).p1, 177)
[50.9] ((171 * div(heapIs $heap_{funcstart\_1032,1}, this.$r.value(heapIs)]
\theta_{funcstart\_1032,1}.p1, 177).rem - (2 * static\_cast < signed)
int>(div(heapIs \$heap_{tuncstart\_1032,1}, this.\$r.value(heapIs
heap_{funcstart_1032,1}.p1, 177).quot))) == temp1
\rightarrow [simplify]
[50.14] 0 == (-\text{temp1} + (-2 * \text{div}(\text{heapIs } \text{$heap}_{funcstart\_1032.1})]
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177).quot) + (171 *
div(\mathbf{heapIs} \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
heap_{funcstart\_1032,1}.p1, 177).rem
[Take given term]
[53.0] heap_{1032,1;1051,8} == heap_{funcstart\_1032,1}._replace(this.$r \rightarrow
operator*(heapIs heap_{funcstart\_1032,1}, this)._replace(p1 \rightarrow
asType<P1Type>(($heap_funcstart_1032,1.M1 *
asType<int>(static_cast<integer>(static_cast<signed
int>(operator^*(heapIs $heap_{funcstart\_1032,1}, this).p1) < (int)0))) +
temp1)))
→ [expand definition of operator '*' in class 'pointer' at built in declaration]
[53.1] heap_{1032,1;1051,8} == heap_{funcstart\_1032,1}._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow
asType<P1Type>(($heap<sub>funcstart_1032,1</sub>.M1 *
asType<int>(static_cast<integer>(static_cast<signed
\mathbf{int} > (\mathbf{operator}^*(\mathbf{heapIs} \ \$ \mathbf{heap}_{funcstart\_1032,1}, \ \mathbf{this}).\mathtt{p1}) < (\mathbf{int})0))) \ +
temp1)))
\rightarrow [const static or extern object]
[53.2] heap_{1032,1;1051,8} == heap_{funcstart\_1032,1}._replace(this.$r \rightarrow
```

```
this.$r.value(heapIs \theta_{funcstart\_1032,1})._replace(p1 \rightarrow
asType < P1Type > ((\$heap_{init}.M1))
as Type < int > (static\_cast < integer > (static\_cast < signed))
int>(operator^*(heapIs $heap_{funcstart\_1032,1}, this).p1) < (int)0))) +
temp1)))
\rightarrow [expand definition of constant 'M1' at prang.cpp (28,26)]
[53.3] $heap<sub>1032,1;1051,8</sub> == $heap<sub>funcstart_1032,1</sub>._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow
asType<P1Type>(((int)30269 *
asType<int>(static_cast<integer>(static_cast<signed
\mathbf{int} > (\mathbf{operator}^*(\mathbf{heapIs} \ \$ \mathbf{heap}_{funcstart\_1032,1}, \ \mathbf{this}).\mathtt{p1}) < (\mathbf{int})0))) \ +
temp1)))
\rightarrow [simplify]
[53.4] heap_{1032,1;1051,8} == heap_{funcstart\_1032,1}.\_replace(this.\$r \rightarrow this)
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow
asType<P1Type>((30269 *
as Type < int > (static\_cast < integer > (static\_cast < signed))
int>(operator^*(heapIs \$heap_{funcstart\_1032,1}, this).p1) < (int)0))) +
temp1)))
→ [expand definition of operator '*' in class 'pointer' at built in declaration]
[53.5] $heap<sub>1032,1;1051,8</sub> == $heap<sub>funcstart_1032,1</sub>._replace(this.$r \rightarrow
\mathbf{this.\$r.value}(\mathbf{heapIs}~\$\mathbf{heap}_{funcstart\_1032,1}).\_\mathbf{replace}(\mathbf{p1}\rightarrow
asType<P1Type>((30269 *
as Type < int > (static\_cast < integer > (static\_cast < signed))
int>(this.\$r.value(heapIs \$heap_{funcstart\_1032,1}).p1) < (int)0))) + temp1)))
\rightarrow [simplify]
[53.9] heap_{1032,1;1051,8} == heap_{funcstart\_1032,1}._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow
asType<P1Type>((30269 * asType<int>(static_cast<integer>(0 <
-this.r.value(heapIs heap_{funcstart\_1032,1}.p1)) + temp1)))
\rightarrow [from term 8.0, literala < -this.$r.value(heapIs $heap_{funcstart\_1032.1}).p1
is false whenever -2 < (0 + literala)
   Proof of rule precondition:
   [53.9.0] - 2 < (0 + 0)
   \rightarrow [simplify]
   [53.9.2] true
[53.10] $\text{heap}_{1032,1;1051,8} == $\text{heap}_{funcstart\_1032,1}.$\text{-replace}(\text{this}.$\text{$\frac{1}{2}}$
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow
asType<P1Type>((30269 * asType<int>(static_cast<integer>(false)))
+ \text{ temp1})))
```

```
\rightarrow [simplify]
[53.11] $\text{heap}_{1032,1;1051,8} == \text{$heap}_{funcstart\_1032,1}.$\text{$_-\text{replace}(this.}$\text{$r} \to \text{$_-\text{$_-$}}
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow
asType<P1Type>((30269 * asType<int>(([false]: 1, []: 0))) + temp1)))
→ [explicitly assert falsehood of skipped guards in subsequent guards]
[53.12] $heap<sub>1032,1;1051,8</sub> == $heap<sub>funcstart_1032,1</sub>._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow
asType<P1Type>((30269 * asType<int>(([false]: 1, [true]: 0))) +
temp1)))
\rightarrow [simplify]
[53.15] $heap<sub>1032,1;1051,8</sub> == $heap<sub>funcstart_1032,1</sub>._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow
asType < P1Type > (0 + temp1))
\rightarrow [from term 50.14, temp1 is equal to (-2 * div(heapIs $heap_{funcstart\_1032.1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177).quot) + (171 *
div(\mathbf{heapIs} \ \$heap_{funcstart\_1032,1}, \ \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
heap_{funcstart_{-1032.1}}.p1, 177).rem
[53.16] $heap<sub>1032,1;1051,8</sub> == $heap<sub>funcstart_1032,1</sub>._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow
asType < P1Type > (0 + ((-2 * div(heapIs $heap_{funcstart\_1032,1},
this.$r.value(heapIs heap_{funcstart\_1032,1}).p1, 177).quot) + (171 *
div(\mathbf{heapIs} \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
heap_{funcstart_{1032,1}}.p1, 177).rem))))
\rightarrow [simplify]
[53.19] $heap<sub>1032,1;1051,8</sub> == $heap<sub>funcstart_1032,1</sub>._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{tuncstart\_1032.1}, this.r.value(heapIs \rho_{tuncstart\_1032.1}).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.}\text{\$r.value}(\text{heapIs}))
heap_{funcstart\_1032,1}.p1, 177.rem)))
[Take given term]
[54.0]\;((\$ heap_{1032,1;1051,8}.r2\;*\;\textbf{static\_cast} < \textbf{signed int} > (\text{div}2.rem))\;-
(\text{sheap}_{1032,1:1051.8}.\text{b2} * \text{static\_cast} < \text{signed int} > (\text{div2.quot}))) == \text{temp2}
\rightarrow [from term 53.19, $heap<sub>1032,1;1051,8</sub> is equal to
heap_{funcstart\ 1032.1}._replace(this.r \rightarrow this.r.value(heapIs)
heap_{funcstart\_1032,1}._replace(p1 \rightarrow (-2 * div(heapIs p_{funcstart\_1032,1}).
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177).quot) + (171 *
div(heapIs $heap_funcstart_1032.1, this.$r.value(heapIs
heap_{funcstart\_1032,1}.p1, 177).rem)))
[54.1] \; ((\$ heap_{funcstart\_1032,1}.\_\textbf{replace}(\textbf{this}.\$r \to \textbf{this}.\$r.\textbf{value}(\textbf{heapIs}))) \\
\rho_{tuncstart\_1032.1}._replace(p1 \rightarrow ((-2 * div(heapIs \rho_{tuncstart\_1032.1})
```

```
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177).quot) + (171 *
div(\mathbf{heapIs} \$ heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
\theta_{funcstart\_1032,1}.p1, 177).rem))).r2 * static_cast < signed
int>(div2.rem)) - (\$heap_{1032,1;1051,8}.b2 * static\_cast < signed
int>(div2.quot)) == temp2
\rightarrow [const member of object with modified fields]
[54.2] \; ((\$heap_{funcstart\_1032,1}.r2 * \textbf{static\_cast} < \textbf{signed int} > (div2.rem)) \; - \\
(\text{sheap}_{1032,1;1051,8}.\text{b2} * \text{static\_cast} < \text{signed int} > (\text{div2.quot}))) == \text{temp2}
\rightarrow [const static or extern object]
[54.3] (($heap_{init}.r2 * static_cast < signed int > (div2.rem)) -
(\text{sheap}_{1032,1:1051.8}.\text{b2} * \text{static\_cast} < \text{signed int} > (\text{div2.quot}))) == \text{temp2}
\rightarrow [expand definition of constant 'r2' at prang.cpp (34,26)]
[54.4] (((int)172 * static_cast<signed int>(div2.rem)) -
(\text{sheap}_{1032.1:1051.8}.\text{b2} * \text{static\_cast} < \text{signed int} > (\text{div}2.\text{quot}))) == \text{temp}2
\rightarrow [simplify]
[54.5] ((172 * static_cast < signed int > (div2.rem)) - ($heap_{1032,1:1051,8}.b2 *
\mathbf{static\_cast} < \mathbf{signed\ int} > (\mathbf{div2.quot}))) == \mathbf{temp2}
\rightarrow [from term 18.6, div2 is equal to div(heapIs $heap_{funcstart\_1032,1},
this.r.value(heapIs $heap_{funcstart\_1032,1}).p2, 176)]
[54.6] ((172 * static_cast<signed int>(div(heapIs $heap_{funcstart\_1032,1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p2, 176).rem)) -
(\text{sheap}_{1032,1:1051.8}.\text{b2} * \text{static\_cast} < \text{signed int} > (\text{div2.quot}))) == \text{temp2}
\rightarrow [simplify]
[54.7] ((172 * div(heapIs \rho_{funcstart\_1032,1}, this.\r.value(heapIs
\text{Sheap}_{funcstart\_1032,1}.p2, 176).rem) - (\text{Sheap}_{1032,1;1051,8}.b2 *
\mathbf{static\_cast} < \mathbf{signed\ int} > (\mathbf{div2.quot}))) == \mathbf{temp2}
\rightarrow [from term 53.19, $heap<sub>1032.1:1051.8</sub> is equal to
$heap_{funcstart\_1032,1}.$_replace(this.$r \rightarrow this.$r.value(heapIs)
heap_{funcstart\_1032,1}._replace(p1 \rightarrow (-2 * div(heapIs \$heap_{funcstart\_1032,1}, -2))
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177).quot) + (171 *
div(\mathbf{heapIs} \ \$heap_{funcstart\_1032,1}, \ \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
heap_{funcstart\_1032,1}.p1, 177).rem)))]
[54.8] ((172 * div(heapIs $heap_{funcstart\_1032,1}, this.$r.value(heapIs)]
\rho_{funcstart\_1032,1}.p2, 176).rem – (\rho_{funcstart\_1032,1}.\_replace)
\rightarrow this.$r.value(heapIs $heap_{tuncstart\_1032.1})._replace(p1 \rightarrow ((-2 *
div(\mathbf{heapIs} \$heap_{funcstart\_1032.1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
\text{Sheap}_{funcstart\_1032,1}.p1, 177).quot) + (171 * div(heapIs \text{Sheap}_{funcstart\_1032,1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177).rem)))).b2 *
static_cast<signed int>(div2.quot))) == temp2
```

```
\rightarrow [const member of object with modified fields]
[54.9] ((172 * div(heapIs $heap<sub>funcstart_1032,1</sub>, this.$r.value(heapIs
\text{Sheap}_{funcstart\_1032,1}.p2, 176).rem) - (\text{Sheap}_{funcstart\_1032,1}.b2 *
static_cast<signed int>(div2.quot))) == temp2
\rightarrow [const static or extern object]
[54.10] ((172 * div(heapIs $heap_{funcstart\_1032,1}, this.$r.value(heapIs
\rho_{tuncstart\_1032,1}.p2, 176).rem – (\rho_{tuncstart\_1032,1}.p2, 176).rem
int>(div2.quot)) == temp2
\rightarrow [expand definition of constant 'b2' at prang.cpp (36,26)]
[54.11] ((172 * div(heapIs heap_{funcstart\_1032,1}, this.r.value(heapIs)
\theta_{nucstart\_1032,1}.p2, 176).rem - ((int)35 * static_cast < signed
int>(div2.quot)) == temp2
\rightarrow [simplify]
[54.12] ((172 * div(heapIs $heap<sub>funcstart_1032,1</sub>, this.$r.value(heapIs)
\theta_{funcstart\_1032,1}.p2, 176).rem - (35 * static\_cast < signed)
int>(div2.quot)) == temp2
\rightarrow [from term 18.6, div2 is equal to div(heapIs $heap_{funcstart\_1032,1},
this.r.value(heapIs $heap_{funcstart\_1032,1}).p2, 176)
[54.13] ((172 * div(heapIs $heap<sub>funcstart_1032,1</sub>, this.$r.value(heapIs)
\theta_{funcstart\_1032,1}.p2, 176).rem) - (35 * static_cast<signed)
int>(div(heapIs \$heap_{funcstart\_1032,1}, this.\$r.value(heapIs
\$ \mathrm{heap}_{funcstart\_1032,1}).\mathrm{p2},\, 176).\mathrm{quot}))) == \, \mathrm{temp2}
\rightarrow [simplify]
[54.18] 0 == (-\text{temp2} + (-35 * \text{div}(\text{heapIs} \$\text{heap}_{funcstart\_1032,1})]
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p2, 176).quot) + (172 *
div(\mathbf{heapIs} \$ heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
heap_{funcstart_{1032,1}}.p2, 176).rem
[Take given term]
[57.0] $\text{heap}_{1032,1;1054,8} == $\text{heap}_{1032,1;1051,8}._\text{replace}(\text{this}.$\text{$r} \to \text{
operator*(heapIs heap_{1032,1;1051,8}, this)._replace(p2 \rightarrow
asType<P2Type>(($heap<sub>1032,1;1051.8</sub>.M2 *
asType<int>(static_cast<integer>(static_cast<signed
int>(operator^*(heapIs $heap_{1032,1;1051,8}, this).p2) < (int)(0))) + temp(2)))
\rightarrow [from term 53.19, $heap<sub>1032,1;1051,8</sub> is equal to
heap_{funcstart\_1032.1}._replace(this.r \rightarrow this.r.value(heapIs)
heap_{funcstart\_1032,1}._replace(p1 \rightarrow (-2 * div(heapIs heap_{funcstart\_1032,1}),
this.$r.value(heapIs heap_{funcstart\_1032,1}).p1, 177).quot) + (171 *
div(\mathbf{heapIs} \ \$heap_{funcstart\_1032,1}, \ \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
heap_{funcstart_{-1032.1}}.p1, 177).rem)))
```

```
[57.2] heap_{1032,1;1054,8} == heap_{funcstart\_1032,1}._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.} \text{\$r.value}(\text{heapIs}))
\rho_{funcstart\_1032,1}.p1, 177).rem)))._replace(this.$r \rightarrow operator*(heapIs)
\rho_{funcstart\_1032,1}._replace(this.r \to this.r.value(heapIs)
heap_{funcstart\_1032,1}._replace(p1 \rightarrow (-2 * div(heapIs p_{funcstart\_1032,1}).
this.$r.value(heapIs heap_{funcstart_{-1032,1}}).p1, 177).quot) + (171 *
div(\mathbf{heapIs} \$ heap_{funcstart\_1032.1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
\theta_{tuncstart_{1032,1}}.p1, 177).rem)), this).replace(p2 \rightarrow
\mathbf{asType}{<} \text{P2Type}{>} ((\$\text{heap}_{1032,1;1051,8}.\text{M2} *
asType<int>(static_cast<integer>(static_cast<signed
int>(operator^*(heapIs $heap_{1032,1;1051,8}, this).p2) < (int)0))) + temp2)))
→ [expand definition of operator '*' in class 'pointer' at built in declaration]
[57.3] heap_{1032,1;1054,8} == heap_{funcstart\_1032,1}._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032.1}, \text{this.} \text{\$r.value}(\text{heapIs}))
\theta_{funcstart\_1032,1}.p1, 177).rem))))._replace(this.$r \rightarrow
this.$r.value(heap
Is $heap_{funcstart\_1032,1}._replace(this.$r \rightarrow
this.$r.value(heapIs \rho_{tuncstart\_1032.1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{tuncstart\_1032.1}, this.r.value(heapIs \rho_{tuncstart\_1032.1}).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.} \text{\$r.value}(\text{heapIs}))
\theta_{funcstart\_1032,1}.p1, 177).rem))))).\_replace(p2 \rightarrow
asType<P2Type>(($heap<sub>1032.1:1051.8</sub>.M2 *
asType<int>(static_cast<integer>(static_cast<signed
int>(operator^*(heapIs $heap_{1032,1;1051,8}, this).p2) < (int)(0))) + temp(2)))
→ [evaluate dereferenced pointer into modified heap]
[57.4] heap_{1032,1;1054,8} == heap_{funcstart\_1032,1}._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\theta_{funcstart\_1032,1}, this.\r.value(heapIs \theta_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs \theta_{funcstart\_1032,1}, this.r.value(heapIs)
\rho_{funcstart\_1032.1}.p1, 177).rem)))._replace(this.$r \rightarrow ([this.$r ==
this.$r]: this.$r.value(heapIs \rho_{tuncstart\_1032,1})._replace(p1 \rightarrow (-2 *
div(\mathbf{heapIs} \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
\text{Sheap}_{funcstart\_1032,1}.p1, 177).quot) + (171 * div(heapIs \text{Sheap}_{funcstart\_1032,1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177).rem)), []:
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p2 \rightarrow
asType<P2Type>(($heap<sub>1032,1:1051,8</sub>.M2 *
asType < int > (static\_cast < integer > (static\_cast < signed
int>(operator^*(heapIs $heap_{1032.1:1051.8}, this).p2) < (int)(0))) + temp(2)))
→ [explicitly assert falsehood of skipped guards in subsequent guards]
[57.5] $heap<sub>1032,1:1054,8</sub> == $heap<sub>funcstart_1032,1</sub>._replace(this.$r \rightarrow
```

```
this.$r.value(heapIs \rho_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.}\text{\$r.value}(\text{heapIs}))
\rho_{funcstart\_1032,1}.p1, 177).rem)))._replace(this.$r \rightarrow ([this.$r ==
this.$r]: this.$r.value(heapIs \rho_{tuncstart\_1032,1})._replace(p1 \rightarrow (-2 *
div(\mathbf{heapIs} \$ heap_{funcstart\_1032.1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
\text{Sheap}_{funcstart\_1032.1}.p1, 177).quot) + (171 * div(heapIs \text{Sheap}_{funcstart\_1032.1},
this.r.value(heapIs \heap_{funcstart\_1032.1}).p1, 177).rem)), [!(this.<math>r = 
this.$r)]: this.$r.value(heapIs \rho_{funcstart\_1032,1})._replace(p2 \rightarrow
asType<P2Type>(($heap<sub>1032,1;1051,8</sub>.M2 *
as Type < int > (static\_cast < integer > (static\_cast < signed
int>(operator^*(heapIs \$heap_{1032,1:1051.8}, this).p2) < (int)0))) + temp2)))
\rightarrow [simplify]
[57.7] heap_{1032,1;1054,8} == heap_{funcstart\_1032,1}._replace(this.r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart_1032,1}, this.r.value(heapIs \rho_{funcstart_1032,1}).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.} \text{\$r.value}(\text{heapIs}))
\theta_{funcstart\_1032,1}.p1, 177).rem))))._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this. r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs $heap<sub>funcstart_1032.1</sub>, this.$r.value(heapIs
\theta_{funcstart\_1032.1}.p1, 177).rem)))._replace(p2 \rightarrow
asType<P2Type>(($heap<sub>1032.1:1051.8</sub>.M2 *
asType < int > (static\_cast < integer > (static\_cast < signed
int>(operator^*(heapIs \$heap_{1032,1;1051,8}, this).p2) < (int)(0))) + temp(2)))
\rightarrow [from term 53.19, $heap<sub>1032.1:1051.8</sub> is equal to
\$heap_{funcstart\_1032,1}.\_\textbf{replace}(\textbf{this}.\$r \rightarrow \textbf{this}.\$r.\textbf{value}(\textbf{heapIs}
heap_{funcstart\_1032,1}._replace(p1 \rightarrow (-2 * div(heapIs $heap_{funcstart\_1032,1}).
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177).quot) + (171)
div(heapIs $heap_{funcstart_1032.1}, this.$r.value(heapIs
heap_{funcstart\_1032,1}.p1, 177).rem)))]
[57.8] heap_{1032,1;1054,8} == heap_{funcstart\_1032,1}._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{heap}_{funcstart\_1032,1}, \text{this.}\text{$r.value}(\text{heapIs}))
\theta_{funcstart\_1032,1}.p1, 177).rem)))).\_replace(this.\$r \rightarrow 0
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.}\text{\$r.value}(\text{heapIs}))
\theta_{funcstart\_1032,1}.p1, 177).rem))).\_replace(p2 \rightarrow
asType < P2Type > ((\$heap_{tuncstart\_1032.1}.\_replace(this.\$r \rightarrow
this.$r.value(heapIs \rho_{tuncstart\_1032.1})._replace(p1 \rightarrow ((-2 * div(heapIs
$\text{heap}_{funcstart_1032.1}$, this.$\text{r.value}(\text{heapIs} \text{$heap}_{funcstart_1032.1}).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.} \text{\$r.value}(\text{heapIs}))
```

```
\theta_{funcstart_{-1032,1}}.p1, 177).rem)))).M2 *
asType<int>(static_cast<integer>(static_cast<signed
int>(operator^*(heapIs $heap_{1032,1;1051,8}, this).p2) < (int)(0))) + temp(2)))
→ [const member of object with modified fields]
[57.9] heap_{1032,1;1054,8} == heap_{funcstart\_1032,1}._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032.1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{heap}_{funcstart\_1032,1}, \text{this.}\text{$r.value}(\text{heapIs}))
\theta_{funcstart\_1032,1}.p1, 177).rem))))._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\ 1032.1}).replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs \theta_{funcstart\_1032,1}, this.r.value(heapIs)
\theta_{funcstart\_1032,1}.p1, 177).rem))._replace(p2 \rightarrow
asType < P2Type > ((\$heap_{funcstart\_1032,1}.M2)^*
asType<int>(static_cast<integer>(static_cast<signed
int > (operator^*(heapIs \$heap_{1032,1;1051,8}, this).p2) < (int)0))) + temp2)))
\rightarrow [const static or extern object]
[57.10] $heap<sub>1032,1;1054,8</sub> == $heap<sub>funcstart_1032,1</sub>._replace(this.$r \rightarrow
this.$r.value(heapIs \rho_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.}\text{\$r.value}(\text{heapIs}))
\theta_{funcstart\_1032,1}.p1, 177).rem))))._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032.1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this. r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.} \text{\$r.value}(\text{heapIs}))
\theta_{funcstart\_1032,1}.p1, 177).rem))).\_replace(p2 \rightarrow
asType < P2Type > ((\$heap_{init}.M2 *
asType<int>(static_cast<integer>(static_cast<signed
int>(operator^*(heapIs $heap_{1032,1;1051,8}, this).p2) < (int)0))) + temp2)))
\rightarrow [expand definition of constant 'M2' at prang.cpp (33,26)]
[57.11] $heap<sub>1032,1;1054,8</sub> == $heap<sub>funcstart_1032,1</sub>._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
\label{eq:continuous_function} $ \text{heap}_{funcstart\_1032,1} . \text{p1}, 177).rem)))).\_\textbf{replace}(\textbf{this}.\$r \rightarrow
this.$r.value(heapIs heapIs_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs \rho_{funcstart\_1032,1}, this.r.value(heapIs)
\theta_{funcstart\_1032,1}.p1, 177).rem))).\_replace(p2 \rightarrow
asType < P2Type > (((int)30307 *
asType<int>(static_cast<integer>(static_cast<signed
int>(operator^*(heapIs $heap_{1032,1;1051,8}, this).p2) < (int)(0))) + temp(2)))
\rightarrow [simplify]
```

```
[57.12] $\text{heap}_{1032,1;1054,8} == $\text{heap}_{funcstart\_1032,1}._\text{replace}(\text{this}.\text{$\frac{1}{2}r$})
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
\theta_{tuncstart\_1032,1}.p1, 177).rem)))).\_replace(this.\$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs $heap<sub>funcstart_1032.1</sub>, this.$r.value(heapIs
\theta_{funcstart\_1032,1}.p1, 177).rem))._replace(p2 \rightarrow
asType<P2Type>((30307 *
asType < int > (static\_cast < integer > (static\_cast < signed
int>(operator^*(heapIs \$heap_{1032,1;1051,8}, this).p2) < (int)(0))) + temp(2)))
\rightarrow [from term 53.19, $heap<sub>1032,1:1051,8</sub> is equal to
heap_{funcstart\_1032,1}._replace(this.r \rightarrow this.r.value(heapIs)
heap_{funcstart\_1032,1}._replace(p1 \rightarrow (-2 * div(heapIs \$heap_{funcstart\_1032,1}, -2 * div(heapIs \$heap_{funcst
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, \ 177).quot) + (171)
div(\mathbf{heapIs} \ \$heap_{funcstart\_1032,1}, \ \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
heap_{funcstart\_1032,1}.p1, 177).rem)))
[57.13] $heap<sub>1032,1;1054,8</sub> == $heap<sub>funcstart_1032,1</sub>._replace(this.$r \rightarrow
\textbf{this.}\$r.\textbf{value}(\textbf{heapIs}~\$heap_{funcstart\_1032,1}).\_\textbf{replace}(p1 \rightarrow ((\text{-}2~*\text{div}(\textbf{heapIs}
$heap_tuncstart_1032.1, this.$r.value(heapIs $heap_tuncstart_1032.1).p1,
177).quot) + (171 * div(heapIs \rho_{funcstart\_1032,1}, this.r.value(heapIs)
\label{eq:continuous_function} $ \text{heap}_{funcstart\_1032,1}.\text{p1},\ 177).\text{rem})))).$ \_\textbf{replace}(\textbf{this}.\$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
(177).quot + (171 * div(heapIs $heap_{funcstart\_1032,1}, this.$r.value(heapIs)
\theta_{funcstart\_1032,1}.p1, 177).rem)))._replace(p2 \rightarrow
\mathbf{asType}{<}\mathrm{P2Type}{>}((30307~*
asType<int>(static_cast<integer>(static_cast<signed
int>(operator^*(heapIs \ heap_{funcstart\_1032,1}.\_replace(this.\$r \rightarrow
\textbf{this.\$r.value}(\textbf{heapIs}~\$ heap_{funcstart\_1032,1}).\_\textbf{replace}(p1 \rightarrow (-2~*div(\textbf{heapIs}
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs \theta_{funcstart\_1032,1}, this.r.value(heapIs)
\text{Sheap}_{funcstart\_1032,1}.\text{p1}, 177).\text{rem})), \text{this}.\text{p2}) < (\text{int})0)) + \text{temp2}))
→ [expand definition of operator '*' in class 'pointer' at built in declaration]
[57.14] $heap<sub>1032,1;1054,8</sub> == $heap<sub>funcstart_1032,1</sub>._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.}\text{\$r.value}(\text{heapIs}))
\theta_{funcstart\_1032,1}.p1, 177).rem)))).replace(this.r \rightarrow 0
this.$r.value(heapIs $heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
$\text{heap}_{funcstart_1032.1}$, this.$\text{r.value}(\text{heapIs} \text{$heap}_{funcstart_1032.1}).p1,
177).quot) + (171 * div(heapIs $heap<sub>funcstart_1032.1</sub>, this.$r.value(heapIs
\theta_{funcstart\_1032,1}.p1, 177).rem))).\_replace(p2 \rightarrow
```

```
asType<P2Type>((30307 *
asType<int>(static_cast<integer>(static_cast<signed
\mathbf{int}{>}(\mathbf{this.\$r.value}(\mathbf{heapIs}\ \$\mathbf{heap}_{funcstart\_1032,1}.\_\mathbf{replace}(\mathbf{this.\$r} \to \mathbf{funcstart}))
this.$r.value(heapIs p_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs \theta_{funcstart\_1032,1}, this.r.value(heapIs)
\theta_{funcstart_{1032,1}}.p1, 177).rem)))).p2) < (int)0))) + temp2)))
\rightarrow [evaluate dereferenced pointer into modified heap]
[57.15] $heap<sub>1032,1;1054,8</sub> == $heap<sub>funcstart_1032,1</sub>._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs \theta_{funcstart\_1032,1}, this.r.value(heapIs)
\theta_{tuncstart\_1032,1}.p1, 177).rem)))).\_replace(this.$r \rightarrow
this.$r.value(heapIs $heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(\mathbf{heapIs} \$ heap_{funcstart\_1032,1}, \mathbf{this}.\$ r. \mathbf{value}(\mathbf{heapIs})
\theta_{uncstart\_1032,1}.p1, 177).rem))).\_replace(p2 \rightarrow
asType<P2Type>((30307 *
asType<int>(static_cast<integer>(static_cast<signed int>(([this.$r
== this.$r]: this.$r.value(heapIs \rho_{tangle} = 1032,1)._replace(p1 \rho (-2 *
div(\mathbf{heapIs} \$ heap_{funcstart\_1032.1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
\text{Sheap}_{funcstart\_1032,1}.p1, 177).quot) + (171 * div(heapIs \text{Sheap}_{funcstart\_1032,1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177).rem)), []:
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p2) < (int)0))) + temp2)))
→ [explicitly assert falsehood of skipped guards in subsequent guards]
[57.16] $\text{heap}_{1032,1;1054,8} == $\text{heap}_{funcstart\_1032,1}._\text{replace}(\text{this.}\text{$\frac{1}{2}}\text{$\text{op}}]$
this.$r.value(heapIs \rho_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\theta_{funcstart\_1032,1}, this.r.value(heapIs \theta_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(\mathbf{heapIs} \ \$heap_{funcstart\_1032,1}, \ \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
\theta_{funcstart\_1032,1}.p1, 177).rem)))).\_replace(this.\$r \rightarrow 0
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\$heap_{funcstart\_1032,1},\, \textbf{this}.\$r.\textbf{value}(\textbf{heapIs}\,\,\$heap_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs \theta_{funcstart\_1032,1}, this.r.value(heapIs)
heap_{funcstart\_1032,1}.p1, 177).rem)))._replace(p2 \rightarrow
asType<P2Type>((30307 *
asType<int>(static_cast<integer>(static_cast<signed int>(([this.$r
== this.$r]: this.$r.value(heapIs \rho_{funcstart\_1032,1})._replace(p1 \rightarrow (-2 *
\mathrm{div}(\mathbf{heapIs}\ \$\mathrm{heap}_{funcstart\_1032,1},\ \mathbf{this}.\$\mathrm{r.value}(\mathbf{heapIs}
\text{Sheap}_{funcstart\_1032,1}.p1, 177).quot) + (171 * div(heapIs \text{Sheap}_{funcstart\_1032,1},
\mathbf{this.\$r.value(heapIs\ \$heap_{funcstart\_1032,1}).p1,\ 177).rem)),\ [!(\mathbf{this.\$r}==
this.r.value(heapIs $heap_{funcstart\_1032.1}).p2) < (int)0))) +
temp2)))
\rightarrow [simplify]
```

```
[57.23] $heap<sub>1032,1;1054,8</sub> == $heap<sub>funcstart_1032,1</sub>._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
\theta_{tuncstart\_1032,1}.p1, 177).rem)))).\_replace(this.\$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032.1}, \text{this.} \text{\$r.value}(\text{heapIs}))
\theta_{tuncstart_1032.1},p1, 177).rem)))._replace(p2 \rightarrow
asType<P2Type>((30307 * asType<int>(static_cast<integer>(0 <
-\mathbf{this.\$r.value}(\mathbf{heapIs}\ \$\mathrm{heap}_{funcstart\_1032,1}).\mathrm{p2}))) + \mathrm{temp2})))
\rightarrow [from term 24.0, literala < -this.$r.value(heapIs $heap_{funcstart\_1032,1}).p2
is false whenever -2 < (0 + literala)
    Proof of rule precondition:
    [57.23.0] - 2 < (0 + 0)
    \rightarrow [simplify]
    [57.23.2] true
[57.24] $\text{heap}_{1032,1;1054,8} == $\text{heap}_{funcstart\_1032,1}._\text{replace}(\text{this}.\text{$\frac{1}{2}r$})
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
\theta_{tuncstart\_1032,1}.p1, 177).rem)))).\_replace(this.\$r \rightarrow
this.$r.value(heapIs \rho_{uncstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs)
\rho_{funcstart_1032,1}, this.\r.value(heapIs \rho_{funcstart_1032,1}).p1,
177).quot) + (171 * div(heapIs $heap<sub>funcstart_1032,1</sub>, this.$r.value(heapIs
\theta_{funcstart\_1032,1}.p1, 177).rem))).\_replace(p2 \rightarrow
asType<P2Type>((30307 * asType<int>(static_cast<integer>(false)))
+ \text{temp2})))
\rightarrow [simplify]
[57.25] $heap<sub>1032,1;1054,8</sub> == $heap<sub>funcstart_1032,1</sub>._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart_1032,1}, this.r.value(heapIs \rho_{funcstart_1032,1}).p1,
177).quot) + (171 * div(\mathbf{heapIs} \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}))
\theta_{tuncstart\_1032.1}.p1, 177).rem)))).\_replace(this.\$r \rightarrow 0
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.\r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.} \text{\$r.value}(\text{heapIs}))
\theta_{funcstart\_1032,1}.p1, 177).rem))._replace(p2 \rightarrow
asType < P2Type > ((30307 * asType < int > (([false]: 1, []: 0))) + temp2)))
→ [explicitly assert falsehood of skipped guards in subsequent guards]
[57.26] $\text{heap}_{1032,1;1054,8} == $\text{heap}_{funcstart\_1032,1}._\text{replace}(\text{this}.$\text{$\frac{1}{2}}\rightarrow$)
```

```
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
\theta_{tuncstart\_1032,1}.p1, 177).rem)))).\_replace(this.\$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs $heap<sub>funcstart_1032,1</sub>, this.$r.value(heapIs
\theta_{tuncstart_{-1032,1}}.p1, 177).rem))._replace(p2 \rightarrow
asType<P2Type>((30307 * asType<int>(([false]: 1, [true]: 0))) +
temp2)))
\rightarrow [simplify]
[57.29] $\text{heap}_{1032,1;1054,8} == $\text{heap}_{funcstart\_1032,1}$._\text{replace}(\text{this}.$\text{$r} \to \text{
this.$r.value(heapIs \rho_{uncstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs)
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
\theta_{funcstart\_1032,1}.p1, 177).rem)))).replace(this.r \rightarrow 0
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\$heap_{funcstart\_1032,1},\, \textbf{this.}\$r.\textbf{value}(\textbf{heapIs}\,\,\$heap_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
\rho_{uncstart\_1032.1}, p1, 177).rem)))._replace(p2 \rightarrow asType<P2Type>(0 +
temp2)))
\rightarrow [from term 54.18, temp2 is equal to (-35 * div(heapIs $heap_{funcstart\_1032,1},
this.r.value(heapIs \ heap_{funcstart\_1032.1}).p2, 176).quot) + (172)
div(heapIs $heap_funcstart_1032.1, this.$r.value(heapIs
$heap_tuncstart_1032.1).p2, 176).rem)]
[57.30] $heap<sub>1032,1;1054,8</sub> == $heap<sub>funcstart_1032,1</sub>._replace(this.$r \rightarrow
this.$r.value(heapIs $heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{tuncstart\_1032.1}, this.r.value(heapIs \rho_{tuncstart\_1032.1}).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.\$r.value}(\text{heapIs}))
\theta_{funcstart_{1032,1}}.p1, 177).rem))))._replace(this.$r \rightarrow
this.$r.value(heapIs \rho_{tuncstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\$heap_{funcstart\_1032,1},\, \textbf{this.}\$r.\textbf{value}(\textbf{heapIs}\,\,\$heap_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(\mathbf{heapIs} \ \$heap_{funcstart\_1032,1}, \ \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
\theta_{tuncstart\_1032,1}.p1, 177).rem))._replace(p2 \rightarrow asType<P2Type>(0 +
((-35 * div(\mathbf{heapIs} \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}))
\text{Sheap}_{funcstart\_1032,1}.p2, 176).quot) + (172 * div(heapIs \text{Sheap}_{funcstart\_1032,1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p2, 176).rem)))))
\rightarrow [simplify]
[57.33] $\text{heap}_{1032,1;1054,8} == $\text{heap}_{funcstart\_1032,1}._\text{replace}(\text{this}.\text{$\frac{1}{2}r$})
this.$r.value(heapIs \rho_{tuncstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
\theta_{funcstart\_1032,1}.p1, 177).rem)))).replace(this.r \rightarrow 0
```

```
this.$r.value(heapIs \rho_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs \theta_{funcstart\_1032,1}, this.r.value(heapIs)
\text{Sheap}_{funcstart\_1032,1}.p1, 177).rem)))._replace(p2 \rightarrow ((-35 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p2,
176).quot) + (172 * div(heapIs $heap<sub>funcstart_1032,1</sub>, this.$r.value(heapIs
heap_{funcstart\_1032,1}.p2, 176).rem)))
[Take goal term]
[1.0] ($heap<sub>1032,1:1054,8</sub>.r3 * static_cast<signed int>(div3.rem)) \leq
maxof(signed int)
\rightarrow [from term 57.33, $heap<sub>1032,1;1054,8</sub> is equal to
$heap_{funcstart\_1032,1}.$_replace(this.$r \rightarrow this.$r.value(heapIs)
heap_{funcstart\_1032.1}._replace(p1 \rightarrow ((-2 * div(heapIs heap_{funcstart\_1032.1}),
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, \ 177).quot) + (171 \ *funcstart\_1032,1).p1
div(heapIs $heap_{tuncstart\_1032.1}, this.$r.value(heapIs
\theta_{funcstart\_1032,1}.p1, 177).rem)))).\_replace(this.\$r \rightarrow 0
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
heap_{funcstart\_1032.1}, this.r.value(heapIs heap_{funcstart\_1032.1}).p1,
177).quot) + (171 * div(\mathbf{heapIs} \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}))
heap_{funcstart\_1032,1}.p1, 177).rem))).\_replace(p2 \rightarrow (-35 * div(heapIs))).
heap_{funcstart\_1032,1}, this.r.value(heapIs heap_{funcstart\_1032,1}).p2,
176).quot) + (172 * div(heapIs $heap_{funcstart\_1032,1}, this.$r.value(heapIs
heap_{funcstart\_1032,1}.p2, 176).rem)))]
[1.1] (heap_{funcstart\_1032.1}._replace(this.r \rightarrow this.r.value(heapIs
\text{Sheap}_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs \text{Sheap}_{funcstart\_1032,1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177).quot) + (171 * 
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_1032,1}, \ \mathbf{this}.\$ r. \mathbf{value}(\mathbf{heapIs}
\label{eq:continuous_function} $ \text{heap}_{funcstart\_1032,1}.\text{p1},\ 177).\text{rem})))).$ \_\textbf{replace}(\textbf{this}.\$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
$heap_funcstart_1032.1, this.$r.value(heapIs $heap_funcstart_1032.1).p1,
177).quot) + (171 * div(\mathbf{heapIs} \ \$heap_{funcstart\_1032,1}, \ \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
\rho_{funcstart\_1032,1}.p1, 177).rem)._replace(p2 \rightarrow ((-35 * div(heapIs
\$heap_{funcstart\_1032,1},\ \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}\ \$heap_{funcstart\_1032,1}).p2,
176).quot) + (172 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.} \text{\$r.value}(\text{heapIs}))
\theta_{funcstart\_1032,1}.p2, 176).rem))).r3 * static_cast < signed
int>(div3.rem)) \le maxof(signed int)
→ [const member of object with modified fields]
[1.3] (\frac{1.3}{\text{heap}_{funcstart\_1032,1}}.r3 * static_cast<signed int>(div3.rem)) <
maxof(signed int)
\rightarrow [const static or extern object]
[1.4] (\frac{1.4}{\text{heap}_{init}}.r3 * static_cast<signed int>(div3.rem)) \leq maxof(signed)
int)
```

```
\rightarrow [expand definition of constant 'r3' at prang.cpp (39,26)]
[1.5] ((int)170 * static_cast<signed int>(div3.rem)) \leq maxof(signed int)
\rightarrow [simplify]
[1.6] (170 * static_cast<signed int>(div3.rem)) < maxof(signed int)
\rightarrow [from term 34.6, div3 is equal to div(heapIs $heap_{funcstart\_1032,1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p3, 178)]
[1.7] (170 * static_cast<signed int>(div(heapIs \rho_{funcstart\_1032,1})
this.r.value(heapIs \$heap_{funcstart\_1032,1}).p3, 178).rem)) \le maxof(signed)
int)
\rightarrow [simplify]
[1.18] -32768 < (-170 * div(heapIs $heap<sub>funcstart_1032,1</sub>, this.$r.value(heapIs)
heap_{funcstart\_1032,1}.p3, 178).rem
\rightarrow [literal comparison of product]
[1.19] ([-170 < 0]: (-32768 / 170) < -\text{div}(\mathbf{heapIs} \ \text{\$} \text{heap}_{funcstart\_1032,1},
this.$r.value(heapIs \theta_{funcstart=1032,1}).p3, 178).rem, [0 < -170]: (-32768 /
-170) < div(heapIs \$heap_{funcstart\_1032,1}, this.\$r.value(heapIs)
heap_{funcstart\_1032,1}.p3, 178).rem, [-170 == 0]: -32768 < 0)
→ [explicitly assert falsehood of skipped guards in subsequent guards]
[1.20] ([-170 < 0]: (-32768 / 170) < -\text{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_1032,1},
this.$r.value(heapIs $heap_{funcstart\_1032,1}).p3, 178).rem, [(0 < -170) \land !(-170
< 0): (-32768 / -170) < div(heapIs $heap_{tuncstart\_1032.1},
this.$r.value(heapIs heap_{funcstart\_1032,1}).p3, 178).rem, [(-170 == 0) \land
!(-170 < 0) \land !(0 < -170)]: -32768 < 0)
\rightarrow [simplify]
heap_{funcstart_{-1032,1}}.p3, 178).rem
\rightarrow [negate goal and search for contradiction]
[1.25]!(-193 < -\text{div}(\text{heapIs }\text{\$heap}_{funcstart\_1032,1}, \text{this.\$r.value}(\text{heapIs})
heap_{funcstart\_1032,1}.p3, 178).rem
\rightarrow [simplify]
[1.28] 192 < div(heapIs $heap<sub>funcstart_1032,1</sub>, this.$r.value(heapIs)
heap_{funcstart\_1032,1}.p3, 178).rem
[Assume known post-assertion, class invariant or type constraint for term 34.6]
[42.0] (asType<integer>(this.$r.value(heapIs \rho_{tuncstart=1032,1}).p3) %
asType<integer>(178)) == asType<integer>(div(heapIs
\rho_{tuncstart\_1032.1}, this.r.value(heapIs \rho_{tuncstart\_1032.1}).p3,
178).rem)
```

```
\rightarrow [simplify]
[42.2] (this.$r.value(heapIs \theta_{funcstart\_1032,1}).p3 % 178) ==
asType<integer>(div(heapIs $heap_funcstart_1032.1, this.$r.value(heapIs
heap_{funcstart\_1032,1}.p3, 178).rem
→ [expand definition of operator '.%' in class 'int' at built in declaration]
[42.3] \; ([\mathbf{asType} < \mathbf{integer} > (\mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs} \; \$ \mathbf{heap}_{funcstart\_1032,1}).\mathbf{p3}) < \mathbf{page}) \\
0]: -(-asType < integer > (this.\$r.value(heapIs \$heap_{funcstart\_1032,1}).p3) \%
178), \parallel: asType<integer>(this.$r.value(heapIs \theta_{funcstart\_1032,1}).p3)
\% 178) == asType<integer>(div(heapIs $heap_{funcstart\_1032,1},
this.r.value(heapIs $heap_{funcstart\_1032,1}).p3, 178).rem)
→ [explicitly assert falsehood of skipped guards in subsequent guards]
[42.4] ([asType<integer>(this.$r.value(heapIs $heap_{funcstart\_1032,1}).p3) <
0]: -(-asType < integer > (this.\$r.value(heapIs \$heap_{funcstart\_1032,1}).p3) \%
178), [!(asType<integer>(this.$r.value(heapIs \rho_{tuncstart\_1032,1}).p3] <
0)]: asType<integer>(this.$r.value(heapIs $heap_{tuncstart\_1032.1}).p3) %
178) == asType < integer > (div(heapIs \$heap_{funcstart\_1032,1},
this.r.value(heapIs $heap_{funcstart\_1032.1}).p3, 178).rem)
\rightarrow [simplify]
[42.7] ([0 < -this.$r.value(heapIs \rho_{tuncstart\_1032,1}).p3]:
-(-\mathbf{asType} < \mathbf{integer} > (\mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}~\$\mathbf{heap}_{funcstart\_1032,1}).\mathbf{p3})~\%
178), [!(asType<integer>(this.r.value(heapIs \heap_{funcstart\_1032,1}).p3) <
0)]: asType<integer>(this.$r.value(heapIs \theta_{tuncstart\_1032.1}).p3) %
178) == asType<integer>(div(heapIs $heap_{funcstart\_1032,1},
\mathbf{this.\$r.value(heapIs}\ \$heap_{funcstart\_1032,1}).p3,\ 178).rem)
\rightarrow [from term 40.0, literala < -this.$r.value(heapIs $heap_{funcstart\_1032,1}).p3
is false whenever -2 < (0 + literala)
   Proof of rule precondition:
   [42.7.0] - 2 < (0 + 0)
   \rightarrow [simplify]
   [42.7.2] true
[42.8] ([false]: -(-asType<integer>(this.$r.value(heapIs
\{\text{heap}_{funcstart\_1032,1}\}, p3) < 0)]: asType<integer>(this.r.value(\text{heapIs})
\text{Sheap}_{funcstart\_1032,1}.p3) % 178) == asType<integer>(div(heapIs)
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p3,
178).rem)
\rightarrow [simplify]
[42.11] ([false]: -(-asType<integer>(this.$r.value(heapIs
\theta_{funcstart\_1032,1}.p3) % 178), [!\theta_{funcstart\_1032,1}.p3) % 178),
```

```
\rho_{funcstart_{-1032,1}}.p3]: asType<integer>(this.$r.value(heapIs)
\theta_{funcstart\_1032,1}.p3 % 178) == asType<integer>(div(heapIs)
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p3,
178).rem)
\rightarrow [from term 40.0, literala < -this.$r.value(heapIs $heap_{funcstart\_1032.1}).p3
is false whenever -2 < (0 + literala)
    Proof of rule precondition:
    [42.11.0] - 2 < (0 + 0)
    \rightarrow [simplify]
    [42.11.2] true
[42.12] ([false]: -(-asType<integer>(this.$r.value(heapIs
\rho_{funcstart_{1032,1}}.p3) \% 178, [!false]:
asType<integer>(this.$r.value(heapIs $heap_{tuncstart\_1032.1}).p3) % 178)
== asType < integer > (div(heapIs $heap_{funcstart\_1032,1},
this.r.value(heapIs $heap_{funcstart\_1032,1}).p3, 178).rem)
\rightarrow [simplify]
[42.17] \ 0 == (-\text{div}(\textbf{heapIs} \ \$ \text{heap}_{funcstart\_1032,1}, \ \textbf{this}.\$ \textbf{r.value}(\textbf{heapIs} \ \texttt{heap}_{funcstart\_1032,1}, \ \textbf{this}.\$ \textbf{r.value}))
\theta_{funcstart\_1032,1}.p3, 178).rem + (this.\$r.value(heapIs)
heap_{funcstart_{1032,1}}.p3 \% 178)
\rightarrow [remainder is less than divisor]
    Proof of rule precondition:
    [42.17.0] (178 + -\text{div}(\text{heapIs }\text{\$heap}_{funcstart\_1032,1}, \text{this.}\text{\$r.value}(\text{heapIs})
    \text{$heap}_{funcstart\_1032,1}.p3, 178).rem) \leq 0
    \rightarrow [simplify]
    [42.17.11]~177 < {\rm div}(\mathbf{heapIs}~\$ \mathrm{heap}_{funcstart\_1032,1},~\mathbf{this}.\$ r. \mathbf{value}(\mathbf{heapIs}
    heap_{funcstart\_1032,1}.p3, 178).rem
    \rightarrow [from term 1.28, literala < div(heapIs $heap_{funcstart\_1032,1},
    this.$r.value(heapIs $heap_{funcstart\_1032,1}).p3, 178).rem is true whenever
    (-1 + literala) < 192
        Proof of rule precondition:
        [42.17.11.0](-1 + 177) < 192
        \rightarrow [simplify]
        [42.17.11.2] true
    [42.17.12] true
[42.18] false
```

Proof of verification condition: Arithmetic result of operator '*' is within

```
limit of type 'signed int'
In the context of class: WHPrang, declared at:
C:\Escher\Customers\prang-cpp\prang.cpp (18,1)
Condition generated at: C:\Escher\Customers\prang-cpp\prang.cpp
(80,57)
Condition defined at:
To prove: minof(signed\ int) \le (\$heap_{1032,1;1054,8}.b3 * static\_cast < signed
int > (div3.quot))
Given:
heap_{init}.LIMIT == (int)80
heap_{init}.class WHPrang \in M1 == (int)30269
heap_{init}.class WHPrang \in r1 == (int)171
heap_{init}.class WHPrang \in a1 == (int)177
heap_{init}.class WHPrang \in b1 == (int)2
\text{$heap}_{init}.\mathbf{class} \text{ WHPrang} \in M2 == (\mathbf{int})30307
heap_{init}.class WHPrang \in r2 == (int)172
heap_{init}.class WHPrang \in a2 == (int)176
heap_{init}.class WHPrang \in b2 == (int)35
\$ heap_{init}.\mathbf{class} \ WHPrang \in M3 == (\mathbf{int})30323
heap_{init}.class WHPrang \in r3 == (int)170
heap_{init}.class WHPrang \in a3 == (int)178
heap_{init}.class WHPrang \in b3 == (int)63
\operatorname{div1} == \operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_1032,1},
\mathbf{static\_cast} < \mathbf{int} > (\mathbf{operator*}(\mathbf{heapIs} \ \$ \mathbf{heap}_{funcstart\_1032,1}, \ \mathbf{this}).\mathtt{p1}),
\mathbf{static\_cast}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_1032,1}.\mathrm{a1}))
(asType < integer > (static\_cast < int > (operator*(heapIs)))
heap_{funcstart\_1032,1}, this).p1) /
asType < integer > (static\_cast < int > (\$heap_{funcstart\_1032,1}.a1))) = =
asType<integer>(div1.quot)
(asType<integer>(static_cast<int>(operator*(heapIs
heap_{funcstart\_1032,1}, this).p1) %
asType < integer > (static\_cast < int > (\$heap_{funcstart\_1032.1}.a1))) = =
asType<integer>(div1.rem)
(\mathbf{asType}{<}\mathbf{integer}{>}(\mathbf{operator}^*(\mathbf{heapIs}\ \$\mathbf{heap}_{funcstart\_1032,1},\ \mathbf{this}).\mathtt{p1}) <
asType < integer > (\$heap_{funcstart\_1032,1}.a1)) = >
```

(asType<integer>(div1.rem) == asType<integer>(operator*(heapIs

```
heap_{funcstart_1032,1}, this).p1)
(asType < integer > (\$heap_{funcstart\_1032,1}.a1) \le
asType<integer>(operator*(heapIs $heap_{funcstart\_1032,1}, this).p1)) =>
!(0 == asType < integer > (div1.quot))
!(0 == asType < integer > (div1.rem)) || !(0 ==
asType<integer>(div1.quot))
\operatorname{div2} == \operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_1032,1},
\mathbf{static\_cast} < \mathbf{int} > (\mathbf{operator}^*(\mathbf{heapIs}\ \$ \mathbf{heap}_{funcstart\_1032,1},\ \mathbf{this}).\mathbf{p2}),
\mathbf{static\_cast}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_1032,1}.\mathrm{a2}))
(asType<integer>(static_cast<int>(operator*(heapIs
heap_{funcstart_1032.1}, this).p2)
\mathbf{asType} < \mathbf{integer} > (\mathbf{static\_cast} < \mathbf{int} > (\$ \mathbf{heap}_{funcstart\_1032,1}.\mathbf{a2}))) = =
asType<integer>(div2.quot)
(asType < integer > (static\_cast < int > (operator*(heapIs
heap_{funcstart\_1032.1}, this).p2)
asType < integer > (static\_cast < int > (\$heap_{funcstart\_1032,1}.a2))) = =
asType<integer>(div2.rem)
(\mathbf{asType}{<}\mathbf{integer}{>}(\mathbf{operator}^*(\mathbf{heapIs}\ \$\mathbf{heap}_{funcstart\_1032,1},\ \mathbf{this}).\mathtt{p2}) <
asType < integer > (\$heap_{funcstart\_1032,1}.a2)) = >
(asType < integer > (div2.rem) == asType < integer > (operator*(heapIs))
heap_{funcstart\ 1032.1}, this).p2)
(\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathrm{heap}_{funcstart\_1032,1}.\mathrm{a2}) \leq
asType<integer>(operator*(heapIs $heap_{tuncstart\_1032,1}, this).p2)) =>
!(0 == asType < integer > (div2.quot))
!(0 == asType < integer > (div2.rem)) || !(0 ==
asType<integer>(div2.quot))
div3 == div(\mathbf{heapIs} \$ heap_{funcstart\_1032,1},
static\_cast < int > (operator*(heapIs $heap_{funcstart\_1032,1}, this).p3),
\mathbf{static\_cast} < \mathbf{int} > (\$ \mathbf{heap}_{funcstart\_1032,1}.\mathbf{a3}))
(asType<integer>(static_cast<int>(operator*(heapIs
heap_{funcstart\_1032,1}, this).p3) /
asType < integer > (static\_cast < int > (\$heap_{funcstart\_1032,1}.a3))) = =
asType<integer>(div3.quot)
(asType<integer>(static_cast<int>(operator*(heapIs
\theta_{funcstart\_1032,1}, this).p3)) \%
asType < integer > (static\_cast < int > (\$heap_{funcstart\_1032,1}.a3))) = =
asType<integer>(div3.rem)
(\mathbf{asType}{<}\mathbf{integer}{>}(\mathbf{operator}^*(\mathbf{heapIs}\ \$\mathbf{heap}_{funcstart\_1032,1},\ \mathbf{this}).\mathtt{p3}) <
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathrm{heap}_{funcstart\_1032,1}.\mathrm{a3})) =>
(asType<integer>(div3.rem) == asType<integer>(operator*(heapIs
heap_{funcstart\_1032,1}, this).p3)
```

```
(asType < integer > (\$heap_{funcstart\_1032,1}.a3) \le
asType < integer > (operator*(heapIs $heap_{funcstart\_1032,1}, this).p3)) = >
!(0 == asType < integer > (div3.quot))
!(0 == asType < integer > (div3.rem)) || !(0 ==
asType<integer>(div3.quot))
temp1 == (\$heap_{funcstart\_1032,1}.r1 * static\_cast < signed int > (div1.rem)) -
($heap_funcstart_1032,1.b1 * static_cast<signed int>(div1.quot))
minof(signed\ int) \le temp1
temp1 < maxof(signed int)
heap_{1032,1;1051,8} == heap_{funcstart\_1032,1}._replace(this.r \rightarrow replace)
operator*(heapIs heap_{funcstart\_1032,1}, this)._replace(p1 \rightarrow
asType<P1Type>(($heap<sub>funcstart_1032,1</sub>.M1 *
asType<int>(static_cast<integer>(static_cast<signed
int>(operator^*(heapIs \$heap_{funcstart\_1032,1}, this).p1) < (int)0))) +
temp1)))
temp2 == (\$heap_{1032,1;1051,8}.r2 * static\_cast < signed int > (div2.rem)) -
(\text{sheap}_{1032,1:1051.8}.\text{b2} * \text{static\_cast} < \text{signed int} > (\text{div}2.\text{quot}))
minof(signed\ int) \le temp2
temp2 \le maxof(signed int)
heap_{1032,1;1054,8} == heap_{1032,1;1051,8}.replace(this.$r \rightarrow
operator*(heapIs heap_{1032,1;1051,8}, this)._replace(p2 \rightarrow
asType<P2Type>(($heap<sub>1032,1;1051,8</sub>.M2 *
asType < int > (static\_cast < integer > (static\_cast < signed)
int>(operator*(heapIs $heap_{1032,1;1051,8}, this).p2) < (int)0))) + temp2)))
Proof:
[Take given term]
[2.0] div1 == div(heapIs $heap_{funcstart\_1032,1},
static\_cast < int > (operator*(heapIs $heap_{funcstart\_1032,1}, this).p1),
\mathbf{static\_cast}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_1032,1}.\mathrm{a1}))
→ [expand definition of operator '*' in class 'pointer' at built in declaration]
[2.1] \operatorname{div1} == \operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_1032,1},
static\_cast < int > (this. r.value(heapIs  heap_{funcstart\_1032,1}).p1),
static\_cast < int > (\$heap_{funcstart\_1032,1}.a1))
\rightarrow [simplify]
[2.2]~{\rm div1} == {\rm div}(\mathbf{heapIs}~\$ \mathrm{heap}_{funcstart\_1032,1},~\mathbf{this}.\$ \mathrm{r.value}(\mathbf{heapIs}
\rho_{tuncstart_{1032.1}}, p1, static_cast<int>(\rho_{tuncstart_{1032.1}})
\rightarrow [const static or extern object]
[2.3] \text{ div1} == \text{div}(\text{heapIs } \text{heap}_{funcstart\_1032,1}, \text{this.}\text{\$r.value}(\text{heapIs})
```

```
\$ heap_{funcstart\_1032,1}).p1, \ \mathbf{static\_cast} < \mathbf{int} > (\$ heap_{init}.a1))
\rightarrow [expand definition of constant 'a1' at prang.cpp (30,26)]
[2.4] \operatorname{div1} == \operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_1032,1}, \mathbf{this}.\$ r. \mathbf{value}(\mathbf{heapIs})
\theta_{funcstart\_1032,1}.p1, \theta_{funcstart\_1032,1}.p1, \theta_{funcstart\_1032,1}.p1, \theta_{funcstart\_1032,1}.p1, \theta_{funcstart\_1032,1}.p1, \theta_{funcstart\_1032,1}.p1, \theta_{funcstart\_1032,1}.p2, \theta_{funcstart\_1032,1}.p2, \theta_{funcstart\_1032,1}.p2, \theta_{funcstart\_1032,1}.p2, \theta_{funcstart\_1032,1}.p2, \theta_{funcstart\_1032,1}.p3, \theta_{funcstart\_1032,1}.p4, \theta_{funcstart\_1032,1}.p4, \theta_{funcstart\_1032,1}.p4, \theta_{funcstart\_1032,1}.p5, \theta_{funcstart\_1032,1
\rightarrow [simplify]
[2.6] \operatorname{div1} == \operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_1032,1}, \mathbf{this.}\$ r.\mathbf{value}(\mathbf{heapIs})
heap_{funcstart\_1032,1}.p1, 177)
[Assume known post-assertion, class invariant or type constraint for term 2.6]
[7.0] (0 < asType<integer>(this.$r.value(heapIs
\theta_{funcstart\_1032,1}.p1) && (asType<integer>(this.$r.value(heapIs)
\$ heap_{funcstart\_1032,1}).p1) < \mathbf{asType} < \mathbf{integer} > (\$ heap.\mathbf{class} \ WHPrang \in \texttt{Prang}) = \texttt{Prang} + \texttt{Prang} 
M1))
\rightarrow [simplify]
[7.2] (0 < this.$r.value(heap
Is \rho_{funcstart\_1032,1}).p1) &&
(this.r.value(heapIs $heap_{tuncstart\_1032.1}).p1 <
asType < integer > (\text{$heap.class WHPrang} \in M1))
\rightarrow [const static or extern object]
[7.3] (0 < this.$r.value(heap
Is \rho_{funcstart\_1032,1}).p1) &&
(this.r.value(heapIs $heap_{funcstart\_1032,1}).p1 <
asType < integer > (\text{$heap}_{init}.class WHPrang \in M1))
\rightarrow [expand definition of constant 'M1' at prang.cpp (28,26)]
[7.4] (0 < this.$r.value(heapIs \rho_{funcstart\_1032,1}).p1) &&
(this.$r.value(heapIs \theta_{funcstart\_1032,1}).p1 <
asType < integer > ((int)30269))
\rightarrow [simplify]
[7.10] (-30269 < -this.$r.value(heapIs $heap_{tuncstart\_1032.1}).p1) \land (0 <
this.r.value(heapIs $heap_{funcstart\_1032,1}).p1)
[Work on sub-term 2 of conjunction in term 7.10]
[8.0] 0 < this.$r.value(heapIs heap_{funcstart\_1032,1}).p1
[Take given term]
[18.0] \text{ div2} == \text{div}(\text{heapIs } \text{$heap}_{funcstart\_1032,1},
static_cast<int>(operator*(heapIs $heap_{funcstart\_1032,1}, this).p2),
\mathbf{static\_cast} < \mathbf{int} > (\$ \mathbf{heap}_{funcstart\_1032,1}.\mathbf{a2}))
→ [expand definition of operator '*' in class 'pointer' at built in declaration]
[18.1] \operatorname{div2} == \operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_1032,1},
static_cast<int>(this.$r.value(heapIs $heap_{funcstart\_1032,1}).p2),
static\_cast < int > (\$heap_{funcstart\_1032,1}.a2))
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\rightarrow [simplify]
[18.2] div2 == div(\mathbf{heapIs} \ \hat{\mathbf{s}}_{heap}), this.\hat{\mathbf{s}}_{r.}value(\mathbf{heapIs}
\rho_{funcstart=1032,1}, p2, static_cast<int>(\rho_{funcstart=1032,1})
\rightarrow [const static or extern object]
[18.3] div2 == div(\mathbf{heapIs} \$ \mathbf{heap}_{funcstart\_1032,1}, \mathbf{this}.\$ \mathbf{r.value}(\mathbf{heapIs})
\theta_{funcstart\_1032,1}.p2, \theta_{funcstart\_1032,1
\rightarrow [expand definition of constant 'a2' at prang.cpp (35,26)]
[18.4] div2 == div(heapIs $heap_{funcstart\_1032,1}, this.$r.value(heapIs)
\theta_{funcstart\_1032,1}.p2, \theta_{funcstart} = \theta_{funcstart}.p2, \theta_{funcstart} = \theta_{funcstart}.p3, \theta_{funcstart} = \theta_{funcstart}.p4, \theta_{funcstart} = \theta_{funcstart}.p4, \theta_{funcstart} = \theta_{funcstart}.p4, \theta_{funcstart} = \theta_{funcstart}.p5, \theta_{funcstart} = \theta_{funcstart}.p7, \theta
\rightarrow [simplify]
[18.6] \text{ div2} == \text{div}(\mathbf{heapIs} \$ \mathbf{heap}_{funcstart\_1032,1}, \mathbf{this.\$r.value}(\mathbf{heapIs}))
heap_{funcstart\_1032,1}.p2, 176)
[Assume known post-assertion, class invariant or type constraint for term 18.6]
[23.0] (0 < asType<integer>(this.$r.value(heapIs
\label{eq:continuous} $\operatorname{heap}_{funcstart\_1032,1}).p2)) \&\& (asType < integer > (this.\$r.value (heapIs)) \\
\rho_{tuncstart=1032.1}.p2 < asType<integer>(\rho_{tuncstart=1032.1}.p2) < asType<integer>(\rho_{tuncstart=1032.1}.p2)
M2))
\rightarrow [simplify]
[23.2] (0 < this.$r.value(heap
Is $heap_{funcstart\_1032,1}).p2) &&
(this.$r.value(heapIs heap_{funcstart\_1032,1}).p2 <
asType < integer > (\text{$heap.class WHPrang} \in M2))
\rightarrow [const static or extern object]
[23.3] (0 < this.$r.value(heapIs heap_{funcstart\_1032,1}).p2) &&
(this.r.value(heapIs $heap_{funcstart\_1032,1}).p2 <
asType < integer > (\text{$heap}_{init}.class WHPrang \in M2))
\rightarrow [expand definition of constant 'M2' at prang.cpp (33,26)]
[23.4] (0 < this.$r.value(heap
Is \rho_{uncstart\_1032,1}).p2) &&
(this.$r.value(heapIs \rho_{funcstart\_1032,1}).p2 <
asType < integer > ((int)30307))
\rightarrow [simplify]
[23.10] (-30307 < -this.$r.value(heapIs $heap_{funcstart\_1032,1}).p2) \land (0 <
this.$r.value(heapIs $heap_{funcstart\_1032.1}).p2)
[Work on sub-term 2 of conjunction in term 23.10]
[24.0] 0 < this.$r.value(heapIs $heap_{funcstart\_1032.1}).p2
[Take given term]
[34.0] div3 == div(heapIs $heap_{funcstart\_1032,1},
static_cast<int>(operator*(heapIs $heap_{tuncstart\_1032.1}, this).p3),
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\mathbf{static\_cast}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_1032,1}.\mathrm{a3}))
→ [expand definition of operator '*' in class 'pointer' at built in declaration]
[34.1] \operatorname{div3} == \operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_1032,1},
static_cast<int>(this.$r.value(heapIs $heap_{funcstart\_1032,1}).p3),
\mathbf{static\_cast}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_1032,1}.\mathrm{a3}))
\rightarrow [simplify]
[34.2] div3 == div(heapIs $heap<sub>funcstart_1032,1</sub>, this.$r.value(heapIs)
\rho_{tuncstart\_1032.1}, p3, static_cast<int>(\rho_{tuncstart\_1032.1})
\rightarrow [const static or extern object]
[34.3]~{\rm div3} == {\rm div}(\mathbf{heapIs}~\$\mathrm{heap}_{funcstart\_1032,1},~\mathbf{this}.\$\mathrm{r.value}(\mathbf{heapIs}
\$ heap_{funcstart\_1032,1}).p3, \ \mathbf{static\_cast} < \mathbf{int} > (\$ heap_{init}.a3))
\rightarrow [expand definition of constant 'a3' at prang.cpp (40,26)]
[34.4] div3 == div(heapIs heapIs heapIs this.r.value(heapIs
\label{eq:cast_int} $$ \rho_{uncstart\_1032,1}.p3, \ \mathbf{static\_cast} < \mathbf{int} > ((\mathbf{int})178)) $$
\rightarrow [simplify]
[34.6]~{\rm div3} == {\rm div}(\mathbf{heapIs}~\$\mathrm{heap}_{funcstart\_1032,1},~\mathbf{this}.\$\mathrm{r.value}(\mathbf{heapIs}
heap_{funcstart_{-1032,1}}.p3, 178
[Assume known post-assertion, class invariant or type constraint for term 34.6]
[39.0] (0 < asType<integer>(this.$r.value(heapIs
\label{eq:continuous} $\operatorname{heap}_{funcstart\_1032,1}).p3)) \&\& (\mathbf{asType}{<}\mathbf{integer}{>} (\mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})) \&\& (\mathbf{asType}{<}\mathbf{integer}{>} (\mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}))) \&\& (\mathbf{asType}{<}\mathbf{integer}{>} (\mathbf{heapIs})) \&\& (\mathbf{asType}{<}\mathbf{
\theta_{funcstart\_1032,1}.p3 < asType<integer>(\theta_{funcstart\_1032,1}.p3) < asType<integer>(\theta_{funcstart\_1032,1}.p3)
M3))
\rightarrow [simplify]
[39.2] (0 < this.$r.value(heap
Is $heap_{funcstart\_1032,1}).p3) &&
(this.$r.value(heap
Is \rho_{funcstart\_1032,1}).p3 <
asType < integer > (\text{$heap.class WHPrang} \in M3))
\rightarrow [const static or extern object]
[39.3] (0 < this.$r.value(heap
Is $heap_{tuncstart\_1032,1}).p3) &&
(this.r.value(heapIs $heap_{funcstart\_1032,1}).p3 <
asType < integer > (\$heap_{init}.class WHPrang \in M3))
→ [expand definition of constant 'M3' at prang.cpp (38,26)]
[39.4] (0 < this.\$r.value(heapIs \$heap_{funcstart_1032,1}).p3) &&
(this.$r.value(heapIs heap_{funcstart\_1032,1}).p3 <
asType < integer > ((int)30323))
\rightarrow [simplify]
[39.10] (-30323 < -this.$r.value(heapIs \rho_{funcstart\_1032,1}).p3) \wedge (0 <
this.r.value(heapIs $heap_{funcstart\_1032,1}).p3)
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[Work on sub-term 2 of conjunction in term 39.10]
[40.0] 0 < this.$r.value(heap
Is $heap_{funcstart\_1032,1}).p3
[Assume known post-assertion, class invariant or type constraint for term 34.6]
[41.0] \ (\mathbf{asType} < \mathbf{integer} > (\mathbf{this.\$r.value} (\mathbf{heapIs} \ \$ \mathbf{heap}_{funcstart\_1032,1}).\mathbf{p3}) \ / \\
asType<integer>(178)) == asType<integer>(div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p3,
178).quot)
\rightarrow [simplify]
[41.2] (this.$r.value(heapIs $heap_{funcstart\_1032,1}).p3 / 178) ==
\mathbf{asType}{<}\mathbf{integer}{>}(\text{div}(\mathbf{heapIs}\ \$\text{heap}_{funcstart\_1032,1},\ \mathbf{this.}\$r.\mathbf{value}(\mathbf{heapIs}
heap_{funcstart\_1032,1}.p3, 178).quot
→ [expand definition of operator './' in class 'int' at built in declaration]
[41.3] ([asType<integer>(this.$r.value(heapIs $heap_{funcstart\_1032,1}).p3) <
0]: -(-asType < integer > (this. r.value(heapIs <math>heap_{funcstart\_1032,1}).p3) /
178), \parallel: asType<integer>(this.\$r.value(heapIs \$heap_{funcstart\_1032,1}).p3) /
178) == asType < integer > (div(heapIs $heap_{funcstart\_1032.1},
this.r.value(heapIs $heap_{funcstart\_1032,1}).p3, 178).quot)
→ [explicitly assert falsehood of skipped guards in subsequent guards]
[41.4] \; ([\mathbf{asType} < \mathbf{integer} > (\mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs} \; \$ \mathbf{heap}_{funcstart\_1032,1}).\mathbf{p3}) < \mathbf{page}) \\
0]: -(-asType < integer > (this. r.value(heapIs $heap_{funcstart\_1032,1}).p3)
178), [!(asType<integer>(this.$r.value(heapIs \rho_{tancetart\_1032,1}).p3] <
0)]: asType<integer>(this.$r.value(heapIs $heap_{funcstart\_1032.1}).p3) /
178) == asType<integer>(div(heapIs $heap_{funcstart\_1032,1},)
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p3, 178).quot)
\rightarrow [simplify]
[41.7] ([0 < -this.$r.value(heapIs $heap<sub>funcstart_1032,1</sub>).p3]:
-(-asType < integer > (this. r.value(heapIs  heap_{funcstart\_1032,1}).p3) /
178), [!(asType<integer>(this.$r.value(heapIs \rho_{tancetart\_1032,1}).p3] <
0)]: asType<integer>(this.r.value(heapIs \heap_{funcstart\_1032,1}).p3) /
178) == asType<integer>(div(heapIs heap_{funcstart\_1032,1},
this.r.value(heapIs $heap_{funcstart\_1032,1}).p3, 178).quot)
\rightarrow [from term 40.0, literala < -this.$r.value(heapIs $heap_{funcstart\_1032,1}).p3
is false whenever -2 < (0 + literala)
   Proof of rule precondition:
   [41.7.0] - 2 < (0 + 0)
   \rightarrow [simplify]
   [41.7.2] true
[41.8] ([false]: -(-asType<integer>(this.$r.value(heapIs
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\label{eq:funcstart_1032,1} $$ \operatorname{heap}_{funcstart_1032,1}.p3) \ / \ 178), \ [!(asType < integer > (this.\$r.value(heapIs))] $$ (asType < integer) $$ (this.\$r.value(heapIs)) $$ (this.
\{\text{heap}_{funcstart\_1032,1}\}.p3) < 0)]: asType<integer>(this.r.value(\text{heapIs}))
\theta_{uncstart\_1032,1}.p3) / 178 = asType < integer > (div(heapIs))
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p3,
178).quot)
\rightarrow [simplify]
[41.11] ([false]: -(-asType<integer>(this.$r.value(heapIs
\theta_{funcstart\_1032,1}.p3) \ / \ 178), \ [!(0 < -this.\$r.value(heapIs)]
\rho_{funcstart\_1032,1}.p3: asType<integer>(this.$r.value(heapIs)
\label{eq:loss_funcstart_1032,1} \$ heap_{funcstart\_1032,1}).p3) \ / \ 178) == \mathbf{asType} < \mathbf{integer} > (\mathrm{div}(\mathbf{heapIs}
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p3,
178).quot)
\rightarrow [from term 40.0, literala < -this.$r.value(heapIs $heap_{funcstart\_1032.1}).p3
is false whenever -2 < (0 + literala)
       Proof of rule precondition:
       [41.11.0] - 2 < (0 + 0)
       \rightarrow [simplify]
       [41.11.2] true
[41.12] ([false]: -(-asType<integer>(this.$r.value(heapIs
heap_{funcstart\_1032,1}.p3) / 178, [!false]:
asType<integer>(this.r.value(heapIs \ heap_{funcstart\_1032,1}).p3) / 178)
== asType<integer>(div(heapIs $heap_{tuncstart_1032.1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p3, 178).quot)
\rightarrow [simplify]
[41.17] 0 == (-\text{div}(\mathbf{heapIs} \$ \text{heap}_{funcstart\_1032,1}, \mathbf{this}.\$ r.\mathbf{value}(\mathbf{heapIs}))
\theta_{funcstart\_1032,1}.p3, 178).quot + (this.r.value(heapIs)
heap_{funcstart_{1032,1}}.p3 / 178)
[Take given term]
[50.0] (($heap_funcstart_1032,1.r1 * static_cast<signed int>(div1.rem)) -
(\text{sheap}_{funcstart\_1032,1}.\text{b1 * static\_cast} < \text{signed int} > (\text{div1.quot}))) == \text{temp1}
\rightarrow [const static or extern object]
[50.1] (($heap<sub>init</sub>.r1 * static_cast<signed int>(div1.rem)) -
(\$heap_{funcstart\_1032,1}.b1 * \mathbf{static\_cast} < \mathbf{signed\ int} > (div1.quot))) == temp1
\rightarrow [expand definition of constant 'r1' at prang.cpp (29,26)]
[50.2] (((int)171 * static_cast<signed int>(div1.rem)) -
(\text{sheap}_{funcstart\_1032.1}.\text{b1 * static\_cast} < \text{signed int} > (\text{div1.quot}))) == \text{temp1}
\rightarrow [simplify]
[50.3] ((171 * static_cast < signed int > (div1.rem)) - ($heap_{funcstart_1032.1}.b1
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* static_cast < signed int > (div1.quot))) == temp1
\rightarrow [from term 2.6, div1 is equal to div(heapIs $heap_{funcstart\_1032,1},
this.r.value(heapIs $heap_{funcstart\_1032,1}).p1, 177)
[50.4] ((171 * static_cast < signed int > (div(heapIs heapIs funcstart_{1032,1}),
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177).rem)) -
(\text{\$heap}_{funcstart\_1032,1}.\text{b1 * static\_cast} < \text{signed int} > (\text{div1.quot}))) == \text{temp1}
\rightarrow [simplify]
[50.5] ((171 * div(heapIs \$heap_{funcstart\_1032,1}, this.\$r.value(heapIs)
\rho_{funcstart\_1032,1}.p1, 177).rem – (\rho_{funcstart\_1032,1}.b1 *
static_cast<signed int>(div1.quot))) == temp1
\rightarrow [const static or extern object]
[50.6] ((171 * div(heapIs $heap<sub>funcstart_1032,1</sub>, this.$r.value(heapIs)
\theta_{tuncstart\_1032.1}.p1, 177).rem) - (\theta_{tuncstart\_1032.1}.p1, 177).rem) - (\theta_{tuncstart\_1032.1}.p1, 177).rem)
int>(div1.quot)) = temp1
\rightarrow [expand definition of constant 'b1' at prang.cpp (31,26)]
[50.7] ((171 * \operatorname{div}(\mathbf{heapIs} \ \mathbf{sheap}_{funcstart\_1032,1}, \mathbf{this}.\mathbf{sr.value}(\mathbf{heapIs})
int>(div1.quot)) == temp1
\rightarrow [simplify]
[50.8] ((171 * div(heapIs $heap_{funcstart\_1032,1}, this.$r.value(heapIs)
\theta_{funcstart\_1032,1}.p1, 177).rem - (2 * static\_cast < signed)
int>(div1.quot))) == temp1
\rightarrow [from term 2.6, div1 is equal to div(heapIs $heap_{funcstart\_1032,1},
\mathbf{this.}\$r.\mathbf{value}(\mathbf{heapIs}~\$heap_{funcstart\_1032,1}).p1,~177)]
[50.9] ((171 * div(heapIs $heap_{funcstart\_1032,1}, this.$r.value(heapIs)]
\theta_{funcstart\_1032,1}.p1, 177).rem - (2 * static\_cast < signed)
int>(div(heapIs \$heap_{funcstart\_1032,1}, this.\$r.value(heapIs
\text{Sheap}_{funcstart\_1032,1}.\text{p1}, 177).\text{quot}))) == \text{temp1}
\rightarrow [simplify]
[50.14] 0 == (-\text{temp1} + (-2 * \text{div}(\text{heapIs } \text{$heap}_{funcstart\_1032,1},
this.$r.value(heapIs heap_{funcstart\_1032,1}).p1, 177).quot) + (171 *
div(\mathbf{heapIs} \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
heap_{funcstart_{1032,1}}.p1, 177).rem)
[Take given term]
[53.0] $heap<sub>1032,1;1051,8</sub> == $heap<sub>funcstart_1032,1</sub>._replace(this.$r \rightarrow
operator*(heapIs heap_{funcstart\_1032.1}, this)._replace(p1 \rightarrow
asType<P1Type>(($heap<sub>funcstart_1032.1</sub>.M1 *
asType<int>(static_cast<integer>(static_cast<signed
int>(operator^*(heapIs \$heap_{funcstart\_1032,1}, this).p1) < (int)0))) +
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temp1)))
→ [expand definition of operator '*' in class 'pointer' at built in declaration]
[53.1] heap_{1032,1;1051,8} == heap_{funcstart\_1032,1}._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow
\mathbf{asType}{<}P1\mathsf{Type}{>}((\$\mathsf{heap}_{funcstart\_1032,1}.\mathsf{M1}\ *
asType<int>(static_cast<integer>(static_cast<signed
int>(operator^*(heapIs \$heap_{funcstart\_1032,1}, this).p1) < (int)0))) +
temp1)))
\rightarrow [const static or extern object]
[53.2] heap_{1032,1;1051,8} == heap_{funcstart\_1032,1}._replace(this.r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow
asType<P1Type>(($heap<sub>init</sub>.M1 *
asType<int>(static_cast<integer>(static_cast<signed
int>(operator^*(heapIs \$heap_{funcstart\_1032,1}, this).p1) < (int)0))) +
temp1)))
→ [expand definition of constant 'M1' at prang.cpp (28,26)]
[53.3] heap_{1032,1;1051,8} == heap_{funcstart\_1032,1}._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow
asType < P1Type > (((int)30269 *
as Type < int > (static\_cast < integer > (static\_cast < signed))
int>(operator^*(heapIs \$heap_{tuncstart 1032.1}, this).p1) < (int)0))) +
temp1)))
\rightarrow [simplify]
[53.4] heap_{1032,1;1051,8} == heap_{funcstart\_1032,1}.\_replace(this.\$r \rightarrow this)
\textbf{this.}\$r.\textbf{value}(\textbf{heapIs}~\$heap_{funcstart\_1032,1}).\_\textbf{replace}(p1 \rightarrow
asType<P1Type>((30269 *
asType<int>(static_cast<integer>(static_cast<signed
\mathbf{int} > (\mathbf{operator}^*(\mathbf{heapIs} \ \$ \mathbf{heap}_{funcstart\_1032,1}, \ \mathbf{this}).\mathtt{p1}) < (\mathbf{int})0))) \ +
temp1)))
→ [expand definition of operator '*' in class 'pointer' at built in declaration]
[53.5] heap_{1032,1;1051,8} == heap_{funcstart\_1032,1}._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow
asType<P1Type>((30269 *
asType<int>(static_cast<integer>(static_cast<signed
int>(this.\$r.value(heapIs \$heap_{funcstart\_1032,1}).p1) < (int)0))) + temp1)))
\rightarrow [simplify]
[53.9] heap_{1032,1;1051,8} == heap_{funcstart\_1032,1}._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow
asType<P1Type>((30269 * asType<int>(static_cast<integer>(0 <
-\mathbf{this.}\$r.\mathbf{value}(\mathbf{heapIs}\ \$\mathrm{heap}_{funcstart\_1032,1}).\mathrm{p1}))) + \mathrm{temp1})))
```

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\rightarrow [from term 8.0, literala < -this.$r.value(heapIs $heap_{funcstart\_1032.1}).p1
is false whenever -2 < (0 + literala)
    Proof of rule precondition:
    [53.9.0] - 2 < (0 + 0)
    \rightarrow [simplify]
    [53.9.2] true
[53.10] $heap<sub>1032,1;1051,8</sub> == $heap<sub>funcstart_1032,1</sub>._replace(this.$r \rightarrow
this.$r.value(heapIs \rho_{funcstart\_1032,1})._replace(p1 \rightarrow
asType<P1Type>((30269 * asType<int>(static_cast<integer>(false)))
+ \text{ temp1})))
\rightarrow [simplify]
[53.11] $\text{heap}_{1032,1;1051,8} == \text{$heap}_{funcstart\_1032,1}.$\text{$_-\text{replace}(this.}$\text{$$r} \rightarrow$
\textbf{this.}\$r.\textbf{value}(\textbf{heapIs}~\$heap_{funcstart\_1032,1}).\_\textbf{replace}(p1 \rightarrow
asType < P1Type > ((30269 * asType < int > (([false]: 1, []: 0))) + temp1)))
→ [explicitly assert falsehood of skipped guards in subsequent guards]
[53.12] $heap<sub>1032.1:1051.8</sub> == $heap<sub>funcstart_1032.1</sub>._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow
asType<P1Type>((30269 * asType<int>(([false]: 1, [true]: 0))) +
temp1)))
\rightarrow [simplify]
[53.15] $\text{heap}_{1032,1:1051.8} == $\text{heap}_{funcstart\_1032,1}.$\text{-replace}(\text{this}.$\text{$r} \to \text{
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow
asType < P1Type > (0 + temp1))
\rightarrow [from term 50.14, temp1 is equal to (-2 * div(heapIs $heap_{funcstart\_1032,1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177).quot) + (171)
div(\mathbf{heapIs} \ \$heap_{funcstart\_1032,1}, \ \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
heap_{funcstart_{1032.1}}.p1, 177).rem
[53.16] $heap<sub>1032,1;1051,8</sub> == $heap<sub>funcstart_1032,1</sub>._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow
asType<P1Type>(0 + ((-2 * div(heapIs $heap_{funcstart\_1032.1},
\mathbf{this.\$r.value(heapIs}\ \$heap_{funcstart\_1032,1}).p1,\ 177).quot) + (171\ *
div(\mathbf{heapIs} \$ heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
heap_{funcstart\_1032,1}.p1, 177).rem))))
\rightarrow [simplify]
[53.19] $heap<sub>1032,1;1051,8</sub> == $heap<sub>funcstart_1032,1</sub>._replace(this.$r \rightarrow
this.$r.value(heapIs \rho_{uncstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs)
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs \theta_{funcstart\_1032,1}, this.r.value(heapIs)
heap_{funcstart_{1032,1}}.p1, 177).rem)))
```

```
[Take given term]
[54.0] (($heap<sub>1032,1:1051,8</sub>.r2 * static_cast<signed int>(div2.rem)) -
(\text{sheap}_{1032,1;1051,8}.\text{b2} * \text{static\_cast} < \text{signed int} > (\text{div2.quot}))) == \text{temp2}
\rightarrow [from term 53.19, $heap<sub>1032,1;1051,8</sub> is equal to
\$heap_{funcstart\_1032,1}.\_\textbf{replace}(\textbf{this}.\$r \rightarrow \textbf{this}.\$r.\textbf{value}(\textbf{heapIs}
heap_{funcstart\_1032.1}._replace(p1 \rightarrow (-2 * div(heapIs heap_{funcstart\_1032.1}),
this.$r.value(heapIs $heap_{funcstart\_1032.1}).p1, 177).quot) + (171
div(heapIs $heap_funcstart_1032.1, this.$r.value(heapIs
heap_{funcstart\_1032,1}.p1, 177.rem)))]
[54.1] \; ((\$ heap_{funcstart\_1032,1}.\_\textbf{replace}(\textbf{this}.\$r \rightarrow \textbf{this}.\$r.\textbf{value}(\textbf{heapIs}))) \\
\rho_{tuncstart\_1032,1}._replace(p1 \rightarrow ((-2 * div(heapIs \rho_{tuncstart\_1032,1}),
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177).quot) + (171 *
div(\mathbf{heapIs} \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
\rho_{tuncstart_{1032,1},p1,177,rem})).r2 * static_cast<signed
\mathbf{int}{>}(\mathrm{div2.rem})) - (\$\mathrm{heap}_{1032,1;1051,8}.\mathrm{b2} * \mathbf{static\_cast}{<} \mathbf{signed}
int>(div2.quot)) = temp2
\rightarrow [const member of object with modified fields]
[54.2] (({\rm sheap}_{funcstart\_1032,1}.r2 * static\_cast < signed int > (div2.rem)) -
(\text{sheap}_{1032,1;1051,8}.\text{b2} * \text{static\_cast} < \text{signed int} > (\text{div2.quot}))) == \text{temp2}
\rightarrow [const static or extern object]
[54.3] (($heap<sub>init</sub>.r2 * static_cast<signed int>(div2.rem)) -
(\text{sheap}_{1032,1:1051.8}.\text{b2} * \text{static\_cast} < \text{signed int} > (\text{div2.quot}))) == \text{temp2}
\rightarrow [expand definition of constant 'r2' at prang.cpp (34,26)]
[54.4] (((int)172 * static_cast<signed int>(div2.rem)) -
(\$heap_{1032,1;1051,8}.b2 * \textbf{static\_cast} < \textbf{signed int} > (div2.quot))) == temp2
\rightarrow [simplify]
[54.5] ((172 * static_cast<signed int>(div2.rem)) - ($heap_{1032,1:1051,8}.b2 *
static_cast<signed int>(div2.quot))) == temp2
\rightarrow [from term 18.6, div2 is equal to div(heapIs $heap_{funcstart\_1032,1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p2, 176)]
[54.6] ((172 * static_cast<signed int>(div(heapIs \theta_{funcstart\_1032,1}),
this.r.value(heapIs $heap_{funcstart\_1032,1}).p2, 176).rem)) -
(\text{sheap}_{1032,1:1051,8}.\text{b2} * \text{static\_cast} < \text{signed int} > (\text{div2.quot}))) == \text{temp2}
\rightarrow [simplify]
[54.7] ((172 * div(heapIs $heap<sub>funcstart_1032,1</sub>, this.$r.value(heapIs)
\text{Sheap}_{funcstart\_1032,1}.p2, 176).rem) - (\text{Sheap}_{1032,1;1051,8}.b2 *
static_cast<signed int>(div2.quot))) == temp2
\rightarrow [from term 53.19, $heap<sub>1032,1:1051,8</sub> is equal to
$heap_{funcstart\_1032,1}.$_{replace}$ (this.$r \to this.$r.value(heapIs)
```

```
heap_{funcstart\_1032,1}._replace(p1 \rightarrow (-2 * div(heapIs $heap_{funcstart\_1032,1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177).quot) + (171)
div(\textbf{heapIs}~\$heap_{funcstart\_1032,1},~\textbf{this.}\$r.\textbf{value}(\textbf{heapIs}
heap_{funcstart\_1032,1}.p1, 177).rem)))
[54.8] ((172 * div(heapIs heapIs funcstart_{1032,1}, this.r.value(heapIs funcstart_{1032,1})
\rho_{funcstart\_1032,1}.p2, 176).rem – (\rho_{funcstart\_1032,1}.replace(his.replace)
\rightarrow this.$r.value(heap
Is \rho_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 *
div(\mathbf{heapIs} \$ heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
\text{Sheap}_{funcstart\_1032,1}.p1, 177).quot) + (171 * div(heapIs \text{Sheap}_{funcstart\_1032,1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177).rem)))).b2 *
static_cast<signed int>(div2.quot))) == temp2
\rightarrow [const member of object with modified fields]
[54.9] ((172 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs = f_{uncstart\_1032,1})
\text{Sheap}_{funcstart\_1032.1}.p2, 176).rem) - (\text{Sheap}_{funcstart\_1032.1}.b2 *
static_cast<signed int>(div2.quot))) == temp2
\rightarrow [const static or extern object]
[54.10] \; ((172 \; * \; \mathrm{div}(\mathbf{heapIs} \; \$ \mathrm{heap}_{funcstart\_1032,1}, \; \mathbf{this}.\$ \mathrm{r.value}(\mathbf{heapIs} \;
\rho_{uncstart\_1032,1}.p2,\,176).rem) — ( \rho_{unit}.b2 * static\_cast < signed  
int>(div2.quot))) == temp2
\rightarrow [expand definition of constant 'b2' at prang.cpp (36,26)]
[54.11] ((172 * div(heapIs $heap_{funcstart\_1032,1}, this.$r.value(heapIs
\theta_{funcstart\_1032.1}.p2, 176).rem) - ((int)35 * static_cast<signed)
int>(div2.quot)) = temp2
\rightarrow [simplify]
[54.12]~((172~^*~{\rm div}({\bf heap Is}~\${\rm heap}_{funcstart\_1032,1},~{\bf this.\$r.value}({\bf heap Is}
\theta_{funcstart\_1032,1}.p2, 176).rem - (35 * static\_cast < signed)
int>(div2.quot)) = temp2
\rightarrow [from term 18.6, div2 is equal to div(heapIs $heap_{funcstart\_1032,1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p2, 176)
[54.13] ((172 * div(heapIs $heap<sub>funcstart_1032,1</sub>, this.$r.value(heapIs)
\theta_{funcstart\_1032,1}.p2, 176).rem - (35 * static\_cast < signed)
int>(div(heapIs \$heap_{funcstart\_1032,1}, this.\$r.value(heapIs
\text{Sheap}_{funcstart\_1032,1}.p2, 176).quot))) == temp2
\rightarrow [simplify]
[54.18] 0 == (-\text{temp2} + (-35 * \text{div}(\text{heapIs} \$\text{heap}_{funcstart\_1032,1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p2, 176).quot) + (172 *
div(\mathbf{heapIs} \$ heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
heap_{funcstart_{1032,1}}.p2, 176).rem
[Take given term]
```

```
[57.0] $\text{heap}_{1032,1;1054,8} == $\text{heap}_{1032,1;1051,8}._\text{replace}(\text{this}.$\text{$r} \to \text{
operator*(heapIs heap_{1032,1;1051,8}, this)._replace(p2 \rightarrow
asType<P2Type>(($heap<sub>1032,1;1051,8</sub>.M2 *
asType<int>(static_cast<integer>(static_cast<signed
int>(operator^*(heapIs $heap_{1032,1;1051,8}, this).p2) < (int)(0))) + temp(2)))
\rightarrow [from term 53.19, $heap<sub>1032,1;1051,8</sub> is equal to
$heap_{funcstart\_1032,1}.$_{replace}$ (this.$r \rightarrow this.$r.value(heapIs) 
heap_{funcstart\_1032,1}._replace(p1 \rightarrow (-2 * div(heapIs \$heap_{funcstart\_1032,1},
div(\mathbf{heapIs} \ \$heap_{funcstart\_1032,1}, \ \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
heap_{funcstart\_1032,1}.p1, 177).rem)))]
[57.2] heap_{1032,1;1054,8} == heap_{funcstart\_1032,1}._replace(this.$r \rightarrow
this.$r.value(heapIs \frac{1}{2} heap\frac{1}{2} heap\frac{1}{2}
heap_{funcstart\_1032,1}, this.r.value(heapIs heap_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
\rho_{funcstart\_1032,1}.p1, 177).rem)))).\_replace(this.\$r \rightarrow operator*(heapIs)
\$heap_{funcstart\_1032,1}.\_\textbf{replace}(\textbf{this}.\$r \rightarrow \textbf{this}.\$r.\textbf{value}(\textbf{heapIs}
\text{Sheap}_{funcstart\_1032.1})._replace(p1 \rightarrow (-2 * div(heapIs \text{Sheap}_{funcstart\_1032.1}),
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177).quot) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_1032,1}, \ \mathbf{this}.\$ r. \mathbf{value}(\mathbf{heapIs}
\theta_{uncstart\_1032.1}, p1, 177).rem))), this)._replace(p2 \rightarrow
asType<P2Type>(($heap<sub>1032.1:1051.8</sub>.M2 *
asType < int > (static\_cast < integer > (static\_cast < signed)
\mathbf{int} > (\mathbf{operator}^*(\mathbf{heapIs} \ \$ \mathrm{heap}_{1032,1;1051,8}, \ \mathbf{this}).\mathrm{p2}) < (\mathbf{int})0))) + \mathrm{temp2})))
→ [expand definition of operator '*' in class 'pointer' at built in declaration]
[57.3] \theta_{1032,1;1054,8} == \theta_{funcstart\_1032,1}._replace(this.$r \to
this.$r.value(heapIs \rho_{uncstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{tuncstart\_1032.1}, this.r.value(heapIs \rho_{tuncstart\_1032.1}).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.} \text{\$r.value}(\text{heapIs}))
\theta_{funcstart\_1032,1}.p1, 177).rem)))).\_replace(this.$r \rightarrow 0
this.$r.value(heapIs heap_{funcstart\_1032,1}._replace(this.$r \rightarrow
\textbf{this.}\$r.\textbf{value}(\textbf{heapIs}~\$heap_{funcstart\_1032,1}).\_\textbf{replace}(p1 \rightarrow ((-2~*div(\textbf{heapIs})))))
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
heap_{funcstart\_1032,1}.p1, 177).rem))))._replace(p2 \rightarrow
asType<P2Type>(($heap<sub>1032,1:1051,8</sub>.M2 *
asType < int > (static\_cast < integer > (static\_cast < signed
int>(operator*(heapIs $heap_{1032,1;1051,8}, this).p2) < (int)0))) + temp2)))
→ [evaluate dereferenced pointer into modified heap]
[57.4] heap_{1032,1;1054,8} == heap_{funcstart\_1032,1}._replace(this.$r \rightarrow
this.$r.value(heapIs p_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(\mathbf{heapIs} \ \$heap_{funcstart\_1032,1}, \ \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
```

```
this.$r]: this.$r.value(heapIs \rho_{tuncstart\_1032,1})._replace(p1 \rightarrow (-2 *
div(\mathbf{heapIs} \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
\text{Sheap}_{funcstart\_1032,1}.p1, 177).quot) + (171 * div(heapIs \text{Sheap}_{funcstart\_1032,1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177).rem)), []:
this.$r.value(heapIs heap_{funcstart\_1032.1})._replace(p2 \rightarrow
asType < P2Type > ((\$heap_{1032,1;1051,8}.M2 *
asType<int>(static_cast<integer>(static_cast<signed
int>(operator^*(heapIs $heap_{1032,1:1051.8}, this).p2) < (int)(0))) + temp(2)))
→ [explicitly assert falsehood of skipped guards in subsequent guards]
[57.5] heap_{1032,1;1054,8} == heap_{funcstart\_1032,1}._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs \theta), this.r.value(heapIs)
\$ heap_{funcstart\_1032,1}).p1,\,177).rem)))).\_\mathbf{replace}(\mathbf{this}.\$r \rightarrow ([\mathbf{this}.\$r ==
this.$r]: this.$r.value(heap
Is \rho_{tart\_1032,1}).\_replace(p1 \rightarrow (-2 * label{eq:this.}))
div(\mathbf{heapIs} \$ heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
\text{Sheap}_{funcstart\_1032.1}.p1, 177).quot) + (171 * div(heapIs \text{Sheap}_{funcstart\_1032.1},
this.r.value(heapIs \ensuremath{\$}heap_{funcstart\_1032,1}).p1, 177).rem)), [!(this.\ensuremath{\$}r ==
\textbf{this.\$r.value}(\textbf{heapIs}~\$ heap_{funcstart\_1032,1})).\_\textbf{replace}(p2 \rightarrow
asType<P2Type>(($heap<sub>1032.1:1051.8</sub>.M2 *
asType<int>(static_cast<integer>(static_cast<signed
int>(operator^*(heapIs $heap_{1032,1;1051,8}, this).p2) < (int)0))) + temp2)))
\rightarrow [simplify]
[57.7] heap_{1032,1;1054,8} == heap_{funcstart\_1032,1}._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
\theta_{funcstart\_1032,1}.p1, 177).rem)))).\_replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs \theta_{funcstart\_1032,1}, this.r.value(heapIs)
\theta_{funcstart\_1032,1}.p1, 177).rem)))._replace(p2 \rightarrow
asType<P2Type>(($heap<sub>1032,1;1051,8</sub>.M2 *
asType<int>(static_cast<integer>(static_cast<signed
int>(operator^*(heapIs $heap_{1032,1;1051,8}, this).p2) < (int)(0))) + temp(2)))
\rightarrow [from term 53.19, $heap<sub>1032,1;1051,8</sub> is equal to
heap_{funcstart\_1032.1}-replace(this.r \rightarrow this.r-value(heapIs
heap_{funcstart\_1032.1}._replace(p1 \rightarrow (-2 * div(heapIs p_{funcstart\_1032.1})
this.r.value(heapIs \ \ heap_{funcstart\_1032,1}).p1, \ 177).quot) + (171 \ \ *
div(\mathbf{heapIs} \ \$heap_{funcstart\_1032,1}, \ \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
heap_{funcstart_{-1032,1}}.p1, 177).rem)))]
[57.8] $heap<sub>1032,1:1054,8</sub> == $heap<sub>funcstart_1032,1</sub>._replace(this.$r \rightarrow
```

```
this.$r.value(heapIs \rho_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
\theta_{tuncstart\_1032,1}.p1, 177).rem)))).\_replace(this.\$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs $heap<sub>funcstart_1032,1</sub>, this.$r.value(heapIs
\theta_{tuncstart_1032.1},p1, 177).rem)))._replace(p2 \rightarrow
asType < P2Type > ((\$heap_{tuncstart\_1032.1}.\_replace(this.\$r \rightarrow
this.$r.value(heapIs \rho_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.} \text{\$r.value}(\text{heapIs}))
\rho_{funcstart_{1032,1}}.p1, 177).rem)))).M2 *
asType<int>(static_cast<integer>(static_cast<signed
int>(operator^*(heapIs $heap_{1032,1;1051,8}, this).p2) < (int)0))) + temp2)))
\rightarrow [const member of object with modified fields]
[57.9] heap_{1032,1;1054,8} == heap_{funcstart\_1032,1}.\_replace(this.\$r \rightarrow
\textbf{this.}\$r.\textbf{value}(\textbf{heapIs}~\$heap_{funcstart\_1032,1}).\_\textbf{replace}(p1 \rightarrow ((\text{-}2~*\text{div}(\textbf{heapIs}
\label{eq:heapIs} $ \text{heap}_{funcstart\_1032,1}, \, \textbf{this}. \\ \$r. \textbf{value}(\textbf{heapIs} \,\, \$ \text{heap}_{funcstart\_1032,1}). \\ \text{p1},
177).quot) + (171 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.\$r.value}(\text{heapIs}))
\theta_{funcstart\_1032,1}.p1, 177).rem))))._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\theta_{funcstart\_1032,1}, this.\r.value(heapIs \theta_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
\theta_{funcstart\_1032.1}.p1, 177).rem)))._replace(p2 \rightarrow
asType<P2Type>(($heap<sub>funcstart_1032,1</sub>.M2 *
as Type < int > (static\_cast < integer > (static\_cast < signed))
int>(operator^*(heapIs $heap_{1032,1;1051,8}, this).p2) < (int)0))) + temp2)))
\rightarrow [const static or extern object]
[57.10] $heap<sub>1032.1:1054.8</sub> == $heap<sub>funcstart_1032.1</sub>._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(\mathbf{heapIs} \ \$heap_{funcstart\_1032,1}, \ \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
\theta_{funcstart\_1032,1}.p1, 177).rem))))._replace(this.$r \rightarrow
this.$r.value(heapIs \theta_{funcstart\_1032,1})._replace(p1 \theta ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs \theta_{funcstart\_1032,1}, this.r.value(heapIs)
\theta_{funcstart\_1032,1}.p1, 177).rem)))._replace(p2 \rightarrow
asType < P2Type > ((\$heap_{init}.M2 *
asType < int > (static\_cast < integer > (static\_cast < signed
int>(operator^*(heapIs $heap_{1032.1:1051.8}, this).p2) < (int)(0))) + temp(2)))
\rightarrow [expand definition of constant 'M2' at prang.cpp (33,26)]
[57.11] $\text{heap}_{1032,1;1054,8} == \text{$heap}_{funcstart\_1032,1}.$\text{$_-\text{replace}(this.}$\text{$r} \to \text{$_-\text{$_-$}}
```

```
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
\theta_{tuncstart\_1032,1}.p1, 177).rem)))).\_replace(this.\$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs $heap<sub>funcstart_1032,1</sub>, this.$r.value(heapIs
heap_{funcstart_1032,1}.p1, 177).rem))._replace(p2 \rightarrow
asType<P2Type>(((int)30307 *
asType<int>(static_cast<integer>(static_cast<signed
int>(operator^*(heapIs $heap_{1032.1:1051.8}, this).p2) < (int)0))) + temp2)))
\rightarrow [simplify]
[57.12] $\text{heap}_{1032,1;1054,8} == $\text{heap}_{funcstart\_1032,1}._\text{replace}(\text{this}.$\text{$r} \to \text{$}
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(\mathbf{heapIs} \$ heap_{funcstart\_1032,1}, \mathbf{this}.\$ r. \mathbf{value}(\mathbf{heapIs})
\theta_{funcstart\_1032,1}.p1, 177).rem))))._replace(this.$r \rightarrow
\textbf{this.}\$r.\textbf{value}(\textbf{heapIs}~\$heap_{funcstart\_1032,1}).\_\textbf{replace}(p1 \rightarrow ((\text{-}2~*\text{div}(\textbf{heapIs}
$\text{heap}_{funcstart_1032.1}$, this.$\text{r.value}(\text{heapIs} \text{$heap}_{funcstart_1032.1}).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.} \text{\$r.value}(\text{heapIs}))
\theta_{funcstart\_1032,1}.p1, 177).rem))).\_replace(p2 \rightarrow
asType<P2Type>((30307 *
asType<int>(static_cast<integer>(static_cast<signed
int>(operator^*(heapIs $heap_{1032.1:1051.8}, this).p2) < (int)(0))) + temp(2)))
\rightarrow [from term 53.19, $heap<sub>1032,1;1051,8</sub> is equal to
\$heap_{funcstart\_1032,1}.\_\textbf{replace}(\textbf{this}.\$r \rightarrow \textbf{this}.\$r.\textbf{value}(\textbf{heapIs}
heap_{funcstart\_1032.1}._replace(p1 \rightarrow (-2 * div(heapIs $heap_{funcstart\_1032.1}), -partial formula for the start of th
this.r.value(heapIs \ \ heap_{funcstart\_1032,1}).p1, \ 177).quot) + (171 \ \ *
div(\mathbf{heapIs} \ \$heap_{funcstart\_1032,1}, \ \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
heap_{funcstart_{1032.1}}.p1, 177.rem)))
[57.13] \theta_{1032,1:1054,8} == \theta_{1032,1:1054,8} == \theta_{1032,1.-replace}(this. r \rightarrow this. r)
\textbf{this.\$r.value}(\textbf{heapIs}~\$ heap_{funcstart\_1032,1}).\_\textbf{replace}(p1 \rightarrow ((-2~*div(\textbf{heapIs})))))
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{heap}_{funcstart\_1032,1}, \text{this.}\text{$r.value}(\text{heapIs}))
\theta_{funcstart\_1032,1}.p1, 177).rem)))).\_replace(this.\$r \rightarrow 0
\textbf{this.}\$r.\textbf{value}(\textbf{heapIs}~\$heap_{funcstart\_1032,1}).\_\textbf{replace}(p1 \rightarrow ((\text{-}2~*\text{div}(\textbf{heapIs}
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs $heap<sub>funcstart_1032,1</sub>, this.$r.value(heapIs
\theta_{funcstart\_1032,1}.p1, 177).rem)))._replace(p2 \rightarrow
asType<P2Type>((30307 *
asType < int > (static\_cast < integer > (static\_cast < signed
int>(operator*(heapIs \rho_{tuncstart\_1032.1}._replace(this.\rho_{tuncstart\_1032.1}._replace(this.
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow (-2 * div(heapIs
\rho_{tuncstart\_1032.1}, this.r.value(heapIs \rho_{tuncstart\_1032.1}).p1,
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177).quot) + (171 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.} \text{\$r.value}(\text{heapIs}))
\text{Sheap}_{funcstart\_1032,1}.\text{p1}, 177).\text{rem})), \text{this}.\text{p2}) < (\text{int})0))) + \text{temp2})))
→ [expand definition of operator '*' in class 'pointer' at built in declaration]
[57.14] $heap<sub>1032,1;1054,8</sub> == $heap<sub>funcstart_1032,1</sub>._replace(this.$r \rightarrow
\textbf{this.}\$r.\textbf{value}(\textbf{heapIs}~\$heap_{funcstart\_1032,1}).\_\textbf{replace}(p1 \rightarrow ((\text{-}2~*\text{div}(\textbf{heapIs}
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs $heap<sub>funcstart_1032,1</sub>, this.$r.value(heapIs
\theta_{funcstart\_1032,1}.p1, 177).rem))))._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\$heap_{funcstart\_1032,1},\, \textbf{this}.\$r.\textbf{value}(\textbf{heapIs}\,\,\$heap_{funcstart\_1032.1}).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.} \text{\$r.value}(\text{heapIs}))
\theta_{funcstart\_1032,1}.p1, 177).rem))).\_replace(p2 \rightarrow
\mathbf{asType}{<}\mathrm{P2Type}{>}((30307~*
asType<int>(static_cast<integer>(static_cast<signed
int>(this.\$r.value(heapIs \$heap_{funcstart\_1032,1}.\_replace(this.\$r \rightarrow funcstart\_1032,1})
this.$r.value(heapIs heap_{funcstart=1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs $heap_{funcstart\_1032,1}, this.$r.value(heapIs
\text{Sheap}_{funcstart\_1032.1}.\text{p1}, 177).\text{rem})))).\text{p2}) < (int)0))) + \text{temp2}))
→ [evaluate dereferenced pointer into modified heap]
[57.15] $heap<sub>1032,1;1054,8</sub> == $heap<sub>funcstart_1032,1</sub>._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.} \text{\$r.value}(\text{heapIs}))
\label{eq:continuous_function} $ \text{heap}_{funcstart\_1032,1} . \text{p1}, 177).rem)))).$ \_\textbf{replace}(\textbf{this}.\$r \rightarrow
\textbf{this.}\$r.\textbf{value}(\textbf{heapIs}~\$heap_{funcstart\_1032,1}).\_\textbf{replace}(p1 \rightarrow ((\text{-}2~*\text{div}(\textbf{heapIs}
\rho_{funcstart\_1032,1}, this.\r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.} \text{\$r.value}(\text{heapIs}))
\theta_{funcstart\_1032,1}.p1, 177).rem))._replace(p2 \rightarrow
asType<P2Type>((30307 *
asType<int>(static_cast<integer>(static_cast<signed int>(([this.$r
== this.$r.value(heapIs \rho_{funcstart\_1032,1})._replace(p1 \rightarrow (-2 *
div(\mathbf{heapIs} \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
\text{Sheap}_{funcstart\_1032,1}.p1, 177).quot) + (171 * div(heapIs \text{Sheap}_{funcstart\_1032,1},
this.$r.value(heapIs heap_{funcstart\_1032,1}).p1, 177).rem)), []:
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p2) < (int)0))) + temp2)))
→ [explicitly assert falsehood of skipped guards in subsequent guards]
[57.16] $heap<sub>1032,1;1054,8</sub> == $heap<sub>funcstart_1032,1</sub>._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs $heap<sub>funcstart_1032,1</sub>, this.$r.value(heapIs
\theta_{funcstart\_1032,1}.p1, 177).rem)))).replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
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\rho_{funcstart=1032,1}, this.r.value(heapIs \rho_{funcstart=1032,1}).p1,
177).quot) + (171 * div(heapIs \theta_{funcstart\_1032,1}, this.r.value(heapIs)
\theta_{funcstart\_1032,1}.p1, 177).rem))).\_replace(p2 \rightarrow
asType<P2Type>((30307 *
asType<int>(static_cast<integer>(static_cast<signed int>(([this.$r
== this.$r]: this.$r.value(heapIs \rho_{uncstart\_1032,1})._replace(p1 \rightarrow (-2 *
div(\mathbf{heapIs} \$ heap_{funcstart\_1032.1}, \mathbf{this}.\$ r. \mathbf{value}(\mathbf{heapIs})
\text{Sheap}_{funcstart_{-1032,1}}, p1, 177).quot) + (171 * div(heapIs \text{Sheap}_{funcstart_{-1032,1}},
this.r.value(heapIs \ heap_{funcstart\_1032.1}).p1, 177).rem)), [!(this.<math>r = 
this.$r)]: this.$r.value(heapIs \theta_{funcstart_1032,1}).p2) < (int)0))) +
temp2)))
\rightarrow [simplify]
[57.23] $heap<sub>1032,1;1054,8</sub> == $heap<sub>funcstart_1032,1</sub>._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\$heap_{funcstart\_1032,1},\, \textbf{this}.\$r.\textbf{value}(\textbf{heapIs}\,\,\$heap_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(\mathbf{heapIs} \$ heap_{funcstart\_1032,1}, \mathbf{this}.\$ r. \mathbf{value}(\mathbf{heapIs})
\theta_{funcstart\_1032,1}.p1, 177).rem))))._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.\r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
\theta_{funcstart\_1032.1}.p1, 177).rem))._replace(p2 \rightarrow
\mathbf{asType} {<} P2Type {>} ((30307 \ * \ \mathbf{asType} {<} \mathbf{int} {>} (\mathbf{static\_cast} {<} \mathbf{integer} {>} (0 <
-this.r.value(heapIs heap_{funcstart\_1032,1}.p2))) + temp2)))
\rightarrow [from term 24.0, literala < -this.$r.value(heapIs $heap_{funcstart\_1032,1}).p2
is false whenever -2 < (0 + literala)
       Proof of rule precondition:
       [57.23.0] - 2 < (0 + 0)
       \rightarrow [simplify]
       [57.23.2] true
[57.24] $heap<sub>1032,1;1054,8</sub> == $heap<sub>funcstart_1032,1</sub>._replace(this.$r \rightarrow
this.$r.value(heapIs \frac{1}{2} heap\frac{1}{2} heap\frac{1}{2}
\rho_{funcstart=1032,1}, this.r.value(heapIs \rho_{funcstart=1032,1}).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.} \text{\$r.value}(\text{heapIs}))
\theta_{tuncstart\_1032.1}.p1, 177).rem)))).\_replace(this.\$r \rightarrow 0
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs))
\$heap_{funcstart\_1032,1},\, \textbf{this.}\$r.\textbf{value}(\textbf{heapIs}\,\,\$heap_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs \theta_{funcstart\_1032,1}, this.r.value(heapIs)
\theta_{funcstart\_1032,1}.p1, 177).rem))).\_replace(p2 \rightarrow
asType<P2Type>((30307 * asType<int>(static_cast<integer>(false)))
+ \text{temp2})))
\rightarrow [simplify]
```

```
[57.25] $\text{heap}_{1032,1;1054,8} == \text{$heap}_{funcstart\_1032,1}._\text{$replace}(\text{this}.\text{$r} \to \text{$r$}
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs $heap<sub>funcstart_1032,1</sub>, this.$r.value(heapIs
\theta_{tuncstart\_1032,1}.p1, 177).rem)))).\_replace(this.\$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs heap_{funcstart_1032,1}, this.r.value(heapIs)
\theta_{funcstart\_1032,1}.p1, 177).rem))).\_replace(p2 \rightarrow
asType<P2Type>((30307 * asType<int>(([false]: 1, []: 0))) + temp2)))
→ [explicitly assert falsehood of skipped guards in subsequent guards]
[57.26] $heap<sub>1032,1;1054,8</sub> == $heap<sub>funcstart_1032,1</sub>._replace(this.$r \rightarrow
this.$r.value(heapIs \rho_{uncstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs)
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
\theta_{funcstart\_1032,1}.p1, 177).rem)))).\_replace(this.\$r \rightarrow 0
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\theta_{funcstart\_1032,1}, this.r.value(heapIs \theta_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs \rho_{funcstart\_1032,1}, this.r.value(heapIs)
\theta_{funcstart\_1032.1}.p1, 177).rem)))._replace(p2 \rightarrow
asType < P2Type > ((30307 * asType < int > (([false]: 1, [true]: 0))) +
temp2)))
\rightarrow [simplify]
[57.29] $\text{heap}_{1032,1;1054,8} == $\text{heap}_{funcstart\_1032,1}._\text{replace}(\text{this}.\text{$\frac{1}{2}r$})
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(\mathbf{heapIs} \$ heap_{funcstart\_1032,1}, \mathbf{this}.\$ r. \mathbf{value}(\mathbf{heapIs})
\theta_{funcstart\_1032,1}.p1, 177).rem)))).\_replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
$heap_funcstart_1032.1, this.$r.value(heapIs $heap_funcstart_1032.1).p1,
177).quot) + (171 * div(heapIs $heap<sub>funcstart_1032,1</sub>, this.$r.value(heapIs
\rho_{funcstart\_1032,1}.p1, 177).rem))._replace(p2 \rightarrow asType<P2Type>(0 +
temp2)))
\rightarrow [from term 54.18, temp2 is equal to (-35 * div(heapIs $heap_{funcstart\_1032,1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p2, 176).quot) + (172 *
div(heapIs $heap_{funcstart_1032.1}, this.$r.value(heapIs
heap_{funcstart_{1032,1}}.p2, 176).rem
[57.30] $\text{heap}_{1032,1;1054,8} == $\text{heap}_{funcstart\_1032,1}._\text{replace}(\text{this}.\text{$\frac{1}{2}r$})
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.} \text{\$r.value}(\text{heapIs}))
this.$r.value(heapIs \rho_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
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\rho_{funcstart=1032,1}, this.r.value(heapIs \rho_{funcstart=1032,1}).p1,
177).quot) + (171 * div(heapIs $heap_{funcstart\_1032,1}, this.$r.value(heapIs
\label{eq:posterior} $\operatorname{heap}_{funcstart\_1032,1}).p1,\ 177).rem))).$\tt-replace(p2 \to asType < P2Type > (0 + p)).$\tt-replace(p2 \to p) = (p) =
((-35 * div(heapIs \$heap_{funcstart\_1032,1}, this.\$r.value(heapIs
\text{Sheap}_{funcstart\_1032.1}.p2, 176).quot) + (172 * div(heapIs \text{Sheap}_{funcstart\_1032.1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p2, 176).rem)))))
\rightarrow [simplify]
[57.33] $heap<sub>1032,1;1054,8</sub> == $heap<sub>funcstart_1032,1</sub>._replace(this.$r \rightarrow
this.$r.value(heapIs heapIs $heapfuncstart_1032,1)._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.}\text{\$r.value}(\text{heapIs}))
\theta_{tuncstart\_1032,1}.p1, 177).rem)))).\_replace(this.\$r \rightarrow
this.$r.value(heapIs p_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
\rho_{funcstart\_1032,1}.p1, 177).rem))._replace(p2 \rightarrow ((-35 * div(heapIs
\rho_{funcstart\_1032,1}, this. r.value(heapIs \rho_{funcstart\_1032,1}).p2,
176).quot) + (172 * div(\mathbf{heapIs} \ \$heap_{funcstart\_1032,1}, \ \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
heap_{funcstart_{1032,1}}.p2, 176).rem)))
[Take goal term]
[1.0] minof(signed int) \leq ($heap<sub>1032.1:1054.8</sub>.b3 * static_cast<signed
int>(div3.quot))
\rightarrow [simplify]
[1.1] -32768 \leq ($heap<sub>1032.1:1054.8</sub>.b3 * static_cast<signed int>(div3.quot))
\rightarrow [from term 57.33, $heap<sub>1032,1;1054,8</sub> is equal to
$heap_{funcstart\_1032,1}.$_replace(this.$r \rightarrow this.$r.value(heapIs)
heap_{funcstart\_1032,1}._replace(p1 \rightarrow ((-2 * div(heapIs heap_{funcstart\_1032,1}),
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177).quot) + (171 *
div(heapIs $heap_{funcstart_1032.1}, this.$r.value(heapIs
\theta_{tuncstart\ 1032.1}).p1, 177).rem))))._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs))
heap_{funcstart\_1032,1}, this.r.value(heapIs heap_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs \$heap_{funcstart\_1032,1}, this.\$r.value(heapIs))
\rho_{funcstart\_1032,1}.p1, 177).rem))).\_replace(p2 \rightarrow (-35 * div(heapIs))).
heap_{funcstart\_1032,1}, this.r.value(heapIs heap_{funcstart\_1032,1}).p2,
176).quot) + (172 * div(heapIs $heap_{funcstart\_1032,1}, this.$r.value(heapIs
heap_{funcstart_{-1032.1}}.p2, 176).rem)))
[1.2] -32768 \le (\$heap_{funcstart\_1032,1}.\_replace(this.\$r \rightarrow this.\$r.value(heapIs))
\text{Sheap}_{funcstart\_1032.1}._replace(p1 \rightarrow ((-2 * div(heapIs \text{Sheap}_{funcstart\_1032.1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177).quot) + (171 *
div(\mathbf{heapIs} \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
\theta_{funcstart\_1032,1}.p1, 177).rem)))).\_replace(this.\$r \rightarrow 0
```

```
this.$r.value(heapIs \rho_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
\rho_{funcstart\_1032,1}.p1, 177).rem))._replace(p2 \rightarrow ((-35 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p2,
176).quot) + (172 * div(heapIs $heap<sub>funcstart_1032,1</sub>, this.$r.value(heapIs
\theta_{funcstart\_1032,1}.p2, 176).rem)))).b3 * static_cast < signed
int > (div3.quot))
\rightarrow [const member of object with modified fields]
[1.4] -32768 \leq ($heap<sub>funcstart 1032.1</sub>.b3 * static_cast<signed
int>(div3.quot))
\rightarrow [const static or extern object]
[1.5] -32768 \leq ($heap<sub>init</sub>.b3 * static_cast \leq signed int\geq (div3.quot))
\rightarrow [expand definition of constant 'b3' at prang.cpp (41,26)]
[1.6] -32768 \leq ((int)63 * static_cast<signed int>(div3.quot))
\rightarrow [simplify]
[1.7] -32768 \leq (63 * static_cast<signed int>(div3.quot))
\rightarrow [from term 34.6, div3 is equal to div(heapIs $heap_{funcstart\_1032,1},
this.r.value(heapIs $heap_{funcstart\_1032,1}).p3, 178)
[1.8] -32768 \leq (63 * static_cast<signed int>(div(heapIs)
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p3,
178).quot))
\rightarrow [simplify]
[1.11] -32769 < (63 * div(heapIs $heap_{funcstart\_1032,1}, this.$r.value(heapIs)]
heap_{funcstart_{1032,1}}.p3, 178).quot
\rightarrow [literal comparison of product]
[1.12] ([63 < 0]: (-32769 / -63) < -\text{div}(\text{heapIs } \text{\$heap}_{tuncstart\_1032,1},
this.$r.value(heapIs heap_{funcstart_1032,1}).p3, 178).quot, [0 < 63]: (-32769 /
63) < \text{div}(\text{heapIs } \text{$heap}_{funcstart\_1032,1}, \text{ this.} \text{$r.value}(\text{heapIs})
\text{Sheap}_{funcstart\_1032,1}.p3, 178).quot, [0 == 63]: -32769 < 0)
→ [explicitly assert falsehood of skipped guards in subsequent guards]
[1.13] ([63 < 0]: (-32769 / -63) < -\text{div}(\mathbf{heapIs} \ \text{\$} \text{heap}_{funcstart\_1032,1},
this.$r.value(heapIs heap_{funcstart_1032,1}).p3, 178).quot, [(0 < 63) \land !(63 <
0)]: (-32769 / 63) < div(heapIs $heap_{funcstart\_1032,1}, this.$r.value(heapIs)
\text{Sheap}_{funcstart\_1032,1}).p3, 178).quot, [(0 == 63) \land !(0 < 63) \land !(63 < 0)]:
-32769 < 0
\rightarrow [simplify]
[1.21] -521 < div(heapIs $heap<sub>funcstart_1032.1</sub>, this.$r.value(heapIs)
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```
heap_{funcstart_{-1032,1}}.p3, 178).quot
\rightarrow [negate goal and search for contradiction]
[1.22]!(-521 < div(heapIs $heap<sub>funcstart_1032,1</sub>, this.$r.value(heapIs)
heap_{funcstart_{1032,1}}.p3, 178).quot
\rightarrow [simplify]
[1.24] 520 < -\text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.} \text{\$r.value}(\text{heapIs})
heap_{funcstart_{1032,1}}.p3, 178.quot
[Create new term from terms 1.24, 41.17 using rule: transitivity 15]
[77.0] (0 + 520) < -(this.$r.value(heapIs $heap_{funcstart\_1032,1}).p3 / 178)
\rightarrow [simplify]
[77.7] 92560 < -this.$r.value(heapIs \rho_{funcstart\_1032,1}).p3
\rightarrow [from term 40.0, literala < -this.$r.value(heapIs $heap_{funcstart\_1032,1}).p3
is false whenever -2 < (0 + literala)
   Proof of rule precondition:
   [77.7.0] - 2 < (0 + 92560)
   \rightarrow [simplify]
   [77.7.2] true
[77.8] false
Proof of verification condition: Arithmetic result of operator '*' is within
limit of type 'signed int'
In the context of class: WHPrang, declared at:
C:\Escher\Customers\prang-cpp\prang.cpp (18,1)
Condition generated at: C:\Escher\Customers\prang-cpp\prang.cpp
(80,57)
Condition defined at:
To prove: (\text{sheap}_{1032,1;1054,8}.\text{b3} * \text{static\_cast} < \text{signed int} > (\text{div}3.\text{quot})) \le
maxof(signed int)
Given:
heap_{init}.LIMIT == (int)80
heap_{init}.class WHPrang \in M1 == (int)30269
heap_{init}.class WHPrang \in r1 == (int)171
heap_{init}.class WHPrang \in a1 == (int)177
heap_{init}.class WHPrang \in b1 == (int)2
heap_{init}.class WHPrang \in M2 == (int)30307
```

```
heap_{init}.class WHPrang \in r2 == (int)172
heap_{init}.class WHPrang \in a2 == (int)176
heap_{init}.class WHPrang \in b2 == (int)35
heap_{init}.class WHPrang \in M3 == (int)30323
heap_{init}.class WHPrang \in r3 == (int)170
heap_{init}.class WHPrang \in a3 == (int)178
heap_{init}.class WHPrang \in b3 == (int)63
\operatorname{div1} == \operatorname{div}(\mathbf{heapIs} \ \operatorname{\$heap}_{funcstart\_1032,1},
\mathbf{static\_cast} {<} \mathbf{int} {>} (\mathbf{operator^*(heapIs}\ \$heap_{funcstart\_1032,1},\ \mathbf{this}).p1),
\mathbf{static\_cast} < \mathbf{int} > (\$ \mathbf{heap}_{funcstart\_1032,1}.\mathbf{a1}))
(asType<integer>(static_cast<int>(operator*(heapIs
heap_{funcstart\_1032,1}, this).p1)
asType < integer > (static\_cast < int > (\$heap_{funcstart\_1032,1}.a1))) = =
asType<integer>(div1.quot)
(asType < integer > (static\_cast < int > (operator*(heapIs)))
heap_{funcstart\_1032,1}, this).p1) %
asType<integer>(static_cast<int>($heap_{funcstart_1032.1}.a1))) ==
asType<integer>(div1.rem)
(\mathbf{asType}{<}\mathbf{integer}{>}(\mathbf{operator}^*(\mathbf{heapIs}\ \$\mathbf{heap}_{funcstart\_1032,1},\ \mathbf{this}).\mathtt{p1}) <
asType < integer > (\$heap_{funcstart\_1032,1}.a1)) = >
(asType<integer>(div1.rem) == asType<integer>(operator*(heapIs
heap_{funcstart_{1032,1}}, this).p1)
(\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathsf{heap}_{funcstart\_1032,1}.\mathsf{a1}) \leq
\mathbf{asType}{<}\mathbf{integer}{>}(\mathbf{operator*}(\mathbf{heapIs}\ \$\mathbf{heap}_{funcstart\_1032,1},\ \mathbf{this}).\mathbf{p1})) =>
!(0 == asType < integer > (div1.quot))
!(0 == asType < integer > (div1.rem)) || !(0 ==
asType<integer>(div1.quot))
div2 == div(\mathbf{heapIs} \$ heap_{funcstart\_1032,1},
static\_cast < int > (operator*(heapIs $heap_{funcstart\_1032,1}, this).p2),
\mathbf{static\_cast}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_1032,1}.\mathrm{a2}))
(asType<integer>(static_cast<int>(operator*(heapIs
heap_{funcstart\_1032.1}, this).p2)
asType < integer > (static\_cast < int > (\$heap_{funcstart\_1032,1}.a2))) = =
asType<integer>(div2.quot)
(asType < integer > (static\_cast < int > (operator*(heapIs)))
heap_{funcstart\_1032,1}, this).p2)
asType < integer > (static\_cast < int > (\$heap_{funcstart\_1032,1}.a2))) = =
asType<integer>(div2.rem)
(\mathbf{asType}{<}\mathbf{integer}{>}(\mathbf{operator}^*(\mathbf{heapIs}\ \$\mathbf{heap}_{funcstart\_1032,1},\ \mathbf{this}).\mathbf{p2})<
```

```
asType < integer > (\$heap_{funcstart\_1032,1}.a2)) = >
(asType<integer>(div2.rem) == asType<integer>(operator*(heapIs
heap_{funcstart\_1032,1}, this).p2)
(\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathbf{heap}_{funcstart\_1032,1}.\mathbf{a2}) \leq
asType<integer>(operator*(heapIs $heap_{tuncstart\_1032.1}, this).p2)) =>
!(0 == asType < integer > (div2.quot))
!(0 == asType < integer > (div2.rem)) || !(0 ==
asType<integer>(div2.quot))
div3 == div(\mathbf{heapIs} \$heap_{funcstart\_1032,1},
\mathbf{static\_cast} < \mathbf{int} > (\mathbf{operator}^*(\mathbf{heapIs}\ \$ \mathbf{heap}_{funcstart\_1032,1},\ \mathbf{this}).\mathbf{p3}),
\mathbf{static\_cast}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_1032,1}.\mathrm{a3}))
(asType<integer>(static_cast<int>(operator*(heapIs
heap_{funcstart\_1032,1}, this).p3)) /
asType < integer > (static\_cast < int > (\$heap_{funcstart\_1032.1}.a3))) = =
asType<integer>(div3.quot)
(asType<integer>(static_cast<int>(operator*(heapIs
heap_{funcstart_{1032.1}}, this).p3)
asType < integer > (static\_cast < int > (\$heap_{funcstart\_1032.1}.a3))) = =
\mathbf{asType}{<}\mathbf{integer}{>}(\mathbf{div3.rem})
(\mathbf{asType}{<}\mathbf{integer}{>}(\mathbf{operator}^*(\mathbf{heapIs}\ \$\mathbf{heap}_{funcstart\_1032,1},\ \mathbf{this}).\mathrm{p3}) <
asType < integer > (\$heap_{funcstart\_1032,1}.a3)) = >
(asType<integer>(div3.rem) == asType<integer>(operator*(heapIs
heap_{funcstart\_1032,1}, this).p3)
(\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathbf{heap}_{funcstart\_1032,1}.\mathbf{a3}) \leq
\mathbf{asType} < \mathbf{integer} > (\mathbf{operator}^*(\mathbf{heapIs} \ \$ \mathbf{heap}_{funcstart\_1032,1}, \ \mathbf{this}).\mathrm{p3})) = >
!(0 == asType < integer > (div3.quot))
!(0 == asType < integer > (div3.rem)) || !(0 ==
asType<integer>(div3.quot))
temp1 == (\$heap_{funcstart\_1032,1}.r1 * \textbf{static\_cast} < \textbf{signed int} > (div1.rem)) - \\
($heap_funcstart_1032.1.b1 * static_cast<signed int>(div1.quot))
minof(signed\ int) \le temp1
temp1 \le maxof(signed\ int)
heap_{1032.1:1051.8} == heap_{funcstart\_1032.1}._replace(this.$r \rightarrow
operator*(heapIs heap_{funcstart\_1032,1}, this)._replace(p1 \rightarrow
\mathbf{asType}{<}P1\mathsf{Type}{>}((\$\mathsf{heap}_{funcstart\_1032,1}.\mathsf{M1}\ *
asType < int > (static\_cast < integer > (static\_cast < signed
int>(operator^*(heapIs \$heap_{funcstart\_1032,1}, this).p1) < (int)0))) +
temp1)))
temp2 == (\$heap_{1032,1;1051,8}.r2 * static\_cast < signed int > (div2.rem)) -
(\text{sheap}_{1032,1;1051,8}.\text{b2} * \text{static\_cast} < \text{signed int} > (\text{div2.quot}))
```

```
minof(signed\ int) \le temp2
temp2 \le maxof(signed int)
heap_{1032,1;1054,8} == heap_{1032,1;1051,8}._replace(this.$r \rightarrow
operator*(heapIs heap_{1032,1;1051,8}, this)._replace(p2 \rightarrow
asType < P2Type > ((\$heap_{1032,1;1051,8}.M2 *
asType<int>(static_cast<integer>(static_cast<signed
int>(operator^*(heapIs $heap_{1032,1;1051,8}, this).p2) < (int)(0))) + temp(2)))
Proof:
[Take given term]
[2.0] \operatorname{div1} == \operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_1032,1},
\mathbf{static\_cast} < \mathbf{int} > (\mathbf{operator}^*(\mathbf{heapIs} \ \$ \mathbf{heap}_{funcstart\_1032,1}, \ \mathbf{this}).\mathtt{p1}),
static\_cast < int > (\$heap_{funcstart\_1032,1}.a1))
→ [expand definition of operator '*' in class 'pointer' at built in declaration]
[2.1] \operatorname{div1} == \operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_1032,1},
\mathbf{static\_cast} < \mathbf{int} > (\mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs} \$ \mathbf{heap}_{funcstart\_1032,1}).p1),
\mathbf{static\_cast}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_1032,1}.\mathrm{a1}))
\rightarrow [simplify]
[2.2] \operatorname{div1} == \operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_1032,1}, \mathbf{this.}\$ r. \mathbf{value}(\mathbf{heapIs})
\theta_{funcstart\_1032,1}.p1, \theta_{funcstart\_1032,1}.p1, \theta_{funcstart\_1032,1}.a1))
\rightarrow [const static or extern object]
[2.3] \text{ div1} == \text{div(heapIs } \text{$heap}_{funcstart\_1032,1}, \text{this.} \text{$r.value(heapIs)}
\theta_{nit}.a1).p1, \theta_{nit}.a1
\rightarrow [expand definition of constant 'a1' at prang.cpp (30,26)]
[2.4] \text{ div1} == \text{div}(\text{heapIs } \text{heap}_{funcstart\_1032,1}, \text{this.}\text{\$r.value}(\text{heapIs})
\theta_{funcstart\_1032,1}.p1, \theta_{funcstart\_1032,1}.p1, \theta_{funcstart\_1032,1}.p1, \theta_{funcstart\_1032,1}.p1, \theta_{funcstart\_1032,1}.p1, \theta_{funcstart\_1032,1}.p1, \theta_{funcstart\_1032,1}.p2, \theta_{funcstart\_1032,1}.p2, \theta_{funcstart\_1032,1}.p2, \theta_{funcstart\_1032,1}.p2, \theta_{funcstart\_1032,1}.p2, \theta_{funcstart\_1032,1}.p3, \theta_{funcstart\_1032,1}.p4, \theta_{funcstart\_1032,1}.p4, \theta_{funcstart\_1032,1}.p4, \theta_{funcstart\_1032,1}.p5, \theta_{funcstart\_1032,1
\rightarrow [simplify]
[2.6] div1 == div(heapIs heap_{funcstart\_1032,1}, this.r.value(heapIs)
heap_{funcstart\_1032,1}.p1, 177)
[Assume known post-assertion, class invariant or type constraint for term 2.6]
[7.0] (0 < asType<integer>(this.$r.value(heapIs
\theta_{funcstart\_1032,1}.p1) && (asType<integer>(this.$r.value(heapIs)
\$heap_{funcstart\_1032,1}).p1) < \mathbf{asType} < \mathbf{integer} > (\$heap.\mathbf{class} \ WHPrang \in \texttt{Constant}) + \texttt{Constant} = \texttt{Constant} 
M1))
\rightarrow [simplify]
[7.2] (0 < this.$r.value(heapIs $heap_{funcstart\_1032,1}).p1) &&
(this.r.value(heapIs $heap_{funcstart\_1032.1}).p1 <
asType < integer > (\$heap.class WHPrang \in M1))
```

```
\rightarrow [const static or extern object]
[7.3] (0 < this.$r.value(heapIs \rho_{funcstart\_1032,1}).p1) &&
(this.r.value(heapIs $heap_{funcstart\_1032,1}).p1 <
asType < integer > (\$heap_{init}.class WHPrang \in M1))
\rightarrow [expand definition of constant 'M1' at prang.cpp (28,26)]
[7.4] (0 < this.\$r.value(heapIs \$heap_{funcstart\_1032.1}).p1) &&
(this.$r.value(heapIs \rho_{funcstart\_1032,1}).p1 <
asType < integer > ((int)30269))
\rightarrow [simplify]
[7.10] (-30269 < -this.$r.value(heap
Is \rho_{funcstart\_1032,1}).p1) <math display="inline">\land (0 <
this.r.value(heapIs $heap_{funcstart\_1032,1}).p1)
[Work on sub-term 2 of conjunction in term 7.10]
[8.0] 0 < this.$r.value(heapIs \theta_{funcstart\_1032,1}).p1
[Take given term]
[18.0] div2 == div(heapIs $heap_{funcstart\_1032,1},
static_cast<int>(operator*(heapIs $heap_{funcstart_1032,1}, this).p2),
\mathbf{static\_cast}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_1032,1}.\mathrm{a2}))
\rightarrow [expand definition of operator '*' in class 'pointer' at built in declaration]
[18.1] \operatorname{div2} == \operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_1032,1},
static\_cast < int > (this. r.value(heapIs $heap_{funcstart\_1032,1}).p2),
static\_cast < int > (\$heap_{funcstart\_1032.1}.a2))
\rightarrow [simplify]
[18.2] \operatorname{div2} == \operatorname{div}(\mathbf{heapIs} \ \mathbf{\$heap}_{funcstart\_1032,1}, \ \mathbf{this.\$r.value}(\mathbf{heapIs})
\theta_{funcstart\_1032,1}.p2, \theta_{funcstart\_1032,1}.p2, \theta_{funcstart\_1032,1}.a2))
\rightarrow [const static or extern object]
[18.3] \operatorname{div2} == \operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_1032,1}, \ \mathbf{this}. \text{\$r.value}(\mathbf{heapIs})
\theta_{uncstart\_1032,1}.p2, \theta_{uncstart\_1032,1}.p3, \theta_{uncstart\_1032
\rightarrow [expand definition of constant 'a2' at prang.cpp (35,26)]
[18.4] \operatorname{div2} == \operatorname{div}(\mathbf{heapIs} \ \text{$heap}_{funcstart\_1032,1}, \ \mathbf{this}.\text{$r.value}(\mathbf{heapIs})
\theta_{funcstart\_1032,1}.p2, \theta_{funcstart\_1032,1}.p2, \theta_{funcstart\_1032,1}.p2, \theta_{funcstart\_1032,1}.p2
\rightarrow [simplify]
[18.6] div2 == div(\mathbf{heapIs} \$ \mathbf{heap}_{funcstart\_1032,1}, \mathbf{this}.\$ \mathbf{r.value}(\mathbf{heapIs})
heap_{funcstart_{-1032,1}}.p2, 176
[Assume known post-assertion, class invariant or type constraint for term 18.6]
[23.0] (0 < asType<integer>(this.$r.value(heapIs
$heap_funcstart_1032.1).p2)) && (asType<integer>(this.$r.value(heapIs
\$ heap_{funcstart\_1032,1}).p2) < \mathbf{asType} < \mathbf{integer} > (\$ heap.\mathbf{class} \ WHPrang \in \texttt{Prang}) = \texttt{Prang} + \texttt{Prang}
```

```
M2))
\rightarrow [simplify]
[23.2] (0 < this.$r.value(heap
Is \rho_{uncstart\_1032,1}).p2) &&
(this.$r.value(heapIs heap_{funcstart\_1032,1}).p2 <
asType < integer > (\text{$heap.class WHPrang} \in M2))
\rightarrow [const static or extern object]
[23.3] (0 < this.r.value(heapIs \ heap_{funcstart\_1032,1}).p2) \&\&
(this.r.value(heapIs $heap_{funcstart\_1032.1}).p2 <
asType < integer > (\$heap_{init}.class WHPrang \in M2))
\rightarrow [expand definition of constant 'M2' at prang.cpp (33,26)]
[23.4] (0 < this.$r.value(heap
Is \rho_{uncstart\_1032,1}).p2) &&
(this.r.value(heapIs $heap_{funcstart\_1032,1}).p2 <
asType < integer > ((int)30307))
\rightarrow [simplify]
[23.10] (-30307 < -this.$r.value(heapIs $heap_{funcstart\_1032,1}).p2) \land (0 <
this.r.value(heapIs $heap_{funcstart\_1032,1}).p2)
[Work on sub-term 2 of conjunction in term 23.10]
[24.0] 0 < this.$r.value(heapIs $heap_{funcstart\_1032,1}).p2
[Take given term]
[34.0] \operatorname{div3} == \operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_1032,1},
\mathbf{static\_cast} < \mathbf{int} > (\mathbf{operator}^*(\mathbf{heapIs} \ \$ \mathbf{heap}_{funcstart\_1032,1}, \ \mathbf{this}).\mathbf{p3}),
\mathbf{static\_cast} < \mathbf{int} > (\$ \mathbf{heap}_{funcstart\_1032,1}.\mathbf{a3}))
→ [expand definition of operator '*' in class 'pointer' at built in declaration]
[34.1] \operatorname{div3} == \operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_1032,1},
static\_cast < int > (this. r.value(heapIs \\ heap_{funcstart\_1032,1}).p3),
\mathbf{static\_cast} < \mathbf{int} > (\$ \mathbf{heap}_{funcstart\_1032,1}.\mathbf{a3}))
\rightarrow [simplify]
[34.2]~{\rm div3} == {\rm div}(\mathbf{heapIs}~\$ \mathrm{heap}_{funcstart\_1032,1},~\mathbf{this}.\$ \mathrm{r.value}(\mathbf{heapIs}
\theta_{funcstart\_1032,1}.p3, \theta_{funcstart\_1032,1}.p3, \theta_{funcstart\_1032,1}.a3))
\rightarrow [const static or extern object]
[34.3] \text{ div3} == \text{div}(\text{heapIs } \text{$heap}_{funcstart\_1032,1}, \text{this.}\text{$r.value}(\text{heapIs})
\theta_{nit}.a3)
\rightarrow [expand definition of constant 'a3' at prang.cpp (40,26)]
[34.4] \text{ div3} == \text{div(heapIs } \text{$heap}_{funcstart\_1032,1}, \text{ this.} \text{$r.value(heapIs)}
\label{eq:cast_int} $$ \rho_{uncstart\_1032,1}.p3, \ \mathbf{static\_cast} < \mathbf{int} > ((\mathbf{int})178)) $$
\rightarrow [simplify]
```

```
[34.6] div3 == div(heapIs $heap<sub>funcstart_1032,1</sub>, this.$r.value(heapIs)
heap_{funcstart\_1032,1}.p3, 178)
[Assume known post-assertion, class invariant or type constraint for term 34.6]
[39.0] (0 < asType<integer>(this.$r.value(heapIs
\theta_{funcstart\_1032,1}.p3 < asType<integer>(\theta_{funcstart\_1032,1}.p3) < asType<integer>(\theta_{funcstart\_1032,1}.p3)
M3))
\rightarrow [simplify]
[39.2] (0 < this.$r.value(heap
Is \rho_{funcstart\_1032,1}).p3) &&
(this.$r.value(heapIs heap_{funcstart\_1032,1}).p3 <
asType < integer > (\text{$heap.class WHPrang} \in M3))
\rightarrow [const static or extern object]
[39.3] (0 < this.\$r.value(heapIs \$heap_{tuncstart_{-1032.1}}).p3) &&
(this.r.value(heapIs $heap_{funcstart\_1032.1}).p3 <
asType < integer > (\text{$heap}_{init}.class WHPrang \in M3))
\rightarrow [expand definition of constant 'M3' at prang.cpp (38,26)]
[39.4] (0 < this.$r.value(heap
Is $heap_{tuncstart\_1032,1}).p3) &&
(this.$r.value(heapIs \rho_{funcstart\_1032,1}).p3 <
asType < integer > ((int)30323))
\rightarrow [simplify]
[39.10] (-30323 < -this.$r.value(heapIs heapIs = f_{uncstart_1032,1}).p3) \land (0 <
\textbf{this.\$r.value}(\textbf{heapIs}~\$\text{heap}_{funcstart\_1032,1}).\text{p3})
\rightarrow [separate conjunction and work on first sub-term]
\textit{[39.11] -30323} < -\textbf{this.\$r.value}(\textbf{heapIs} \ \$ heap_{funcstart\_1032,1}).p3
[Work on sub-term 2 of conjunction in term 39.10]
[40.0] 0 < this.$r.value(heapIs $heap_{funcstart\_1032.1}).p3
[Assume known post-assertion, class invariant or type constraint for term 34.6]
[41.0] (asType<integer>(this.$r.value(heapIs $heap_{funcstart\_1032,1}).p3) /
asType<integer>(178)) == asType<integer>(div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p3,
178).quot)
\rightarrow [simplify]
[41.2] (this.$r.value(heapIs heap_{funcstart\_1032,1}).p3 / 178) ==
\mathbf{asType}{<}\mathbf{integer}{>}(\text{div}(\mathbf{heapIs}\ \$\text{heap}_{funcstart\_1032,1},\ \mathbf{this.}\$r.\mathbf{value}(\mathbf{heapIs}
heap_{funcstart\_1032,1}.p3, 178).quot
→ [expand definition of operator './' in class 'int' at built in declaration]
[41.3] ([asType<integer>(this.$r.value(heapIs $heap_{funcstart\_1032.1}).p3) <
```

```
0]: -(-asType < integer > (this. r.value(heapIs  heap_{funcstart\_1032,1}).p3) / 
178), \parallel: asType<integer>(this.$r.value(heapIs $heap_{funcstart\_1032,1}).p3) /
178) == asType<integer>(div(heapIs heap_{funcstart\_1032,1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p3, 178).quot)
→ [explicitly assert falsehood of skipped guards in subsequent guards]
[41.4] \; ([\mathbf{asType} < \mathbf{integer} > (\mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs} \; \$ \mathbf{heap}_{funcstart\_1032,1}).\mathbf{p3}) < \mathbf{page}) \\
0]: -(-asType < integer > (this. r.value(heapIs  heap_{funcstart\_1032,1}).p3) / (this. r.value(heapIs  heap_{funcstart\_1032,1}).p3)
178), [!(asType<integer>(this.$r.value(heapIs $heap_{funcstart\_1032.1}).p3) <
0)]: asType<integer>(this.r.value(heapIs \heap_{funcstart\_1032,1}).p3) /
178) == asType<integer>(div(heapIs $heap_{tuncstart 1032.1},
this.$r.value(heapIs \theta_{funcstart\_1032,1}).p3, 178).quot)
\rightarrow [simplify]
[41.7] ([0 < -this.$r.value(heapIs $heap<sub>funcstart_1032,1</sub>).p3]:
-(-asType<integer>(this.$r.value(heapIs $heap_{funcstart\_1032,1}).p3) /
178), [!(asType<integer>(this.$r.value(heapIs $heap_{tuncstart\_1032,1}).p3) <
0)]: as
Type<integer>(this.$r.value(heap
Is \rho_{funcstart\_1032,1}).p3) / 
178) == asType<integer>(div(heapIs heap_{funcstart\_1032,1},
\mathbf{this.\$r.value}(\mathbf{heapIs}~\$ \mathrm{heap}_{funcstart\_1032,1}).\mathrm{p3},~178).\mathrm{quot})
\rightarrow [from term 40.0, literala < -this.$r.value(heapIs $heap_{funcstart\_1032.1}).p3
is false whenever -2 < (0 + literala)
      Proof of rule precondition:
      [41.7.0] - 2 < (0 + 0)
      \rightarrow [simplify]
      [41.7.2] true
[41.8] ([false]: -(-asType<integer>(this.$r.value(heapIs
$heap_funcstart_1032,1).p3) / 178), [!(asType<integer>(this.$r.value(heapIs
\rho_{funcstart_1032,1}.p3 < 0: asType<integer>(this.$r.value(heapIs)
\theta_{funcstart=1032.1}.p3) / 178) == asType<integer>(div(heapIs)
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p3,
178).quot)
\rightarrow [simplify]
[41.11] ([false]: -(-asType < integer > (this. r.value(heapIs))
\rho_{tuncstart_1032.1}.p3 / 178), [!(0 < -this.\r.value(heapIs)
\rho_{uncstart_1032,1}.p3]: asType<integer>(this.$r.value(heapIs)
\theta_{funcstart\_1032,1}.p3) / 178 = asType < integer > (div(heapIs)) / 178 = as
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p3,
178).quot)
\rightarrow [from term 40.0, literala < -this.$r.value(heapIs $heap_{funcstart\_1032,1}).p3
is false whenever -2 < (0 + literala)
```

Proof of rule precondition:

```
[41.11.0] - 2 < (0 + 0)
    \rightarrow [simplify]
    [41.11.2] true
[41.12] ([false]: -(-asType < integer > (this. r.value(heapIs))
\frac{\text{sheap}_{funcstart\_1032,1}.p3}{178}, [!false]:
asType<integer>(this.r.value(heapIs \ heap_{funcstart\_1032,1}).p3) / 178)
== asType<integer>(div(heapIs $heap_{funcstart\_1032,1},
this.r.value(heapIs $heap_{funcstart\_1032,1}).p3, 178).quot)
\rightarrow [simplify]
[41.17] \ 0 == (-\text{div}(\mathbf{heapIs} \ \$ \text{heap}_{funcstart\_1032,1}, \ \mathbf{this}.\$ \text{r.value}(\mathbf{heapIs} \ \texttt{heap}_{funcstart\_1032,1}, \ \mathbf{this}.\$ \text{r.value}))
\theta_{funcstart\_1032,1}.p3, 178.quot + (this.r.value(heapIs)
heap_{funcstart_{-1032,1}}.p3 / 178)
[Take given term]
[50.0] (($heap_{tuncstart\_1032,1}.r1 * static_cast<signed int>(div1.rem)) -
(\text{sheap}_{funcstart\_1032,1}.\text{b1} * \text{static\_cast} < \text{signed int} > (\text{div1.quot}))) == \text{temp1}
\rightarrow [const static or extern object]
[50.1] ((\theta_{init}.r1 * static_cast<signed int>(div1.rem)) -
(\$heap_{funcstart\_1032,1}.b1 * \textbf{static\_cast} < \textbf{signed int} > (div1.quot))) == temp1
\rightarrow [expand definition of constant 'r1' at prang.cpp (29,26)]
[50.2]\;(((\mathbf{int})171\;*\;\mathbf{static\_cast}{<}\mathbf{signed}\;\mathbf{int}{>}(\mathrm{div}1.\mathrm{rem}))\;-
(\text{sheap}_{funcstart\_1032.1}.\text{b1 * static\_cast} < \text{signed int} > (\text{div1.quot}))) == \text{temp1}
\rightarrow [simplify]
[50.3] ((171 * static_cast < signed int > (div1.rem)) - ($heap_{funcstart\_1032.1}.b1
* static_cast<signed int>(div1.quot))) == temp1
\rightarrow [from term 2.6, div1 is equal to div(heapIs $heap_{funcstart\_1032,1},
this.r.value(heapIs $heap_{funcstart\_1032,1}).p1, 177)]
[50.4] ((171 * static_cast<signed int>(div(heapIs $heap_{funcstart\_1032,1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177).rem)) -
($heap_tuncstart_1032.1.b1 * static_cast<signed int>(div1.quot))) == temp1
\rightarrow [simplify]
[50.5] ((171 * div(heapIs $heap_{funcstart\_1032,1}, this.$r.value(heapIs
\text{Sheap}_{funcstart\_1032.1}.p1, 177).rem) - (\text{Sheap}_{funcstart\_1032.1}.b1 *
static_cast<signed int>(div1.quot))) == temp1
\rightarrow [const static or extern object]
[50.6] ((171 * \mathrm{div}(\mathbf{heapIs}\ \$\mathrm{heap}_{funcstart\_1032,1},\ \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}
\rho_{uncstart\_1032.1}.p1, 177.rem) - (\rho_{uncstart\_1032.1}).p1, 177.rem) - (\rho_{uncstart\_1032.1}).p1, 177.rem)
int>(div1.quot)) = temp1
```

```
\rightarrow [expand definition of constant 'b1' at prang.cpp (31,26)]
[50.7] ((171 * div(heapIs $heap<sub>funcstart_1032.1</sub>, this.$r.value(heapIs
\theta_{funcstart\_1032,1}.p1, 177).rem) - ((int)2 * static_cast<signed
int>(div1.quot))) == temp1
\rightarrow [simplify]
[50.8] ((171 * div(heapIs $heap_{funcstart\_1032,1}, this.$r.value(heapIs 
\theta_{funcstart\_1032,1}.p1, 177).rem – (2 * static_cast<signed)
int>(div1.quot)) == temp1
\rightarrow [from term 2.6, div1 is equal to div(heapIs $heap_{funcstart\_1032,1},
this.$r.value(heapIs $heap_{funcstart\_1032,1}).p1, 177)]
[50.9] ((171 * div(heapIs \$heap_{funcstart\_1032,1}, this.\$r.value(heapIs
\theta_{funcstart\_1032,1}.p1, 177).rem) - (2 * static_cast<signed
int>(div(heapIs \$heap_{funcstart\_1032,1}, this.\$r.value(heapIs
\text{Sheap}_{funcstart\_1032,1}.\text{p1}, 177).\text{quot}))) == \text{temp1}
\rightarrow [simplify]
[50.14] 0 == (-\text{temp1} + (-2 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177).quot) + (171 *
div(\mathbf{heapIs} \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
heap_{funcstart_{-1032,1}}.p1, 177).rem
[Take given term]
[53.0] heap_{1032,1;1051,8} == heap_{funcstart\_1032,1}._replace(this.$r \rightarrow
operator*(heapIs heap_{funcstart\_1032,1}, this)._replace(p1 \rightarrow
asType<P1Type>(($heap_funcstart_1032,1.M1 *
asType<int>(static_cast<integer>(static_cast<signed
\mathbf{int} > (\mathbf{operator}^*(\mathbf{heapIs} \ \$ \mathbf{heap}_{funcstart\_1032,1}, \ \mathbf{this}).\mathtt{p1}) < (\mathbf{int})0))) \ +
temp1)))
→ [expand definition of operator '*' in class 'pointer' at built in declaration]
[53.1] \theta_{1032,1;1051,8} == \theta_{1032,1;1051,8} = \theta_{1032,1;1051,8} == \theta
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow
\mathbf{asType}{<}P1\mathsf{Type}{>}((\$\mathsf{heap}_{funcstart\_1032,1}.\mathsf{M1}~*
asType<int>(static_cast<integer>(static_cast<signed
int>(operator^*(heapIs \$heap_{funcstart\_1032,1}, this).p1) < (int)0))) +
temp1)))
\rightarrow [const static or extern object]
[53.2] heap_{1032,1;1051,8} == heap_{funcstart\_1032,1}._replace(this.$r \rightarrow
\textbf{this.}\$r.\textbf{value}(\textbf{heapIs}~\$heap_{funcstart\_1032,1}).\_\textbf{replace}(p1 \rightarrow
asType < P1Type > ((\$heap_{init}.M1 *
asType < int > (static\_cast < integer > (static\_cast < signed
int>(operator^*(heapIs \$heap_{funcstart\_1032,1}, this).p1) < (int)0))) +
temp1)))
```

```
\rightarrow [expand definition of constant 'M1' at prang.cpp (28,26)]
[53.3] $heap<sub>1032,1;1051,8</sub> == $heap<sub>funcstart_1032,1</sub>._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow
asType<P1Type>(((int)30269 *
asType < int > (static\_cast < integer > (static\_cast < signed)
int>(operator^*(heapIs \$heap_{funcstart\_1032,1}, this).p1) < (int)0))) +
temp1)))
\rightarrow [simplify]
[53.4] heap_{1032,1;1051,8} == heap_{funcstart\_1032,1}._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow
asType<P1Type>((30269 *
asType < int > (static\_cast < integer > (static\_cast < signed)
int>(operator*(heapIs $heap_{funcstart\_1032,1}, this).p1) < (int)0))) +
temp1)))
→ [expand definition of operator '*' in class 'pointer' at built in declaration]
[53.5] $heap<sub>1032,1;1051,8</sub> == $heap<sub>funcstart_1032,1</sub>._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow
asType<P1Type>((30269 *
asType{<}int{>}(static\_cast{<}integer{>}(static\_cast{<}signed
int>(this.\$r.value(heapIs \$heap_{funcstart\_1032.1}).p1) < (int)0))) + temp1)))
\rightarrow [simplify]
[53.9] $heap<sub>1032,1;1051,8</sub> == $heap<sub>funcstart_1032,1</sub>._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow
asType<P1Type>((30269 * asType<int>(static_cast<integer>(0 <
-\mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}\ \$\mathrm{heap}_{funcstart\_1032,1}).\mathrm{p1}))) + \mathrm{temp1})))
\rightarrow [from term 8.0, literala < -this.$r.value(heapIs $heap_{funcstart\_1032,1}).p1
is false whenever -2 < (0 + literala)
   Proof of rule precondition:
   [53.9.0] - 2 < (0 + 0)
   \rightarrow [simplify]
   [53.9.2] true
[53.10] $heap<sub>1032,1;1051,8</sub> == $heap<sub>funcstart_1032,1</sub>._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow
asType<P1Type>((30269 * asType<int>(static_cast<integer>(false)))
+ \text{ temp1}))
\rightarrow [simplify]
[53.11] $\text{heap}_{1032,1;1051,8} == $\text{heap}_{funcstart\_1032,1}._\text{replace}(\text{this}.\text{$\frac{1}{2}r$})
\mathbf{this.\$r.value}(\mathbf{heapIs}~\$ \mathrm{heap}_{funcstart\_1032,1}).\_\mathbf{replace}(\mathrm{p1} \rightarrow
asType < P1Type > ((30269 * asType < int > (([false]: 1, []: 0))) + temp1)))
```

```
→ [explicitly assert falsehood of skipped guards in subsequent guards]
[53.12] $heap<sub>1032,1;1051,8</sub> == $heap<sub>funcstart_1032,1</sub>._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow
asType<P1Type>((30269 * asType<int>(([false]: 1, [true]: 0))) +
temp1)))
\rightarrow [simplify]
[53.15] $heap<sub>1032,1;1051,8</sub> == $heap<sub>funcstart_1032,1</sub>._replace(this.$r \rightarrow
\textbf{this.}\$r.\textbf{value}(\textbf{heapIs}~\$heap_{funcstart\_1032,1}).\_\textbf{replace}(p1 \rightarrow
asType < P1Type > (0 + temp1))
\rightarrow [from term 50.14, temp1 is equal to (-2 * div(heapIs $heap_{funcstart\_1032.1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177).quot) + (171 *
div(heapIs $heap_{funcstart_1032.1}, this.$r.value(heapIs
heap_{funcstart\_1032,1}.p1, 177).rem
[53.16] $heap<sub>1032,1;1051,8</sub> == $heap<sub>funcstart_1032,1</sub>._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow
asType<P1Type>(0 + ((-2 * div(heapIs $heap_{funcstart\_1032,1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177).quot) + (171 *
div(\mathbf{heapIs} \$ heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
heap_{funcstart_{1032,1}}.p1, 177).rem))))
\rightarrow [simplify]
[53.19] \theta_{1032,1;1051,8} == \theta_{1032,1;1051,8} == \theta_{1032,1}.replace(this.$r \to
this.$r.value(heapIs \rho_{tuncstart\_1032.1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.} \text{\$r.value}(\text{heapIs}))
heap_{funcstart\_1032,1}.p1, 177.rem)))
[Take given term]
[54.0] (($heap<sub>1032.1:1051.8</sub>.r2 * static_cast<signed int>(div2.rem)) -
(\text{sheap}_{1032,1;1051,8}.\text{b2} * \text{static\_cast} < \text{signed int} > (\text{div2.quot}))) = = \text{temp2}
\rightarrow [from term 53.19, $heap<sub>1032,1;1051,8</sub> is equal to
\$heap_{funcstart\_1032,1}.\_\textbf{replace}(\textbf{this}.\$r \rightarrow \textbf{this}.\$r.\textbf{value}(\textbf{heapIs}
heap_{funcstart\_1032,1}._replace(p1 \rightarrow (-2 * div(heapIs \$heap_{funcstart\_1032,1},
this.r.value(heapIs \ \ heap_{funcstart\_1032,1}).p1, \ 177).quot) + (171 \ \ *
div(heapIs $heap_funcstart_1032.1, this.$r.value(heapIs
heap_{funcstart\_1032,1}.p1, 177).rem)))
[54.1] ((\text{\$heap}_{funcstart\_1032,1}._replace(this.\text{\$r} \to \text{this}.\text{\$r.value}(\text{heapIs})
\text{Sheap}_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs \text{Sheap}_{funcstart\_1032,1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177).quot) + (171 *
div(\mathbf{heapIs} \$ heap_{funcstart\_1032.1}, \mathbf{this.}\$r.\mathbf{value}(\mathbf{heapIs})
\rho_{tuncstart_1032,1}.p1, 177).rem))).r2 * static_cast < signed
int>(div2.rem)) - (\$heap_{1032.1:1051.8}.b2 * static\_cast < signed)
int>(div2.quot)) = temp2
```

```
\rightarrow [const member of object with modified fields]
[54.2] \; ((\$heap_{funcstart\_1032,1}.r2 * \textbf{static\_cast} < \textbf{signed int} > (\text{div2.rem})) \; - \\
(\text{sheap}_{1032,1:1051,8}.\text{b2} * \text{static\_cast} < \text{signed int} > (\text{div2.quot}))) == \text{temp2}
\rightarrow [const static or extern object]
[54.3] \; ((\$ heap_{init}.r2 \; * \; \textbf{static\_cast} < \textbf{signed int} > (div2.rem)) \; - \;
(\text{sheap}_{1032,1;1051,8}.\text{b2} * \text{static\_cast} < \text{signed int} > (\text{div2.quot}))) == \text{temp2}
\rightarrow [expand definition of constant 'r2' at prang.cpp (34,26)]
[54.4] (((int)172 * static_cast<signed int>(div2.rem)) -
(\text{sheap}_{1032,1;1051,8}.\text{b2} * \text{static\_cast} < \text{signed int} > (\text{div2.quot}))) == \text{temp2}
\rightarrow [simplify]
[54.5] ((172 * static_cast < signed int > (div2.rem)) - ($heap_{1032.1:1051.8}.b2 *
static_cast<signed int>(div2.quot))) == temp2
\rightarrow [from term 18.6, div2 is equal to div(heapIs $heap_{funcstart\_1032,1},
this.r.value(heapIs $heap_{funcstart\_1032,1}).p2, 176)]
[54.6] ((172 * static_cast<signed int>(div(heapIs $heap_{tuncstart\_1032.1})
this.r.value(heapIs $heap_{funcstart\_1032,1}).p2, 176).rem)) -
(\text{sheap}_{1032,1:1051.8}.\text{b2} * \text{static\_cast} < \text{signed int} > (\text{div}2.\text{quot}))) = = \text{temp}2
\rightarrow [simplify]
[54.7] ((172 * div(heapIs $heap_{funcstart\_1032,1}, this.$r.value(heapIs
\text{heap}_{funcstart\_1032.1}.p2, 176).rem) - (\text{heap}_{1032.1:1051.8}.b2 *
\mathbf{static\_cast} < \mathbf{signed\ int} > (\mathbf{div2.quot}))) == \mathbf{temp2}
\rightarrow [from term 53.19, $heap<sub>1032,1;1051,8</sub> is equal to
\$heap_{funcstart\_1032,1}.\_\textbf{replace}(\textbf{this}.\$r \rightarrow \textbf{this}.\$r.\textbf{value}(\textbf{heapIs}
heap_{funcstart\_1032,1}._replace(p1 \rightarrow (-2 * div(heapIs p_{funcstart\_1032,1}).
this.$r.value(heapIs $heap_{funcstart\_1032,1}).p1, 177).quot) + (171 ^{\circ}
div(heapIs $heap_{tuncstart\_1032.1}, this.$r.value(heapIs
heap_{funcstart\_1032,1}.p1, 177).rem)))]
[54.8] ((172 * div(heapIs $heap_{funcstart\_1032,1}, this.$r.value(heapIs)]
\rho_{tuncstart\_1032,1}.p2, 176).rem – (\rho_{tuncstart\_1032,1}.peplace(this.r
\rightarrow this.$r.value(heapIs $heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 *
div(\mathbf{heapIs} \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
\text{Sheap}_{funcstart\_1032,1}.p1, 177).quot) + (171 * div(heapIs \text{Sheap}_{funcstart\_1032,1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177).rem)))).b2 *
static_cast<signed int>(div2.quot))) == temp2
\rightarrow [const member of object with modified fields]
[54.9] ((172 * div(heapIs $heap<sub>funcstart_1032,1</sub>, this.$r.value(heapIs)
\text{Sheap}_{funcstart\_1032,1}.p2, 176).rem) - (\text{Sheap}_{funcstart\_1032,1}.b2 *
static_cast<signed int>(div2.quot))) == temp2
\rightarrow [const static or extern object]
```

```
[54.10] ((172 * div(heapIs $heap<sub>funcstart_1032.1</sub>, this.$r.value(heapIs)
\rho_{funcstart\_1032,1}.p2, 176).rem – (\rho_{init}.b2 * static\_cast < signed
int>(div2.quot)) == temp2
\rightarrow [expand definition of constant 'b2' at prang.cpp (36,26)]
[54.11] ((172 * div(heapIs $heap_{funcstart\_1032,1}, this.$r.value(heapIs
\rho_{tuncstart=1032.1}.p2, 176).rem - ((int)35 * static_cast < signed)
int>(div2.quot))) == temp2
\rightarrow [simplify]
[54.12] ((172 * div(heapIs $heap_{funcstart\_1032,1}, this.$r.value(heapIs)]
\rho_{tuncstart=1032.1}, p2, 176).rem) - (35 * static_cast<signed)
int>(div2.quot)) = temp2
\rightarrow [from term 18.6, div2 is equal to div(heapIs $heap_{funcstart\_1032,1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p2, 176)]
[54.13] ((172 * div(heapIs $heap<sub>funcstart_1032,1</sub>, this.$r.value(heapIs
\mathbf{int}{>} (\mathbf{div}(\mathbf{heapIs} \ \$\mathbf{heap}_{funcstart\_1032,1}, \ \mathbf{this}.\$\mathbf{r.value}(\mathbf{heapIs}
heap_{funcstart_1032,1}.p2, 176).quot)) = temp2
\rightarrow [simplify]
[54.18] 0 == (-\text{temp2} + (-35 * \text{div}(\text{heapIs } \text{$heap}_{funcstart\_1032.1})]
this.r.value(heapIs \ensuremath{\$}heap_{funcstart\_1032,1}).p2, 176).quot) + (172 *
div(\mathbf{heapIs} \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
heap_{funcstart_{-1032.1}}.p2, 176).rem
[Take given term]
[57.0] $\text{heap}_{1032,1:1054.8} == \text{heap}_{1032,1:1051.8}._\text{replace}(\text{this}.\text{$r$} \to \text{
operator*(heapIs heap_{1032,1:1051.8}, this)._replace(p2 \rightarrow
asType<P2Type>(($heap<sub>1032.1:1051.8</sub>.M2 *
asType < int > (static\_cast < integer > (static\_cast < signed
int > (operator^*(heapIs \$heap_{1032,1;1051,8}, this).p2) < (int)0))) + temp2)))
\rightarrow [from term 53.19, $heap<sub>1032.1:1051.8</sub> is equal to
\$heap_{funcstart\_1032,1}.\_\textbf{replace}(\textbf{this}.\$r \rightarrow \textbf{this}.\$r.\textbf{value}(\textbf{heapIs}
heap_{funcstart\_1032,1}._replace(p1 \rightarrow (-2 * div(heapIs p_{funcstart\_1032,1}).
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177).quot) + (171)
div(\mathbf{heapIs} \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
heap_{funcstart\_1032,1}.p1, 177).rem)))
[57.2] heap_{1032,1;1054,8} == heap_{funcstart\_1032,1}._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
\$ heap_{funcstart\_1032,1}).p1,\ 177).rem)))).\_\textbf{replace}(\textbf{this}.\$r \rightarrow \textbf{operator*}(\textbf{heapIs})))).
\rho_{funcstart\_1032,1}._replace(this.r \to this.r.value(heapIs)
\text{Sheap}_{funcstart\_1032,1}._replace(p1 \rightarrow (-2 * div(heapIs $heap_{funcstart\_1032,1},
```

```
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177).quot) + (171 *
{\rm div}(\mathbf{heapIs}~\$\mathrm{heap}_{funcstart\_1032,1},~\mathbf{this.\$r.value}(\mathbf{heapIs}
\theta_{funcstart\_1032,1}.p1, 177).rem))), this)._replace(p2 \rightarrow
asType<P2Type>(($heap<sub>1032,1:1051,8</sub>.M2 *
asType<int>(static_cast<integer>(static_cast<signed
int>(operator^*(heapIs $heap_{1032,1;1051,8}, this).p2) < (int)(0))) + temp(2)))
\rightarrow [expand definition of operator '*' in class 'pointer' at built in declaration]
[57.3] \theta_{1032,1;1054,8} == \theta_{1032,1;1054,8} = \theta_{1032,1;1054,8
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
$\text{heap}_{funcstart=1032.1}$, this.$\text{r.value}(\text{heapIs} \text{$heap}_{funcstart=1032.1}).p1,
177).quot) + (171 * div(heapIs $heap<sub>funcstart_1032,1</sub>, this.$r.value(heapIs
\theta_{tuncstart\_1032,1}.p1, 177).rem)))).\_replace(this.\$r \rightarrow 0
this.$r.value(heapIs heap_{funcstart\_1032,1}._replace(this.$r \rightarrow
this.$r.value(heapIs \rho_{uncstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs)
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
\theta_{uncstart\_1032,1}.p1, 177).rem)))))._replace(p2 \rightarrow
asType<P2Type>(($heap<sub>1032,1:1051,8</sub>.M2 *
asType<int>(static_cast<integer>(static_cast<signed
int>(operator^*(heapIs $heap_{1032.1:1051.8}, this).p2) < (int)(0))) + temp(2)))
→ [evaluate dereferenced pointer into modified heap]
[57.4] heap_{1032,1;1054,8} == heap_{funcstart\_1032,1}._replace(this.$r \rightarrow
this.$r.value(heapIs $heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{tuncstart\_1032.1}, this.r.value(heapIs \rho_{tuncstart\_1032.1}).p1,
177).quot) + (171 * div(\mathbf{heapIs} \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}))
\theta_{uncstart\_1032,1}.p1, 177).rem))))._replace(this.$r \rightarrow ([this.$r ===
this.$r]: this.$r.value(heapIs \rho_{funcstart\_1032,1})._replace(p1 \rightarrow (-2 *
div(\mathbf{heapIs} \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
\text{Sheap}_{funcstart\_1032,1}.p1, 177).quot) + (171 * div(heapIs \text{Sheap}_{funcstart\_1032,1},
this.r.value(heapIs \ heap_{funcstart\_1032.1}).p1, 177).rem)), []:
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p2 \rightarrow
asType<P2Type>(($heap<sub>1032,1:1051,8</sub>.M2 *
asType<int>(static_cast<integer>(static_cast<signed
int>(operator^*(heapIs $heap_{1032,1;1051,8}, this).p2) < (int)(0))) + temp(2)))
→ [explicitly assert falsehood of skipped guards in subsequent guards]
[57.5] heap_{1032,1;1054,8} == heap_{funcstart\_1032,1}._replace(this.$r \rightarrow
this.$r.value(heapIs \rho_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
\label{eq:continuous_funcstart_1032,1} $$ \operatorname{heap}_{funcstart_1032,1}.p1,\ 177).rem)))).$$ $$ $$ replace(this.$r \to ([this.$r == ]]) $$
this.$r]: this.$r.value(heapIs \rho_{tuncstart\_1032,1})._replace(p1 \rightarrow (-2 *
div(\mathbf{heapIs} \$ heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
\text{Sheap}_{funcstart\_1032,1}.p1, 177).quot) + (171 * div(heapIs \text{Sheap}_{funcstart\_1032,1},
```

```
this.r.value(heapIs \heap_{funcstart\_1032,1}).p1, 177).rem)), [!(this.<math>r = 
\textbf{this.\$r.value}(\textbf{heapIs}~\$ heap_{funcstart\_1032,1})).\_\textbf{replace}(p2 \rightarrow
asType<P2Type>(($heap<sub>1032,1:1051,8</sub>.M2 *
as Type < int > (static\_cast < integer > (static\_cast < signed
int>(operator^*(heapIs $heap_{1032,1:1051,8}, this).p2) < (int)0))) + temp2)))
\rightarrow [simplify]
[57.7] heap_{1032,1;1054,8} == heap_{funcstart\_1032,1}._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.} \text{\$r.value}(\text{heapIs}))
\theta_{funcstart, 1032.1}.p1, 177.rem)))._replace(this.$r \rightarrow
\textbf{this.\$r.value}(\textbf{heapIs}~\$ heap_{funcstart\_1032,1}).\_\textbf{replace}(p1 \rightarrow ((\text{-}2~*\text{div}(\textbf{heapIs}
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
\theta_{funcstart\_1032,1}.p1, 177).rem))).\_replace(p2 \rightarrow
\mathbf{asType} {<} P2Type {>} ((\$heap_{1032,1;1051,8}.M2 *
asType < int > (static\_cast < integer > (static\_cast < signed)
int>(operator^*(heapIs $heap_{1032.1:1051.8}, this).p2) < (int)(0))) + temp(2)))
\rightarrow [from term 53.19, $heap<sub>1032.1:1051.8</sub> is equal to
\$heap_{funcstart\_1032,1}.\_\textbf{replace}(\textbf{this}.\$r \rightarrow \textbf{this}.\$r.\textbf{value}(\textbf{heapIs}
heap_{funcstart\_1032,1}._replace(p1 \rightarrow (-2 * div(heapIs $heap_{funcstart\_1032,1},
this.r.value(heapIs \ \ heap_{funcstart\_1032,1}).p1, \ 177).quot) + (171 \ \ *
div(\mathbf{heapIs} \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
heap_{funcstart_{1032,1}}.p1, 177).rem)))
[57.8] heap_{1032,1;1054,8} == heap_{funcstart\_1032,1}._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{tuncstart\_1032.1}, this.r.value(heapIs \rho_{tuncstart\_1032.1}).p1,
177).quot) + (171 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
\theta_{funcstart\_1032,1}.p1, 177).rem)))).\_replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032.1})._replace(p1 \rightarrow ((-2 * div(heapIs
$\text{heap}_{funcstart=1032.1}$, this.$\text{r.value}$(\text{heapIs} $\text{heap}_{funcstart=1032.1}).p1,
177).quot) + (171 * div(heapIs \theta_{funcstart\_1032,1}, this.r.value(heapIs)
\label{eq:continuous_function} $\operatorname{heap}_{funcstart\_1032,1}).p1,\ 177).rem))).\_\mathbf{replace}(p2 \to
asType < P2Type > ((\$heap_{funcstart\_1032,1}.\_replace(this.\$r \rightarrow
this.$r.value(heapIs $heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.}\text{\$r.value}(\text{heapIs}))
$heap_funcstart_1032,1).p1, 177).rem)))).M2 *
asType<int>(static_cast<integer>(static_cast<signed
int > (operator^*(heapIs \$heap_{1032,1;1051,8}, this).p2) < (int)0))) + temp2)))
→ [const member of object with modified fields]
[57.9] heap_{1032,1;1054,8} == heap_{funcstart\_1032,1}._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
```

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\rho_{funcstart=1032,1}, this.r.value(heapIs \rho_{funcstart=1032,1}).p1,
177).quot) + (171 * div(heapIs \theta_{funcstart\_1032,1}, this.r.value(heapIs)
\theta_{funcstart\_1032,1}.p1, 177).rem))))._replace(this.$r \rightarrow
this.$r.value(heapIs \frac{1}{2} heap\frac{1}{2} line \frac{1}{2} heap\frac{1}{2} heap\frac{1}{2
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs $heap<sub>funcstart_1032,1</sub>, this.$r.value(heapIs
heap_{funcstart\_1032,1}.p1, 177).rem)))._replace(p2 \rightarrow
asType<P2Type>(($heap_tuncstart_1032.1.M2 *
asType<int>(static_cast<integer>(static_cast<signed
int>(operator^*(heapIs $heap_{1032,1;1051,8}, this).p2) < (int)(0))) + temp(2)))
\rightarrow [const static or extern object]
[57.10] $heap<sub>1032,1;1054,8</sub> == $heap<sub>funcstart_1032,1</sub>._replace(this.$r \rightarrow
this.$r.value(heapIs p_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
\theta_{funcstart\_1032,1}.p1, 177).rem)))).\_replace(this.\$r \rightarrow 0
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\$heap_{funcstart\_1032,1},\, \textbf{this.}\$r.\textbf{value}(\textbf{heapIs}\,\,\$heap_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs \theta_{funcstart\_1032,1}, this.r.value(heapIs)
\theta_{funcstart\_1032,1}.p1, 177).rem))).\_replace(p2 \rightarrow
asType<P2Type>(($heap<sub>init</sub>.M2 *
asType<int>(static_cast<integer>(static_cast<signed
int>(operator^*(heapIs $heap_{1032,1;1051,8}, this).p2) < (int)0))) + temp2)))
\rightarrow [expand definition of constant 'M2' at prang.cpp (33,26)]
[57.11] $\text{heap}_{1032,1;1054,8} == \text{$heap}_{funcstart\_1032,1}._\text{replace}(\text{this.}\text{$r} \to \text{$}
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.\r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
\theta_{funcstart\_1032,1}.p1, 177).rem)))).\_replace(this.$r \rightarrow
this.$r.value(heapIs \rho_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\theta_{funcstart\_1032,1}, this.\r.value(heapIs \theta_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs \theta_{funcstart\_1032,1}, this.r.value(heapIs)
\theta_{funcstart\_1032,1}.p1, 177).rem)))._replace(p2 \rightarrow
asType<P2Type>(((int)30307 *
asType<int>(static_cast<integer>(static_cast<signed
\mathbf{int} > (\mathbf{operator}^*(\mathbf{heapIs} \ \$ \mathrm{heap}_{1032,1;1051,8}, \ \mathbf{this}).p2) < (\mathbf{int})0))) \ + \ \mathrm{temp}2)))
\rightarrow [simplify]
[57.12] $heap<sub>1032,1;1054,8</sub> == $heap<sub>funcstart_1032,1</sub>._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs $heap<sub>funcstart_1032,1</sub>, this.$r.value(heapIs
\theta_{funcstart\_1032,1}.p1, 177).rem)))).replace(this.$r \rightarrow
this.$r.value(heapIs \rho_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
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\rho_{tuncstart=1032.1}, this.r.value(heapIs \rho_{tuncstart=1032.1}).p1,
177).quot) + (171 * div(heapIs \theta), this.$r.value(heapIs
\theta_{funcstart\_1032,1}.p1, 177).rem))).\_replace(p2 \rightarrow
asType<P2Type>((30307 *
asType<int>(static_cast<integer>(static_cast<signed
int>(operator^*(heapIs $heap_{1032,1:1051,8}, this).p2) < (int)0))) + temp2)))
\rightarrow [from term 53.19, $heap_{1032,1;1051,8}$ is equal to
$heap_{funcstart\_1032,1}.$_{replace(this.$r} \rightarrow this.$r.value(heapIs)$
heap_{funcstart\_1032,1}._replace(p1 \rightarrow (-2 * div(heapIs p_{funcstart\_1032,1}).
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177).quot) + (171 *
div(\mathbf{heapIs}\ \$heap_{funcstart\_1032,1},\ \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}
heap_{funcstart_{-1032.1}}.p1, 177).rem)))
[57.13] $heap<sub>1032,1;1054,8</sub> == $heap<sub>funcstart_1032,1</sub>._replace(this.$r \rightarrow
this.$r.value(heapIs p_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\$heap_{funcstart\_1032,1},\, \textbf{this}.\$r.\textbf{value}(\textbf{heapIs}\,\,\$heap_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(\mathbf{heapIs} \$ heap_{funcstart\_1032,1}, \mathbf{this}.\$ r. \mathbf{value}(\mathbf{heapIs})
\theta_{funcstart\_1032,1}.p1, 177).rem))))._replace(this.$r \rightarrow
\textbf{this.}\$r.\textbf{value}(\textbf{heapIs}~\$heap_{funcstart\_1032,1}).\_\textbf{replace}(p1 \rightarrow ((\text{-}2~*\text{div}(\textbf{heapIs}
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(\mathbf{heapIs} \ \$heap_{funcstart\_1032,1}, \ \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
\theta_{funcstart\_1032,1}.p1, 177).rem))).\_replace(p2 \rightarrow
asType<P2Type>((30307 *
as Type < int > (static\_cast < integer > (static\_cast < signed
\mathbf{int}{>}(\mathbf{operator}^*(\mathbf{heapIs}\ \$\mathbf{heap}_{funcstart\_1032,1}.\_\mathbf{replace}(\mathbf{this}.\$\mathbf{r}\rightarrow
this.$r.value(heapIs \rho_{tuncstart\_1032.1})._replace(p1 \rightarrow (-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs \theta_{funcstart\_1032,1}, this.r.value(heapIs)
heap_{funcstart\_1032,1}.p1, 177).rem)), this).p2) < (int)0))) + temp2)))
→ [expand definition of operator '*' in class 'pointer' at built in declaration]
[57.14] $heap<sub>1032,1;1054,8</sub> == $heap<sub>funcstart_1032,1</sub>._replace(this.$r \rightarrow
\textbf{this.}\$r.\textbf{value}(\textbf{heapIs}~\$heap_{funcstart\_1032,1}).\_\textbf{replace}(p1 \rightarrow ((\text{-}2~*\text{div}(\textbf{heapIs}
\$heap_{funcstart\_1032,1},\, \textbf{this}.\$r.\textbf{value}(\textbf{heapIs}\,\,\$heap_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(\mathbf{heapIs} \ \$heap_{funcstart\_1032,1}, \ \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
\theta_{funcstart\_1032,1}.p1, 177).rem))))._replace(this.$r \rightarrow
this.$r.value(heapIs \rho_{tuncstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
\theta_{funcstart\_1032,1}.p1, 177).rem)))._replace(p2 \rightarrow
asType<P2Type>((30307 *
asType < int > (static\_cast < integer > (static\_cast < signed
\mathbf{int}{>}(\mathbf{this.\$r.value}(\mathbf{heapIs}\ \$\mathbf{heap}_{funcstart\_1032,1}.\_\mathbf{replace}(\mathbf{this.\$r}\ \rightarrow\ 
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
$\text{heap}_{funcstart_1032.1}$, this.$\text{r.value}(\text{heapIs} \text{$heap}_{funcstart_1032.1}).p1,
177).quot) + (171 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
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\text{Sheap}_{funcstart=1032.1}.p1, 177).rem)))).p2) < (int)0))) + temp2)))
→ [evaluate dereferenced pointer into modified heap]
[57.15] $heap<sub>1032,1;1054,8</sub> == $heap<sub>funcstart_1032,1</sub>._replace(this.$r \rightarrow
this.$r.value(heapIs heapIs_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.\$r.value}(\text{heapIs}))
\theta_{funcstart\_1032,1}.p1, 177).rem)))).\_replace(this.\$r \rightarrow 0
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs $heap<sub>funcstart 1032.1</sub>, this.$r.value(heapIs
\theta_{funcstart\_1032,1}.p1, 177).rem))).\_replace(p2 \rightarrow
asType<P2Type>((30307 *
asType < int > (static\_cast < integer > (static\_cast < signed\ int > (([this.\$r])))) \\
== this.$r]: this.$r.value(heapIs \rho_{funcstart\_1032,1})._replace(p1 \rightarrow (-2 *
div(\mathbf{heapIs} \$ heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
\text{Sheap}_{funcstart\_1032,1}.p1, 177).quot) + (171 * div(heapIs \text{Sheap}_{funcstart\_1032,1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177).rem)), []:
this.r.value(heapIs \ heap_{funcstart\_1032.1}).p2) < (int)0)) + temp2)))
→ [explicitly assert falsehood of skipped guards in subsequent guards]
[57.16] $heap<sub>1032,1;1054,8</sub> == $heap<sub>funcstart_1032,1</sub>._replace(this.$r \rightarrow
\textbf{this.\$r.value}(\textbf{heapIs}~\$ heap_{funcstart\_1032,1}).\_\textbf{replace}(p1 \rightarrow ((\text{-}2~*\text{div}(\textbf{heapIs}
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
\theta_{funcstart\_1032,1}.p1, 177).rem))))._replace(this.$r \rightarrow
\textbf{this.}\$r.\textbf{value}(\textbf{heapIs}~\$heap_{funcstart\_1032,1}).\_\textbf{replace}(p1 \rightarrow ((\text{-}2~*\text{div}(\textbf{heapIs}
\rho_{funcstart\_1032,1}, this.\r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032.1}, \text{this.} \text{\$r.value}(\text{heapIs}))
\theta_{funcstart\_1032,1}.p1, 177).rem))).\_replace(p2 \rightarrow
asType<P2Type>((30307 *
asType<int>(static_cast<integer>(static_cast<signed int>(([this.$r
== this.$r]: this.$r.value(heapIs \rho_{tuncstart\_1032,1})._replace(p1 \rightarrow (-2 *
div(\mathbf{heapIs} \$ heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
\text{Sheap}_{funcstart\_1032,1}.p1, 177).quot) + (171 * div(heapIs \text{Sheap}_{funcstart\_1032,1},
this.r.value(heapIs \ heap_{funcstart\_1032.1}).p1, 177).rem)), [!(this.<math>r = 
this.$r)]: this.$r.value(heapIs \rho_{tuncstart = 1032.1}).p2) < (int)0)) +
temp2)))
\rightarrow [simplify]
[57.23] $heap<sub>1032,1;1054,8</sub> == $heap<sub>funcstart_1032,1</sub>._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs $heap<sub>funcstart_1032,1</sub>, this.$r.value(heapIs
\theta_{funcstart\_1032,1}.p1, 177).rem)))).replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
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\rho_{funcstart=1032,1}, this.r.value(heapIs \rho_{funcstart=1032,1}).p1,
177).quot) + (171 * div(heapIs \theta_{funcstart\_1032,1}, this.r.value(heapIs)
\theta_{funcstart\_1032,1}.p1, 177).rem))).\_replace(p2 \rightarrow
{\bf asType} < P2Type > ((30307 * {\bf asType} < {\bf int} > ({\bf static\_cast} < {\bf integer} > (0 < {\bf output})) < {\bf output} > ({\bf output}) < {\bf o
-this.r.value(heapIs heap_{funcstart\_1032,1}.p2))) + temp2)))
\rightarrow [from term 24.0, literala < -this.$r.value(heapIs $heap_{funcstart\_1032.1}).p2
is false whenever -2 < (0 + literala)
      Proof of rule precondition:
      [57.23.0] - 2 < (0 + 0)
      \rightarrow [simplify]
      [57.23.2] true
[57.24] heap_{1032,1;1054,8} == heap_{funcstart\_1032,1}._replace(this.$r \rightarrow
this.$r.value(heapIs \rho_{uncstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs)
\rho_{tuncstart\_1032.1}, this.r.value(heapIs \rho_{tuncstart\_1032.1}).p1,
177).quot) + (171 * div(heapIs \theta_{funcstart\_1032,1}, this.r.value(heapIs)
\theta_{funcstart\_1032,1}.p1, 177).rem)))).\_replace(this.\$r \rightarrow 0
this.$r.value(heapIs heap_{tuncstart=1032.1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
\theta_{funcstart\_1032,1}.p1, 177).rem))).\_replace(p2 \rightarrow
asType<P2Type>((30307 * asType<int>(static_cast<integer>(false)))
+ \text{temp2})))
\rightarrow [simplify]
[57.25] $heap<sub>1032,1;1054,8</sub> == $heap<sub>funcstart_1032,1</sub>._replace(this.$r \rightarrow
\textbf{this.\$r.value}(\textbf{heapIs}~\$ heap_{funcstart\_1032,1}).\_\textbf{replace}(p1 \rightarrow ((-2~*div(\textbf{heapIs})))))
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs $heap<sub>funcstart_1032,1</sub>, this.$r.value(heapIs
\theta_{funcstart\_1032,1}.p1, 177).rem)))).\_replace(this.\$r \rightarrow 0
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs $heap<sub>funcstart_1032,1</sub>, this.$r.value(heapIs
\theta_{funcstart\_1032,1}.p1, 177).rem))).\_replace(p2 \rightarrow
asType<P2Type>((30307 * asType<int>(([false]: 1, []: 0))) + temp2)))
→ [explicitly assert falsehood of skipped guards in subsequent guards]
[57.26] $heap<sub>1032,1;1054,8</sub> == $heap<sub>funcstart_1032,1</sub>._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\$heap_{funcstart\_1032,1},\, \textbf{this}.\$r.\textbf{value}(\textbf{heapIs}\,\,\$heap_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs \rho_{funcstart\_1032,1}, this.r.value(heapIs)
\label{eq:continuous_function} $ \text{heap}_{funcstart\_1032,1} . \text{p1}, 177).rem)))).$ \_\textbf{replace}(\textbf{this}.\$r \rightarrow
this.$r.value(heapIs \rho_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.\r.value(heapIs \rho_{funcstart\_1032,1}).p1,
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177).quot) + (171 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.} \text{\$r.value}(\text{heapIs}))
\theta_{funcstart\_1032,1}.p1, 177).rem)))._replace(p2 \rightarrow
asType<P2Type>((30307 * asType<int>(([false]: 1, [true]: 0))) +
temp2)))
\rightarrow [simplify]
[57.29] $heap<sub>1032,1;1054,8</sub> == $heap<sub>funcstart_1032,1</sub>._replace(this.$r \rightarrow
this.$r.value(heapIs \rho_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
\theta_{tuncstart\ 1032.1}.p1,\ 177.rem)))._replace(this.r \rightarrow
this.$r.value(heapIs p_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.} \text{\$r.value}(\text{heapIs}))
\text{Sheap}_{funcstart\_1032,1}.p1, 177).rem)))._replace(p2 \rightarrow asType<P2Type>(0 +
temp2)))
\rightarrow [from term 54.18, temp2 is equal to (-35 * div(heapIs $heap_{funcstart\_1032,1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p2, 176).quot) + (172 \ *
div(heapIs $heap_{funcstart_1032.1}, this.$r.value(heapIs
heap_{funcstart\_1032,1}.p2, 176).rem
[57.30] $heap<sub>1032,1;1054,8</sub> == $heap<sub>funcstart_1032,1</sub>._replace(this.$r \rightarrow
\textbf{this.\$r.value}(\textbf{heapIs}~\$ heap_{funcstart\_1032,1}).\_\textbf{replace}(p1 \rightarrow ((\text{-}2~*\text{div}(\textbf{heapIs}
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(\mathbf{heapIs} \ \$heap_{funcstart\_1032,1}, \ \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
\theta_{funcstart\_1032,1}.p1, 177).rem))))._replace(this.$r \rightarrow
\textbf{this.}\$r.\textbf{value}(\textbf{heapIs}~\$heap_{funcstart\_1032,1}).\_\textbf{replace}(p1 \rightarrow ((-2~*div(\textbf{heapIs})))))
\rho_{funcstart\_1032,1}, this.\r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(\mathbf{heapIs} \ \$heap_{funcstart\_1032,1}, \ \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
\rho_{funcstart\_1032,1}.p1, 177).rem)._replace(p2 \rightarrow asType<P2Type>(0 +
((-35 * div(\mathbf{heapIs} \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}))
\text{Sheap}_{funcstart_1032.1}, p2, 176).quot) + (172 * div(heapIs \text{Sheap}_{funcstart_1032.1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p2, 176).rem))))
\rightarrow [simplify]
[57.33] $\text{heap}_{1032,1;1054,8} == \text{$heap}_{funcstart\_1032,1}._\text{replace}(\text{this.}\text{$r} \to \text{$}
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs))
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs $heap_{funcstart\_1032,1}, this.$r.value(heapIs
\theta_{funcstart\_1032,1}.p1, 177).rem))))._replace(this.$r \rightarrow
this.$r.value(heapIs \rho_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.}\text{\$r.value}(\text{heapIs}))
\rho_{uncstart\_1032,1}.p1, 177).rem))._replace(p2 \rightarrow ((-35 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p2,
176).quot) + (172 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.} \text{\$r.value}(\text{heapIs}))
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heap_{funcstart_{-1032,1}}.p2, 176).rem)))
[Take goal term]
[1.0] ($heap<sub>1032.1:1054.8</sub>.b3 * static_cast<signed int>(div3.quot)) \leq
maxof(signed int)
\rightarrow [from term 57.33, $heap<sub>1032,1:1054,8</sub> is equal to
$heap_{funcstart\_1032,1}.$_replace(this.$r \rightarrow this.$r.value(heapIs)
heap_{funcstart\_1032.1}._replace(p1 \rightarrow ((-2 * div(heapIs $heap_{funcstart\_1032.1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177).quot) + (171)^3
div(\mathbf{heapIs} \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
heap_{funcstart\_1032,1}.p1, 177).rem))))._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\$heap_{funcstart\_1032,1}, \ \textbf{this}.\$r. \textbf{value(heapIs} \ \$heap_{funcstart\_1032,1}).p1,
 177).quot) + (171 * div(\mathbf{heapIs} \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}))
\rho_{funcstart\_1032.1}.p1, 177).rem))._replace\rho_{funcstart\_1032.1}.p1, 177).rem))
heap_{funcstart\_1032,1}, this.r.value(heapIs heap_{funcstart\_1032,1}).p2,
 176).quot) + (172 * div(\mathbf{heapIs} \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}))
heap_{funcstart_1032.1}.p2, 176).rem)))]
[1.1] \; (\$heap_{funcstart\_1032,1}. \_replace (this.\$r \rightarrow this.\$r. value (heapIs)) \; (\$heap_{funcstart\_1032,1}. \_replace (this.\$r)) \; (\$
\text{Sheap}_{funcstart=1032.1})._replace(p1 \rightarrow ((-2 * div(heapIs \text{Sheap}_{funcstart=1032.1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177).quot) + (171 *
div(\mathbf{heapIs} \$ heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
\theta_{funcstart\_1032,1}.p1, 177).rem))))._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.} \text{\$r.value}(\text{heapIs}))
\rho_{uncstart\_1032,1}.p1, 177).rem))._replace(p2 \rightarrow ((-35 * div(heapIs
\rho_{tuncstart\_1032.1}, this.r.value(heapIs \rho_{tuncstart\_1032.1}).p2,
176).quot) + (172 * \text{div}(\text{heapIs } \text{heap}_{funcstart\_1032,1}, \text{this.} \text{$r.value}(\text{heapIs}))
\theta_{funcstart\_1032,1}.p2, 176).rem))).b3 * static\_cast < signed
int > (div3.quot)) < maxof(signed int)
\rightarrow [const member of object with modified fields]
[1.3] (\theta_{1.3}) (\theta_{1.3})
maxof(signed int)
\rightarrow [const static or extern object]
[1.4] ($heap<sub>init</sub>.b3 * static_cast<signed int>(div3.quot)) < maxof(signed
int)
\rightarrow [expand definition of constant 'b3' at prang.cpp (41,26)]
[1.5] ((int)63 * static_cast<signed int>(div3.quot)) \le maxof(signed int)
\rightarrow [simplify]
[1.6] (63 * static_cast<signed int>(div3.quot)) \leq maxof(signed int)
```

```
\rightarrow [from term 34.6, div3 is equal to div(heapIs $heap_{funcstart_1032.1},
this.r.value(heapIs $heap_{funcstart\_1032,1}).p3, 178)]
[1.7] (63 * static_cast<signed int>(div(heapIs $heap_{tuncstart\_1032,1},
\mathbf{this.\$r.value}(\mathbf{heapIs}~\$ \mathrm{heap}_{funcstart\_1032,1}).\mathrm{p3},~178).\mathrm{quot})) \leq \mathbf{maxof}(\mathbf{signed})
int)
\rightarrow [simplify]
[1.18] -32768 < (-63 * div(heapIs $heap<sub>funcstart_1032,1</sub>, this.$r.value(heapIs)
heap_{funcstart_{-1032,1}}.p3, 178).quot
\rightarrow [literal comparison of product]
[1.19] ([-63 < 0]: (-32768 / 63) < -\text{div}(\mathbf{heapIs} \$ \text{heap}_{funcstart\_1032,1},
this.$r.value(heapIs heap_{funcstart\_1032,1}).p3, 178).quot, [0 < -63]: (-32768 /
-63) < \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.} \text{\$r.value}(\text{heapIs})
\text{Sheap}_{funcstart\_1032,1}).p3, 178).quot, [-63 == 0]: -32768 < 0)
→ [explicitly assert falsehood of skipped guards in subsequent guards]
[1.20] ([-63 < 0]: (-32768 / 63) < -\text{div}(\mathbf{heapIs} \$ \mathbf{heap}_{funcstart\_1032,1},
this.$r.value(heapIs heap_{funcstart\_1032,1}).p3, 178).quot, [(0 < -63) \land !(-63 <
0)]: (-32768 / -63) < \text{div}(\text{heapIs } \text{$heap}_{funcstart\_1032,1}, \text{this.}\text{$r.value}(\text{heapIs}))
\text{Sheap}_{funcstart\_1032,1}).p3, 178).quot, [(-63 == 0) \land!(-63 < 0) \land!(0 < -63)]:
-32768 < 0
\rightarrow [simplify]
[1.24]-521 < -{\rm div}(\mathbf{heapIs}\ \$\mathbf{heap}_{funcstart\_1032,1},\ \mathbf{this}.\$\mathbf{r}.\mathbf{value}(\mathbf{heapIs}
\theta_{funcstart_{1032,1}}.p3, 178).quot
→ [negate goal and search for contradiction]
[1.25]!(-521 < -\text{div}(\mathbf{heapIs} \$ \text{heap}_{funcstart\_1032,1}, \mathbf{this}.\$ r. \mathbf{value}(\mathbf{heapIs}))
heap_{funcstart\_1032,1}.p3, 178).quot
\rightarrow [simplify]
[1.28] 520 < div(heapIs heap_{funcstart\_1032,1}, this.r.value(heapIs)
heap_{funcstart\_1032,1}.p3, 178.quot
[Create new term from terms 1.28, 41.17 using rule: transitivity 16]
[77.0] (0 + 520) < (this.$r.value(heapIs $heap_{funcstart\_1032,1}).p3 / 178)
\rightarrow [simplify]
[77.8] 92737 < this.$r.value(heapIs \rho_{funcstart\_1032,1}).p3
[Assume known post-assertion, class invariant or type constraint for term 34.6]
[39.11] -30323 < -this.$r.value(heapIs $heap_{funcstart\_1032,1}).p3
\rightarrow [from term 77.8, literala < -this.$r.value(heapIs $heap_{funcstart\_1032,1}).p3
is false whenever -2 < (92737 + literala)
```

Proof of rule precondition:

```
[39.11.0] - 2 < (-30323 + 92737)
   \rightarrow [simplify]
   [39.11.2] true
[39.12] false
Proof of verification condition: Arithmetic result of operator '-' is within
limit of type 'signed int'
In the context of class: WHPrang, declared at:
C:\Escher\Customers\prang-cpp\prang.cpp (18,1)
Condition generated at: C:\Escher\Customers\prang-cpp\prang.cpp
(80,52)
Condition defined at:
To prove: minof(signed int) \leq (($heap_{1032,1;1054,8}.r3 *
static_cast<signed int>(div3.rem)) - ($heap<sub>1032.1:1054.8</sub>.b3 *
static_cast<signed int>(div3.quot)))
Given:
heap_{init}.LIMIT == (int)80
heap_{init}.class WHPrang \in M1 == (int)30269
heap_{init}.class WHPrang \in r1 == (int)171
heap_{init}.class WHPrang \in a1 == (int)177
heap_{init}.class WHPrang \in b1 == (int)2
heap_{init}.class WHPrang \in M2 == (int)30307
heap_{init}.class WHPrang \in r2 == (int)172
heap_{init}.class WHPrang \in a2 == (int)176
heap_{init}.class WHPrang \in b2 == (int)35
heap_{init}.class WHPrang \in M3 == (int)30323
heap_{init}.class WHPrang \in r3 == (int)170
heap_{init}.class WHPrang \in a3 == (int)178
heap_{init}.class WHPrang \in b3 == (int)63
\label{eq:div1} \text{div1} == \text{div}(\mathbf{heapIs} \ \$ \text{heap}_{funcstart\_1032,1},
\mathbf{static\_cast} {<} \mathbf{int} {>} (\mathbf{operator^*(heapIs}\ \$heap_{funcstart\_1032,1},\ \mathbf{this}).p1),
\mathbf{static\_cast} < \mathbf{int} > (\$ \mathbf{heap}_{funcstart\_1032,1}.\mathbf{a1}))
(asType<integer>(static_cast<int>(operator*(heapIs
```

 $asType < integer > (static_cast < int > (\$heap_{funcstart_1032.1}.a1))) = =$

 $heap_{funcstart_1032,1}, this).p1)$ /

asType<integer>(div1.quot)

```
(asType<integer>(static_cast<int>(operator*(heapIs
heap_{funcstart\_1032,1}, this).p1) %
asType < integer > (static\_cast < int > (\$heap_{funcstart\_1032.1}.a1))) = =
asType<integer>(div1.rem)
(asType<integer>(operator*(heapIs $heap_{funcstart\_1032.1}, this).p1) <
asType < integer > (\$heap_{funcstart\_1032,1}.a1)) = >
(\mathbf{asType} < \mathbf{integer} > (\mathbf{div1.rem}) = = \mathbf{asType} < \mathbf{integer} > (\mathbf{operator}^*(\mathbf{heapIs}))
heap_{funcstart\_1032,1}, this).p1)
(asType < integer > (\$heap_{funcstart\_1032,1}.a1) \le
asType < integer > (operator*(heapIs $heap_{funcstart\_1032,1}, this).p1)) =>
!(0 == asTvpe < integer > (div1.quot))
!(0 == asType < integer > (div1.rem)) || !(0 ==
asType<integer>(div1.quot))
div2 == div(\mathbf{heapIs} \$heap_{funcstart\_1032,1},
static_cast<int>(operator*(heapIs $heap_{funcstart\_1032.1}, this).p2),
\mathbf{static\_cast}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_1032,1}.\mathrm{a2}))
(asType<integer>(static_cast<int>(operator*(heapIs
heap_{funcstart\_1032.1}, this).p2)
asType < integer > (static\_cast < int > (\$heap_{funcstart\_1032.1}.a2))) = =
asType<integer>(div2.quot)
(asType<integer>(static_cast<int>(operator*(heapIs
heap_{funcstart\_1032,1}, this).p2) %
asType < integer > (static\_cast < int > (\$heap_{funcstart\_1032.1}.a2))) = =
asType<integer>(div2.rem)
(\mathbf{asType}{<}\mathbf{integer}{>}(\mathbf{operator}^*(\mathbf{heapIs}\ \$\mathbf{heap}_{funcstart\_1032,1},\ \mathbf{this}).\mathtt{p2}) <
asType < integer > (\$heap_{funcstart\_1032.1}.a2)) = >
(asType<integer>(div2.rem) == asType<integer>(operator*(heapIs
heap_{funcstart\_1032.1}, this).p2)
(\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathsf{heap}_{funcstart\_1032,1}.\mathsf{a2}) \leq
asType<integer>(operator*(heapIs $heap_funcstart_1032,1, this).p2)) =>
!(0 == asType < integer > (div2.quot))
!(0 == asType < integer > (div2.rem)) || !(0 ==
asType<integer>(div2.quot))
div3 == div(\mathbf{heapIs} \$heap_{funcstart\_1032,1},
static\_cast < int > (operator*(heapIs $heap_{funcstart\_1032,1}, this).p3),
static\_cast < int > (\$heap_{funcstart\_1032,1}.a3))
(asType < integer > (static\_cast < int > (operator*(heapIs)))
heap_{funcstart\_1032.1}, this).p3)
asType < integer > (static\_cast < int > (\$heap_{funcstart\_1032.1}.a3))) = =
asType<integer>(div3.quot)
(asType < integer > (static\_cast < int > (operator*(heapIs)))
```

```
heap_{funcstart=1032.1}, this).p3)
\mathbf{asType} < \mathbf{integer} > (\mathbf{static\_cast} < \mathbf{int} > (\$ \mathbf{heap}_{funcstart\_1032,1}.\mathbf{a3}))) = =
asType<integer>(div3.rem)
(\mathbf{asType}{<}\mathbf{integer}{>}(\mathbf{operator}^*(\mathbf{heapIs}\ \$\mathbf{heap}_{funcstart\_1032,1},\ \mathbf{this}).\mathrm{p3}) <
asType < integer > (\$heap_{funcstart\_1032,1}.a3)) = >
(asType<integer>(div3.rem) == asType<integer>(operator*(heapIs
heap_{funcstart\_1032,1}, this).p3)
(\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathsf{heap}_{funcstart\_1032,1}.\mathsf{a3}) \leq
asType < integer > (operator*(heapIs $heap_{funcstart\_1032,1}, this).p3)) = > 
!(0 == asType < integer > (div3.quot))
!(0 == asType < integer > (div3.rem)) || !(0 ==
asType<integer>(div3.quot))
temp1 == (\$heap_{funcstart\_1032,1}.r1 * \textbf{static\_cast} < \textbf{signed int} > (div1.rem)) -
(\text{sheap}_{funcstart\_1032.1}.\text{b1} * \text{static\_cast} < \text{signed int} > (\text{div1.quot}))
minof(signed int) < temp1
temp1 \le maxof(signed int)
heap_{1032,1;1051,8} == heap_{funcstart\_1032,1}._replace(this.$r \rightarrow
operator*(heapIs heap_{funcstart\_1032,1}, this)._replace(p1 \rightarrow
asType < P1Type > ((\$heap_{funcstart\_1032,1}.M1 *
asType < int > (static\_cast < integer > (static\_cast < signed
int>(operator^*(heapIs \$heap_{funcstart\_1032,1}, this).p1) < (int)0))) +
temp1)))
temp2 == (\$heap_{1032,1;1051,8}.r2 * \textbf{static\_cast} < \textbf{signed int} > (div2.rem)) -
(\text{sheap}_{1032.1:1051.8}.\text{b2} * \text{static\_cast} < \text{signed int} > (\text{div2.quot}))
minof(signed int) \le temp2
temp2 < maxof(signed int)
heap_{1032,1;1054,8} == heap_{1032,1;1051,8}._replace(this.$r \rightarrow
operator*(heapIs \theta_{1032,1;1051,8}, this)._replace(p2 \rightarrow
asType<P2Type>(($heap<sub>1032,1:1051,8</sub>.M2 *
asType<int>(static_cast<integer>(static_cast<signed
int>(operator^*(heapIs $heap_{1032,1;1051,8}, this).p2) < (int)(0))) + temp(2)))
Proof:
[Take given term]
[2.0] \operatorname{div1} == \operatorname{div}(\mathbf{heapIs} \ \text{$heap}_{funcstart\_1032,1},
static_cast<int>(operator*(heapIs $heap_{funcstart\_1032.1}, this).p1),
\mathbf{static\_cast}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_1032,1}.\mathrm{a1}))
→ [expand definition of operator '*' in class 'pointer' at built in declaration]
[2.1] \operatorname{div1} == \operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_1032,1},
\mathbf{static\_cast} < \mathbf{int} > (\mathbf{this.\$r.value}(\mathbf{heapIs} \ \$ \mathbf{heap}_{funcstart\_1032,1}).\mathbf{p1}),
```

```
static\_cast < int > (\$heap_{funcstart\_1032.1}.a1))
\rightarrow [simplify]
[2.2] \operatorname{div1} == \operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_1032,1}, \mathbf{this.}\$ r.\mathbf{value}(\mathbf{heapIs})
\theta_{funcstart\_1032,1}.p1, \theta_{funcstart\_1032,1}.p1, \theta_{funcstart\_1032,1}.a1))
\rightarrow [const static or extern object]
[2.3] \operatorname{div1} == \operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_1032,1}, \mathbf{this.}\$ r. \mathbf{value}(\mathbf{heapIs})
\theta_{funcstart\_1032,1}.p1, \theta_{funcstart\_1032,1}.p1, \theta_{funcstart\_1032,1}.p1, \theta_{funcstart\_1032,1}.p1
\rightarrow [expand definition of constant 'a1' at prang.cpp (30,26)]
[2.4] \text{ div1} == \text{div}(\text{heapIs } \text{heap}_{funcstart\_1032,1}, \text{this.}\text{\$r.value}(\text{heapIs})
\theta_{tuncstart\_1032.1}.p1, \theta_{tuncstart\_1032.1}.p1, \theta_{tuncstart\_1032.1}.p1, \theta_{tuncstart\_1032.1}.p1, \theta_{tuncstart\_1032.1}.p1, \theta_{tuncstart\_1032.1}.p1, \theta_{tuncstart\_1032.1}.p2, \theta_{tuncstart\_1032.1}.p2, \theta_{tuncstart\_1032.1}.p2, \theta_{tuncstart\_1032.1}.p2, \theta_{tuncstart\_1032.1}.p2, \theta_{tuncstart\_1032.1}.p3, \theta_{tuncstart\_1032.1}.p2, \theta_{tuncstart\_1032.1}.p3, \theta_{tuncstart\_1032.1}.p4, \theta_{tuncstart\_1032.1}.p3, \theta_{tuncstart\_1032.1}.p4, \theta_{tuncstart\_1032.1}.p5, \theta_{tuncstart\_1032.1}.p5, \theta_{tuncstart\_1032.1}.p6, \theta_{tuncstart\_1032.1}.p7, \theta_{tuncstart\_1032.1
\rightarrow [simplify]
 [2.6] \operatorname{div1} == \operatorname{div}(\mathbf{heapIs} \ \mathbf{heap}_{funcstart\_1032,1}, \mathbf{this}.\mathbf{r.value}(\mathbf{heapIs})
heap_{funcstart_{-1032,1}}.p1, 177
[Assume known post-assertion, class invariant or type constraint for term 2.6]
[7.0] (0 < asType<integer>(this.$r.value(heapIs)
\label{eq:continuous} $\operatorname{heap}_{funcstart\_1032,1}).p1)) \&\& (\mathbf{asType} < \mathbf{integer} > (\mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}))) \&\& (\mathbf{asType} < \mathbf{integer} > (\mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})))) \&\& (\mathbf{asType} < \mathbf{integer} > (\mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}))))) \&\& (\mathbf{asType} < \mathbf{integer} > (\mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}))))
\text{Sheap}_{funcstart\_1032,1}).\text{p1} < \text{asType} < \text{integer} > (\text{Sheap.class WHPrang} \in
M1))
\rightarrow [simplify]
[7.2] (0 < this.$r.value(heap
Is $heap_{funcstart\_1032,1}).p1) &&
(this.$r.value(heap
Is \rho_{funcstart\_1032,1}).p1 <
asType < integer > (\$heap.class WHPrang \in M1))
\rightarrow [const static or extern object]
[7.3] (0 < this.$r.value(heapIs \rho_{funcstart\_1032,1}).p1) &&
(this.$r.value(heap
Is \theta_{funcstart\_1032,1}).p1 <
asType < integer > (\$heap_{init}.class WHPrang \in M1))
\rightarrow [expand definition of constant 'M1' at prang.cpp (28,26)]
[7.4] (0 < this.$r.value(heapIs \rho_{funcstart\_1032,1}).p1) &&
(this.$r.value(heapIs \theta_{funcstart\_1032,1}).p1 <
asType < integer > ((int)30269))
\rightarrow [simplify]
[7.10] (-30269 < -this.$r.value(heapIs heapIs = f_{uncstart\_1032,1}).p1) <math>\land (0 < f_{uncstart\_1032,1}).p1)
\textbf{this.\$r.value}(\textbf{heapIs}~\$\text{heap}_{funcstart\_1032,1}).\text{p1})
[Work on sub-term 2 of conjunction in term 7.10]
[8.0] 0 < this.$r.value(heapIs $heap<sub>funcstart_1032,1</sub>).p1
[Take given term]
```

```
[18.0] \ \mathrm{div2} == \ \mathrm{div}(\mathbf{heapIs} \ \$ \mathrm{heap}_{funcstart\_1032,1},
\mathbf{static\_cast} < \mathbf{int} > (\mathbf{operator}^*(\mathbf{heapIs} \ \$ \mathbf{heap}_{funcstart\_1032,1}, \ \mathbf{this}).\mathbf{p2}),
\mathbf{static\_cast}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_1032,1}.\mathrm{a2}))
→ [expand definition of operator '*' in class 'pointer' at built in declaration]
[18.1] \operatorname{div2} == \operatorname{div}(\mathbf{heapIs} \ \text{$heap}_{funcstart\_1032,1},
static\_cast < int > (this. r.value(heapIs  heap_{funcstart\_1032,1}).p2),
\mathbf{static\_cast}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_1032,1}.\mathrm{a2}))
\rightarrow [simplify]
[18.2] div2 == div(\mathbf{heapIs} \$ \mathbf{heap}_{funcstart\_1032,1}, \mathbf{this}.\$ \mathbf{r.value}(\mathbf{heapIs})
\label{eq:cast_int} $$ \theta_{funcstart\_1032,1}.p2, \ \mathbf{static\_cast} < \mathbf{int} > (\$ \theta_{funcstart\_1032,1}.a2))$$
\rightarrow [const static or extern object]
[18.3] div2 == div(\mathbf{heapIs} \$ \mathbf{heap}_{funcstart\_1032,1}, \mathbf{this}.\$ \mathbf{r.value}(\mathbf{heapIs})
\label{eq:cast_int} $$ \rho_{funcstart\_1032,1}.p2, \ \textbf{static\_cast} < \textbf{int} > ($$ \rho_{init}.a2)) $$
\rightarrow [expand definition of constant 'a2' at prang.cpp (35,26)]
[18.4] div2 == div(heapIs $heap_{tuncstart\_1032.1}, this.$r.value(heapIs)
\theta_{funcstart\_1032,1}.p2, \theta_{funcstart}
\rightarrow [simplify]
[18.6] \text{ div2} == \text{div}(\mathbf{heapIs} \$ \mathbf{heap}_{funcstart\_1032,1}, \mathbf{this.\$r.value}(\mathbf{heapIs}))
heap_{funcstart_{1032,1}}.p2, 176
[Assume known post-assertion, class invariant or type constraint for term 18.6]
[23.0] (0 < asType<integer>(this.$r.value(heapIs
$heap_funcstart_1032.1).p2)) && (asType<integer>(this.$r.value(heapIs
\$heap_{funcstart\_1032,1}).p2) < \mathbf{asType} < \mathbf{integer} > (\$heap.\mathbf{class} \ WHPrang \in \texttt{Constart} = \texttt{Constart} =
M2))
\rightarrow [simplify]
[23.2] (0 < this.$r.value(heap
Is $heap_{funcstart\_1032,1}).p2) &&
(this.$r.value(heapIs \rho_{funcstart\_1032,1}).p2 <
asType < integer > (\text{$heap.class WHPrang} \in M2))
\rightarrow [const static or extern object]
[23.3] (0 < this.$r.value(heap
Is \rho_{uncstart\_1032,1}).p2) &&
(this.$r.value(heapIs heap_{funcstart\_1032,1}).p2 <
asType < integer > (\$heap_{init}.class WHPrang \in M2))
\rightarrow [expand definition of constant 'M2' at prang.cpp (33,26)]
[23.4] (0 < this.$r.value(heap
Is \rho_{uncstart\_1032,1}).p2) &&
(this.r.value(heapIs $heap_{funcstart\_1032,1}).p2 <
asType < integer > ((int)30307))
\rightarrow [simplify]
```

```
this.r.value(heapIs $heap_{funcstart\_1032,1}).p2)
[Work on sub-term 2 of conjunction in term 23.10]
[24.0] 0 < this.$r.value(heapIs $heap_{funcstart\_1032,1}).p2
[Take given term]
[34.0] div3 == div(heapIs heap_{funcstart\_1032,1},
static_cast<int>(operator*(heapIs $heap_{funcstart\_1032,1}, this).p3),
\mathbf{static\_cast} {<} \mathbf{int} {>} (\$ \mathbf{heap}_{funcstart\_1032,1}.\mathbf{a3}))
→ [expand definition of operator '*' in class 'pointer' at built in declaration]
[34.1] \text{ div3} == \text{div}(\mathbf{heapIs} \$ heap_{funcstart\_1032,1},
static\_cast < int > (this. r.value(heapIs $heap_{funcstart\_1032,1}).p3),
static\_cast < int > (\$heap_{funcstart\_1032.1}.a3))
\rightarrow [simplify]
[34.2] div3 == div(heapIs heapIs  heap_{funcstart\_1032,1}, this.r.value(heapIs)
\rho_{tuncstart_1032.1}, p3, static_cast<int>(\rho_{tuncstart_1032.1})
\rightarrow [const static or extern object]
[34.3] \text{div3} == \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.} \text{\$r.value}(\text{heapIs})
\theta_{funcstart\_1032,1}.p3, \theta_{funcstart\_1032,1}.p4, \theta_{funcstart\_1032,1}.p4, \theta_{funcstart\_1032,1}.p4, \theta_{funcstart\_1032,1}.p4, \theta_{funcstart\_1032,1}.p5, \theta_{funcstart\_1032,1}.p5, \theta_{funcstart\_1032,1}.p5, \theta_{funcstart\_1032,1}.p5, \theta_{funcstart\_1032,1}.p5, \theta_{funcstart\_1032,1}.p5, \theta_{funcstart\_1032,1}.p5, \theta_{funcstart\_1032,1
\rightarrow [expand definition of constant 'a3' at prang.cpp (40,26)]
[34.4] \text{ div3} == \text{div(heapIs $heap}_{funcstart\_1032,1}, \text{ this.} \$r. value(heapIs)
\theta_{funcstart\_1032,1}.p3, \theta_{funcstart\_1032,1}.p3, \theta_{funcstart\_1032,1}.p3
\rightarrow [simplify]
[34.6]~{\rm div3} == {\rm div(heapIs~\$heap}_{funcstart\_1032,1},\, {\bf this.\$r.value(heapIs}
heap_{funcstart_{-1032,1}}.p3, 178
[Assume known post-assertion, class invariant or type constraint for term 34.6]
[39.0] (0 < asType<integer>(this.$r.value(heapIs
\label{eq:continuous} $\operatorname{heap}_{funcstart\_1032,1}).p3)) \&\& (\mathbf{asType}{<}\mathbf{integer}{>} (\mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})) \&\& (\mathbf{asType}{<}\mathbf{integer}{>} (\mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}))) \&\& (\mathbf{asType}{<}\mathbf{integer}{>} (\mathbf{heapIs})) \&\& (\mathbf{asType}{<}\mathbf{
\theta_{funcstart\_1032,1}.p3 < asType<integer>(\theta_{funcstart\_1032,1}.p3) < asType<integer>(\theta_{funcstart\_1032,1}.p3)
M3))
\rightarrow [simplify]
[39.2] (0 < this.\$r.value(heapIs \$heap_{tuncstart_1032.1}).p3) &&
(this.r.value(heapIs $heap_{funcstart\_1032,1}).p3 <
asType < integer > (\text{heap.class WHPrang} \in M3))
\rightarrow [const static or extern object]
[39.3] (0 < this.\$r.value(heapIs \$heap_{funcstart_{-1032,1}}).p3) &&
(this.r.value(heapIs $heap_{funcstart\_1032,1}).p3 <
asType < integer > (\$heap_{init}.class WHPrang \in M3))
```

```
\rightarrow [expand definition of constant 'M3' at prang.cpp (38,26)]
[39.4] (0 < this.$r.value(heap
Is $heap_{funcstart\_1032,1}).p3) &&
(this.$r.value(heapIs \theta_{funcstart\_1032,1}).p3 <
asType < integer > ((int)30323))
\rightarrow [simplify]
[39.10] (-30323 < -this.$r.value(heapIs \rho_{funcstart\_1032,1}).p3) \wedge (0 <
this.r.value(heapIs $heap_{funcstart\_1032,1}).p3)
\rightarrow [separate conjunction and work on first sub-term]
\lceil 39.11 \rceil -30323 < -this.$r.value(heapIs \rho_{funcstart\_1032,1}).p3
[Work on sub-term 2 of conjunction in term 39.10]
\textit{[40.0] 0} < \textbf{this.\$r.value(heapIs \$heap}_{funcstart\_1032,1}).p3
[Assume known post-assertion, class invariant or type constraint for term 34.6]
[41.0] (asType<integer>(this.r.value(heapIs \ heap_{funcstart\_1032,1}).p3) /
asType<integer>(178)) == asType<integer>(div(heapIs
\rho_{funcstart\_1032,1}, this. r.value(heapIs \rho_{funcstart\_1032,1}).p3,
178).quot)
\rightarrow [simplify]
[41.2] (this.$r.value(heapIs $heap_{funcstart_1032.1}).p3 / 178) ==
\mathbf{asType} {<} \mathbf{integer} {>} ( \mathbf{div} (\mathbf{heapIs} \ \$ \mathbf{heap}_{funcstart\_1032,1}, \ \mathbf{this}.\$ \mathbf{r.value} (\mathbf{heapIs} \ \mathbf{heapIs}) )
heap_{funcstart_{1032,1}}.p3, 178).quot
→ [expand definition of operator './' in class 'int' at built in declaration]
[41.3] \; ([\mathbf{asType} < \mathbf{integer} > (\mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs} \; \$ \mathbf{heap}_{funcstart\_1032,1}).\mathbf{p3}) < \mathbf{page}) \\
0]: -(-asType < integer > (this. r.value(heapIs  heap_{funcstart\_1032,1}).p3) / (this. r.value(heapIs  heap_{funcstart\_1032,1}).p3)
178), []: asType<integer>(this.$r.value(heapIs $heap_{tuncstart\_1032.1}).p3) /
178) == asType<integer>(div(heapIs heap_{funcstart\_1032,1},
\mathbf{this.\$r.value}(\mathbf{heapIs}~\$\mathbf{heap}_{funcstart\_1032,1}).\mathbf{p3},~178).\mathbf{quot})
→ [explicitly assert falsehood of skipped guards in subsequent guards]
[41.4] \; ([\mathbf{asType} < \mathbf{integer} > (\mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs} \; \$ \mathbf{heap}_{funcstart\_1032,1}).\mathbf{p3}) < \mathbf{page}) \\
0]: -(-asType < integer > (this. r.value(heapIs <math>heap_{funcstart\_1032,1}).p3) /
178), [!(asType<integer>(this.$r.value(heapIs \rho_{tart_1032,1}).p3) <
0)]: asType<integer>(this.$r.value(heapIs $heap_{funcstart\_1032.1}).p3) /
178) == asType < integer > (div(heapIs \$heap_{funcstart\_1032,1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p3, 178).quot)
\rightarrow [simplify]
\label{eq:continuous} \textit{[41.7] ([0 < -this.\$r.value(heapIs \$heap_{funcstart\_1032,1}).p3]:}
-(-asType < integer > (this. r.value(heapIs  heap_{funcstart\_1032,1}).p3) /
178), [!(asType<integer>(this.r.value(heapIs \heap_{funcstart\_1032,1}).p3) <
0)]: asType < integer > (this. r.value(heapIs <math>heapIs heap_{funcstart\_1032,1}).p3) / (this. r.value(heapIs heapIs heapI
```

```
178) == asType < integer > (div(heapIs $heap_{funcstart\_1032,1},
\mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}~\$\mathrm{heap}_{funcstart\_1032,1}).\mathrm{p3},~178).\mathrm{quot})
\rightarrow [from term 40.0, literala < -this.$r.value(heapIs $heap_{funcstart\_1032.1}).p3
is false whenever -2 < (0 + literala)
       Proof of rule precondition:
       [41.7.0] - 2 < (0 + 0)
       \rightarrow [simplify]
       [41.7.2] true
[41.8] ([false]: -(-asType<integer>(this.$r.value(heapIs
\rho_{uncstart\_1032,1}.p3) / 178, [!(asType<integer>(this.$r.value(heapIs)
\verb§heap$_{funcstart\_1032,1}).p3) < 0)]: \textbf{ asType} < \textbf{integer} > (\textbf{this}.\$r.\textbf{value}(\textbf{heapIs})))
\theta_{funcstart\_1032.1}.p3) / 178) == asType<integer>(div(heapIs
\rho_{tuncstart\_1032.1}, this.r.value(heapIs \rho_{tuncstart\_1032.1}).p3,
178).quot)
\rightarrow [simplify]
[41.11] ([false]: -(-asType<integer>(this.$r.value(heapIs
\rho_{funcstart\_1032,1}.p3) / 178, [!\rho_{funcstart\_1032,1}.p3] / 178, [!\rho_{funcstart\_1032,1}.p3]
\rho_{uncstart\_1032,1}.p3): asType<integer>(this.$r.value(heapIs)
\theta_{funcstart\_1032,1}.p3) / 178 = asType < integer > (div(heapIs)) / 178 = as
\rho_{funcstart\_1032,1}, this.\r.value(heapIs \rho_{funcstart\_1032,1}).p3,
178).quot)
\rightarrow [from term 40.0, literala < -this.$r.value(heapIs $heap_{funcstart\_1032,1}).p3
is false whenever -2 < (0 + literala)
       Proof of rule precondition:
       [41.11.0] - 2 < (0 + 0)
       \rightarrow [simplify]
       [41.11.2] true
[41.12] ([false]: -(-asType<integer>(this.$r.value(heapIs
heap_{funcstart_{1032,1}}.p3) / 178, [!false]:
asType<integer>(this.$r.value(heapIs $heap_funcstart_1032,1).p3) / 178)
== asType < integer > (div(heapIs $heap_{funcstart\_1032,1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p3, 178).quot)
\rightarrow [simplify]
[41.17] 0 == (-\text{div}(\mathbf{heapIs} \$ \text{heap}_{funcstart\_1032,1}, \mathbf{this}.\$ r.\mathbf{value}(\mathbf{heapIs}))
\theta_{tuncstart_{-1032,1}}.p3, 178.quot + (this.r.value(heapIs)
heap_{funcstart\_1032,1}.p3 / 178)
[Assume known post-assertion, class invariant or type constraint for term 34.6]
[42.0] (asType<integer>(this.$r.value(heapIs $heap_{tuncstart_1032.1}).p3) %
```

```
asType<integer>(178)) == asType<integer>(div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p3,
178).rem)
\rightarrow [simplify]
[42.2] (this.$r.value(heapIs heap_{funcstart\_1032,1}).p3 % 178) ==
asType<integer>(div(heapIs $heap_{funcstart\_1032,1}, this.$r.value(heapIs
heap_{funcstart\_1032,1}.p3, 178).rem
→ [expand definition of operator '.%' in class 'int' at built in declaration]
\textit{[42.3]} \; ([\textbf{asType} < \textbf{integer} > (\textbf{this}.\$r.\textbf{value}(\textbf{heapIs} \; \$ heap_{funcstart\_1032,1}).p3) < \texttt{(asType} < \textbf{integer} > (\textbf{this}.\$r.\textbf{value}(\textbf{heapIs} \; \$ heap_{funcstart\_1032,1}).p3)) < \texttt{(asType} < \textbf{(integer)} > (\textbf{integer}) < \texttt{(integer)} > (\textbf{integer)} > (\textbf{integer}) < \texttt{(integer)} > (\textbf{integer)} > (\textbf{integer}) < \texttt{(integer)} > (\textbf{integer}) < \texttt{(integer)} > (\textbf{integer}) < \texttt{(
0]: -(-asType < integer > (this.\$r.value(heapIs \$heap_{funcstart\_1032,1}).p3) \%
178), []: asType<integer>(this.$r.value(heapIs $heap_{tuncstart\_1032.1}).p3)
\% 178) == asType<integer>(div(heapIs $heap_{tuncstart\_1032.1},
this.$r.value(heapIs heap_{funcstart\_1032,1}).p3, 178).rem)
→ [explicitly assert falsehood of skipped guards in subsequent guards]
{\it [42.4]}\;([{\bf asType}{<}{\bf integer}{>}({\bf this.\$r.value}({\bf heapIs}\;\${\bf heap}_{funcstart\_1032,1}).{\bf p3})<
0]: -(-asType < integer > (this. r.value(heapIs  heap_{funcstart\_1032,1}).p3) %
178), [!(asType<integer>(this.r.value(heapIs \heap_{funcstart\_1032,1}).p3) <
0)]: asType<integer>(this.$r.value(heapIs \rho_{uncstart\_1032,1}).p3) %
178) == asType<integer>(div(heapIs heap_{funcstart\_1032,1},
this.r.value(heapIs $heap_{funcstart\_1032,1}).p3, 178).rem)
\rightarrow [simplify]
[42.7] ([0 < -this.$r.value(heapIs $heap<sub>funcstart_1032,1</sub>).p3]:
-(-asType < integer > (this. r.value(heapIs  heap_{funcstart\_1032,1}).p3) \%
0)]: asType<integer>(this.$r.value(heapIs \rho_{uncstart\_1032,1}).p3) %
178) == asType<integer>(div(heapIs heap_{funcstart\_1032,1}),
this.r.value(heapIs $heap_{funcstart\_1032,1}).p3, 178).rem)
\rightarrow [from term 40.0, literala < -this.$r.value(heapIs $heap_{funcstart\_1032,1}).p3
is false whenever -2 < (0 + literala)
           Proof of rule precondition:
           [42.7.0] - 2 < (0 + 0)
           \rightarrow [simplify]
           [42.7.2] true
[42.8] ([false]: -(-asType<integer>(this.$r.value(heapIs
\rho_{tuncstart\_1032.1},p3) % 178), [!(asType<integer>(this.$r.value(heapIs)
\theta_{uncstart_{1032,1}}.p3 < 0: asType<integer>(this.$r.value(heapIs)
\label{eq:heapfuncstart_1032,1} \$ heap_{funcstart\_1032,1}).p3) \% \ 178) == \mathbf{asType} < \mathbf{integer} > (\mathrm{div}(\mathbf{heapIs})) < \mathrm{div}(\mathbf{heapIs}) < \mathrm{
\rho_{tuncstart_1032.1}, this.r.value(heapIs \rho_{tuncstart_1032.1}).p3,
178).rem)
```

```
\rightarrow [simplify]
[42.11] ([false]: -(-asType<integer>(this.$r.value(heapIs
heap_{funcstart_1032,1}.p3) \% 178, [!(0 < -this.$r.value(heapIs)
\label{eq:continuous} $\operatorname{heap}_{funcstart\_1032,1}).p3)]: \ \mathbf{asType} < \mathbf{integer} > (\mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})).p3) = \mathbf{asType} < \mathbf{integer} > (\mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})).p3) = \mathbf{asType} < \mathbf{asType}
\theta_{funcstart\_1032.1}.p3) % 178) == asType<integer>(div(heapIs)
\rho_{tuncstart\_1032.1}, this.r.value(heapIs \rho_{tuncstart\_1032.1}).p3,
178).rem)
\rightarrow [from term 40.0, literala < -this.$r.value(heapIs $heap_{funcstart = 1032.1}).p3
is false whenever -2 < (0 + literala)
        Proof of rule precondition:
        [42.11.0] - 2 < (0 + 0)
        \rightarrow [simplify]
        [42.11.2] true
[42.12] ([false]: -(-asType < integer > (this. r.value(heapIs))
heap_{funcstart\_1032,1}.p3) \% 178, [!false]:
asType<integer>(this.$r.value(heapIs $heap_{funcstart\_1032,1}).p3) % 178)
== asType < integer > (div(heapIs $heap_{funcstart\_1032,1},
this.r.value(heapIs $heap_{funcstart\_1032,1}).p3, 178).rem)
\rightarrow [simplify]
[42.17] 0 == (-\text{div}(\mathbf{heapIs} \$ \text{heap}_{funcstart\_1032,1}, \mathbf{this}.\$ \mathbf{r.value}(\mathbf{heapIs}))
\$heap_{funcstart\_1032,1}).p3,\ 178).rem + (\textbf{this}.\$r.\textbf{value}(\textbf{heapIs}
heap_{funcstart\_1032,1}.p3 \% 178)
[Take given term]
[50.0]\;((\$heap_{funcstart\_1032,1}.r1\;*\;\textbf{static\_cast}{<}\textbf{signed int}{>}(\text{div}1.rem))\;-
(\text{sheap}_{funcstart\_1032,1}.\text{b1} * \text{static\_cast} < \text{signed int} > (\text{div1.quot}))) == \text{temp1}
\rightarrow [const static or extern object]
[50.1] (($heap<sub>init</sub>.r1 * static_cast<signed int>(div1.rem)) -
(\text{sheap}_{funcstart\_1032,1}.\text{b1} * \text{static\_cast} < \text{signed int} > (\text{div1.quot}))) == \text{temp1}
\rightarrow [expand definition of constant 'r1' at prang.cpp (29,26)]
[50.2] (((int)171 * static_cast<signed int>(div1.rem)) -
($heap_tuncstart_1032.1.b1 * static_cast<signed int>(div1.quot))) == temp1
\rightarrow [simplify]
[50.3] ((171 * static_cast < signed int > (div1.rem)) - ($heap_{funcstart\_1032.1}.b1
* static_cast<signed int>(div1.quot))) == temp1
\rightarrow [from term 2.6, div1 is equal to div(heapIs $heap_{funcstart\_1032,1},
this.r.value(heapIs $heap_{funcstart\_1032,1}).p1, 177)
[50.4] ((171 * static_cast<signed int>(div(heapIs $heap_{funcstart\_1032,1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177).rem)) -
```

```
(\text{sheap}_{funcstart\_1032,1}.\text{b1 * static\_cast} < \text{signed int} > (\text{div1.quot}))) == \text{temp1}
\rightarrow [simplify]
[50.5] ((171 * div(heapIs $heap_{funcstart\_1032,1}, this.$r.value(heapIs)
\text{Sheap}_{funcstart\_1032,1}.p1, 177).rem) - (\text{Sheap}_{funcstart\_1032,1}.b1 *
static_cast<signed int>(div1.quot))) == temp1
\rightarrow [const static or extern object]
[50.6] ((171 * div(heapIs $heap<sub>funcstart_1032,1</sub>, this.$r.value(heapIs)
\rho_{uncstart\_1032.1}.p1, 177.rem) - (\rho_{uncstart\_1032.1}).p1, 177.rem) - (\rho_{uncstart\_1032.1}).p1, 177.rem)
int>(div1.quot)) == temp1
\rightarrow [expand definition of constant 'b1' at prang.cpp (31,26)]
[50.7] ((171 * div(heapIs $heap<sub>funcstart_1032,1</sub>, this.$r.value(heapIs)
\theta_{funcstart\_1032.1}.p1, 177).rem) - ((int)2 * static_cast<signed)
int>(div1.quot)) == temp1
\rightarrow [simplify]
[50.8] ((171 * div(heapIs $heap<sub>funcstart_1032.1</sub>, this.$r.value(heapIs
\theta_{tuncstart\_1032.1}.p1, 177).rem) - (2 * static_cast<signed)
int>(div1.quot)) = temp1
\rightarrow [from term 2.6, div1 is equal to div(heapIs $heap_{funcstart\_1032,1},
\mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}~\$heap_{funcstart\_1032,1}).p1,~177)]
[50.9] ((171 * div(heapIs $heap_{funcstart\_1032,1}, this.$r.value(heapIs)
\theta_{funcstart\_1032.1}.p1, 177).rem) - (2 * static_cast<signed)
\mathbf{int}{>}(\mathrm{div}(\mathbf{heapIs}\ \$\mathrm{heap}_{funcstart\_1032,1},\ \mathbf{this}.\$\mathrm{r.value}(\mathbf{heapIs}
\theta_{funcstart\_1032,1}.p1, 177).quot))) == temp1
\rightarrow [simplify]
[50.14] 0 == (-\text{temp1} + (-2 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1},
this.r.value(heapIs \ensuremath{\$}heap_{funcstart\_1032,1}).p1, 177).quot) + (171 *
div(\mathbf{heapIs} \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
heap_{funcstart\_1032,1}.p1, 177).rem))
[Take given term]
[53.0] heap_{1032,1;1051,8} == heap_{funcstart\_1032,1}._replace(this.$r \rightarrow
operator*(heapIs heap_{funcstart\_1032,1}, this)._replace(p1 \rightarrow
asType<P1Type>(($heap_tuncstart_1032,1.M1 *
asType < int > (static\_cast < integer > (static\_cast < signed)
int>(operator*(heapIs $heap_{funcstart\_1032,1}, this).p1) < (int)0))) +
temp1)))
→ [expand definition of operator '*' in class 'pointer' at built in declaration]
[53.1] $\text{heap}_{1032.1:1051.8} == $\text{heap}_{funcstart\_1032.1}._\text{replace}(\text{this}.\text{$\frac{1}{2}r$})
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow
\mathbf{asType}{<}\mathrm{P1Type}{>}((\$\mathrm{heap}_{funcstart\_1032,1}.\mathrm{M1}~*
```

```
asType<int>(static_cast<integer>(static_cast<signed
int>(operator^*(heapIs \$heap_{funcstart\_1032,1}, this).p1) < (int)0))) +
temp1)))
\rightarrow [const static or extern object]
[53.2] heap_{1032,1;1051,8} == heap_{funcstart\_1032,1}._replace(this.r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow
asType<P1Type>(($heap<sub>init</sub>.M1 '
asType{<}int{>}(static\_cast{<}integer{>}(static\_cast{<}signed
int>(operator^*(heapIs \$heap_{funcstart\_1032,1}, this).p1) < (int)0))) +
temp1)))
\rightarrow [expand definition of constant 'M1' at prang.cpp (28,26)]
[53.3] heap_{1032,1;1051,8} == heap_{funcstart\_1032,1}._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow
asType<P1Type>(((int)30269 *
as Type < int > (static\_cast < integer > (static\_cast < signed))
int>(operator^*(heapIs $heap_{funcstart\_1032,1}, this).p1) < (int)0))) +
temp1)))
\rightarrow [simplify]
[53.4] heap_{1032,1;1051,8} == heap_{funcstart\_1032,1}.\_replace(this.\$r \rightarrow this)
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow
asType<P1Type>((30269 *
asType<int>(static_cast<integer>(static_cast<signed
int>(operator^*(heapIs \$heap_{funcstart\_1032,1}, this).p1) < (int)0))) +
temp1)))
→ [expand definition of operator '*' in class 'pointer' at built in declaration]
[53.5] $\text{heap}_{1032,1:1051,8} == \text{$heap}_{funcstart\_1032,1}.$\_\text{replace}(\text{this}.\text{$r} \to \text{$}
this.r.value(heapIs \ heap_{funcstart\_1032,1}).\_replace(p1 \rightarrow
asType<P1Type>((30269 *
as Type < int > (static\_cast < integer > (static\_cast < signed))
int>(this.\$r.value(heapIs \$heap_{funcstart\_1032,1}).p1) < (int)0))) + temp1)))
\rightarrow [simplify]
[53.9] heap_{1032,1;1051,8} == heap_{funcstart\_1032,1}._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow
asType<P1Type>((30269 * asType<int>(static_cast<integer>(0 <
-\mathbf{this.\$r.value}(\mathbf{heapIs}\ \$\mathbf{heap}_{funcstart\_1032,1}).\mathbf{p1}))) + \mathbf{temp1})))
\rightarrow [from term 8.0, literala < -this.$r.value(heapIs $heap_{funcstart\_1032,1}).p1
is false whenever -2 < (0 + literala)
   Proof of rule precondition:
   [53.9.0] - 2 < (0 + 0)
   \rightarrow [simplify]
```

```
[53.9.2] true
[53.10] $heap<sub>1032,1;1051,8</sub> == $heap<sub>funcstart_1032,1</sub>._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow
asType<P1Type>((30269 * asType<int>(static_cast<integer>(false)))
+ temp1)))
\rightarrow [simplify]
[53.11] \theta_{1032,1;1051,8} == \theta_{1032,1;1051,8} == \theta_{1032,1}._replace(this.$r \to
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow
asType < P1Type > ((30269 * asType < int > (([false]: 1, []: 0))) + temp1)))
→ [explicitly assert falsehood of skipped guards in subsequent guards]
[53.12] $\text{heap}_{1032,1;1051,8} == $\text{heap}_{funcstart\_1032,1}._\text{replace}(\text{this}.\text{$\frac{1}{2}r$})
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow
asType<P1Type>((30269 * asType<int>(([false]: 1, [true]: 0))) +
temp1)))
\rightarrow [simplify]
[53.15] $heap<sub>1032,1;1051,8</sub> == $heap<sub>funcstart_1032,1</sub>._replace(this.$r \rightarrow
\mathbf{this.\$r.value}(\mathbf{heapIs}\ \$\mathbf{heap}_{funcstart\_1032,1}).\_\mathbf{replace}(\mathbf{p1} \to \mathbf{p1})
asType < P1Type > (0 + temp1))
\rightarrow [from term 50.14, temp1 is equal to (-2 * div(heapIs $heap_{funcstart\_1032,1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177).quot) + (171 *
div(\mathbf{heapIs} \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
heap_{funcstart_{-1032.1}}.p1, 177).rem
[53.16] $heap<sub>1032,1;1051,8</sub> == $heap<sub>funcstart_1032,1</sub>._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow
asType < P1Type > (0 + ((-2 * div(heapIs $heap_{funcstart\_1032,1},
this.r.value(heapIs \ensuremath{\$}heap_{funcstart\_1032,1}).p1, 177).quot) + (171 *
div(heapIs $heap<sub>funcstart_1032.1</sub>, this.$r.value(heapIs
heap_{funcstart_{1032.1}}.p1, 177).rem))))
\rightarrow [simplify]
[53.19] $heap<sub>1032,1;1051,8</sub> == $heap<sub>funcstart_1032,1</sub>._replace(this.$r \rightarrow
\textbf{this.\$r.value}(\textbf{heapIs}~\$\text{heap}_{funcstart\_1032,1}).\_\textbf{replace}(\text{p1} \rightarrow ((-2~*\text{div}(\textbf{heapIs}))))))
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.} \text{\$r.value}(\text{heapIs}))
heap_{funcstart_{1032,1}}.p1, 177).rem))))
[Take given term]
[54.0] \; ((\$ heap_{1032,1;1051,8}.r2 * {\bf static\_cast}{<} {\bf signed \; int}{>} ({\rm div2.rem})) \; - \;
(\text{sheap}_{1032,1;1051,8}.\text{b2} * \text{static\_cast} < \text{signed int} > (\text{div2.quot}))) == \text{temp2}
\rightarrow [from term 53.19, $heap_{1032,1;1051,8}$ is equal to
\$heap_{funcstart\_1032,1}.\_\textbf{replace}(\textbf{this.}\$r \rightarrow \textbf{this.}\$r.\textbf{value}(\textbf{heapIs}
heap_{funcstart\_1032,1}._replace(p1 \rightarrow (-2 * div(heapIs heap_{funcstart\_1032,1}),
```

```
this.r.value(heapIs \ \ heap_{funcstart\_1032,1}).p1, \ 177).quot) + (171 *
div(\mathbf{heapIs} \ \$heap_{funcstart\_1032,1}, \ \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
heap_{funcstart\_1032,1}.p1, 177).rem)))
[54.1] \; ((\$ heap_{funcstart\_1032,1}.\_\textbf{replace}(\textbf{this}.\$r \rightarrow \textbf{this}.\$r.\textbf{value}(\textbf{heapIs}))) \\
\rho_{tuncstart\_1032.1}._replace(p1 \rightarrow ((-2 * div(heapIs \rho_{tuncstart\_1032.1})
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177).quot) + (171 * 
div(\mathbf{heapIs} \$ heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
\label{eq:cast_signed} $$ \hat{p}_{funcstart\_1032,1}.p1,\ 177).rem))).r2** {\bf static\_cast} < {\bf signed} $$
\mathbf{int}{>}(\mathrm{div2.rem})) - (\$\mathrm{heap}_{1032,1;1051,8}.\mathrm{b2} * \mathbf{static\_cast}{<} \mathbf{signed}
int>(div2.quot)) == temp2
\rightarrow [const member of object with modified fields]
[54.2] \; ((\$heap_{funcstart\_1032,1}.r2 * \textbf{static\_cast} < \textbf{signed int} > (\text{div}2.rem)) \; - \\
(\text{sheap}_{1032,1:1051,8}.\text{b2} * \text{static\_cast} < \text{signed int} > (\text{div2.quot}))) == \text{temp2}
\rightarrow [const static or extern object]
[54.3] (($heap<sub>init</sub>.r2 * static_cast<signed int>(div2.rem)) -
(\text{sheap}_{1032.1:1051.8}.\text{b2} * \text{static\_cast} < \text{signed int} > (\text{div2.quot}))) == \text{temp2}
\rightarrow [expand definition of constant 'r2' at prang.cpp (34,26)]
[54.4] (((int)172 * static_cast<signed int>(div2.rem)) -
(\text{sheap}_{1032,1:1051,8}.\text{b2} * \text{static\_cast} < \text{signed int} > (\text{div2.quot}))) == \text{temp2}
\rightarrow [simplify]
[54.5] ((172 * static_cast<signed int>(div2.rem)) - ($heap_1032.1:1051.8.b2 *
static_cast<signed int>(div2.quot))) == temp2
\rightarrow [from term 18.6, div2 is equal to div(heapIs $heap_{funcstart\_1032,1},
this.r.value(heapIs \ heap_{funcstart\_1032.1}).p2, 176)
[54.6] ((172 * static_cast<signed int>(div(heapIs $heap_{tuncstart\_1032.1}),
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p2, 176).rem)) -
(\text{sheap}_{1032,1;1051,8}.\text{b2} * \text{static\_cast} < \text{signed int} > (\text{div2.quot}))) == \text{temp2}
\rightarrow [simplify]
[54.7] ((172 * div(heapIs $heap<sub>funcstart_1032,1</sub>, this.$r.value(heapIs)
\text{heap}_{funcstart\_1032,1}.p2, 176).rem) - (\text{heap}_{1032,1;1051,8}.b2 *
static_cast<signed int>(div2.quot))) == temp2
\rightarrow [from term 53.19, $heap<sub>1032,1:1051.8</sub> is equal to
$heap_{funcstart\_1032,1}.$_replace(this.$r \rightarrow this.$r.value(heapIs)
heap_{funcstart\_1032,1}._replace(p1 \rightarrow (-2 * div(heapIs \$heap_{funcstart\_1032,1},
this.r.value(heapIs \ \ heap_{funcstart\_1032.1}).p1, \ 177).quot) + (171 *
div(heapIs $heap_{funcstart_1032.1}, this.$r.value(heapIs
heap_{funcstart_{1032,1}}.p1, 177).rem)))
[54.8] ((172 * div(heapIs $heap<sub>funcstart_1032,1</sub>, this.$r.value(heapIs)
\rho_{funcstart\_1032,1}.p2, 176).rem – (\rho_{funcstart\_1032,1}.replace)
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\rightarrow this.$r.value(heapIs $heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 *
{\rm div}(\mathbf{heapIs}~\$\mathrm{heap}_{funcstart\_1032,1},~\mathbf{this.\$r.value}(\mathbf{heapIs}
\text{Sheap}_{funcstart\_1032,1}.p1, 177).quot) + (171 * div(heapIs \text{Sheap}_{funcstart\_1032,1},
this.$r.value(heapIs $heap_{tuncstart_1032,1}).p1, 177).rem)))).b2 *
static_cast<signed int>(div2.quot))) == temp2
→ [const member of object with modified fields]
[54.9] ((172 * div(heapIs $heap<sub>funcstart_1032,1</sub>, this.$r.value(heapIs)
\text{Sheap}_{funcstart\_1032,1}.p2, 176).rem) - (\text{Sheap}_{funcstart\_1032,1}.b2 *
static_cast<signed int>(div2.quot))) == temp2
\rightarrow [const static or extern object]
[54.10] ((172 * div(heapIs $heap<sub>funcstart_1032.1</sub>, this.$r.value(heapIs)
\rho_{funcstart\_1032,1}.p2, 176).rem – (\rho_{funcstart\_1032,1}.p2, 176).rem
int > (div2.quot)) = temp2
\rightarrow [expand definition of constant 'b2' at prang.cpp (36,26)]
[54.11] ((172 * div(heapIs $heap_{funcstart\_1032,1}, this.$r.value(heapIs
\rho_{funcstart\_1032,1}.p2, 176).rem - ((int)35 * static\_cast < signed)
int>(div2.quot)) == temp2
\rightarrow [simplify]
[54.12] ((172 * div(heapIs heap_{funcstart\_1032,1}, this.r.value(heapIs)
\theta_{funcstart\_1032,1}.p2, 176).rem - (35 * static\_cast < signed)
int>(div2.quot))) == temp2
\rightarrow [from term 18.6, div2 is equal to div(heapIs $heap_{funcstart\_1032,1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p2, 176)
[54.13] ((172 * div(heapIs heap_{funcstart\_1032,1}, this.r.value(heapIs)
\theta_{tuncstart\_1032.1}.p2, 176).rem) - (35 * static_cast<signed)
int>(div(heapIs \$heap_{funcstart\_1032,1}, this.\$r.value(heapIs
\text{Sheap}_{funcstart\_1032,1}.p2, 176).quot))) == temp2
\rightarrow [simplify]
[54.18] 0 == (-\text{temp2} + (-35 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1},
this.$r.value(heapIs heap_{funcstart\_1032.1}).p2, 176).quot) + (172 *
div(\mathbf{heapIs} \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
heap_{funcstart_{1032,1}}.p2, 176).rem
[Take given term]
[57.0] $\text{heap}_{1032,1;1054,8} == $\text{heap}_{1032,1;1051,8}._\text{replace}(\text{this}.$\text{$r} \to \text{
operator*(heapIs heap_{1032,1:1051.8}, this)._replace(p2 \rightarrow
asType<P2Type>(($heap<sub>1032,1:1051,8</sub>.M2 *
asType{<}int{>}(static\_cast{<}integer{>}(static\_cast{<}signed
int>(operator^*(heapIs $heap_{1032.1:1051.8}, this).p2) < (int)(0))) + temp(2)))
\rightarrow [from term 53.19, $heap<sub>1032,1;1051,8</sub> is equal to
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$heap_{funcstart\_1032,1}.$-replace(this.$r \rightarrow this.$r.value(heapIs)
heap_{funcstart\_1032,1}._replace(p1 \rightarrow (-2 * div(heapIs $heap_{funcstart\_1032,1}).
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177).quot) + (171 *
div(heapIs $heap_{funcstart\_1032,1}, this.$r.value(heapIs)
heap_{funcstart_{1032,1}}.p1, 177).rem)))
[57.2] \rho_{1032,1;1054,8} == 
\textbf{this}.\$r.\textbf{value}(\textbf{heapIs}~\$heap_{funcstart\_1032,1}).\_\textbf{replace}(p1 \rightarrow ((-2~*div(\textbf{heapIs})))))
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
(177).quot + (171 * div(heapIs $heap_{funcstart\_1032,1}, this.$r.value(heapIs)
\hat{p}_{funcstart\_1032,1}.p1, 177).rem)))).\_replace(this.\$r \rightarrow operator*(heapIs))
\$heap_{funcstart\_1032,1}.\_\textbf{replace}(\textbf{this}.\$r. \bm{\$this}.\$r. \bm{\$r.value}(\textbf{heapIs}
\rho_{tuncstart_1032.1}._replace(p1 \rightarrow (-2 * div(heapIs \rho_{tuncstart_1032.1}).
this.$r.value(heapIs heap_{funcstart, 1032, 1}).p1, 177).quot) + (171)
div(heapIs $heap<sub>funcstart 1032.1</sub>, this.$r.value(heapIs
\theta_{tuncstart\_1032,1}.p1, 177).rem)), this)._replace(p2 \rightarrow
asType<P2Type>(($heap<sub>1032,1;1051,8</sub>.M2 *
as Type < int > (static\_cast < integer > (static\_cast < signed))
int>(operator^*(heapIs $heap_{1032,1;1051,8}, this).p2) < (int)(0))) + temp(2)))
→ [expand definition of operator '*' in class 'pointer' at built in declaration]
[57.3] heap_{1032,1;1054,8} == heap_{funcstart\_1032,1}._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
\theta_{funcstart\_1032,1}.p1, 177).rem)))).replace(this.r \rightarrow
this.$r.value(heapIs \rho_{funcstart\_1032,1}._replace(this.$r \rightarrow
this.$r.value(heapIs \rho_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{tuncstart_{1032,1}}, this.r.value(heapIs \rho_{tuncstart_{1032,1}}).p1,
177).quot) + (171 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
\theta_{funcstart\_1032,1}.p1, 177).rem)))).\_replace(p2 \rightarrow
asType<P2Type>(($heap<sub>1032.1:1051.8</sub>.M2 *
asType<int>(static_cast<integer>(static_cast<signed
int>(operator^*(heapIs $heap_{1032,1;1051,8}, this).p2) < (int)0))) + temp2)))
→ [evaluate dereferenced pointer into modified heap]
[57.4] \theta_{1032,1;1054,8} == \theta_{1032,1;1054,8} = \theta_{1032,1;1054,8} == \theta
\textbf{this.}\$r.\textbf{value}(\textbf{heapIs}~\$heap_{funcstart\_1032,1}).\_\textbf{replace}(p1 \rightarrow ((-2~*div(\textbf{heapIs})))))
\rho_{tuncstart\_1032.1}, this.r.value(heapIs \rho_{tuncstart\_1032.1}).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.} \text{\$r.value}(\text{heapIs}))
\$ heap_{funcstart\_1032,1}).p1,\,177).rem)))).\_\mathbf{replace}(\mathbf{this}.\$r \rightarrow ([\mathbf{this}.\$r ==
this.$r]: this.$r.value(heapIs \rho_{funcstart\_1032,1})._replace(p1 \rightarrow (-2 *
div(\mathbf{heapIs} \$ heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
\text{Sheap}_{funcstart\_1032,1}.p1, 177).quot) + (171 * div(heapIs \text{Sheap}_{funcstart\_1032,1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177).rem)), []:
this.$r.value(heapIs heap_{funcstart\_1032.1})._replace(p2 \rightarrow
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asType<P2Type>(($heap<sub>1032.1:1051.8</sub>.M2 *
asType<int>(static_cast<integer>(static_cast<signed
int>(operator^*(heapIs $heap_{1032,1;1051,8}, this).p2) < (int)(0))) + temp(2)))
→ [explicitly assert falsehood of skipped guards in subsequent guards]
[57.5] heap_{1032,1;1054,8} == heap_{funcstart\_1032,1}._replace(this.$r \rightarrow
this.$r.value(heapIs \rho_{tuncstart\_1032.1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs $heap<sub>funcstart_1032,1</sub>, this.$r.value(heapIs
\rho_{tuncstart\_1032,1}.p1, 177).rem))))._replace(this.$r \rightarrow ([this.$r == 
this.$r]: this.$r.value(heapIs \rho_{tuncstart\_1032,1})._replace(p1 \rightarrow (-2 *
div(\mathbf{heapIs} \$ heap_{funcstart\_1032.1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
\text{Sheap}_{funcstart\_1032.1}.p1, 177).quot) + (171 * div(heapIs \text{Sheap}_{funcstart\_1032.1},
this.r.value(heapIs \heap_{funcstart\_1032.1}).p1, 177).rem)), [!(this.<math>r = 
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p2 \rightarrow
asType<P2Type>(($heap<sub>1032,1;1051,8</sub>.M2 *
asType < int > (static\_cast < integer > (static\_cast < signed
int>(operator^*(heapIs $heap_{1032,1;1051,8}, this).p2) < (int)0))) + temp2)))
\rightarrow [simplify]
[57.7] \theta_{1032,1;1054,8} == \theta_{1032,1;1054,8} = \theta_{1032,1;1054,8} == \theta
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart_1032,1}, this.r.value(heapIs \rho_{funcstart_1032,1}).p1,
177).quot) + (171 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
\theta_{tuncstart\_1032.1}.p1, 177).rem)))).\_replace(this.\$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.\r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(\mathbf{heapIs} \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}))
\theta_{funcstart\_1032.1}.p1, 177).rem)))._replace(p2 \rightarrow
asType<P2Type>(($heap<sub>1032.1;1051.8</sub>.M2 *
asType < int > (static\_cast < integer > (static\_cast < signed
int>(operator^*(heapIs $heap_{1032.1:1051.8}, this).p2) < (int)(0))) + temp(2)))
\rightarrow [from term 53.19, $heap<sub>1032,1:1051,8</sub> is equal to
$heap_{funcstart\_1032,1}.$_replace(this.$r \rightarrow this.$r.value(heapIs)
heap_{funcstart\_1032,1}._replace(p1 \rightarrow (-2 * div(heapIs $heap_{funcstart\_1032,1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177).quot) + (171)
div(\mathbf{heapIs} \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
heap_{funcstart_{1032,1}}.p1, 177).rem)))
[57.8] heap_{1032,1;1054,8} == heap_{funcstart\_1032,1}._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.}\text{\$r.value}(\text{heapIs}))
\theta_{tuncstart\_1032,1}.p1, 177).rem)))).\_replace(this.\$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
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177).quot) + (171 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.} \text{\$r.value}(\text{heapIs}))
\theta_{funcstart\_1032,1}.p1, 177).rem)))._replace(p2 \rightarrow
asType < P2Type > ((\$heap_{funcstart\_1032,1}.\_replace(this.\$r \rightarrow funcstart\_1032,1))
this.$r.value(heapIs \rho_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs $heap<sub>funcstart_1032,1</sub>, this.$r.value(heapIs
heap_{funcstart_{1032,1}}.p1, 177).rem))).M2 *
asType<int>(static_cast<integer>(static_cast<signed
int>(operator^*(heapIs $heap_{1032,1:1051.8}, this).p2) < (int)(0))) + temp(2)))
→ [const member of object with modified fields]
[57.9] heap_{1032,1;1054,8} == heap_{funcstart\_1032,1}._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs \theta), this.r.value(heapIs)
\label{eq:continuous_function} $ \text{heap}_{funcstart\_1032,1} . \text{p1}, 177).rem)))).$ \textbf{replace(this.} \$r \rightarrow $ \text{the properties of the prop
this.$r.value(heapIs heap_{funcstart=1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{heap}_{funcstart\_1032,1}, \text{this.} \text{$r.value}(\text{heapIs}))
\theta_{funcstart\_1032,1}.p1, 177).rem))).\_replace(p2 \rightarrow
asType<P2Type>(($heap_funcstart_1032,1.M2 *
as Type < int > (static\_cast < integer > (static\_cast < signed
int>(operator^*(heapIs \$heap_{1032,1;1051,8}, this).p2) < (int)(0))) + temp(2)))
\rightarrow [const static or extern object]
[57.10] \theta_{1032,1;1054,8} == \theta_{funcstart\_1032,1}._replace(this.$r \to
this.$r.value(heapIs \theta_{funcstart\_1032,1})._replace(p1 \theta ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.\r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032.1}, \text{this.} \text{\$r.value}(\text{heapIs}))
\theta_{funcstart\_1032.1}.p1, 177).rem)))._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
$heap_funcstart_1032.1, this.$r.value(heapIs $heap_funcstart_1032.1).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.}\text{\$r.value}(\text{heapIs}))
\label{eq:condition} $\operatorname{heap}_{funcstart\_1032,1}).p1,\ 177).rem))).\_\mathbf{replace}(p2 \to
asType < P2Type > ((\$heap_{init}.M2))
asType < int > (static\_cast < integer > (static\_cast < signed)
int > (operator^*(heapIs \$heap_{1032,1;1051,8}, this).p2) < (int)0))) + temp2)))
\rightarrow [expand definition of constant 'M2' at prang.cpp (33,26)]
[57.11] $\text{heap}_{1032,1;1054,8} == $\text{heap}_{funcstart\_1032,1}._\text{replace}(\text{this}.\text{$\frac{1}{2}r$})
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.}\text{\$r.value}(\text{heapIs}))
\theta_{tuncstart\_1032,1}.p1, 177).rem)))).\_replace(this.\$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
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177).quot) + (171 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
\theta_{funcstart\_1032,1}.p1, 177).rem))).\_replace(p2 \rightarrow
asType<P2Type>(((int)30307 *
as Type < int > (static\_cast < integer > (static\_cast < signed))
int>(operator^*(heapIs $heap_{1032,1:1051,8}, this).p2) < (int)0))) + temp2)))
[57.12] \theta_{1032,1:1054,8} == \theta_{funcstart\_1032,1}._replace(this.$r \to
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.} \text{\$r.value}(\text{heapIs}))
\theta_{funcstart, 1032.1}.p1, 177).rem)))._replace(this.$r \rightarrow
this.$r.value(heapIs \rho_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs heap_{funcstart\_1032,1}, this.r.value(heapIs)
heap_{funcstart\_1032,1}.p1, 177).rem))).\_replace(p2 \rightarrow
asType<P2Type>((30307 *
asType < int > (static\_cast < integer > (static\_cast < signed)
int>(operator^*(heapIs $heap_{1032.1:1051.8}, this).p2) < (int)(0))) + temp(2)))
\rightarrow [from term 53.19, $heap<sub>1032.1:1051.8</sub> is equal to
\$heap_{funcstart\_1032,1}.\_\textbf{replace}(\textbf{this}.\$r \rightarrow \textbf{this}.\$r.\textbf{value}(\textbf{heapIs}
heap_{funcstart\_1032,1}._replace(p1 \rightarrow (-2 * div(heapIs $heap_{funcstart\_1032,1}, 
this.r.value(heapIs \ \ heap_{funcstart\_1032,1}).p1, \ 177).quot) + (171 \ \ *
div(\mathbf{heapIs} \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
heap_{funcstart_{1032,1}}.p1, 177).rem)))
[57.13] $heap<sub>1032,1;1054,8</sub> == $heap<sub>funcstart_1032,1</sub>._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{tuncstart\_1032.1}, this.r.value(heapIs \rho_{tuncstart\_1032.1}).p1,
177).quot) + (171 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
\theta_{funcstart\_1032,1}.p1, 177).rem)))).\_replace(this.\$r \rightarrow 0
this.$r.value(heapIs heap_{funcstart\_1032.1})._replace(p1 \rightarrow ((-2 * div(heapIs
$\text{heap}_{funcstart=1032.1}$, this.$\text{r.value}(\text{heapIs} \text{$heap}_{funcstart=1032.1}).p1,
177).quot) + (171 * div(heapIs \theta_{funcstart\_1032,1}, this.r.value(heapIs)
\label{eq:continuous_function} $\operatorname{heap}_{funcstart\_1032,1}).p1,\ 177).rem))).\_\mathbf{replace}(p2 \to
asType<P2Type>((30307 *
asType<int>(static_cast<integer>(static_cast<signed
\mathbf{int}{>}(\mathbf{operator}^*(\mathbf{heapIs}\ \$\mathbf{heap}_{funcstart\_1032,1}.\_\mathbf{replace}(\mathbf{this}.\$\mathbf{r}\rightarrow
this.$r.value(heapIs \theta_{funcstart\_1032,1})._replace(p1 \theta (-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.}\text{\$r.value}(\text{heapIs}))
\theta_{funcstart_{1032,1}}.p1, 177).rem)), this).p2) < (int)0)) + temp2)))
→ [expand definition of operator '*' in class 'pointer' at built in declaration]
[57.14] $heap<sub>1032,1:1054,8</sub> == $heap<sub>funcstart_1032,1</sub>._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
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\rho_{funcstart=1032,1}, this.r.value(heapIs \rho_{funcstart=1032,1}).p1,
177).quot) + (171 * div(heapIs \theta_{funcstart\_1032,1}, this.r.value(heapIs)
\theta_{funcstart\_1032,1}.p1, 177).rem)))._replace(this.$r \rightarrow
this.$r.value(heapIs p_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs $heap<sub>funcstart_1032,1</sub>, this.$r.value(heapIs
heap_{funcstart\_1032,1}.p1, 177).rem)))._replace(p2 \rightarrow
asType<P2Type>((30307 *
asType<int>(static_cast<integer>(static_cast<signed
\mathbf{int}{>}(\mathbf{this.\$r.value}(\mathbf{heapIs}\ \$\mathbf{heap}_{funcstart\_1032,1}.\_\mathbf{replace}(\mathbf{this.\$r} \to \mathbf{funcstart}))
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{$heap}_{funcstart\_1032,1}, \text{this.} \text{$r.value}(\text{heapIs}))
\text{Sheap}_{funcstart\_1032,1}.\text{p1}, 177).\text{rem})))).\text{p2}) < (int)0)) + \text{temp2}))
→ [evaluate dereferenced pointer into modified heap]
[57.15] $heap<sub>1032,1;1054,8</sub> == $heap<sub>funcstart_1032,1</sub>._replace(this.$r \rightarrow
this.$r.value(heapIs \theta_{funcstart\_1032,1})._replace(p1 \theta ((-2 * div(heapIs
\rho_{tuncstart\_1032.1}, this.r.value(heapIs \rho_{tuncstart\_1032.1}).p1,
177).quot) + (171 * div(heapIs $heap_{funcstart\_1032,1}, this.$r.value(heapIs
\theta_{tuncstart\_1032.1}.p1, 177).rem)))).\_replace(this.\$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{tuncstart_{1032.1}}, this. r.value(heapIs \rho_{tuncstart_{1032.1}}).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.} \text{\$r.value}(\text{heapIs}))
\theta_{funcstart\_1032,1}.p1, 177).rem))).\_replace(p2 \rightarrow
asType<P2Type>((30307 *
asType<int>(static_cast<integer>(static_cast<signed int>(([this.$r
== this.$r]: this.$r.value(heapIs \rho_{funcstart\_1032,1})._replace(p1 \rightarrow (-2 *
div(\mathbf{heapIs} \$ heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
\text{Sheap}_{funcstart\_1032,1}.p1, 177).quot) + (171 * div(heapIs \text{Sheap}_{funcstart\_1032,1},
this.r.value(heapIs \ heap_{funcstart\_1032.1}).p1, 177).rem)), []:
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p2) < (int)0))) + temp2)))
→ [explicitly assert falsehood of skipped guards in subsequent guards]
[57.16] $heap<sub>1032,1;1054,8</sub> == $heap<sub>funcstart_1032,1</sub>._replace(this.$r \rightarrow
this.$r.value(heapIs \rho_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs \theta_{funcstart\_1032,1}, this.r.value(heapIs)
\theta_{funcstart\_1032,1}.p1, 177).rem)))).\_replace(this.\$r \rightarrow 0
this.$r.value(heapIs \rho_{uncstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs)
\$heap_{funcstart\_1032,1},\, \textbf{this}.\$r.\textbf{value}(\textbf{heapIs}\,\,\$heap_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs $heap<sub>funcstart_1032,1</sub>, this.$r.value(heapIs
heap_{funcstart\_1032,1}.p1, 177).rem)))._replace(p2 \rightarrow
asType<P2Type>((30307 *
asType<int>(static_cast<integer>(static_cast<signed int>(([this.$r
== this.$r|: this.$r.value(heapIs \theta_{tuncstart\_1032,1})._replace(p1 \rightarrow (-2 *
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div(\mathbf{heapIs} \$ heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
\text{Sheap}_{funcstart\_1032,1}.p1, 177).quot) + (171 * div(heapIs \text{Sheap}_{funcstart\_1032,1},
this.r.value(heapIs \ensuremath{\$}heap_{funcstart\_1032,1}).p1, 177).rem)), [!(this.\ensuremath{\$}r ==
this.$r.value(heapIs \rho_{funcstart\_1032,1}).p2) < (int)0))) +
temp2)))
\rightarrow [simplify]
[57.23] $heap<sub>1032,1;1054,8</sub> == $heap<sub>funcstart_1032,1</sub>._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.} \text{\$r.value}(\text{heapIs}))
\theta_{funcstart, 1032.1}.p1, 177).rem)))._replace(this.$r \rightarrow
\textbf{this.\$r.value}(\textbf{heapIs}~\$ heap_{funcstart\_1032,1}).\_\textbf{replace}(p1 \rightarrow ((-2~*div(\textbf{heapIs})))))
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
\theta_{funcstart\_1032,1}.p1, 177).rem))).\_replace(p2 \rightarrow
{\bf asType} < P2Type > ((30307 * {\bf asType} < {\bf int} > ({\bf static\_cast} < {\bf integer} > (0 < {\bf output})) < {\bf output} > ({\bf output}) < {\bf o
-\mathbf{this.\$r.value}(\mathbf{heapIs}\ \$\mathrm{heap}_{funcstart\_1032,1}).\mathrm{p2}))) + \mathrm{temp2})))
\rightarrow [from term 24.0, literala < -this.$r.value(heapIs $heap_{funcstart\_1032.1}).p2
is false whenever -2 < (0 + literala)
       Proof of rule precondition:
       [57.23.0] - 2 < (0 + 0)
       \rightarrow [simplify]
       [57.23.2] true
[57.24] $heap<sub>1032,1;1054,8</sub> == $heap<sub>funcstart_1032,1</sub>._replace(this.$r \rightarrow
\textbf{this.\$r.value}(\textbf{heapIs}~\$ heap_{funcstart\_1032,1}).\_\textbf{replace}(p1 \rightarrow ((\text{-}2~*\text{div}(\textbf{heapIs}
$heap_funcstart_1032,1, this.$r.value(heapIs $heap_funcstart_1032,1).p1,
177).quot) + (171 * div(heapIs $heap<sub>funcstart_1032,1</sub>, this.$r.value(heapIs
\theta_{funcstart\_1032,1}.p1, 177).rem)))).\_replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs $heap<sub>funcstart_1032,1</sub>, this.$r.value(heapIs
heap_{funcstart\_1032,1}.p1, 177).rem))).\_replace(p2 \rightarrow
asType<P2Type>((30307 * asType<int>(static_cast<integer>(false)))
+ \text{temp2})))
\rightarrow [simplify]
[57.25] heap_{1032,1;1054,8} == heap_{funcstart\_1032,1}._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
\theta_{tuncstart\_1032.1}.p1, 177).rem)))).\_replace(this.\$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
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\rho_{funcstart=1032,1}, this.r.value(heapIs \rho_{funcstart=1032,1}).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.} \text{\$r.value}(\text{heapIs}))
\theta_{funcstart\_1032,1}.p1, 177).rem))).\_replace(p2 \rightarrow
asType < P2Type > ((30307 * asType < int > (([false]: 1, []: 0))) + temp2)))
→ [explicitly assert falsehood of skipped guards in subsequent guards]
[57.26] $heap<sub>1032,1;1054,8</sub> == $heap<sub>funcstart_1032,1</sub>._replace(this.$r \rightarrow
this.$r.value(heapIs \rho_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.} \text{\$r.value}(\text{heapIs}))
\theta_{tuncstart\ 1032.1}.p1,\ 177.rem)))._replace(this.r \rightarrow
this.$r.value(heapIs \frac{1}{2} heap\frac{1}{2} heap\frac{1}{2}
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(\mathbf{heapIs} \ \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
heap_{funcstart\_1032,1}.p1, 177).rem))._replace(p2 \rightarrow
asType<P2Type>((30307 * asType<int>(([false]: 1, [true]: 0))) +
temp2)))
\rightarrow [simplify]
[57.29] heap_{1032,1;1054,8} == heap_{funcstart\_1032,1}.replace(this.r \to 1000
this.$r.value(heapIs heap_{funcstart=1032.1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.}\text{\$r.value}(\text{heapIs}))
\theta_{funcstart\_1032,1}.p1, 177).rem))))._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{tuncstart\_1032.1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this. r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(\mathbf{heapIs} \ \$heap_{funcstart\_1032,1}, \ \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
\rho_{uncstart\_1032,1}.p1, 177).rem))._replace(p2 \rightarrow asType<P2Type>(0 +
\rightarrow [from term 54.18, temp2 is equal to (-35 * div(heapIs $heap_{funcstart\_1032.1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p2, 176).quot) + (172 \ *
div(\mathbf{heapIs} \ \$heap_{funcstart\_1032,1}, \ \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
heap_{funcstart\_1032,1}.p2, 176).rem
[57.30] $heap<sub>1032.1:1054.8</sub> == $heap<sub>funcstart_1032.1</sub>._replace(this.$r \rightarrow
\textbf{this.\$r.value}(\textbf{heapIs}~\$ heap_{funcstart\_1032,1}).\_\textbf{replace}(p1 \rightarrow ((-2~*div(\textbf{heapIs}
\$heap_{funcstart\_1032,1},\ \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}\ \$heap_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs heapIs = 1032,1, this.r.value(heapIs)
\theta_{tuncstart_1032.1}.p1, 177.rem)))._replace(this.$r \rightarrow
this.$r.value(heapIs $heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs $heap_{funcstart\_1032,1}, this.$r.value(heapIs
\rho_{funcstart\_1032,1}.p1, 177).rem))._replace(p2 \rightarrow asType<P2Type>(0 +
((-35 * div(heapIs $heap_{funcstart\_1032,1}, this.$r.value(heapIs)]
\rho_{tuncstart_{1032.1}, p2, 176} = 176, quot \rho_{tuncstart_{1032.1}, p3} + 176
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p2, 176).rem)))))
```

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\rightarrow [simplify]
[57.33] $heap<sub>1032,1;1054,8</sub> == $heap<sub>funcstart_1032,1</sub>._replace(this.$r \rightarrow
\textbf{this.\$r.value}(\textbf{heapIs}~\$ heap_{funcstart\_1032,1}).\_\textbf{replace}(p1 \rightarrow ((-2~*div(\textbf{heapIs})))))
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.} \text{\$r.value}(\text{heapIs}))
\theta_{funcstart\_1032,1}.p1, 177).rem)))).\_replace(this.\$r \rightarrow 0
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs)
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs \rho_{funcstart\_1032,1}, this.r.value(heapIs)
\rho_{uncstart\_1032,1}.p1, 177).rem))).\_replace(p2 \rightarrow ((-35 * div(heapIs)))._replace(p2 \rightarrow ((-35 * div(heapIs))))._replace(p3 \rightarrow ((-35 * div(heapIs)))))
\rho_{funcstart\_1032,1}, this. r.value(heapIs \rho_{funcstart\_1032,1}).p2,
176).quot) + (172 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
heap_{funcstart_{-1032.1}}.p2, 176).rem)))
[Take goal term]
[1.0] minof(signed int) \leq ((\theta_{1.032,1:1054,8}.r3 * static_cast\theta_{1.032,1:1054,8}.r3
int>(div3.rem)) - (\$heap_{1032,1;1054,8}.b3 * static\_cast < signed
int>(div3.quot)))
\rightarrow [simplify]
[1.1] -32768 \leq (($heap_{1032,1;1054,8}.r3 * static_cast < signed int > (div3.rem)) -
(\text{sheap}_{1032.1:1054.8}.\text{b3} * \text{static\_cast} < \text{signed int} > (\text{div3.quot})))
\rightarrow [from term 57.33, $heap<sub>1032,1;1054,8</sub> is equal to
\$heap_{funcstart\_1032,1}.\_\textbf{replace}(\textbf{this}.\$r \rightarrow \textbf{this}.\$r.\textbf{value}(\textbf{heapIs}
heap_{funcstart\_1032,1}._replace(p1 \rightarrow ((-2 * div(heapIs $heap_{funcstart\_1032,1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, \ 177).quot) + (171 \ respectively)
div(heapIs $heap_{tuncstart_1032.1}, this.$r.value(heapIs)
heap_{funcstart\_1032,1}.p1, 177).rem)))).\_replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
heap_{funcstart\_1032,1}, this.r.value(heapIs heap_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(\mathbf{heapIs} \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}))
heap_{funcstart\_1032,1}.p1, 177).rem))).\_replace(p2 \rightarrow (-35 * div(heapIs))).
$heap_funcstart_1032.1, this.$r.value(heapIs $heap_funcstart_1032.1).p2,
(176).quot) + (172*div(\textbf{heapIs} \$heap_{funcstart\_1032,1}, \textbf{this}.\$r.\textbf{value}(\textbf{heapIs}))
heap_{funcstart\_1032,1}.p2, 176).rem)))]
[1.2] -32768 \leq (($heap_funcstart_1032,1._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032.1}, \text{this.} \text{\$r.value}(\text{heapIs}))
\theta_{tuncstart_1032.1}.p1, 177.rem)))._replace(this.r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\theta_{funcstart\_1032,1}, this.r.value(heapIs \theta_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs \rho_{funcstart\_1032,1}, this.r.value(heapIs)
\rho_{funcstart\_1032,1}.p1, 177).rem)._replace(p2 \rightarrow ((-35 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p2,
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176).quot) + (172 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.} \text{\$r.value}(\text{heapIs}))
int>(div3.rem)) - (\$heap_{1032,1:1054,8}.b3 * static\_cast < signed
int>(div3.quot)))
→ [const member of object with modified fields]
[1.4] -32768 \leq (($heap_funcstart_1032,1.r3 * static_cast<signed)
int>(div3.rem)) - (\$heap_{1032,1:1054,8}.b3 * static\_cast < signed)
int>(div3.quot)))
\rightarrow [const static or extern object]
[1.5] -32768 \leq (($heap<sub>init</sub>.r3 * static_cast<signed int>(div3.rem)) -
(\text{sheap}_{1032.1:1054.8}.\text{b3} * \text{static\_cast} < \text{signed int} > (\text{div3.quot})))
\rightarrow [expand definition of constant 'r3' at prang.cpp (39,26)]
[1.6] -32768 \leq (((int)170 * static_cast<signed int>(div3.rem)) -
(\text{sheap}_{1032.1:1054.8}.\text{b3} * \text{static\_cast} < \text{signed int} > (\text{div3.quot})))
[1.7] -32768 \leq ((170 * static_cast < signed int > (div3.rem)) -
(\text{sheap}_{1032,1;1054,8}.\text{b3} * \text{static\_cast} < \text{signed int} > (\text{div3.quot})))
\rightarrow [from term 34.6, div3 is equal to div(heapIs $heap_{funcstart\_1032,1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p3, 178)
[1.8] -32768 \leq ((170 * static_cast<signed int>(div(heapIs))
\rho_{funcstart\_1032.1}, this.r.value(heapIs \rho_{funcstart\_1032.1}).p3,
(178).rem) - (\text{sheap}_{1032,1;1054,8}.b3 * static\_cast < signed int > (div3.quot)))
\rightarrow [simplify]
[1.9] -32768 \leq ((170 * div(heapIs $heap_{funcstart\_1032,1}, this.$r.value(heapIs)]
\text{Sheap}_{tuncstart\_1032.1}.p3, 178).rem) - (\text{Sheap}_{1032.1:1054.8}.b3 *
static_cast<signed int>(div3.quot)))
\rightarrow [from term 57.33, $heap<sub>1032.1:1054.8</sub> is equal to
\$heap_{funcstart\_1032,1}.\_\textbf{replace}(\textbf{this}.\$r \rightarrow \textbf{this}.\$r.\textbf{value}(\textbf{heapIs}
heap_{funcstart\_1032,1}._replace(p1 \rightarrow ((-2 * div(heapIs $heap_{funcstart\_1032,1},
this.r.value(heapIs \ \ heap_{funcstart\_1032,1}).p1, \ 177).quot) + (171 \ \ *
div(\mathbf{heapIs} \ \$heap_{funcstart\_1032,1}, \ \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
\label{eq:continuous_flux_start} $$ $heap_{funcstart\_1032,1}.p1,\ 177).rem)))).$$ $$ \_replace(this.\$r \rightarrow \ \ \ \ \ \ )
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
$heap_funcstart_1032,1, this.$r.value(heapIs $heap_funcstart_1032,1).p1,
177).quot) + (171 * div(\mathbf{heapIs} \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}))
heap_{funcstart\_1032,1}.p1, 177).rem)))_replace(p2 \rightarrow (-35 * div(heapIs))
heap_{funcstart\_1032,1}, this.r.value(heapIs heap_{funcstart\_1032,1}).p2,
176).quot) + (172 * div(\mathbf{heapIs} \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}))
heap_{funcstart\_1032,1}.p2, 176).rem)))]
\lceil 1.10 \rceil -32768 \leq ((170 * \text{div}(\mathbf{heapIs} \$ \text{heap}_{funcstart\_1032,1}, \mathbf{this}.\$ r. \mathbf{value}(\mathbf{heapIs} ))
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\rho_{funcstart_{-1032,1}}.p3, 178).rem – (\rho_{funcstart_{-1032,1}}.p_{funcsta
\rightarrow this.$r.value(heap
Is \rho_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs}\ \$ \mathrm{heap}_{funcstart\_1032,1},\ \mathbf{this}.\$ \mathrm{r.value}(\mathbf{heapIs}
\text{Sheap}_{funcstart\_1032,1}.p1, 177).quot) + (171 * div(heapIs \text{Sheap}_{funcstart\_1032,1},
\mathbf{this.\$r.value(heapIs\ \$heap}_{funcstart\_1032,1}).p1,\ 177).rem)))).\_\mathbf{replace(this.\$r}
\rightarrow this.$r.value(heapIs $heap_{tuncstart\_1032,1})._replace(p1 \rightarrow ((-2 *
div(\mathbf{heapIs} \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
\text{Sheap}_{funcstart\_1032.1}.p1, 177).quot) + (171 * div(heapIs \text{Sheap}_{funcstart\_1032.1},
this.r.value(heapIs \ heap_{funcstart\_1032.1}).p1, 177).rem))).\_replace(p2 \rightarrow
((-35 * div(heapIs \$heap_{funcstart\_1032,1}, this.\$r.value(heapIs
\text{Sheap}_{funcstart\_1032,1}.p2, 176).quot) + (172 * div(heapIs \text{Sheap}_{funcstart\_1032,1},
this.r.value(heapIs \ensuremath{\$}heap_{funcstart\_1032,1}).p2, 176).rem)))).b3
static_cast<signed int>(div3.quot)))
\rightarrow [const member of object with modified fields]
[1.12] -32768 \leq ((170 * div(heapIs $heap_{funcstart\_1032,1},
\mathbf{this.\$r.value(heapIs}\ \$heap_{funcstart\_1032,1}).p3,\ 178).rem)\ -
(\$heap_{funcstart\_1032,1}.b3 * \textbf{static\_cast} < \textbf{signed int} > (\text{div3.quot})))
\rightarrow [const static or extern object]
[1.13] -32768 \leq ((170 * div(heapIs $heap_{funcstart\_1032,1},)
this.r.value(heapIs $heap_{funcstart\_1032,1}).p3, 178).rem) - ($heap_{init}.b3 *
static_cast<signed int>(div3.quot)))
\rightarrow [expand definition of constant 'b3' at prang.cpp (41,26)]
[1.14] -32768 \leq ((170 * div(heapIs $heap_{funcstart\_1032,1},)
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p3, 178).rem) - ((int)63 *
static_cast<signed int>(div3.quot)))
\rightarrow [simplify]
[1.15] -32768 \leq ((170 * div(heapIs $heap_{funcstart\_1032,1},)
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p3, 178).rem) - (63 *
static_cast<signed int>(div3.quot)))
\rightarrow [from term 34.6, div3 is equal to div(heapIs $heap_{funcstart\_1032.1},
this.r.value(heapIs \ heap_{funcstart\_1032.1}).p3, 178)
[1.16] -32768 \leq ((170 * div(heapIs $heap_{funcstart\_1032,1},
this.r.value(heapIs \heap_{funcstart\_1032,1}).p3, 178).rem) - (63 *
static\_cast < signed int > (div(heapIs $heap_{funcstart\_1032,1},
\mathbf{this.\$r.value(heapIs}\ \$heap_{funcstart\_1032,1}).p3,\ 178).quot)))
\rightarrow [simplify]
[1.21] -32769 < ((-63 * div(heapIs $heap<sub>funcstart_1032,1</sub>, this.$r.value(heapIs)
\text{Sheap}_{funcstart\_1032,1}.p3, 178).quot) + (170 * div(heapIs \text{Sheap}_{funcstart\_1032,1},
\mathbf{this.\$r.value}(\mathbf{heapIs}\ \$\mathbf{heap}_{funcstart\_1032,1}).\mathbf{p}3,\ 178).\mathbf{rem}))
\rightarrow [negate goal and search for contradiction]
```

```
[1.22]!(-32769 < ((-63 * div(heapIs $heap_{funcstart\_1032,1},
this.r.value(heapIs \ensuremath{\$}heap_{funcstart\_1032,1}).p3, 178).quot) + (170 *
div(\mathbf{heapIs} \$ heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
heap_{funcstart\_1032,1}.p3, 178).rem))
\rightarrow [simplify]
[1.27] 32768 < ((63 * div(heapIs \$heap_{funcstart\_1032,1}, this.\$r.value(heapIs))
\text{heap}_{funcstart\_1032,1}.p3, 178).quot) + (-170 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p3,
178).rem))
[Copy term 1.27]
[85.0] 32768 < ((-170 * div(heapIs $heap_{funcstart\_1032,1}, this.$r.value(heapIs)]
\text{Sheap}_{funcstart\_1032.1}, p3, 178).rem) + (63 * div(heapIs \text{Sheap}_{funcstart\_1032.1},
this.r.value(heapIs $heap_{funcstart\_1032,1}).p3, 178).quot))
\rightarrow [from term 42.17, div(heapIs $heap_{funcstart\_1032,1}$, this.$r.value(heapIs)
heap_{funcstart\_1032,1}.p3, 178.rem is equal to this.r.value(heapIs)
heap_{funcstart\_1032.1}.p3 % 178
[85.1] 32768 < ((-170 * (this. r.value(heapIs $heap_{tuncstart\_1032.1}).p3 %]
178)) + (63 * \text{div}(\text{heapIs } \text{$heap}_{funcstart\_1032,1}, \text{this.} \text{$r.value}(\text{heapIs}))
heap_{funcstart\_1032,1}.p3, 178.quot)
[Create new term from term 41.17 using rule: condition for equality of division]
[133.0] ((178 * (0 + -(-\text{div}(\mathbf{heapIs} \$ \text{heap}_{funcstart\_1032,1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p3, 178).quot))) < (1 + 
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p3)) \land (this.\ r.value(heapIs
\text{heap}_{funcstart\ 1032.1}.p3 < (178 * (0 + 1 + -(-\text{div}(\text{heapIs}))))
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p3,
178).quot))))
\rightarrow [simplify]
[133.15] (-1 < ((-178 * div(heapIs heapIs f_{uncstart\_1032.1}, this. r.value(heapIs)
\theta_{funcstart\_1032,1}.p3, 178).quot) + this.$r.value(heapIs)
\$heap_{funcstart\_1032,1}).p3)) \land (-178 < (-\mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}))) \land (-178 < (-\mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})))
\text{Sheap}_{funcstart\_1032,1}.p3 + (178 * div(heapIs \text{Sheap}_{funcstart\_1032,1}),
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p3, 178).quot)))
[Work on sub-term 2 of conjunction in term 133.15]
[134.0] -1 < ((-178 * div(heapIs $heap_{funcstart 1032.1}, this.$r.value(heapIs)]
\theta_{funcstart\_1032,1}.p3, 178).quot) + this.r.value(\theta)
heap_{funcstart_{1032,1}}.p3
[Create new term from terms 134.0, 39.11 using rule: transitivity 2]
[145.0] (-30323 + -1 + 1) < (-178 * div(heapIs $heap_{funcstart\_1032,1},
this.r.value(heapIs $heap_{funcstart\_1032,1}).p3, 178).quot)
```

```
\rightarrow [simplify]
[145.1] -30323 < (-178 * div(heapIs $heap<sub>funcstart_1032,1</sub>,
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p3, 178).quot)
\rightarrow [literal comparison of product]
[145.2] ([-178 < 0]: (-30323 / 178) < -\text{div}(\mathbf{heapIs} \$ \text{heap}_{funcstart\_1032,1},
this.$r.value(heapIs \frac{1}{1000} $\text{heap} \frac{1}{1000} \frac{1}{1000} = \frac{1}{10
 / -178) < \operatorname{div}(\mathbf{heapIs} \ \mathbf{\$} \operatorname{heap}_{funcstart\_1032,1}, \ \mathbf{this}.\mathbf{\$r.value}(\mathbf{heapIs})
\text{Sheap}_{funcstart\_1032,1}).p3, 178).quot, [-178 == 0]: -30323 < 0)
→ [explicitly assert falsehood of skipped guards in subsequent guards]
[145.3] ([-178 < 0]: (-30323 / 178) < -\text{div}(\mathbf{heapIs} \$ \text{heap}_{funcstart\_1032,1},
this.$r.value(heapIs heap_{funcstart\_1032,1}).p3, 178).quot, [(0 < -178) \land !(-178
< 0)]: (-30323 / -178) < div(heap
Is $heap_{funcstart\_1032,1},
this.$r.value(heapIs heap_{funcstart\_1032,1}).p3, 178).quot, [(-178 == 0) \land
!(-178 < 0) \land !(0 < -178)]: -30323 < 0)
\rightarrow [simplify]
[145.7] -171 < -\text{div}(\mathbf{heapIs} \ \text{heap}_{funcstart\_1032.1}, \ \mathbf{this}.\ \text{r.value}(\mathbf{heapIs})
heap_{funcstart_{1032,1}}.p3, 178).quot
[Create new term from terms 145.7, 85.1 using rule: transitivity 5]
[148.0] 32768 < ((-170 * (this.$r.value(heap
Is $heap_{funcstart\_1032,1}).p3 %
(178) + (63 * -(-171 + 1)))
\rightarrow [simplify]
[148.5] 22058 < (-170 * (this.$r.value(heapIs $heap_{tuncstart\_1032,1}).p3 %
178))
\rightarrow [literal comparison of product]
[148.6] ([-170 < 0]: (22058 / 170) < -(this.$r.value(heapIs
heap_{funcstart_{-1032,1}}.p3 \% 178, [0 < -170]: (22058 / -170) < -170
(this.$r.value(heapIs \theta_{funcstart-1032,1}).p3 % 178), [-170 == 0]: 22058 <
0)
→ [explicitly assert falsehood of skipped guards in subsequent guards]
[148.7] ([-170 < 0]: (22058 / 170) < -(this.$r.value(heapIs)
\frac{170}{100} + \frac{170}{100} = 
(this.$r.value(heapIs heap_{funcstart\_1032,1}).p3 % 178), [(-170 == 0) \land !(-170
< 0) \land !(0 < -170)]: 22058 < 0)
\rightarrow [simplify]
[148.12] false
```

Proof of verification condition: Arithmetic result of operator '-' is within limit of type 'signed int'

```
In the context of class: WHPrang, declared at:
C:\Escher\Customers\prang-cpp\prang.cpp (18,1)
Condition generated at: C:\Escher\Customers\prang-cpp\prang.cpp
(80,52)
Condition defined at:
To prove: ((\text{\$heap}_{1032,1:1054,8}.r3 * \text{static\_cast} < \text{signed int} > (\text{div}3.rem)) -
(\text{sheap}_{1032,1:1054,8}.\text{b3} * \text{static\_cast} < \text{signed int} > (\text{div}3.\text{quot}))) \le
maxof(signed int)
Given:
heap_{init}.LIMIT == (int)80
heap_{init}.class WHPrang \in M1 == (int)30269
heap_{init}.class WHPrang \in r1 == (int)171
heap_{init}.class WHPrang \in a1 == (int)177
heap_{init}.class WHPrang \in b1 == (int)2
heap_{init}.class WHPrang \in M2 == (int)30307
heap_{init}.class WHPrang \in r2 == (int)172
heap_{init}.class WHPrang \in a2 == (int)176
heap_{init}.class WHPrang \in b2 == (int)35
heap_{init}.class WHPrang \in M3 == (int)30323
heap_{init}.class WHPrang \in r3 == (int)170
heap_{init}.class WHPrang \in a3 == (int)178
heap_{init}.class WHPrang \in b3 == (int)63
\operatorname{div} 1 == \operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_1032,1},
static_cast<int>(operator*(heapIs $heap_{funcstart\_1032,1}, this).p1),
\mathbf{static\_cast}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_1032,1}.\mathrm{a1}))
(asType<integer>(static_cast<int>(operator*(heapIs
heap_{funcstart\_1032,1}, this).p1) /
asType < integer > (static\_cast < int > (\$heap_{funcstart\_1032,1}.a1))) = =
asType<integer>(div1.quot)
(asType<integer>(static_cast<int>(operator*(heapIs
heap_{funcstart\_1032,1}, this).p1) %
asType < integer > (static\_cast < int > (\$heap_{funcstart\_1032.1}.a1))) = =
asType<integer>(div1.rem)
(\mathbf{asType}{<}\mathbf{integer}{>}(\mathbf{operator}^*(\mathbf{heapIs}\ \$\mathbf{heap}_{funcstart\_1032,1},\ \mathbf{this}).\mathtt{p1}) <
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathrm{heap}_{funcstart\_1032,1}.\mathrm{a1})) =>
(asType<integer>(div1.rem) == asType<integer>(operator*(heapIs
heap_{funcstart\_1032,1}, this).p1)
```

```
(\mathbf{asType} < \mathbf{integer} > (\$ \mathbf{heap}_{funcstart\_1032,1}.\mathbf{a1}) \le
asType < integer > (operator*(heapIs $heap_{funcstart\_1032,1}, this).p1)) = >
!(0 == asType < integer > (div1.quot))
!(0 == asType < integer > (div1.rem)) || !(0 ==
asType<integer>(div1.quot))
div2 == div(\mathbf{heapIs} \$ heap_{funcstart\_1032,1},
static\_cast < int > (operator*(heapIs $heap_{funcstart\_1032,1}, this).p2),
\mathbf{static\_cast}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_1032,1}.\mathrm{a2}))
(asType < integer > (static\_cast < int > (operator*(heapIs)))
heap_{funcstart\_1032,1}, this).p2)
asType < integer > (static\_cast < int > (\$heap_{funcstart\_1032.1}.a2))) = =
asType < integer > (div2.quot)
(asType<integer>(static_cast<int>(operator*(heapIs
heap_{funcstart\_1032,1}, this).p2)
asType < integer > (static\_cast < int > (\$heap_{funcstart\_1032,1}.a2))) = =
asType<integer>(div2.rem)
(asType<integer>(operator*(heapIs $heap_{tuncstart\_1032.1}, this).p2) <
asType < integer > (\$heap_{funcstart\_1032,1}.a2)) = >
(asType<integer>(div2.rem) == asType<integer>(operator*(heapIs
heap_{funcstart\_1032.1}, this).p2)
(asType < integer > (\$heap_{funcstart\_1032,1}.a2) \le
\mathbf{asType} < \mathbf{integer} > (\mathbf{operator}^*(\mathbf{heapIs} \ \$ \mathbf{heap}_{funcstart\_1032,1}, \ \mathbf{this}).\mathtt{p2})) = >
!(0 == asType < integer > (div2.quot))
!(0 == asType < integer > (div2.rem)) || !(0 ==
asType<integer>(div2.quot))
div3 == div(\mathbf{heapIs} \$ heap_{funcstart\_1032,1},
\mathbf{static\_cast} {<} \mathbf{int} {>} (\mathbf{operator}^*(\mathbf{heapIs}\ \$\mathbf{heap}_{funcstart\_1032,1},\ \mathbf{this}).\mathbf{p3}),
\mathbf{static\_cast} < \mathbf{int} > (\$ \mathbf{heap}_{funcstart\_1032,1}.\mathbf{a3}))
(asType<integer>(static_cast<int>(operator*(heapIs
heap_{funcstart\_1032,1}, this).p3)
asType < integer > (static\_cast < int > (\$heap_{funcstart\_1032.1}.a3))) = =
asType<integer>(div3.quot)
(asType<integer>(static_cast<int>(operator*(heapIs
heap_{funcstart\_1032,1}, this).p3)
\mathbf{asType} < \mathbf{integer} > (\mathbf{static\_cast} < \mathbf{int} > (\$ \mathbf{heap}_{funcstart\_1032,1}.\mathbf{a3}))) = =
asType<integer>(div3.rem)
(asType < integer > (operator*(heapIs $heap_{funcstart\_1032,1}, this).p3) < footnote{the content of the conte
asType < integer > (\$heap_{funcstart\_1032,1}.a3)) = >
(asType<integer>(div3.rem) == asType<integer>(operator*(heapIs
heap_{funcstart=1032.1}, this).p3)
(asType < integer > (\$heap_{funcstart\_1032,1}.a3) \le
```

```
asType < integer > (operator*(heapIs $heap_{funcstart\_1032.1}, this).p3)) = >
!(0 == asType < integer > (div3.quot))
!(0 == asType < integer > (div3.rem)) || !(0 ==
asType<integer>(div3.quot))
temp1 == (\text{sheap}_{funcstart\_1032,1}.r1 * static\_cast < signed int > (div1.rem)) -
(\text{sheap}_{funcstart\_1032,1}.\text{b1} * \text{static\_cast} < \text{signed int} > (\text{div1.quot}))
minof(signed\ int) \le temp1
temp1 \le maxof(signed int)
heap_{1032,1;1051,8} == heap_{funcstart\_1032,1}._replace(this.$r \rightarrow
operator*(heapIs heap_{funcstart\_1032,1}, this)._replace(p1 \rightarrow
\mathbf{asType}{<}P1\mathsf{Type}{>}((\$\mathsf{heap}_{funcstart\_1032,1}.\mathsf{M1}~*
asType < int > (static\_cast < integer > (static\_cast < signed)
int>(operator^*(heapIs \$heap_{funcstart\_1032,1}, this).p1) < (int)0))) +
temp1)))
temp2 == (\$heap_{1032,1;1051,8}.r2 * static\_cast < signed int > (div2.rem)) -
(\text{sheap}_{1032,1:1051.8}.\text{b2} * \text{static\_cast} < \text{signed int} > (\text{div}2.\text{quot}))
minof(signed int) \le temp2
temp2 \le maxof(signed int)
heap_{1032,1;1054,8} == heap_{1032,1;1051,8}.replace(this.$r \rightarrow
operator*(heapIs heap_{1032,1;1051,8}, this)._replace(p2 \rightarrow
asType<P2Type>(($heap<sub>1032,1:1051,8</sub>.M2 *
as Type < int > (static\_cast < integer > (static\_cast < signed))
int>(operator*(heapIs $heap_{1032,1;1051,8}, this).p2) < (int)0))) + temp2)))
Proof:
[Take given term]
[2.0] \operatorname{div1} == \operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_1032.1},
static\_cast < int > (operator*(heapIs $heap_{funcstart\_1032,1}, this).p1),
\mathbf{static\_cast}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_1032,1}.\mathrm{a1}))
→ [expand definition of operator '*' in class 'pointer' at built in declaration]
[2.1] \operatorname{div}1 == \operatorname{div}(\mathbf{heapIs} \ \operatorname{\$heap}_{funcstart\_1032,1},
static\_cast < int > (this. r.value(heapIs  heap_{funcstart\_1032,1}).p1),
\mathbf{static\_cast}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_1032,1}.\mathrm{a1}))
\rightarrow [simplify]
[2.2] \operatorname{div1} == \operatorname{div}(\mathbf{heapIs} \ \mathbf{\$heap}_{funcstart\_1032,1}, \ \mathbf{this}.\mathbf{\$r.value}(\mathbf{heapIs})
\rho_{tuncstart=1032,1}, p1, static_cast<int>(\rho_{tuncstart=1032,1})
\rightarrow [const static or extern object]
[2.3] \text{ div1} == \text{div(heapIs } \text{$heap}_{funcstart\_1032,1}, \text{ this.} \text{$r.value(heapIs)}
\theta_{funcstart\_1032,1}.p1, \theta_{funcstart\_1032,1}.p1, \theta_{funcstart\_1032,1}.p1, \theta_{funcstart\_1032,1}.p1, \theta_{funcstart\_1032,1}.p1, \theta_{funcstart\_1032,1}.p2, \theta_{funcstart\_1032,1}.p2, \theta_{funcstart\_1032,1}.p2, \theta_{funcstart\_1032,1}.p3, \theta_{funcstart\_1032,1}.p4, \theta_{funcstart\_1032,1}.p4, \theta_{funcstart\_1032,1}.p4, \theta_{funcstart\_1032,1}.p4, \theta_{funcstart\_1032,1}.p4, \theta_{funcstart\_1032,1}.p4, \theta_{funcstart\_1032,1}.p4, \theta_{funcstart\_1032,1}.p4, \theta_{funcstart\_1032,1}.p5, \theta_{funcstart\_1032,1}.p5, \theta_{funcstart\_1032,1}.p5, \theta_{funcstart\_1032,1}.p5, \theta_{funcstart\_1032,1}.p5, \theta_{funcstart\_1032,1}.p5, \theta_{funcstart\_1032,1}.p5, \theta_{funcstart\_1032,1
```

```
\rightarrow [expand definition of constant 'a1' at prang.cpp (30,26)]
[2.4] \text{ div1} == \text{div}(\text{heapIs } \text{heap}_{funcstart\_1032,1}, \text{this.}\text{\$r.value}(\text{heapIs})
\theta_{funcstart\_1032,1}.p1, \theta_{funcstart\_1032,1}.p1, \theta_{funcstart\_1032,1}.p1, \theta_{funcstart\_1032,1}.p1, \theta_{funcstart\_1032,1}.p1, \theta_{funcstart\_1032,1}.p1, \theta_{funcstart\_1032,1}.p2, \theta_{funcstart\_1032,1}.p2, \theta_{funcstart\_1032,1}.p2, \theta_{funcstart\_1032,1}.p2, \theta_{funcstart\_1032,1}.p2, \theta_{funcstart\_1032,1}.p3, \theta_{funcstart\_1032,1}.p4, \theta_{funcstart\_1032,1}.p4, \theta_{funcstart\_1032,1}.p4, \theta_{funcstart\_1032,1}.p5, \theta_{funcstart\_1032,1
\rightarrow [simplify]
[2.6] div1 == div(heapIs $heap_{funcstart\_1032,1}, this.$r.value(heapIs)
heap_{funcstart\_1032,1}.p1, 177)
[Assume known post-assertion, class invariant or type constraint for term 2.6]
[7.0] (0 < asType<integer>(this.$r.value(heapIs
\label{eq:continuous} $\operatorname{heap}_{funcstart\_1032,1}).p1)) \&\& (\mathbf{asType} < \mathbf{integer} > (\mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}))) \&\& (\mathbf{asType} < \mathbf{integer} > (\mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})))) \&\& (\mathbf{asType} < \mathbf{integer} > (\mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}))))) \&\& (\mathbf{asType} < \mathbf{integer} > (\mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})))) \&\& (\mathbf{asType} < \mathbf{integer} > (\mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})))))
\$ heap_{funcstart\_1032,1}).p1) < \mathbf{asType} < \mathbf{integer} > (\$ heap.\mathbf{class} \ WHPrang \in \texttt{Prang}) = \texttt{Prang} + \texttt{Prang} 
M1))
\rightarrow [simplify]
[7.2] (0 < this.$r.value(heapIs \rho_{funcstart\_1032,1}).p1) &&
(this.r.value(heapIs $heap_{funcstart\_1032,1}).p1 <
asType < integer > (\$heap.class WHPrang \in M1))
\rightarrow [const static or extern object]
[7.3] (0 < this.$r.value(heap
Is $heap_{funcstart\_1032,1}).p1) &&
(this.$r.value(heapIs heap_{funcstart\_1032,1}).p1 <
asType < integer > (\$heap_{init}.class WHPrang \in M1))
\rightarrow [expand definition of constant 'M1' at prang.cpp (28,26)]
[7.4] (0 < this.\$r.value(heapIs \$heap_{funcstart_1032.1}).p1) &&
(this.r.value(heapIs $heap_{funcstart\_1032,1}).p1 <
asType < integer > ((int)30269))
\rightarrow [simplify]
[7.10] (-30269 < -this.$r.value(heapIs heap_{funcstart\_1032,1}).p1) <math>\land (0 < 
this.r.value(heapIs $heap_{funcstart\_1032,1}).p1)
[Work on sub-term 2 of conjunction in term 7.10]
[8.0] 0 < this.$r.value(heapIs \theta_{funcstart\_1032,1}).p1
[Take given term]
[18.0] div2 == div(heapIs heap_{funcstart\_1032,1},
static_cast<int>(operator*(heapIs $heap_{funcstart\_1032,1}, this).p2),
\mathbf{static\_cast}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_1032,1}.\mathrm{a2}))
→ [expand definition of operator '*' in class 'pointer' at built in declaration]
[18.1] \operatorname{div2} == \operatorname{div}(\mathbf{heapIs} \ \operatorname{\$heap}_{funcstart\_1032,1},
static\_cast < int > (this. r.value(heapIs $heap_{funcstart\_1032,1}).p2),
static\_cast < int > (\$heap_{funcstart\_1032.1}.a2))
\rightarrow [simplify]
```

```
[18.2] \text{ div2} == \text{div}(\text{heapIs } \text{$heap}_{funcstart\_1032,1}, \text{this.}\text{$r.value}(\text{heapIs}))
\theta_{funcstart\_1032,1}.p2, \theta_{funcstart\_1032,1}.p2, \theta_{funcstart\_1032,1}.a2))
\rightarrow [const static or extern object]
\theta_{uncstart\_1032,1}.p2, \theta_{uncstart\_1032,1}.p3, \theta_{uncstart\_1032,1}.p2, \theta_{uncstart\_1032,1}.p2, \theta_{uncstart\_1032,1}.p3, \theta_{uncstart\_1032,1}.p4, \theta_{uncstart\_1032,1}.p4, \theta_{uncstart\_1032
\rightarrow [expand definition of constant 'a2' at prang.cpp (35,26)]
[18.4] div2 == div(\mathbf{heapIs} \$ \mathbf{heap}_{funcstart\_1032,1}, \mathbf{this}.\$ \mathbf{r.value}(\mathbf{heapIs})
\theta_{tuncstart\_1032.1}.p2, static_cast<int>((int)176))
\rightarrow [simplify]
[18.6] div2 == div(heapIs $heap<sub>funcstart_1032,1</sub>, this.$r.value(heapIs)
heap_{funcstart\_1032,1}.p2, 176)
[Assume known post-assertion, class invariant or type constraint for term 18.6]
[23.0] (0 < asType<integer>(this.$r.value(heapIs
\label{eq:loss_funcstart_1032,1} $$ $ p_{uncstart_1032,1}.p_2) \& \& (asType < integer > (this. r.value(heapIs)) $$
\rho_{tuncstart\_1032.1},p2) < asType<integer>(\rho_{tuncstart\_1032.1}).p2) < asType<integer>(\rho_{tuncstart\_1032.1}).p2)
M2))
\rightarrow [simplify]
[23.2] (0 < this.$r.value(heap
Is \rho_{uncstart\_1032,1}).p2) &&
(this.r.value(heapIs $heap_{funcstart\_1032,1}).p2 <
asType < integer > (\text{$heap.class WHPrang} \in M2))
\rightarrow [const static or extern object]
[23.3] (0 < this.$r.value(heapIs \rho_{funcstart\_1032,1}).p2) &&
(this.$r.value(heapIs heap_{funcstart\_1032,1}).p2 <
asType < integer > (\$heap_{init}.class WHPrang \in M2))
\rightarrow [expand definition of constant 'M2' at prang.cpp (33,26)]
[23.4] (0 < this.$r.value(heapIs heap_{funcstart\_1032,1}).p2) &&
(this.r.value(heapIs $heap_{funcstart\_1032,1}).p2 <
asType < integer > ((int)30307))
\rightarrow [simplify]
[23.10] (-30307 < -this.$r.value(heapIs \rho_{funcstart\_1032,1}).p2) \wedge (0 <
this.r.value(heapIs $heap_{funcstart\_1032,1}).p2)
[Work on sub-term 2 of conjunction in term 23.10]
[24.0] 0 < this.$r.value(heap
Is \rho_{uncstart\_1032,1}).p2
[Take given term]
[34.0] div3 == div(heapIs heap_{funcstart\_1032,1},
static\_cast < int > (operator*(heapIs $heap_{funcstart\_1032,1}, this).p3),
static\_cast < int > (\$heap_{funcstart\_1032,1}.a3))
```

```
→ [expand definition of operator '*' in class 'pointer' at built in declaration]
[34.1] \operatorname{div3} == \operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_1032,1},
static_cast<int>(this.$r.value(heapIs $heap_{funcstart\_1032,1}).p3),
\mathbf{static\_cast}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_1032,1}.\mathrm{a3}))
\rightarrow [simplify]
[34.2] \text{ div3} == \text{div(heapIs $heap}_{funcstart\_1032,1}, \text{ this.} \$r. \text{value(heapIs)}
\theta_{funcstart\_1032,1}.p3, \theta_{funcstart\_1032,1}.a3))
\rightarrow [const static or extern object]
[34.3] div3 == div(heapIs heapIs heapIs this.r.value(heapIs
\theta_{funcstart\_1032,1}.p3, \theta_{funcstart\_1032,1}.p4, \theta_{funcstart\_1032,1}.p4, \theta_{funcstart\_1032,1}.p4, \theta_{funcstart\_1032,1
\rightarrow [expand definition of constant 'a3' at prang.cpp (40,26)]
[34.4] \text{ div3} == \text{div(heapIs $heap}_{funcstart\_1032,1}, \text{ this.} \text{\$r.value(heapIs)}
\theta_{funcstart\_1032,1}.p3, \theta_{funcstart\_1032,1}.p4, \theta_{funcstart\_1032,1}.p4, \theta_{funcstart\_1032,1}.p4, \theta_{funcstart\_1032,1}.p4, \theta_{funcstart\_1032,1}.p5, \theta_{funcstart\_1032,1}.p5, \theta_{funcstart\_1032,1}.p5, \theta_{funcstart\_1032,1}.p5, \theta_{funcstart\_1032,1}.p5, \theta_{funcstart\_1032,1
\rightarrow [simplify]
[34.6] div3 == div(heapIs $heap<sub>funcstart_1032,1</sub>, this.$r.value(heapIs)
heap_{funcstart_{-1032,1}}.p3, 178)
[Assume known post-assertion, class invariant or type constraint for term 34.6]
[39.0] (0 < asType<integer>(this.\$r.value(heapIs
\verb§heap$_{funcstart\_1032,1}).p3)) \&\& (\mathbf{asType} < \mathbf{integer} > (\mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}))) \&\& (\mathbf{asType} < \mathbf{integer} > (\mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}))) \&\& (\mathbf{asType} < \mathbf{integer} > (\mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})))) \&\& (\mathbf{asType} < \mathbf{integer} > (\mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}))))) \&\& (\mathbf{asType} < \mathbf{integer} > (\mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}))))) \&\& (\mathbf{asType} < \mathbf{integer} > (\mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})))))
\label{eq:continuous} \$ \text{heap}_{funcstart\_1032,1}).\text{p3}) < \mathbf{asType} < \mathbf{integer} > (\$ \text{heap}.\mathbf{class} \ \text{WHPrang} \in \texttt{Continuous}) < \mathsf{class} \ \text{Continuous}
M3)
\rightarrow [simplify]
[39.2] (0 < this.$r.value(heap
Is $heap_{funcstart\_1032,1}).p3) &&
(this.r.value(heapIs $heap_{funcstart\_1032,1}).p3 <
asType < integer > (\text{$heap.class WHPrang} \in M3))
\rightarrow [const static or extern object]
[39.3] (0 < this.$r.value(heapIs \rho_{funcstart\_1032,1}).p3) &&
(this.r.value(heapIs $heap_{funcstart\_1032,1}).p3 <
asType < integer > (\$heap_{init}.class WHPrang \in M3))
\rightarrow [expand definition of constant 'M3' at prang.cpp (38,26)]
[39.4] (0 < this.$r.value(heapIs \rho_{funcstart\_1032,1}).p3) &&
(this.$r.value(heapIs heap_{funcstart\_1032,1}).p3 <
asType < integer > ((int)30323))
\rightarrow [simplify]
[39.10] (-30323 < -this.$r.value(heap
Is \rho_{uncstart\_1032,1}).p3) <math display="inline">\land (0 <
\mathbf{this.\$r.value}(\mathbf{heapIs}~\$\mathbf{heap}_{funcstart\_1032,1}).\mathbf{p3})
[Work on sub-term 2 of conjunction in term 39.10]
```

```
\ [40.0]\ 0 < {\bf this.\$r.value(heap Is}\ \$heap_{funcstart\_1032,1}).p3
[Assume known post-assertion, class invariant or type constraint for term 34.6]
[41.0] \; (\mathbf{asType} {<} \mathbf{integer} {>} (\mathbf{this.\$r.value} (\mathbf{heapIs} \; \$ \mathbf{heap}_{funcstart\_1032,1}).\mathbf{p3}) \; / \\
asType<integer>(178)) == asType<integer>(div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p3,
178).quot)
\rightarrow [simplify]
[41.2] (this.$r.value(heapIs $heap_{funcstart\_1032.1}).p3 / 178) ==
\mathbf{asType}{<}\mathbf{integer}{>}(\text{div}(\mathbf{heapIs}\ \$\text{heap}_{funcstart\_1032,1},\ \mathbf{this}.\$\mathbf{r}.\mathbf{value}(\mathbf{heapIs}\ \texttt{heap})
heap_{funcstart_{1032.1}}, p3, 178).quot
→ [expand definition of operator './' in class 'int' at built in declaration]
\textit{[41.3]} \; ([\textbf{asType} < \textbf{integer} > (\textbf{this}.\$r.\textbf{value}(\textbf{heapIs} \; \$ heap_{funcstart\_1032,1}).p3) < \texttt{1.3})
0]: -(-asType<integer>(this.$r.value(heapIs $heap_{tuncstart\_1032.1}).p3) /
178), []: asType<integer>(this.$r.value(heapIs $heap_{tuncstart\_1032.1}).p3) /
178) == asType < integer > (div(heapIs $heap_{funcstart\_1032,1},
\mathbf{this.\$r.value}(\mathbf{heapIs}\ \$\mathbf{heap}_{funcstart\_1032,1}).\mathbf{p}3,\ 178).\mathbf{quot})
→ [explicitly assert falsehood of skipped guards in subsequent guards]
[41.4] \; ([\mathbf{asType} < \mathbf{integer} > (\mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs} \; \$ \mathbf{heap}_{funcstart\_1032,1}).\mathbf{p3}) < \mathbf{page}) \\
0]: -(-asType < integer > (this. r.value(heapIs  heap_{funcstart\_1032,1}).p3) / (this. r.value(heapIs  heap_{funcstart\_1032,1}).p3)
178), [!(asType<integer>(this.$r.value(heapIs \rho_{tart_{-1032,1}}.p3) <
0)]: asType < integer > (this. r.value(heapIs  heap_{funcstart\_1032,1}).p3) / 
178) == asType<integer>(div(heapIs heap_{funcstart\_1032.1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p3, 178).quot)
\rightarrow [simplify]
[41.7] ([0 < -this.$r.value(heapIs \rho_{funcstart\_1032,1}).p3]:
-(-\mathbf{asType} < \mathbf{integer} > (\mathbf{this.\$r.value} (\mathbf{heapIs}\ \$ \mathbf{heap}_{funcstart\_1032,1}).\mathbf{p3})\ /
178), [!(asType<integer>(this.r.value(heapIs \heap_{funcstart\_1032,1}).p3) <
0)]: asType < integer > (this. r.value(heapIs <math>heapIs heap_{funcstart\_1032,1}).p3) / 
178) == asType < integer > (div(heapIs $heap_{funcstart\_1032.1},
this.r.value(heapIs $heap_{funcstart\_1032,1}).p3, 178).quot)
\rightarrow [from term 40.0, literala < -this.$r.value(heapIs $heap_{funcstart\_1032,1}).p3
is false whenever -2 < (0 + literala)
      Proof of rule precondition:
      [41.7.0] - 2 < (0 + 0)
      \rightarrow [simplify]
      [41.7.2] true
[41.8] ([false]: -(-asType<integer>(this.$r.value(heapIs
\theta_{funcstart\_1032,1}.p3) / 178, [!(asType<integer>(this.$r.value(heapIs)
\label{eq:funcstart_1032,1} $$ \operatorname{heap}_{funcstart_1032,1}.p3) < 0)$ ]: $$ \operatorname{asType}_{funcstart_1032,1}.p3) < 0)$ ]: $$ asType_{funcstart_1032,1}.p3) < 0)$ ]: $$ asType_{funcstart_1032,1}.p3) < 0)$ ] $$ asType_{funcstart_1032,1}.p3) < 0.00$ ] asType_{funcstart_1032,1}.p3) < 0.00$ ] $$ asType_{funcstart_1032
```

```
\label{eq:funcstart_1032,1} \$ heap_{funcstart\_1032,1}).p3) \ / \ 178) == \mathbf{asType} < \mathbf{integer} > (\mathrm{div}(\mathbf{heapIs})).p3) 
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p3,
178).quot)
\rightarrow [simplify]
[41.11] ([false]: -(-asType<integer>(this.$r.value(heapIs
\theta_{funcstart_{-1032,1}}.p3) / 178, [!\theta_{funcstart_{-1032,1}}.p3] / 178), [!\theta_{funcstart_{-1032,1}}.p3]
\theta_{funcstart\_1032,1}.p3) / 178 = asType < integer > (div(heapIs))
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p3,
178).quot)
\rightarrow [from term 40.0, literala < -this.$r.value(heapIs $heap_{funcstart\_1032,1}).p3
is false whenever -2 < (0 + literala)
     Proof of rule precondition:
     [41.11.0] - 2 < (0 + 0)
     \rightarrow [simplify]
     [41.11.2] true
\textit{[41.12] ([false]: -(-asType < integer > (this.\$r.value(heapIs))))}
heap_{funcstart\_1032,1}.p3) / 178, [!false]:
asType<integer>(this.$r.value(heapIs $heap_{funcstart\_1032,1}).p3) / 178)
== asType<integer>(div(heapIs heap_{funcstart\_1032,1},
\mathbf{this.\$r.value}(\mathbf{heapIs}~\$ \mathrm{heap}_{funcstart\_1032,1}).\mathrm{p3},~178).\mathrm{quot})
\rightarrow [simplify]
\label{eq:continuous} \textit{[41.17] } 0 == (-\text{div}(\mathbf{heapIs} \ \$ \text{heap}_{funcstart\_1032,1}, \ \mathbf{this}.\$ r. \mathbf{value}(\mathbf{heapIs} \ \texttt{heap}_{funcstart\_1032,1}, \ \mathbf{value}(\mathbf{heapIs}))
\rho_{tuncstart_{1032.1}}, p3, 178).quot + (this.\r.\value(heapIs)
heap_{funcstart_{1032,1}}.p3 / 178)
[Assume known post-assertion, class invariant or type constraint for term 34.6]
[42.0] (asType<integer>(this.r.value(heapIs \ heap_{funcstart\_1032,1}).p3) \%
asType<integer>(178)) == asType<integer>(div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p3,
178).\text{rem}
\rightarrow [simplify]
[42.2] (this.$r.value(heapIs heap_{funcstart\_1032,1}).p3 % 178) ==
\mathbf{asType}{<}\mathbf{integer}{>}(\mathbf{div}(\mathbf{heapIs}\ \$\mathbf{heap}_{funcstart\_1032,1},\ \mathbf{this.\$r.value}(\mathbf{heapIs}
\$ \operatorname{heap}_{funcstart\_1032,1}).p3,\, 178).rem)
→ [expand definition of operator '.%' in class 'int' at built in declaration]
[42.3] ([asType<integer>(this.$r.value(heapIs $heap_{funcstart\_1032.1}).p3) <
0]: -(-asType < integer > (this. r.value(heapIs  heap_{funcstart\_1032,1}).p3) \%
178), []: asType<integer>(this.$r.value(heapIs $heap_{tuncstart\_1032.1}).p3)
\% 178) == asType<integer>(div(heapIs $heap_{tuncstart\_1032,1},
```

```
this.r.value(heapIs $heap_{funcstart\_1032,1}).p3, 178).rem)
→ [explicitly assert falsehood of skipped guards in subsequent guards]
[42.4] \; ([\mathbf{asType} < \mathbf{integer} > (\mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs} \; \$ \mathbf{heap}_{funcstart\_1032,1}).\mathbf{p3}) < \mathbf{page}) \\
0]: -(-asType < integer > (this. r.value(heapIs  heap_{funcstart\_1032,1}).p3) %
178), [!(asType<integer>(this.r.value(heapIs \ heap_{funcstart\_1032,1}).p3) <
0)]: asType<integer>(this.$r.value(heapIs $heap_{tuncstart\_1032.1}).p3) %
178) == asType < integer > (div(heapIs $heap_{funcstart\_1032.1},
this.r.value(heapIs $heap_{funcstart\_1032,1}).p3, 178).rem)
\rightarrow [simplify]
[42.7] ([0 < -this.$r.value(heapIs $heap_{funcstart\_1032.1}).p3]:
-(-\mathbf{asType} < \mathbf{integer} > (\mathbf{this.\$r.value} (\mathbf{heapIs} \ \$ \mathbf{heap}_{funcstart\_1032,1}).\mathbf{p3}) \ \%
178), [!(asType<integer>(this.r.value(heapIs \heap_{funcstart\_1032,1}).p3) <
0)]: asType<integer>(this.r.value(heapIs $heap_{funcstart\_1032,1}).p3) %
178) == asType<integer>(div(heapIs $heap_{funcstart\_1032,1},
this.r.value(heapIs $heap_{funcstart\_1032,1}).p3, 178).rem)
\rightarrow [from term 40.0, literala < -this.$r.value(heapIs $heap_{funcstart\_1032,1}).p3
is false whenever -2 < (0 + literala)
        Proof of rule precondition:
        [42.7.0] - 2 < (0 + 0)
        \rightarrow [simplify]
        [42.7.2] true
[42.8] ([false]: -(-asType<integer>(this.$r.value(heapIs
$heap_tuncstart_1032.1).p3) % 178), [!(asType<integer>(this.$r.value(heapIs
\{\text{heap}_{funcstart\_1032.1}\}.p3) < 0)]: asType<integer>(this.r.value(\text{heapIs})
\theta_{funcstart\_1032,1}.p3) \% 178 = asType < integer > (div(heapIs))
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p3,
178).rem)
\rightarrow [simplify]
[42.11] ([false]: -(-asType<integer>(this.$r.value(heapIs
heap_{funcstart\_1032,1}.p3) \% 178, [!(0 < -this. r.value(heapIs)]
\verb§heap$ funcstart\_1032,1).p3)]: \textbf{ asType} < \textbf{integer} > (\textbf{this}.\$r.\textbf{value}(\textbf{heapIs})) + \textbf{funcstart} = \textbf
\theta_{funcstart\_1032,1}.p3) \% 178 = asType < integer > (div(heapIs))
\rho_{tuncstart_1032.1}, this.r.value(heapIs \rho_{tuncstart_1032.1}).p3,
178).rem)
\rightarrow [from term 40.0, literala < -this.$r.value(heapIs $heap_{funcstart\_1032,1}).p3
is false whenever -2 < (0 + literala)
```

$$[42.11.0]$$
 -2 < (0 + 0)
→ $[simplify]$

```
[42.11.2] true
[42.12] ([false]: -(-asType<integer>(this.$r.value(heapIs
heap_{funcstart_{1032,1}}.p3) \% 178, [!false]:
asType<integer>(this.$r.value(heapIs $heap_{funcstart\_1032,1}).p3) % 178)
== asType<integer>(div(heapIs $heap_{tuncstart\_1032.1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p3, 178).rem)
\rightarrow [simplify]
[42.17] \ 0 == (-\text{div}(\textbf{heapIs} \ \$ \text{heap}_{funcstart\_1032,1}, \ \textbf{this}.\$ \textbf{r.value}(\textbf{heapIs} \ \texttt{heap}_{funcstart\_1032,1}, \ \textbf{this}.\$ \textbf{r.value}))
\theta_{tuncstart_1032,1}.p3, 178).rem + (this.r.value(heapIs)
heap_{funcstart_{1032,1}}.p3 \% 178)
[Take given term]
[47.0] (asType<integer>(operator*(heapIs $heap_{tuncstart\_1032,1}, this).p3)
< asType<integer>($heap_{funcstart\_1032,1}.a3)) =>
(asType<integer>(div3.rem) == asType<integer>(operator*(heapIs
heap_{funcstart_{1032,1}}, this).p3)
→ [expand definition of operator '*' in class 'pointer' at built in declaration]
[47.1] \; (\mathbf{asType} < \mathbf{integer} > (\mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs} \; \$ \mathbf{heap}_{funcstart\_1032,1}).\mathbf{p3}) < \mathbf{page}(\mathbf{page}) 
asType < integer > (\$heap_{tuncstart_1032,1}.a3)) = >
(asType<integer>(div3.rem) == asType<integer>(operator*(heapIs
heap_{funcstart\_1032,1}, this).p3)
\rightarrow [simplify]
[47.2] (this.$r.value(heapIs $heap_{funcstart\_1032.1}).p3 <
asType < integer > (\$heap_{funcstart\_1032,1}.a3)) = >
(asType<integer>(div3.rem) == asType<integer>(operator*(heapIs
heap_{funcstart_1032,1}, this).p3)
\rightarrow [const static or extern object]
[47.3] (this.$r.value(heapIs \rho_{funcstart\_1032,1}).p3 <
\mathbf{asType} < \mathbf{integer} > (\$ \mathbf{heap}_{init}.\mathbf{a3})) = > (\mathbf{asType} < \mathbf{integer} > (\mathbf{div3.rem}) = =
\mathbf{asType} < \mathbf{integer} > (\mathbf{operator}^*(\mathbf{heapIs} \ \$ \mathbf{heap}_{funcstart\_1032,1}, \ \mathbf{this}).\mathbf{p3}))
\rightarrow [expand definition of constant 'a3' at prang.cpp (40,26)]
[47.4] (this.$r.value(heapIs \theta_{funcstart\_1032,1}).p3 <
asType<integer>((int)178)) => (asType<integer>(div3.rem) ==
asType<integer>(operator*(heapIs $heap_{funcstart\_1032.1}, this).p3))
\rightarrow [simplify]
[47.9] (-178 < -this.$r.value(heapIs $heap_{funcstart\_1032,1}).p3) =>
(asType<integer>(div3.rem) == asType<integer>(operator*(heapIs
heap_{funcstart\_1032,1}, this).p3)
\rightarrow [from term 34.6, div3 is equal to div(heapIs $heap_{funcstart\_1032,1},
this.r.value(heapIs $heap_{funcstart\_1032,1}).p3, 178)
```

```
[47.10] \; (-178 < -\mathbf{this.}\$r.\mathbf{value}(\mathbf{heapIs} \; \$heap_{funcstart\_1032,1}).p3) = >
(\mathbf{asType} < \mathbf{integer} > (\mathbf{div}(\mathbf{heapIs} \ \$ \mathbf{heap}_{funcstart\_1032,1}, \ \mathbf{this}.\$ \mathbf{r.value}(\mathbf{heapIs} \ \mathsf{heap}_{funcstart\_1032,1}, \ \mathbf{this}.\$ \mathbf{r.value}(\mathbf{heapIs} \ \mathsf{heap}_{funcstart\_1032,1}, \ \mathbf{this}.\$ \mathbf{r.value}(\mathbf{heapIs} \ \mathsf{heap}_{funcstart\_1032,1}, \ \mathbf{this}.\$ \mathbf{r.value}(\mathbf{heapIs}))
heap_{funcstart_1032,1}.p3, 178).rem = 
asType<integer>(operator*(heapIs $heap_{funcstart\_1032.1}, this).p3))
\rightarrow [simplify]
[47.11] (-178 < -this.$r.value(heapIs $heap_{funcstart\_1032,1}).p3) =>
(\text{div}(\mathbf{heapIs} \$ \text{heap}_{funcstart\_1032,1}, \mathbf{this}.\$ \text{r.value}(\mathbf{heapIs}))
heap_{funcstart_1032,1}.p3, 178).rem ==
\mathbf{asType} < \mathbf{integer} > (\mathbf{operator}^*(\mathbf{heapIs} \ \$ \mathbf{heap}_{funcstart\_1032,1}, \ \mathbf{this}).\mathbf{p3}))
→ [expand definition of operator '*' in class 'pointer' at built in declaration]
[47.12] (-178 < -this.$r.value(heapIs heap_{funcstart\_1032,1}).p3) =>
(\text{div}(\mathbf{heapIs} \$ \text{heap}_{funcstart\_1032.1}, \mathbf{this}.\$ \text{r.value}(\mathbf{heapIs}))
heap_{funcstart_1032,1}.p3, 178).rem ==
asType<integer>(this.$r.value(heapIs $heap_{funcstart\_1032,1}).p3))
\rightarrow [simplify]
[47.18] (0 == (-this.$r.value(heapIs $heap_{funcstart\_1032,1}).p3 + div(heapIs)
\rho_{funcstart_1032,1}, this. r.value(heapIs \rho_{funcstart_1032,1}).p3,
178).rem)) \vee (177 < this.$r.value(heapIs $heap_{funcstart\_1032,1}).p3)
[Take given term]
[50.0] (($heap_funcstart_1032,1.r1 * static_cast<signed int>(div1.rem)) -
(\text{\$heap}_{funcstart\_1032,1}.\text{b1 * static\_cast} < \text{signed int} > (\text{div1.quot}))) = = \text{temp1}
\rightarrow [const static or extern object]
[50.1] (($heap<sub>init</sub>.r1 * static_cast<signed int>(div1.rem)) -
(\text{\$heap}_{funcstart\_1032,1}.\text{b1 * static\_cast} < \text{signed int} > (\text{div1.quot}))) == \text{temp1}
\rightarrow [expand definition of constant 'r1' at prang.cpp (29,26)]
[50.2] (((int)171 * static_cast<signed int>(div1.rem)) -
(\text{\$heap}_{funcstart\_1032,1}.\text{b1 * static\_cast} < \text{signed int} > (\text{div1.quot}))) == \text{temp1}
\rightarrow [simplify]
[50.3] ((171 * static_cast<signed int>(div1.rem)) - ($heap_{tuncstart_1032.1}.b1
* static_cast<signed int>(div1.quot))) == temp1
\rightarrow [from term 2.6, div1 is equal to div(heapIs $heap_{funcstart\_1032.1},
this.r.value(heapIs \ heap_{funcstart\_1032.1}).p1, 177)
[50.4] ((171 * static_cast<signed int>(div(heapIs $heap_{funcstart\_1032.1},
this.r.value(heapIs \ heap_{funcstart\_1032.1}).p1, 177).rem)) -
(\text{sheap}_{funcstart\_1032,1}.\text{b1 * static\_cast} < \text{signed int} > (\text{div1.quot}))) == \text{temp1}
\rightarrow [simplify]
[50.5] ((171 * \mathrm{div}(\mathbf{heapIs}\ \$\mathrm{heap}_{funcstart\_1032,1},\ \mathbf{this}.\$\mathrm{r.value}(\mathbf{heapIs}
\text{Sheap}_{funcstart\_1032,1}.p1, 177).rem) - (\text{Sheap}_{funcstart\_1032,1}.b1 *
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```
static_cast<signed int>(div1.quot))) == temp1
\rightarrow [const static or extern object]
[50.6] ((171 * \operatorname{div}(\mathbf{heapIs} \ \mathbf{sheap}_{funcstart\_1032,1}, \mathbf{this}.\mathbf{sr.value}(\mathbf{heapIs})
\theta_{funcstart\_1032,1}.p1, 177).rem) - (\theta_{funcstart\_1032,1}.rem) - (\theta_{funcstart\_1032,1}).p1, 177).rem)
int>(div1.quot)) == temp1
\rightarrow [expand definition of constant 'b1' at prang.cpp (31,26)]
[50.7] ((171 * div(heapIs \$heap_{funcstart\_1032,1}, this.\$r.value(heapIs
\theta_{funcstart\_1032,1}.p1, 177).rem - ((int)2 * static\_cast < signed)
int>(div1.quot)) = temp1
\rightarrow [simplify]
[50.8] ((171 * div(heapIs $heap_{funcstart\_1032,1}, this.$r.value(heapIs 
\rho_{tuncstart\_1032.1}, p1, 177).rem) - (2 * static_cast<signed
int>(div1.quot)) == temp1
\rightarrow [from term 2.6, div1 is equal to div(heapIs $heap_{funcstart\_1032,1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177)]
[50.9] ((171 * div(heapIs $heap_{funcstart\_1032,1}, this.$r.value(heapIs)
\theta_{funcstart\_1032,1}.p1, 177).rem - (2 * static\_cast < signed)
int>(div(heapIs \$heap_{funcstart\_1032,1}, this.\$r.value(heapIs
\text{Sheap}_{funcstart\_1032,1}).p1, 177).quot))) == temp1
\rightarrow [simplify]
[50.14] 0 == (-\text{temp1} + (-2 * \text{div}(\text{heapIs } \text{$heap}_{funcstart\_1032,1},
this.r.value(heapIs \ensuremath{\$}heap_{funcstart\_1032,1}).p1, 177).quot) + (171 *
div(\mathbf{heapIs} \$ heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
heap_{funcstart_{1032.1}}.p1, 177).rem
[Take given term]
[53.0] heap_{1032,1;1051,8} == heap_{funcstart\_1032,1}._replace(this.$r \rightarrow
operator*(heapIs heap_{funcstart\_1032,1}, this)._replace(p1 \rightarrow
asType < P1Type > ((\$heap_{funcstart\_1032,1}.M1 *
asType<int>(static_cast<integer>(static_cast<signed
int>(operator^*(heapIs \$heap_{tuncstart\_1032.1}, this).p1) < (int)0))) +
→ [expand definition of operator '*' in class 'pointer' at built in declaration]
[53.1] \theta_{1032,1;1051,8} == \theta_{funcstart\_1032,1}._replace(this.$r \to
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow
asType<P1Type>(($heap<sub>funcstart_1032.1</sub>.M1 *
asType<int>(static_cast<integer>(static_cast<signed
int>(operator^*(heapIs \$heap_{funcstart\_1032,1}, this).p1) < (int)0))) +
temp1)))
\rightarrow [const static or extern object]
```

```
[53.2] \theta_{1032,1;1051,8} == \theta_{funcstart_{-1032,1}}.replace(this.$r \to
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow
asType<P1Type>(($heap<sub>init</sub>.M1 *
asType<int>(static_cast<integer>(static_cast<signed
int>(operator^*(heapIs \$heap_{funcstart\_1032,1}, this).p1) < (int)0))) +
temp1)))
\rightarrow [expand definition of constant 'M1' at prang.cpp (28,26)]
[53.3] $heap<sub>1032,1;1051,8</sub> == $heap<sub>funcstart_1032,1</sub>._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow
asType<P1Type>(((int)30269 *
asType<int>(static_cast<integer>(static_cast<signed
\mathbf{int} > (\mathbf{operator}^*(\mathbf{heapIs} \ \$ \mathbf{heap}_{funcstart\_1032,1}, \ \mathbf{this}).\mathtt{p1}) < (\mathbf{int})0))) \ +
temp1)))
\rightarrow [simplify]
[53.4] heap_{1032,1;1051,8} == heap_{funcstart\_1032,1}._replace(this.r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow
asType<P1Type>((30269 *
asType{<}int{>}(static\_cast{<}integer{>}(static\_cast{<}signed
int>(operator^*(heapIs $heap_{funcstart\_1032,1}, this).p1) < (int)0))) +
temp1)))
→ [expand definition of operator '*' in class 'pointer' at built in declaration]
[53.5] heap_{1032,1;1051,8} == heap_{funcstart\_1032,1}._replace(this.$r \rightarrow
\mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}~\$heap_{funcstart\_1032,1}).\_\mathbf{replace}(p1 \rightarrow
asType<P1Type>((30269 *
asType<int>(static_cast<integer>(static_cast<signed
int>(this.\$r.value(heapIs \$heap_{funcstart\_1032,1}).p1) < (int)0))) + temp1)))
\rightarrow [simplify]
[53.9] heap_{1032,1;1051,8} == heap_{funcstart\_1032,1}._replace(this.r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow
asType<P1Type>((30269 * asType<int>(static_cast<integer>(0 <
-\mathbf{this.}\$r.\mathbf{value}(\mathbf{heapIs}\ \$\mathrm{heap}_{funcstart\_1032,1}).\mathrm{p1}))) + \mathrm{temp1})))
\rightarrow [from term 8.0, literala < -this.$r.value(heapIs $heap_{funcstart\_1032.1}).p1
is false whenever -2 < (0 + literala)
    Proof of rule precondition:
    [53.9.0] - 2 < (0 + 0)
    \rightarrow [simplify]
    [53.9.2] true
[53.10] $\text{heap}_{1032,1;1051,8} == $\text{heap}_{funcstart\_1032,1}._\text{replace}(\text{this.}\text{$\frac{1}{2}}\text{$\text{op}}]$
this.$r.value(heapIs $heap_{tuncstart\_1032,1}).$replace(p1 $\rightarrow$ asType<P1Type>((30269 * asType<int>(static_cast<integer>(false)))
```

```
+ \text{temp1})))
\rightarrow [simplify]
[53.11] heap_{1032,1:1051,8} == heap_{funcstart\_1032,1}._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow
asType < P1Type > ((30269 * asType < int > (([false]: 1, []: 0))) + temp1)))
→ [explicitly assert falsehood of skipped guards in subsequent guards]
[53.12] $heap<sub>1032,1;1051,8</sub> == $heap<sub>funcstart_1032,1</sub>._replace(this.$r \rightarrow
this.$r.value(heapIs \rho_{funcstart\_1032,1})._replace(p1 \rightarrow
temp1)))
\rightarrow [simplify]
[53.15] $heap<sub>1032,1;1051,8</sub> == $heap<sub>funcstart_1032,1</sub>._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow
asType < P1Type > (0 + temp1))
\rightarrow [from term 50.14, temp1 is equal to (-2 * div(heapIs $heap_{funcstart\_1032,1},
this.$r.value(heapIs $heap_{tuncstart\_1032,1}).p1, 177).quot) + (171 *
div(\mathbf{heapIs}\ \$heap_{funcstart\_1032,1},\ \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}
heap_{funcstart_{-1032,1}}.p1, 177).rem
[53.16] heap_{1032,1;1051,8} == heap_{funcstart\_1032,1}.\_replace(this.$r \rightarrow funcstart\_1032,1]
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow
asType < P1Type > (0 + ((-2 * div(heapIs $heap_{tuncstart\_1032.1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177).quot) + (171 *
div(heapIs $heap<sub>funcstart_1032,1</sub>, this.$r.value(heapIs
heap_{funcstart_1032,1}.p1, 177.rem))))
\rightarrow [simplify]
[53.19] $\text{heap}_{1032,1;1051,8} == $\text{heap}_{funcstart\_1032,1}._\text{replace}(\text{this.}\text{$\frac{1}{2}}\text{$\text{op}}]$
\textbf{this.}\$r.\textbf{value}(\textbf{heapIs}~\$heap_{funcstart\_1032,1}).\_\textbf{replace}(p1 \rightarrow ((\text{-}2~*\text{div}(\textbf{heapIs}
\rho_{tuncstart=1032.1}, this.r.value(heapIs \rho_{tuncstart=1032.1}).p1,
177).quot) + (171 * div(heapIs \rho_{funcstart\_1032,1}, this.r.value(heapIs)
heap_{funcstart\_1032,1}.p1, 177.rem)))
[Take given term]
[54.0] \; ((\$heap_{1032,1;1051,8}.r2 * \mathbf{static\_cast} < \mathbf{signed int} > (div2.rem)) \; - \\
(\text{sheap}_{1032.1:1051.8}.\text{b2} * \text{static\_cast} < \text{signed int} > (\text{div2.quot}))) == \text{temp2}
\rightarrow [from term 53.19, $heap<sub>1032,1;1051,8</sub> is equal to
$heap_{funcstart\_1032,1}.$_replace(this.$r \rightarrow this.$r.value(heapIs)
heap_{funcstart\_1032,1}._replace(p1 \rightarrow (-2 * div(heapIs heap_{funcstart\_1032,1}),
div(\mathbf{heapIs} \ \$heap_{funcstart\_1032,1}, \ \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
heap_{funcstart\_1032,1}.p1, 177).rem)))]
[54.1] \; ((\$ heap_{funcstart\_1032,1}.\_\mathbf{replace}(\mathbf{this}.\$r \to \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}))) \\
```

```
\text{Sheap}_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs \text{Sheap}_{funcstart\_1032,1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177).quot) + (171)
div(\mathbf{heapIs} \$ heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
\rho_{funcstart\_1032,1}.p1, 177).rem))).r2 * static_cast < signed
int>(div2.rem)) - (\$heap_{1032,1;1051,8}.b2 * static\_cast < signed
int > (div2.quot))) == temp2
\rightarrow [const member of object with modified fields]
[54.2]\;((\$heap_{funcstart\_1032,1}.r2\;*\;\textbf{static\_cast}{<}\textbf{signed int}{>}(\text{div}2.\text{rem}))\;-
(\text{\$heap}_{1032,1;1051,8}.\text{b2} * \textbf{static\_cast} < \textbf{signed int} > (\text{div2.quot}))) = \text{temp2}
\rightarrow [const static or extern object]
[54.3] (($heap<sub>init</sub>.r2 * static_cast<signed int>(div2.rem)) -
(\text{sheap}_{1032,1;1051,8}.\text{b2} * \text{static\_cast} < \text{signed int} > (\text{div2.quot}))) == \text{temp2}
\rightarrow [expand definition of constant 'r2' at prang.cpp (34,26)]
[54.4] (((int)172 * static_cast<signed int>(div2.rem)) -
(\$heap_{1032,1;1051,8}.b2 * \textbf{static\_cast} < \textbf{signed int} > (\texttt{div2}.\texttt{quot}))) == temp2
\rightarrow [simplify]
[54.5] ((172 * static_cast<signed int>(div2.rem)) - ($heap_{1032.1:1051.8}.b2 *
static_cast<signed int>(div2.quot))) == temp2
\rightarrow [from term 18.6, div2 is equal to div(heapIs $heap_{funcstart\_1032,1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p2, 176)
[54.6] ((172 * static_cast<signed int>(div(heapIs $heap_{funcstart\_1032,1},
this.r.value(heapIs $heap_{funcstart\_1032,1}).p2, 176).rem)) -
(\text{sheap}_{1032.1:1051.8}.\text{b2} * \text{static\_cast} < \text{signed int} > (\text{div2.quot}))) == \text{temp2}
\rightarrow [simplify]
[54.7] ((172 * div(heapIs $heap<sub>funcstart_1032,1</sub>, this.$r.value(heapIs)
\text{Sheap}_{tuncstart\_1032.1}.p2, 176).rem) - (\text{Sheap}_{1032.1:1051.8}.b2 *
static_cast<signed int>(div2.quot))) == temp2
\rightarrow [from term 53.19, $heap<sub>1032,1;1051,8</sub> is equal to
$heap_{funcstart\_1032,1}.$_replace(this.$r \rightarrow this.$r.value(heapIs)
heap_{funcstart\_1032,1}._replace(p1 \rightarrow (-2 * div(heapIs heap_{funcstart\_1032,1})
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177).quot) + (171 *
div(\mathbf{heapIs} \ \$heap_{funcstart\_1032,1}, \ \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
heap_{funcstart\_1032,1}.p1, 177).rem)))]
[54.8] ((172 * div(heap
Is \rho_{funcstart\_1032,1}, this.\r.value(heap
Is
\rho_{tuncstart\_1032.1}.p2, 176).rem – (\rho_{tuncstart\_1032.1}.replace)
\rightarrow this.$r.value(heap
Is \rho_{uncstart\_1032,1})._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_1032,1}, \ \mathbf{this}.\$ r. \mathbf{value}(\mathbf{heapIs}
\rho_{funcstart_{1032,1}}.p1, 177).quot + (171 * div(heapIs $heap_{funcstart_{1032,1}})
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177).rem)))).b2 *
static_cast<signed int>(div2.quot))) == temp2
```

```
\rightarrow [const member of object with modified fields]
[54.9] ((172 * div(heapIs $heap<sub>funcstart_1032,1</sub>, this.$r.value(heapIs
\text{Sheap}_{funcstart\_1032,1}.p2, 176).rem) - (\text{Sheap}_{funcstart\_1032,1}.b2 *
static_cast<signed int>(div2.quot))) == temp2
\rightarrow [const static or extern object]
[54.10] ((172 * div(heapIs $heap_{funcstart\_1032,1}, this.$r.value(heapIs
\rho_{tuncstart\_1032,1}.p2, 176).rem – (\rho_{tuncstart\_1032,1}.p2, 176).rem
int>(div2.quot)) == temp2
\rightarrow [expand definition of constant 'b2' at prang.cpp (36,26)]
[54.11] ((172 * div(heapIs heap_{funcstart\_1032,1}, this.r.value(heapIs)
\theta_{nucstart\_1032,1}.p2, 176).rem - ((int)35 * static_cast < signed
int>(div2.quot)) == temp2
\rightarrow [simplify]
[54.12] ((172 * div(heapIs $heap<sub>funcstart_1032,1</sub>, this.$r.value(heapIs)
\theta_{funcstart\_1032,1}.p2, 176).rem) - (35 * static_cast<signed)
int>(div2.quot)) == temp2
\rightarrow [from term 18.6, div2 is equal to div(heapIs $heap_{funcstart\_1032,1},
this.r.value(heapIs $heap_{funcstart\_1032,1}).p2, 176)
[54.13] ((172 * div(heapIs $heap<sub>funcstart_1032,1</sub>, this.$r.value(heapIs)
\theta_{funcstart\_1032,1}.p2, 176).rem) - (35 * static_cast<signed)
int>(div(heapIs \$heap_{funcstart\_1032,1}, this.\$r.value(heapIs
\$ \mathrm{heap}_{funcstart\_1032,1}).\mathrm{p2},\, 176).\mathrm{quot}))) == \, \mathrm{temp2}
\rightarrow [simplify]
[54.18] 0 == (-\text{temp2} + (-35 * \text{div}(\text{heapIs} \$\text{heap}_{funcstart\_1032,1})]
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p2, 176).quot) + (172 *
div(\mathbf{heapIs} \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
heap_{funcstart_{1032,1}}.p2, 176).rem
[Take given term]
[57.0] $\text{heap}_{1032,1;1054,8} == $\text{heap}_{1032,1;1051,8}._\text{replace}(\text{this}.$\text{$r} \to \text{
operator*(heapIs heap_{1032,1;1051,8}, this)._replace(p2 \rightarrow
asType<P2Type>(($heap<sub>1032,1;1051.8</sub>.M2 *
asType<int>(static_cast<integer>(static_cast<signed
int>(operator^*(heapIs $heap_{1032,1;1051,8}, this).p2) < (int)(0))) + temp(2)))
\rightarrow [from term 53.19, $heap<sub>1032,1;1051,8</sub> is equal to
heap_{funcstart\_1032.1}._replace(this.r \rightarrow this.r.value(heapIs)
heap_{funcstart\_1032,1}._replace(p1 \rightarrow (-2 * div(heapIs p_{funcstart\_1032,1}).
this.$r.value(heapIs heap_{funcstart\_1032,1}).p1, 177).quot) + (171 *
div(\mathbf{heapIs} \ \$heap_{funcstart\_1032,1}, \ \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
heap_{funcstart_{-1032.1}}.p1, 177).rem)))
```

```
[57.2] heap_{1032,1;1054,8} == heap_{funcstart\_1032,1}._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.} \text{\$r.value}(\text{heapIs}))
\rho_{funcstart\_1032,1}.p1, 177).rem)))._replace(this.$r \rightarrow operator*(heapIs)
\rho_{funcstart\_1032,1}._replace(this.r \to this.r.value(heapIs)
heap_{funcstart\_1032,1}._replace(p1 \rightarrow (-2 * div(heapIs p_{funcstart\_1032,1}).
this.$r.value(heapIs heap_{funcstart_{-1032,1}}).p1, 177).quot) + (171 *
div(\mathbf{heapIs} \$ heap_{funcstart\_1032.1}, \mathbf{this.}\$r.\mathbf{value}(\mathbf{heapIs})
\theta_{tuncstart_{1032,1}}.p1, 177).rem)), this).replace(p2 \rightarrow
\mathbf{asType}{<} \text{P2Type}{>} ((\$\text{heap}_{1032,1;1051,8}.\text{M2} *
asType<int>(static_cast<integer>(static_cast<signed
int>(operator^*(heapIs $heap_{1032,1;1051,8}, this).p2) < (int)0))) + temp2)))
→ [expand definition of operator '*' in class 'pointer' at built in declaration]
[57.3] heap_{1032,1;1054,8} == heap_{funcstart\_1032,1}._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032.1}, \text{this.} \text{\$r.value}(\text{heapIs}))
\theta_{funcstart\_1032,1}.p1, 177).rem))))._replace(this.$r \rightarrow
this.$r.value(heap
Is $heap_{funcstart\_1032,1}._replace(this.$r \rightarrow
this.$r.value(heapIs \rho_{tuncstart\_1032.1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{tuncstart\_1032.1}, this.r.value(heapIs \rho_{tuncstart\_1032.1}).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.} \text{\$r.value}(\text{heapIs}))
\theta_{funcstart\_1032,1}.p1, 177).rem))))).\_replace(p2 \rightarrow
asType<P2Type>(($heap<sub>1032.1:1051.8</sub>.M2 *
asType<int>(static_cast<integer>(static_cast<signed
int>(operator^*(heapIs $heap_{1032,1;1051,8}, this).p2) < (int)(0))) + temp(2)))
→ [evaluate dereferenced pointer into modified heap]
[57.4] heap_{1032,1;1054,8} == heap_{funcstart\_1032,1}._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\theta_{funcstart\_1032,1}, this.\r.value(heapIs \theta_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs \theta_{funcstart\_1032,1}, this.r.value(heapIs)
\rho_{funcstart\_1032.1}.p1, 177).rem)))._replace(this.$r \rightarrow ([this.$r ==
this.$r]: this.$r.value(heapIs \rho_{tuncstart\_1032,1})._replace(p1 \rightarrow (-2 *
div(\mathbf{heapIs} \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
\text{Sheap}_{funcstart\_1032,1}.p1, 177).quot) + (171 * div(heapIs \text{Sheap}_{funcstart\_1032,1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177).rem)), []:
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p2 \rightarrow
asType<P2Type>(($heap<sub>1032,1:1051,8</sub>.M2 *
asType < int > (static\_cast < integer > (static\_cast < signed
int>(operator^*(heapIs $heap_{1032.1:1051.8}, this).p2) < (int)(0))) + temp(2)))
→ [explicitly assert falsehood of skipped guards in subsequent guards]
[57.5] $heap<sub>1032,1:1054,8</sub> == $heap<sub>funcstart_1032,1</sub>._replace(this.$r \rightarrow
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```
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.}\text{\$r.value}(\text{heapIs}))
\rho_{funcstart\_1032,1}.p1, 177).rem)))._replace(this.$r \rightarrow ([this.$r ==
this.$r]: this.$r.value(heapIs \rho_{tuncstart\_1032,1})._replace(p1 \rightarrow (-2 *
div(\mathbf{heapIs} \$ heap_{funcstart\_1032.1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
\text{Sheap}_{funcstart\_1032.1}.p1, 177).quot) + (171 * div(heapIs \text{Sheap}_{funcstart\_1032.1},
this.r.value(heapIs \heap_{funcstart\_1032.1}).p1, 177).rem)), [!(this.<math>r = 
this.$r)]: this.$r.value(heapIs \rho_{funcstart\_1032,1})._replace(p2 \rightarrow
asType<P2Type>(($heap<sub>1032,1;1051,8</sub>.M2 *
as Type < int > (static\_cast < integer > (static\_cast < signed
int>(operator^*(heapIs $heap_{1032,1;1051,8}, this).p2) < (int)0))) + temp2)))
\rightarrow [simplify]
[57.7] heap_{1032,1;1054,8} == heap_{funcstart\_1032,1}._replace(this.r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart_1032,1}, this.r.value(heapIs \rho_{funcstart_1032,1}).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.} \text{\$r.value}(\text{heapIs}))
\theta_{funcstart\_1032,1}.p1, 177).rem))))._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this. r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs $heap<sub>funcstart_1032.1</sub>, this.$r.value(heapIs
\theta_{funcstart\_1032.1}.p1, 177).rem)))._replace(p2 \rightarrow
asType<P2Type>(($heap<sub>1032.1:1051.8</sub>.M2 *
asType < int > (static\_cast < integer > (static\_cast < signed
int>(operator^*(heapIs \$heap_{1032,1;1051,8}, this).p2) < (int)(0))) + temp(2)))
\rightarrow [from term 53.19, $heap<sub>1032.1:1051.8</sub> is equal to
\$heap_{funcstart\_1032,1}.\_\textbf{replace}(\textbf{this}.\$r \rightarrow \textbf{this}.\$r.\textbf{value}(\textbf{heapIs}
heap_{funcstart\_1032,1}._replace(p1 \rightarrow (-2 * div(heapIs $heap_{funcstart\_1032,1}).
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177).quot) + (171)
div(heapIs $heap_{funcstart_1032.1}, this.$r.value(heapIs
heap_{funcstart\_1032,1}.p1, 177.rem)))
[57.8] heap_{1032,1;1054,8} == heap_{funcstart\_1032,1}._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{heap}_{funcstart\_1032,1}, \text{this.}\text{$r.value}(\text{heapIs}))
\theta_{funcstart\_1032,1}.p1, 177).rem)))).\_replace(this.\$r \rightarrow 0
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.}\text{\$r.value}(\text{heapIs}))
\theta_{funcstart\_1032,1}.p1, 177).rem))).\_replace(p2 \rightarrow
asType < P2Type > ((\$heap_{tuncstart\_1032.1}.\_replace(this.\$r \rightarrow
this.$r.value(heapIs \rho_{tuncstart\_1032.1})._replace(p1 \rightarrow ((-2 * div(heapIs
$heap_tuncstart_1032.1, this.$r.value(heapIs $heap_tuncstart_1032.1).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.} \text{\$r.value}(\text{heapIs}))
```

```
\theta_{funcstart_{-1032,1}}.p1, 177).rem)))).M2 *
asType<int>(static_cast<integer>(static_cast<signed
int>(operator^*(heapIs $heap_{1032,1;1051,8}, this).p2) < (int)(0))) + temp(2)))
→ [const member of object with modified fields]
[57.9] heap_{1032,1;1054,8} == heap_{funcstart\_1032,1}._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032.1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{heap}_{funcstart\_1032,1}, \text{this.}\text{$r.value}(\text{heapIs}))
\theta_{funcstart\_1032,1}.p1, 177).rem))))._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\ 1032.1}).replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs \theta_{funcstart\_1032,1}, this.r.value(heapIs)
\theta_{funcstart\_1032,1}.p1, 177).rem))).\_replace(p2 \rightarrow
asType < P2Type > ((\$heap_{funcstart\_1032,1}.M2)^*
asType<int>(static_cast<integer>(static_cast<signed
int > (operator^*(heapIs \$heap_{1032,1;1051,8}, this).p2) < (int)0))) + temp2)))
\rightarrow [const static or extern object]
[57.10] $heap<sub>1032,1;1054,8</sub> == $heap<sub>funcstart_1032,1</sub>._replace(this.$r \rightarrow
this.$r.value(heapIs \rho_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.}\text{\$r.value}(\text{heapIs}))
\theta_{funcstart\_1032,1}.p1, 177).rem))))._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032.1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this. r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.} \text{\$r.value}(\text{heapIs}))
\theta_{funcstart\_1032,1}.p1, 177).rem))).\_replace(p2 \rightarrow
asType < P2Type > ((\$heap_{init}.M2 *
asType<int>(static_cast<integer>(static_cast<signed
int>(operator^*(heapIs $heap_{1032,1;1051,8}, this).p2) < (int)0))) + temp2)))
\rightarrow [expand definition of constant 'M2' at prang.cpp (33,26)]
[57.11] $heap<sub>1032,1;1054,8</sub> == $heap<sub>funcstart_1032,1</sub>._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
\label{eq:continuous_function} $ \text{heap}_{funcstart\_1032,1} . \text{p1}, 177).rem)))).\_\textbf{replace}(\textbf{this}.\$r \rightarrow
this.$r.value(heapIs heapIs_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs \rho_{funcstart\_1032,1}, this.r.value(heapIs)
\theta_{funcstart\_1032,1}.p1, 177).rem))).\_replace(p2 \rightarrow
asType < P2Type > (((int)30307 *
asType<int>(static_cast<integer>(static_cast<signed
int>(operator^*(heapIs $heap_{1032,1;1051,8}, this).p2) < (int)(0))) + temp(2)))
\rightarrow [simplify]
```

```
[57.12] $\text{heap}_{1032,1;1054,8} == $\text{heap}_{funcstart\_1032,1}._\text{replace}(\text{this}.\text{$\frac{1}{2}r$})
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
\theta_{tuncstart\_1032,1}.p1, 177).rem)))).\_replace(this.\$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs $heap<sub>funcstart_1032.1</sub>, this.$r.value(heapIs
\theta_{funcstart\_1032,1}.p1, 177).rem))).\_replace(p2 \rightarrow
asType<P2Type>((30307 *
asType < int > (static\_cast < integer > (static\_cast < signed
int>(operator^*(heapIs \$heap_{1032,1;1051,8}, this).p2) < (int)(0))) + temp(2)))
\rightarrow [from term 53.19, $heap<sub>1032,1:1051,8</sub> is equal to
heap_{funcstart\_1032,1}._replace(this.r \rightarrow this.r.value(heapIs)
heap_{funcstart\_1032,1}._replace(p1 \rightarrow (-2 * div(heapIs $heap_{funcstart\_1032,1}, 
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, \ 177).quot) + (171)
div(\mathbf{heapIs} \ \$heap_{funcstart\_1032,1}, \ \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
heap_{funcstart\_1032,1}.p1, 177).rem)))
[57.13] $heap<sub>1032,1;1054,8</sub> == $heap<sub>funcstart_1032,1</sub>._replace(this.$r \rightarrow
\textbf{this.}\$r.\textbf{value}(\textbf{heapIs}~\$heap_{funcstart\_1032,1}).\_\textbf{replace}(p1 \rightarrow ((\text{-}2~*\text{div}(\textbf{heapIs}
$heap_tuncstart_1032.1, this.$r.value(heapIs $heap_tuncstart_1032.1).p1,
177).quot) + (171 * div(heapIs $heap<sub>funcstart_1032.1</sub>, this.$r.value(heapIs
\label{eq:continuous_function} $ \text{heap}_{funcstart\_1032,1} . \text{p1, 177}.rem)))).\_\textbf{replace}(\textbf{this}.\$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
(177).quot + (171 * div(heapIs $heap_{funcstart\_1032,1}, this.$r.value(heapIs)
\theta_{funcstart\_1032,1}.p1, 177).rem)))._replace(p2 \rightarrow
\mathbf{asType}{<}\mathrm{P2Type}{>}((30307~*
asType<int>(static_cast<integer>(static_cast<signed
int>(operator^*(heapIs \ heap_{funcstart\_1032,1}.\_replace(this.\$r \rightarrow
\textbf{this.\$r.value}(\textbf{heapIs}~\$ heap_{funcstart\_1032,1}).\_\textbf{replace}(p1 \rightarrow (-2~*div(\textbf{heapIs}
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs \theta_{funcstart\_1032,1}, this.r.value(heapIs)
\text{Sheap}_{funcstart\_1032,1}.\text{p1}, 177).\text{rem})), \text{this}.\text{p2}) < (\text{int})0)) + \text{temp2}))
→ [expand definition of operator '*' in class 'pointer' at built in declaration]
[57.14] $heap<sub>1032,1;1054,8</sub> == $heap<sub>funcstart_1032,1</sub>._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.}\text{\$r.value}(\text{heapIs}))
\theta_{funcstart\_1032,1}.p1, 177).rem)))).replace(this.r \rightarrow 0
this.$r.value(heapIs $heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
$\text{heap}_{funcstart_1032.1}$, this.$\text{r.value}(\text{heapIs} \text{$heap}_{funcstart_1032.1}).p1,
177).quot) + (171 * div(heapIs $heap<sub>funcstart_1032.1</sub>, this.$r.value(heapIs
\theta_{funcstart\_1032,1}.p1, 177).rem))).\_replace(p2 \rightarrow
```

```
asType<P2Type>((30307 *
asType<int>(static_cast<integer>(static_cast<signed
\mathbf{int}{>}(\mathbf{this.\$r.value}(\mathbf{heapIs}\ \$\mathbf{heap}_{funcstart\_1032,1}.\_\mathbf{replace}(\mathbf{this.\$r} \to \mathbf{funcstart}))
this.$r.value(heapIs p_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs \theta_{funcstart\_1032,1}, this.r.value(heapIs)
\theta_{funcstart_{1032,1}}.p1, 177).rem)))).p2) < (int)0))) + temp2)))
\rightarrow [evaluate dereferenced pointer into modified heap]
[57.15] $heap<sub>1032,1;1054,8</sub> == $heap<sub>funcstart_1032,1</sub>._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs \theta_{funcstart\_1032,1}, this.r.value(heapIs)
\theta_{tuncstart\_1032,1}.p1, 177).rem)))).\_replace(this.$r \rightarrow
this.$r.value(heapIs $heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(\mathbf{heapIs} \$ heap_{funcstart\_1032,1}, \mathbf{this}.\$ r. \mathbf{value}(\mathbf{heapIs})
\theta_{uncstart\_1032,1}.p1, 177).rem))).\_replace(p2 \rightarrow
asType<P2Type>((30307 *
asType<int>(static_cast<integer>(static_cast<signed int>(([this.$r
== this.$r]: this.$r.value(heapIs \rho_{tangle} = 1032,1)._replace(p1 \rho (-2 *
div(\mathbf{heapIs} \$ heap_{funcstart\_1032.1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
\text{Sheap}_{funcstart\_1032,1}.p1, 177).quot) + (171 * div(heapIs \text{Sheap}_{funcstart\_1032,1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177).rem)), []:
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p2) < (int)0))) + temp2)))
→ [explicitly assert falsehood of skipped guards in subsequent guards]
[57.16] $\text{heap}_{1032,1;1054,8} == $\text{heap}_{funcstart\_1032,1}._\text{replace}(\text{this.}\text{$\frac{1}{2}}\text{$\text{op}})$
this.$r.value(heapIs \rho_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\theta_{funcstart\_1032,1}, this.r.value(heapIs \theta_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(\mathbf{heapIs} \ \$heap_{funcstart\_1032,1}, \ \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
\theta_{funcstart\_1032,1}.p1, 177).rem)))).\_replace(this.\$r \rightarrow 0
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\$heap_{funcstart\_1032,1},\, \textbf{this}.\$r.\textbf{value}(\textbf{heapIs}\,\,\$heap_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs \theta_{funcstart\_1032,1}, this.r.value(heapIs)
heap_{funcstart\_1032,1}.p1, 177).rem)))._replace(p2 \rightarrow
asType<P2Type>((30307 *
asType<int>(static_cast<integer>(static_cast<signed int>(([this.$r
== this.$r]: this.$r.value(heapIs \rho_{funcstart\_1032,1})._replace(p1 \rightarrow (-2 *
\mathrm{div}(\mathbf{heapIs}\ \$\mathrm{heap}_{funcstart\_1032,1},\ \mathbf{this}.\$\mathrm{r.value}(\mathbf{heapIs}
\text{Sheap}_{funcstart\_1032,1}.p1, 177).quot) + (171 * div(heapIs \text{Sheap}_{funcstart\_1032,1},
\mathbf{this.\$r.value(heapIs\ \$heap}_{funcstart\_1032,1}).p1,\ 177).rem)),\ [!(\mathbf{this.\$r}==
this.r.value(heapIs $heap_{funcstart\_1032.1}).p2) < (int)0))) +
temp2)))
\rightarrow [simplify]
```

```
[57.23] $\text{heap}_{1032,1;1054,8} == \text{$heap}_{funcstart\_1032,1}._\text{replace}(\text{this.}\text{$r} \to \text{$}
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
\theta_{tuncstart\_1032,1}.p1, 177).rem)))).\_replace(this.\$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032.1}, \text{this.} \text{\$r.value}(\text{heapIs}))
\theta_{tuncstart_1032.1},p1, 177).rem)))._replace(p2 \rightarrow
asType<P2Type>((30307 * asType<int>(static_cast<integer>(0 <
-\mathbf{this.\$r.value}(\mathbf{heapIs}\ \$\mathrm{heap}_{funcstart\_1032,1}).\mathrm{p2}))) + \mathrm{temp2})))
\rightarrow [from term 24.0, literala < -this.$r.value(heapIs $heap_{funcstart\_1032,1}).p2
is false whenever -2 < (0 + literala)
    Proof of rule precondition:
    [57.23.0] - 2 < (0 + 0)
    \rightarrow [simplify]
    [57.23.2] true
[57.24] $\text{heap}_{1032,1;1054,8} == $\text{heap}_{funcstart\_1032,1}._\text{replace}(\text{this}.\text{$\frac{1}{2}r$})
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
\theta_{tuncstart\_1032,1}.p1, 177).rem)))).\_replace(this.\$r \rightarrow
this.$r.value(heapIs \rho_{uncstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs)
\rho_{funcstart_1032,1}, this.\r.value(heapIs \rho_{funcstart_1032,1}).p1,
177).quot) + (171 * div(heapIs $heap<sub>funcstart_1032,1</sub>, this.$r.value(heapIs
\theta_{funcstart\_1032,1}.p1, 177).rem))).\_replace(p2 \rightarrow
asType < P2Type > ((30307 * asType < int > (static\_cast < integer > (false)))
+ \text{temp2})))
\rightarrow [simplify]
[57.25] $heap<sub>1032,1;1054,8</sub> == $heap<sub>funcstart_1032,1</sub>._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart_1032,1}, this.r.value(heapIs \rho_{funcstart_1032,1}).p1,
177).quot) + (171 * div(heapIs \$heap_{funcstart\_1032,1}, this.\$r.value(heapIs))
\rho_{tuncstart_{1032.1}, p1, 177, rem)}))._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\theta_{funcstart\_1032,1}, this.\r.value(heapIs \theta_{funcstart\_1032,1}).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.} \text{\$r.value}(\text{heapIs}))
\theta_{funcstart\_1032,1}.p1, 177).rem))._replace(p2 \rightarrow
asType < P2Type > ((30307 * asType < int > (([false]: 1, []: 0))) + temp2)))
→ [explicitly assert falsehood of skipped guards in subsequent guards]
[57.26] $\text{heap}_{1032,1;1054,8} == $\text{heap}_{funcstart\_1032,1}._\text{replace}(\text{this}.$\text{$\frac{1}{2}}\)
```

```
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
\theta_{tuncstart\_1032,1}.p1, 177).rem)))).\_replace(this.\$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs $heap<sub>funcstart_1032,1</sub>, this.$r.value(heapIs
\theta_{tuncstart_{-1032.1}}.p1, 177).rem))._replace(p2 \rightarrow
asType<P2Type>((30307 * asType<int>(([false]: 1, [true]: 0))) +
temp2)))
\rightarrow [simplify]
[57.29] $\text{heap}_{1032,1;1054,8} == $\text{heap}_{funcstart\_1032,1}$._\text{replace}(\text{this}.$\text{$r} \to \text{
this.$r.value(heapIs \rho_{uncstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs)
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
\theta_{funcstart\_1032,1}.p1, 177).rem)))).replace(this.r \rightarrow 0
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\$heap_{funcstart\_1032,1},\, \textbf{this.}\$r.\textbf{value}(\textbf{heapIs}\,\,\$heap_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
\rho_{uncstart\_1032.1}, p1, 177).rem)))._replace(p2 \rightarrow asType<P2Type>(0 +
temp2)))
\rightarrow [from term 54.18, temp2 is equal to (-35 * div(heapIs $heap_{funcstart\_1032,1},
this.r.value(heapIs \ heap_{funcstart\_1032.1}).p2, 176).quot) + (172)
div(heapIs $heap_funcstart_1032.1, this.$r.value(heapIs
$heap_tuncstart_1032.1).p2, 176).rem)]
[57.30] $heap<sub>1032,1;1054,8</sub> == $heap<sub>funcstart_1032,1</sub>._replace(this.$r \rightarrow
this.$r.value(heapIs $heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{tuncstart\_1032.1}, this.r.value(heapIs \rho_{tuncstart\_1032.1}).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.\$r.value}(\text{heapIs}))
\theta_{funcstart\_1032,1}.p1, 177).rem)))).replace(this.r \rightarrow
this.$r.value(heapIs \rho_{tuncstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\$heap_{funcstart\_1032,1},\, \textbf{this.}\$r.\textbf{value}(\textbf{heapIs}\,\,\$heap_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(\mathbf{heapIs} \ \$heap_{funcstart\_1032,1}, \ \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
\theta_{tuncstart\_1032,1}.p1, 177).rem))._replace(p2 \rightarrow asType<P2Type>(0 +
((-35 * div(\mathbf{heapIs} \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}))
\text{Sheap}_{funcstart\_1032,1}.p2, 176).quot) + (172 * div(heapIs \text{Sheap}_{funcstart\_1032,1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p2, 176).rem)))))
\rightarrow [simplify]
[57.33] $\text{heap}_{1032,1;1054,8} == $\text{heap}_{funcstart\_1032,1}._\text{replace}(\text{this}.\text{$\frac{1}{2}r$})
this.$r.value(heapIs \rho_{tuncstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
\theta_{funcstart\_1032,1}.p1, 177).rem)))).replace(this.r \rightarrow 0
```

```
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.}\text{\$r.value}(\text{heapIs}))
\rho_{funcstart\_1032,1}.p1, 177).rem))._replace(p2 \rightarrow ((-35 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p2,
176).quot) + (172 * div(heapIs $heap<sub>funcstart_1032,1</sub>, this.$r.value(heapIs
heap_{funcstart\_1032,1}.p2, 176).rem)))
[Take goal term]
[1.0] (($heap<sub>1032,1:1054,8</sub>.r3 * static_cast<signed int>(div3.rem)) -
(\text{sheap}_{1032,1:1054.8}.\text{b3} * \text{static\_cast} < \text{signed int} > (\text{div3.quot}))) \le
maxof(signed int)
\rightarrow [from term 57.33, $heap<sub>1032,1;1054,8</sub> is equal to
heap_{funcstart\_1032.1}-replace(this.r \rightarrow this.r-value(heapIs
heap_{funcstart\_1032.1}._replace(p1 \rightarrow ((-2 * div(heapIs $heap_{funcstart\_1032.1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177).quot) + (171 * leapIs \ heap_{funcstart\_1032,1}).p1, 177).quot)
div(\mathbf{heapIs}\ \$heap_{funcstart\_1032,1},\ \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}
heap_{funcstart\_1032,1}.p1, 177).rem)))). replace(this.$r \rightarrow
this.r.value(heapIs \ heap_{funcstart\_1032,1}).\_replace(p1 \rightarrow ((-2 * div(heapIs + 
heap_{funcstart\_1032,1}, this.r.value(heapIs heap_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(\mathbf{heapIs} \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}))
\rho_{100} = \rho_{1000} = 1.032, 1.01, 177. sheap \rho_{1000} = 1.032, 1.01, 177. replace (p2 \rightarrow (-35 * div(heap Is)).
heap_{funcstart\_1032,1}, this.r.value(heapIs heap_{funcstart\_1032,1}).p2,
176).quot) + (172 * div(heapIs $heap_{funcstart\_1032,1}, this.$r.value(heapIs
heap_{funcstart_{1032,1}}.p2, 176).rem)))
\textit{[1.1]} \ ((\$ heap_{funcstart\_1032,1}.\_\textbf{replace}(\textbf{this}.\$r \rightarrow \textbf{this}.\$r.\textbf{value}(\textbf{heapIs})))
\rho_{tuncstart\_1032,1}._replace(p1 \rightarrow ((-2 * div(heapIs \rho_{tuncstart\_1032,1}).
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177).quot) + (171 *
div(\mathbf{heapIs} \$ heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
\theta_{funcstart\_1032,1}.p1, 177).rem)))).\_replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{tuncstart\_1032,1}, this.r.value(heapIs \rho_{tuncstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs \theta_{funcstart\_1032,1}, this.r.value(heapIs)
\rho_{funcstart\_1032,1}.p1, 177).rem)._replace(p2 \rightarrow ((-35 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p2,
176).quot) + (172 * div(heapIs \rho_{funcstart\_1032,1}, this.r.value(heapIs)
int>(div3.rem)) - (\$heap_{1032,1:1054,8}.b3 * static\_cast < signed
int > (div3.quot))) \le maxof(signed int)
→ [const member of object with modified fields]
[1.3] (($heap<sub>funcstart_1032,1</sub>.r3 * static_cast<signed int>(div3.rem)) -
(\text{sheap}_{1032,1;1054,8}.\text{b3} * \text{static\_cast} < \text{signed int} > (\text{div3.quot}))) \le
maxof(signed\ int)
\rightarrow [const static or extern object]
```

```
[1.4] (($heap<sub>init</sub>.r3 * static_cast<signed int>(div3.rem)) -
(\$heap_{1032,1;1054,8}.b3 * \textbf{static\_cast} < \textbf{signed int} > (\texttt{div3.quot}))) <
maxof(signed int)
\rightarrow [expand definition of constant 'r3' at prang.cpp (39,26)]
[1.5] (((int)170 * static_cast < signed int > (div3.rem)) - ($heap_{1032.1:1054.8}.b3)
* static\_cast < signed int > (div3.quot))) \le maxof(signed int)
\rightarrow [simplify]
[1.6] ((170 * static_cast < signed int > (div3.rem)) - ($heap_{1032.1:1054.8}.b3 *
static_cast<signed int>(div3.quot))) < maxof(signed int)
\rightarrow [from term 34.6, div3 is equal to div(heapIs $heap_{funcstart\_1032,1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p3, 178)
[1.7] ((170 * static_cast < signed int > (div(heapIs $heap_{tuncstart\_1032.1},
this.r.value(heapIs \ heap_{funcstart\_1032.1}).p3, 178).rem)) -
(\text{sheap}_{1032,1:1054,8.b3} * \text{static\_cast} < \text{signed int} > (\text{div}3.\text{quot}))) <
maxof(signed int)
\rightarrow [simplify]
[1.8] ((170 * div(heapIs heap_{funcstart\_1032,1}, this.r.value(heapIs
heap_{funcstart\_1032,1}.p3, 178).rem - (heap_{1032,1:1054,8}.b3 *
static\_cast < signed int > (div3.quot))) \le maxof(signed int)
\rightarrow [from term 57.33, $heap<sub>1032.1:1054.8</sub> is equal to
$heap_{funcstart\_1032,1}$.$replace(this.$r \rightarrow this.$r.value(heapIs)
heap_{funcstart\_1032,1}._replace(p1 \rightarrow ((-2 * div(heapIs $heap_{funcstart\_1032,1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, \ 177).quot) + (171)
div(heapIs $heap_{funcstart_1032,1}, this.$r.value(heapIs)
heap_{funcstart\_1032,1}.p1, 177).rem))).\_replace(this.$r \rightarrow
this.$r.value(heapIs $heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
$heap_funcstart_1032.1, this.$r.value(heapIs $heap_funcstart_1032.1).p1,
177).quot) + (171 * div(\mathbf{heapIs} * \mathbf{heap}_{funcstart\_1032,1}, \mathbf{this}. \$r. \mathbf{value}(\mathbf{heapIs} * \mathbf{heap}_{funcstart\_1032,1}, \mathbf{this}))
heap_{funcstart\_1032,1}.p1, 177).rem))).\_replace(p2 \rightarrow (-35 * div(heapIs))).
heap_{funcstart\_1032,1}, this.r.value(heapIs heap_{funcstart\_1032,1}).p2,
176).quot) + (172 * div(heapIs $heap_{tuncstart\_1032.1}, this.$r.value(heapIs
heap_{funcstart\_1032,1}.p2, 176).rem)))]
[1.9] ((170 * div(\mathbf{heapIs} \ \$heap_{funcstart\_1032,1}, \ \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
\rho_{funcstart\_1032,1}.p3, 178.rem) - (\rho_{funcstart\_1032,1}.p_{funcstart\_1032,1}.p_{funcstart\_1032,1}
\rightarrow this.$r.value(heapIs $heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 *
div(\mathbf{heapIs} \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
\text{Sheap}_{funcstart\_1032,1}.p1, 177).quot) + (171 * div(heapIs \text{Sheap}_{funcstart\_1032,1},
\mathbf{this.\$r.value(heapIs}\ \$heap_{funcstart\_1032,1}).p1,\ 177).rem)))).\_\mathbf{replace(this.\$r}
\rightarrow this.$r.value(heapIs $heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 *
div(\mathbf{heapIs} \$ heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
\text{Sheap}_{funcstart\_1032,1}.p1, 177).quot) + (171 * div(heapIs \text{Sheap}_{funcstart\_1032,1},
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this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177).rem))).\_replace(p2 \rightarrow
((-35 * \mathrm{div}(\mathbf{heapIs}\ \$\mathrm{heap}_{funcstart\_1032,1},\ \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}
\text{Sheap}_{funcstart\_1032,1}.p2, 176).quot) + (172 * div(heapIs \text{Sheap}_{funcstart\_1032,1},
this.$r.value(heapIs $heap_{tuncstart_1032,1}).p2, 176).rem)))).b3 *
static\_cast < signed int > (div3.quot))) \le maxof(signed int)
→ [const member of object with modified fields]
[1.11] ((170 * div(heapIs $heap_{funcstart\_1032,1}, this.$r.value(heapIs)]
\text{Sheap}_{funcstart\_1032,1}.p3, 178).rem) - (\text{Sheap}_{funcstart\_1032,1}.b3 *
static\_cast < signed int > (div3.quot))) \le maxof(signed int)
\rightarrow [const static or extern object]
[1.12] ((170 * div(heapIs $heap<sub>funcstart_1032.1</sub>, this.$r.value(heapIs)
\rho_{uncstart_{-1032,1}}.p3, 178).rem – (\rho_{uncstart_{-1032,1}}.p3, 178).rem
int > (div3.quot))) \le maxof(signed int)
\rightarrow [expand definition of constant 'b3' at prang.cpp (41,26)]
[1.13] ((170 * \mathrm{div}(\mathbf{heapIs}\ \$\mathrm{heap}_{funcstart\_1032,1},\ \mathbf{this}.\$\mathrm{r.value}(\mathbf{heapIs}
\rho_{tuncstart\_1032.1}.p3, 178).rem - ((int)63 * static\_cast < signed)
int > (div3.quot))) \le maxof(signed int)
\rightarrow [simplify]
[1.14] ((170 * div(heapIs $heap<sub>funcstart_1032,1</sub>, this.$r.value(heapIs)
\theta_{funcstart\_1032,1}.p3, 178).rem - (63 * static\_cast < signed)
int > (div3.quot))) \le maxof(signed int)
\rightarrow [from term 34.6, div3 is equal to div(heapIs $heap_{funcstart\_1032,1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p3, 178)
[1.15] ((170 * div(heapIs $heap<sub>funcstart_1032,1</sub>, this.$r.value(heapIs)
\theta_{tuncstart\_1032.1}.p3, 178).rem) - (63 * static_cast<signed
int>(div(heapIs \$heap_{funcstart\_1032,1}, this.\$r.value(heapIs
\text{Sheap}_{funcstart\_1032,1}.\text{p3}, 178).\text{quot}))) \leq \max \text{of}(\text{signed int})
\rightarrow [simplify]
[1.32] -32768 < ((-170 * div(heapIs $heap_{funcstart\_1032,1},
this.r.value(heapIs \ heap_{funcstart\_1032.1}).p3, 178).rem) + (63 * div(heapIs)
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p3,
178).quot))
\rightarrow [negate goal and search for contradiction]
[1.33] ! (-32768 < ((-170 * div(heapIs $heap_{funcstart\_1032,1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p3, 178).rem) + (63 * div(heapIs \ heapIs))
$\text{heap}_{tuncstart=1032.1}$, this.$\text{r.value}(\text{heapIs} $\text{heap}_{tuncstart=1032.1}).p3,
178).quot)))
\rightarrow [simplify]
[1.38] 32767 < ((170 * div(heapIs heapIs  heap_{funcstart\_1032,1}, this.r.value(heapIs)
```

```
\mathbf{this.\$r.value}(\mathbf{heapIs}\ \$\mathbf{heap}_{funcstart\_1032,1}).\mathbf{p3},\ 178).\mathbf{quot}))
[Branch on disjunction or conditional in term 47.18]
[74.0] (0 == (-\text{this.\$r.value}(\text{heapIs }\text{\$heap}_{funcstart\_1032,1}).\text{p3} + \text{div}(\text{heapIs})
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p3,
178).rem)) \vee (177 < this.$r.value(heapIs $heap<sub>funcstart_1032,1</sub>).p3) \vee !(0 ==
(-this.\$r.value(heapIs \$heap_{funcstart\_1032,1}).p3 + div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p3,
178).rem))
[Copy term 1.38]
[75.0] (32767 < ((-63 * div(heapIs heapIs funcstart_{-1032,1}, this.r.value(heapIs funcstart_{-1032,1})
\text{Sheap}_{funcstart=1032.1}).p3, 178).quot) + (170 * div(heapIs \text{Sheap}_{funcstart=1032.1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p3, 178).rem))) <math>\lor (177 < 
this.$r.value(heapIs $heap_{funcstart\_1032,1}).p3) \lor !(0 ==
(-this.\$r.value(heapIs \$heap_{funcstart\_1032,1}).p3 + div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p3,
178).rem))
\rightarrow [from term 74.0, div(heapIs $heap_{funcstart\_1032,1}$, this.$r.value(heapIs)
$heap_{funcstart\_1032,1}$).p3, 178).rem is equal to this.$r.value(heapIs)
heap_{funcstart\_1032.1}.p3
[75.1] (32767 < ((-63 * div(heapIs $heap_{funcstart\_1032,1}, this.$r.value(heapIs)]
\theta_{funcstart\_1032,1}.p3, 178).quot + (170 * this. r.value(heapIs)
heap_{funcstart\_1032,1}.p3)) \lor ...
[Copy term 42.17]
[76.0] (0 == (-\text{div}(\mathbf{heapIs} \$ \text{heap}_{funcstart\_1032,1}, \mathbf{this}.\$ \mathbf{r.value}(\mathbf{heapIs}))
\theta_{tuncstart\_1032,1}.p3, 178.rem + (this.r.value(heapIs)
\theta_{funcstart\_1032,1}.p3~\%~178))) <math display="inline">\vee (177 < this. r.value(heapIs)
\$heap_{funcstart\_1032,1}).p3) \lor !(0 == (-\mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}
\text{Sheap}_{funcstart\_1032,1}.p3 + div(heapIs \text{Sheap}_{funcstart\_1032,1},
this.r.value(heapIs $heap_{funcstart\_1032.1}).p3, 178).rem))
\rightarrow [from term 74.0, div(heapIs $heap_{tuncstart\_1032.1}$, this.$r.value(heapIs)
heap_{funcstart\_1032,1}.p3, 178.rem is equal to this.r.value(heapIs)
$heap_{funcstart\_1032,1}).p3]
[76.1] (0 == (-this.$r.value(heapIs \theta_{funcstart\_1032,1}).p3 +
(this.$r.value(heapIs heap_{funcstart\_1032,1}).p3 % 178))) \vee ...
[Assume known post-assertion, class invariant or type constraint for term 76.1]
[77.0] (this.$r.value(heapIs heap_{funcstart\_1032,1}).p3 < 178) \vee (177 <
this.$r.value(heapIs heap_{funcstart\_1032,1}).p3) \lor !(0 ==
(-\mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}\ \$\mathbf{heap}_{funcstart\_1032,1}).\mathbf{p}3 + \mathbf{div}(\mathbf{heapIs}
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p3,
178).rem))
```

 $\text{Sheap}_{funcstart=1032.1}$.p3, 178).rem) + (-63 * div(heapIs $\text{Sheap}_{funcstart=1032.1}$,

```
\rightarrow [simplify]
[77.3] (-178 < -this.$r.value(heapIs $heap_{funcstart\_1032,1}).p3) \lor \dots
[Copy term 75.1]
[80.0] \ (32767 < ((-63 * \mathrm{div}(\mathbf{heapIs} \ \$ \mathrm{heap}_{funcstart\_1032,1}, \ \mathbf{this}.\$ r. \mathbf{value}(\mathbf{heapIs}))
\theta_{funcstart\_1032,1}.p3, 178).quot + (170 * this. r.value(heapIs)
heap_{funcstart_{1032,1}}.p3)) \lor (177 < this. r.value(heapIs)
\$heap_{funcstart\_1032,1}).p3) \lor !(0 == (-\mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}
heap_{funcstart\_1032,1}.p3 + div(heapIs heap_{funcstart\_1032,1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p3, 178).rem))
\rightarrow [from term 41.17, div(heapIs $heap_{funcstart\_1032,1}$, this.$r.value(heapIs)
$heap_funcstart_1032.1).p3, 178).quot is equal to this.$r.value(heapIs
heap_{funcstart_{-1032,1}}.p3 / 178
[80.1] (32767 < ((-63 * (this.$r.value(heapIs \rho_{uncstart\_1032,1}).p3 / 178))
+ (170 * this.$r.value(heap
Is \rho_{uncstart\_1032,1}).p3))) <math display="inline">\vee \dots
\rightarrow [division by larger divisor]
        Proof of rule precondition 1:
        [80.1.0.0] literald < -this.$r.value(heapIs $heap_{funcstart\_1032,1}).p3
        \rightarrow [unify with term 77.3]
        [80.1.0.1] true
        Proof of rule precondition 2:
        [80.1.1.0] literalc < this.r.value(heapIs $heap_{funcstart\_1032,1}).p3
        \rightarrow [unify with term 40.0]
        [80.1.1.1] true
        Proof of rule precondition 3:
        [80.1.2.0] --178 < 178
        \rightarrow [simplify]
        [80.1.2.2] true
        Proof of rule precondition 4:
        [80.1.3.0] - 2 < 0
        \rightarrow [simplify]
        [80.1.3.1] true
[80.2] (32767 < ((-63 * this.$r.value(heapIs $heap_{funcstart\_1032,1}).p3) + (170 + (170 + (170 + (170 + (170 + (170 + (170 + (170 + (170 + (170 + (170 + (170 + (170 + (170 + (170 + (170 + (170 + (170 + (170 + (170 + (170 + (170 + (170 + (170 + (170 + (170 + (170 + (170 + (170 + (170 + (170 + (170 + (170 + (170 + (170 + (170 + (170 + (170 + (170 + (170 + (170 + (170 + (170 + (170 + (170 + (170 + (170 + (170 + (170 + (170 + (170 + (170 + (170 + (170 + (170 + (170 + (170 + (170 + (170 + (170 + (170 + (170 + (170 + (170 + (170 + (170 + (170 + (170 + (170 + (170 + (170 + (170 + (170 + (170 + (170 + (170 + (170 + (170 + (170 + (170 + (170 + (170 + (170 + (170 + (170 + (170 + (170 + (170 + (170 + (170 + (170 + (170 + (170 + (170 + (170 + (170 + (170 + (170 + (170 + (170 + (170 + (170 + (170 + (170 + (170 + (170 + (170 + (170 + (170 + (170 + (170 + (170 + (170 + (170 + (170 + (170 + (170 + (170 + (170 + (170 + (170 + (170 + (170 + (170 + (170 + (170 + (170 + (170 + (170 + (170 + (170 + (170 + (170 + (170 + (170 + (170 + (170 + (170 + (170 + (170 + (170 + (170 + (170 + (170 + (170 + (170 + (170 + (170 + (170 + (170 + (170 + (170 + (170 + (170 + (170 + (170 + (170 + (170 + (170 + (170 + (170 + (170 + (170 + (170 + (170 + (170 + (170 + (170 + (170 + (170 + (170 + (170 + (170 + (170 + (170 + (170 + (170 + (170 + (170 + (170 + (170 + (170 + (170 + (170 + (170 + (170 + (170 + (170 + (170 + (170 + (170 + (170 + (170 + (170 + (170 + (170 + (170 + (170 + (170 + (170 + (170 + (170 + (170 + (170 + (170 + (170 + (170 + (170 + (170 + (170 + (170 + (170 + (170 + (170 + (170 + (170 + (170 + (170 + (170 + (170 + (170 + (170 + (170 + (170 + (170 + (170 + (170 + (170 + (170 + (170 + (170 + (170 + (170 + (170 + (170 + (170 + (170 + (170 + (170 + (170 + (170 + (170 + (170 + (170 + (170 + (170 + (170 + (170 + (170 + (170 + (170 + (170 + (170 + (170 + (170 + (170 + (170 + (170 + (170 + (170 + (170 + (170 + (170 + (170 + (170 + (170 + (170 + (170 + (170 + (170 + (170 + (170 + (170 + (170 + (170 + (170 + (170 + (170 + (170 + (170 + (170 + (
* this.$r.value(heapIs \theta_{funcstart\_1032.1}).p3))) \vee ...
\rightarrow [simplify]
[80.4] (32767 < (107 * this.$r.value(heap
Is $heap_{funcstart\_1032,1}).p3)) \vee \dots
```

```
\rightarrow [literal comparison of product]
[80.5] ([107 < 0]: (32767 / -107) < -this.$r.value(heapIs
\rho_{tuncstart_{-1032,1}}.p3, [0 < 107]: (32767 / 107) < this. r.value(heapIs)
\label{eq:heapfuncstart_1032,1} $$ heap_{funcstart_1032,1}.p3, [0 == 107]: 32767 < 0) \lor \dots $$
→ [explicitly assert falsehood of skipped guards in subsequent guards]
[80.6] ([107 < 0]: (32767 / -107) < -this.$r.value(heapIs
\rho_{funcstart\_1032,1}.p3, [(0 < 107) \land !(107 < 0)]: (32767 / 107) < (0 < 107) < 107)
this.$r.value(heapIs p_{funcstart_1032,1}).p3, [(0 == 107) \land !(0 < 107) \land
!(107 < 0)]: 32767 < 0) \lor ...
\rightarrow [simplify]
[80.13] (true \land (306 < this.$r.value(heapIs $heap_{funcstart\_1032.1}).p3)) \lor ...
\rightarrow [from term 77.3, literala < this.$r.value(heapIs $heap_{tuncstart\_1032.1}).p3
is false whenever -2 < (-178 + literala)
       Proof of rule precondition:
       [80.13.0] - 2 < (-178 + 306)
       \rightarrow [simplify]
       [80.13.2] true
[80.14] (true \wedge false) \vee \dots
\rightarrow [simplify]
[80.15] false \vee ...
[Remove 'false' term 80.15 and fetch new term from containing clause]
[81.0] 177 < this.$r.value(heapIs $heap_{funcstart\_1032,1}).p3
[Copy term 1.38]
[84.0]~32767 < ((-63 * \operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_1032,1}, \mathbf{this}.\$ r. \mathbf{value}(\mathbf{heapIs} + \mathbf{heapIs}))
\rho_{tuncstart_{1032.1}, p3, 178} = 178 \cdot (170 * div(heapIs $heap_{tuncstart_{1032.1}, p3, 178}) = 178 \cdot (170 * div(heapIs $heap_{tuncstart_{1032.1}, p3, 178}) = 178 \cdot (170 * div(heapIs $heap_{tuncstart_{1032.1}, p3, 178}) = 178 \cdot (170 * div(heapIs $heap_{tuncstart_{1032.1}, p3, 178}) = 178 \cdot (170 * div(heapIs $heap_{tuncstart_{1032.1}, p3, 178}) = 178 \cdot (170 * div(heapIs $heap_{tuncstart_{1032.1}, p3, 178}) = 178 \cdot (170 * div(heapIs $heap_{tuncstart_{1032.1}, p3, 178}) = 178 \cdot (170 * div(heapIs $heap_{tuncstart_{1032.1}, p3, 178}) = 178 \cdot (170 * div(heapIs $heap_{tuncstart_{1032.1}, p3, 178}) = 178 \cdot (170 * div(heapIs $heap_{tuncstart_{1032.1}, p3, 178}) = 178 \cdot (170 * div(heapIs $heap_{tuncstart_{1032.1}, p3, 178}) = 178 \cdot (170 * div(heapIs $heap_{tuncstart_{1032.1}, p3, 178}) = 178 \cdot (170 * div(heapIs $heap_{tuncstart_{1032.1}, p3, 178}) = 178 \cdot (170 * div(heapIs $heap_{tuncstart_{1032.1}, p3, 178}) = 178 \cdot (170 * div(heapIs $heap_{tuncstart_{1032.1}, p3, 178}) = 178 \cdot (170 * div(heapIs $heap_{tuncstart_{1032.1}, p3, 178}) = 178 \cdot (170 * div(heapIs $heap_{tuncstart_{1032.1}, p3, 178}) = 178 \cdot (170 * div(heapIs $heap_{tuncstart_{1032.1}, p3, 178}) = 178 \cdot (170 * div(heapIs $heap_{tuncstart_{1032.1}, p3, 178}) = 178 \cdot (170 * div(heapIs $heap_{tuncstart_{1032.1}, p3, 178}) = 178 \cdot (170 * div(heapIs $heap_{tuncstart_{1032.1}, p3, 178}) = 178 \cdot (170 * div(heapIs $heap_{tuncstart_{1032.1}, p3, 178}) = 178 \cdot (170 * div(heapIs $heap_{tuncstart_{1032.1}, p3, 178}) = 178 \cdot (170 * div(heapIs $heap_{tuncstart_{1032.1}, p3, 178}) = 178 \cdot (170 * div(heapIs $heap_{tuncstart_{1032.1}, p3, 178}) = 178 \cdot (170 * div(heapIs $heap_{tuncstart_{1032.1}, p3, 178}) = 178 \cdot (170 * div(heapIs $heap_{tuncstart_{1032.1}, p3, 178}) = 178 \cdot (170 * div(heapIs $heap_{tuncstart_{1032.1}, p3, 178}) = 178 \cdot (170 * div(heapIs $heap_{tuncstart_{1032.1}, p3, 178}) = 178 \cdot (170 * div(heapIs $heap_{tuncstart_{1032.1}, p3, 178}) = 178 \cdot (170 * div(heapIs $heap_{tuncstart_{1032.1}, p3, 178}) = 178 \cdot (170 * div(heapIs $heap_{tuncstart_{1032.1}, p3, 17
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p3, 178).rem))
\rightarrow [from term 42.17, div(heapIs $heap_{funcstart\_1032.1}, this.$r.value(heapIs)
$heap<sub>funcstart_1032.1</sub>).p3, 178).rem is equal to this.$r.value(heapIs
heap_{funcstart\_1032,1}.p3 % 178]
[84.1] 32767 < ((-63 * div(heapIs $heap_{funcstart\_1032,1}, this.$r.value(heapIs funcstart_1032,1)  
\theta_{uncstart\_1032,1}.p3, 178.quot) + (170 * (this.$r.value(heapIs)
heap_{funcstart_{1032,1}}.p3 \% 178)
[Create new term from term 41.17 using rule: condition for equality of division]
[136.0] ((178 * (0 + -(-\text{div}(\mathbf{heapIs} \$ \text{heap}_{funcstart\_1032,1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p3, 178).quot))) < (1 + 
\textbf{this.\$r.value}(\textbf{heapIs}~\$ heap_{funcstart\_1032,1}).p3)) \land (\textbf{this.\$r.value}(\textbf{heapIs}
```

 $\text{Sheap}_{funcstart_1032.1}$.p3 < (178 * (0 + 1 + -(-div(heapIs)))

```
\rho_{funcstart_1032,1}, this.\r.value(heapIs \rho_{funcstart_1032,1}).p3,
178).quot))))
\rightarrow [simplify]
[136.15] (-1 < ((-178 * div(heapIs $heap<sub>funcstart_1032,1</sub>, this.$r.value(heapIs)
\theta_{funcstart_{1032,1}}.p3, 178.quot) + this.r.value(heapIs)
\theta_{funcstart\_1032,1}.p3) \land (-178 < (-this.\$r.value(heapIs))
\text{Sheap}_{funcstart\_1032,1}.p3 + (178 * div(heapIs \text{Sheap}_{funcstart\_1032,1}).
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p3, 178).quot)))
\rightarrow [separate conjunction and work on first sub-term]
[136.16]-178 < (-this.$r.value(heapIs \rho_{funcstart\_1032,1}).p3 + (178 *
div(heapIs $heap<sub>funcstart_1032.1</sub>, this.$r.value(heapIs
heap_{funcstart_{-1032,1}}.p3, 178).quot)
[Create new term from terms 136.16, 81.0 using rule: transitivity 2]
[147.0] (-178 + 1 + 177) < (178 * div(heapIs $heap_{tuncstart\_1032.1},
this.r.value(heapIs $heap_{funcstart\_1032,1}).p3, 178).quot)
\rightarrow [simplify]
[147.1] 0 < (178 * div(heapIs $heap_{funcstart\_1032,1}, this.$r.value(heapIs
heap_{funcstart\_1032,1}.p3, 178).quot
\rightarrow [product is positive]
[147.2] ((0 < 178) \wedge (0 < div(heapIs $heap_{funcstart\_1032,1},
this.$r.value(heapIs $heap_{tuncstart\_1032,1}).p3, 178).quot)) \lor ((178 < 0) \land
(\operatorname{div}(\mathbf{heapIs}\ \$ \operatorname{heap}_{funcstart\_1032,1},\ \mathbf{this}.\$ r. \mathbf{value}(\mathbf{heapIs}
\$ heap_{funcstart\_1032,1}).p3,\,178).quot\,<\,0))
\rightarrow [simplify]
[147.7] 0 < \text{div}(\mathbf{heapIs} \$ \text{heap}_{funcstart\_1032,1}, \mathbf{this}.\$ \mathbf{r.value}(\mathbf{heapIs})
heap_{funcstart_{1032,1}}.p3, 178).quot
[Create new term from terms 147.7, 84.1 using rule: transitivity 11]
[149.0] (1 + 32767 + (0 * 63)) < (170 * (this.\$r.value(heapIs))
\theta_{funcstart\_1032,1}.p3~\%~178))
\rightarrow [simplify]
[149.2] 32768 < (170 * (this. r.value(heapIs $heap_{tuncstart\_1032.1}).p3 % 178))
\rightarrow [literal comparison of product]
[149.3] ([170 < 0]: (32768 / -170) < -(this.$r.value(heapIs
heap_{funcstart\_1032,1}.p3 % 178), [0 < 170]: (32768 / 170) <
(this.$r.value(heapIs \rho_{tuncstart\_1032,1}).p3 % 178), [0 == 170]: 32768 <
→ [explicitly assert falsehood of skipped guards in subsequent guards]
```

```
[149.4] ([170 < 0]: (32768 / -170) < -(this.$r.value(heapIs $heap_{funcstart\_1032,1}).p3 % 178), [(0 < 170) \land !(170 < 0)]: (32768 / 170) < (this.$r.value(heapIs $heap_{funcstart\_1032,1}).p3 % 178), [(0 == 170) \land !(0 < 170) \land !(170 < 0)]: 32768 < 0) \rightarrow [simplify] [149.13] false
```

Proof of verification condition: Type constraint satisfied in explicit conversion from 'integer' to 'int'

In the context of class: WHPrang, declared at: C:\Escher\Customers\prang-cpp\prang.cpp (18,1)

Condition generated at: C:\Escher\Customers\prang-cpp\prang.cpp (81,18)

Condition defined at:

To prove: $minof(int) \le static_cast < integer > (static_cast < signed int > (operator*(heapIs $heap_{1032,1;1054,8}, this).p3) < (int)0)$

Given:

```
heap_{init}.LIMIT == (int)80
heap_{init}.class WHPrang \in M1 == (int)30269
heap_{init}.class WHPrang \in r1 == (int)171
\text{heap}_{init}.\mathbf{class} \text{ WHPrang } \in \text{a1} == (\mathbf{int})177
heap_{init}.class WHPrang \in b1 == (int)2
heap_{init}.class WHPrang \in M2 == (int)30307
heap_{init}.class WHPrang \in r2 == (int)172
heap_{init}.class WHPrang \in a2 == (int)176
heap_{init}.class WHPrang \in b2 == (int)35
heap_{init}.class WHPrang \in M3 == (int)30323
heap_{init}.class WHPrang \in r3 == (int)170
heap_{init}.class WHPrang \in a3 == (int)178
heap_{init}.class WHPrang \in b3 == (int)63
\operatorname{div1} == \operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_1032,1},
\mathbf{static\_cast} {<} \mathbf{int} {>} (\mathbf{operator}^*(\mathbf{heapIs}\ \$ \mathbf{heap}_{funcstart\_1032,1},\ \mathbf{this}).\mathtt{p1}),
\mathbf{static\_cast}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_1032,1}.\mathrm{a1}))
(asType < integer > (static\_cast < int > (operator*(heapIs)))
heap_{funcstart_1032.1}, this).p1) /
asType<integer>(static_cast<int>($heap_{funcstart_1032.1}.a1))) ==
```

```
asType<integer>(div1.quot)
(asType<integer>(static_cast<int>(operator*(heapIs
heap_{funcstart\_1032,1}, this).p1) %
asType < integer > (static\_cast < int > (\$heap_{funcstart\_1032.1}.a1))) = =
asType<integer>(div1.rem)
(asType < integer > (operator*(heapIs $heap_{funcstart\_1032,1}, this).p1) < footnote{the content of the conte
asType < integer > (\$heap_{funcstart\_1032,1}.a1)) = >
(asType<integer>(div1.rem) == asType<integer>(operator*(heapIs
heap_{funcstart\_1032,1}, this).p1)
(\mathbf{asType} < \mathbf{integer} > (\$ \mathbf{heap}_{funcstart\_1032,1}.\mathbf{a1}) \le
asType < integer > (operator*(heapIs $heap_{funcstart\_1032,1}, this).p1)) =>
!(0 == asType < integer > (div1.quot))
!(0 == asType < integer > (div1.rem)) || !(0 ==
asType<integer>(div1.quot))
\label{eq:div2} \text{div2} == \text{div}(\mathbf{heapIs} \ \$ \text{heap}_{funcstart\_1032,1},
static_cast<int>(operator*(heapIs $heap_{funcstart\_1032,1}, this).p2),
static\_cast < int > (\$heap_{funcstart\_1032.1}.a2))
(asType<integer>(static_cast<int>(operator*(heapIs
heap_{funcstart\_1032,1}, this).p2)) /
asType < integer > (static\_cast < int > (\$heap_{funcstart\_1032,1}.a2))) = =
asType<integer>(div2.quot)
(asType<integer>(static_cast<int>(operator*(heapIs
heap_{funcstart\_1032.1}, this).p2)
asType < integer > (static\_cast < int > (\$heap_{funcstart\_1032,1}.a2))) = =
asType<integer>(div2.rem)
(\mathbf{asType}{<}\mathbf{integer}{>}(\mathbf{operator}^*(\mathbf{heapIs}\ \$\mathbf{heap}_{funcstart\_1032,1},\ \mathbf{this}).\mathtt{p2}) <
asType < integer > (\$heap_{funcstart\_1032,1}.a2)) = >
(asType<integer>(div2.rem) == asType<integer>(operator*(heapIs
heap_{funcstart\_1032,1}, this).p2)
(\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathrm{heap}_{funcstart\_1032,1}.a2) \leq
asType < integer > (operator*(heapIs $heap_{funcstart\_1032.1}, this).p2)) =>
!(0 == asType < integer > (div2.quot))
!(0 == asType < integer > (div2.rem)) || !(0 ==
asType<integer>(div2.quot))
div3 == div(\mathbf{heapIs} \$heap_{funcstart\_1032,1},
\mathbf{static\_cast} < \mathbf{int} > (\mathbf{operator}^*(\mathbf{heapIs}\ \$ \mathbf{heap}_{funcstart\_1032,1},\ \mathbf{this}).\mathbf{p3}),
static\_cast < int > (\$heap_{funcstart\_1032,1}.a3))
(asType<integer>(static_cast<int>(operator*(heapIs
heap_{funcstart\_1032,1}, this).p3)) /
asType < integer > (static\_cast < int > (\$heap_{funcstart\_1032.1}.a3))) = =
asType<integer>(div3.quot)
```

```
(asType<integer>(static_cast<int>(operator*(heapIs
heap_{funcstart\_1032,1}, this).p3)
asType < integer > (static\_cast < int > (\$heap_{funcstart\_1032.1}.a3))) = =
asType<integer>(div3.rem)
(asType<integer>(operator*(heapIs $heap_{funcstart\_1032.1}, this).p3) <
asType < integer > (\$heap_{funcstart\_1032,1}.a3)) = >
(asType<integer>(div3.rem) == asType<integer>(operator*(heapIs
heap_{funcstart\_1032,1}, this).p3)
(asType < integer > (\$heap_{funcstart\_1032,1}.a3) \le
asType < integer > (operator^*(heapIs \$heap_{funcstart\_1032,1}, this).p3)) = >
!(0 == asTvpe < integer > (div3.quot))
!(0 == asType < integer > (div3.rem)) || !(0 ==
asType<integer>(div3.quot))
temp1 == (\$heap_{funcstart\_1032,1}.r1 * \textbf{static\_cast} < \textbf{signed int} > (div1.rem)) - (div1.rem) + (div1.r
($heap_funcstart_1032,1.b1 * static_cast<signed int>(div1.quot))
minof(signed int) < temp1
temp1 \le maxof(signed int)
heap_{1032,1;1051,8} == heap_{funcstart\_1032,1}._replace(this.$r \rightarrow
operator*(heapIs heap_{funcstart\_1032,1}, this)._replace(p1 \rightarrow
\mathbf{asType} < \text{P1Type} > ((\$\text{heap}_{funcstart\_1032,1}.\text{M1} *
asType < int > (static\_cast < integer > (static\_cast < signed)
int>(operator*(heapIs $heap_{funcstart\_1032,1}, this).p1) < (int)0))) +
temp1)))
temp2 == (\$heap_{1032,1;1051,8}.r2 * \mathbf{static\_cast} < \mathbf{signed\ int} > (div2.rem)) -
(\text{sheap}_{1032,1:1051,8}.\text{b2} * \text{static\_cast} < \text{signed int} > (\text{div}2.\text{quot}))
minof(signed\ int) \le temp2
temp2 \le maxof(signed int)
\text{heap}_{1032,1;1054,8} == \text{heap}_{1032,1;1051,8}.\_\text{replace}(\text{this}.\$r \rightarrow
operator*(heapIs heap_{1032,1;1051,8}, this)._replace(p2 \rightarrow
asType < P2Type > ((\$heap_{1032,1;1051,8}.M2 *
as Type < int > (static\_cast < integer > (static\_cast < signed))
\mathbf{int} > (\mathbf{operator}^*(\mathbf{heapIs} \ \$ \mathrm{heap}_{1032,1;1051,8}, \ \mathbf{this}).\mathrm{p2}) < (\mathbf{int})0))) + \mathrm{temp2})))
temp3 == (\$heap_{1032,1:1054.8}.r3 * static\_cast < signed int > (div3.rem)) -
(\text{sheap}_{1032,1:1054,8}.\text{b3} * \text{static\_cast} < \text{signed int} > (\text{div}3.\text{quot}))
minof(signed int) \le temp3
temp3 < maxof(signed int)
Proof:
[Take given term]
```

```
[2.0] \ \mathrm{div1} == \mathrm{div}(\mathbf{heapIs} \ \$ \mathrm{heap}_{funcstart\_1032,1},
\mathbf{static\_cast} < \mathbf{int} > (\mathbf{operator}^*(\mathbf{heapIs} \ \$ \mathbf{heap}_{funcstart\_1032,1}, \ \mathbf{this}).\mathtt{p1}),
\mathbf{static\_cast}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_1032,1}.\mathrm{a1}))
→ [expand definition of operator '*' in class 'pointer' at built in declaration]
[2.1] \operatorname{div1} == \operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_1032,1},
static\_cast < int > (this. r.value(heapIs  heap_{funcstart\_1032,1}).p1),
\mathbf{static\_cast}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_1032,1}.\mathrm{a1}))
\rightarrow [simplify]
[2.2] \operatorname{div1} == \operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_1032,1}, \mathbf{this}.\$ r. \mathbf{value}(\mathbf{heapIs}))
\label{eq:cast_int} $$ \theta_{funcstart\_1032,1}.p1, \ \mathbf{static\_cast} < \mathbf{int} > (\$ \theta_{funcstart\_1032,1}.a1))$$
\rightarrow [const static or extern object]
[2.3] \operatorname{div1} == \operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_1032,1}, \mathbf{this}.\$ r. \mathbf{value}(\mathbf{heapIs})
\label{eq:cast} $$ \theta_{funcstart\_1032,1}.p1, \ \mathbf{static\_cast} < \mathbf{int} > (\theta_{init}.a1))$
\rightarrow [expand definition of constant 'a1' at prang.cpp (30,26)]
[2.4] \text{ div1} == \text{div}(\text{heapIs } \text{heap}_{funcstart\_1032.1}, \text{this.} \text{$r.value}(\text{heapIs})
\theta_{funcstart\_1032,1}.p1, \theta_{funcstart\_1032,1}.p1, \theta_{funcstart\_1032,1}.p1, \theta_{funcstart\_1032,1}.p1
\rightarrow [simplify]
[2.6] \operatorname{div1} == \operatorname{div}(\mathbf{heapIs} \ \mathbf{\$heap}_{funcstart\_1032,1}, \ \mathbf{this}.\mathbf{\$r.value}(\mathbf{heapIs})
heap_{funcstart\_1032,1}.p1, 177
[Assume known post-assertion, class invariant or type constraint for term 2.6]
[7.0] (0 < asType<integer>(this.$r.value(heapIs)
$\text{heap}_{funcstart\_1032.1}\text{).p1}) && (asType<integer>(this.$r.value(heapIs)
\$ heap_{funcstart\_1032,1}).p1) < \mathbf{asType} < \mathbf{integer} > (\$ heap.\mathbf{class} \ WHPrang \in \texttt{Prance})
M1))
\rightarrow [simplify]
[7.2] (0 < this.$r.value(heapIs \rho_{funcstart\_1032,1}).p1) &&
(this.$r.value(heapIs \theta_{funcstart\_1032,1}).p1 <
asType < integer > (\text{$heap.class WHPrang} \in M1))
\rightarrow [const static or extern object]
[7.3] (0 < this.$r.value(heap
Is \rho_{funcstart\_1032,1}).p1) &&
(this.$r.value(heapIs heap_{funcstart\_1032,1}).p1 <
asType < integer > (\$heap_{init}.class WHPrang \in M1))
\rightarrow [expand definition of constant 'M1' at prang.cpp (28,26)]
[7.4] (0 < this.$r.value(heap
Is \rho_{funcstart\_1032,1}).p1) &&
(this.r.value(heapIs $heap_{funcstart\_1032,1}).p1 <
asType < integer > ((int)30269))
\rightarrow [simplify]
```

```
[7.10] (-30269 < -this.$r.value(heapIs heap_{funcstart\_1032,1}).p1) <math>\land (0 < 
this.r.value(heapIs $heap_{funcstart\_1032,1}).p1)
[Work on sub-term 2 of conjunction in term 7.10]
[8.0] 0 < this.$r.value(heapIs $heap<sub>funcstart_1032,1</sub>).p1
[Take given term]
[18.0] \operatorname{div2} == \operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_1032,1},
static_cast<int>(operator*(heapIs $heap_{funcstart\_1032,1}, this).p2),
\mathbf{static\_cast} {<} \mathbf{int} {>} (\$ \mathbf{heap}_{funcstart\_1032,1}.\mathbf{a2}))
→ [expand definition of operator '*' in class 'pointer' at built in declaration]
[18.1] \operatorname{div2} == \operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_1032,1},
static\_cast < int > (this. r.value(heapIs $heap_{funcstart\_1032,1}).p2),
static\_cast < int > (\$heap_{funcstart\_1032.1}.a2))
\rightarrow [simplify]
[18.2] \text{div2} == \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.} \text{\$r.value}(\text{heapIs})
\rho_{tuncstart_{1032.1}}, p2, static_cast<int>(\rho_{tuncstart_{1032.1}})
\rightarrow [const static or extern object]
[18.3] \operatorname{div2} == \operatorname{div}(\mathbf{heapIs} \ \text{$heap}_{funcstart\_1032,1}, \ \mathbf{this}.\text{$r.value}(\mathbf{heapIs})
\theta_{funcstart\_1032,1}.p2, \theta_{funcstart\_1032,1}.p3, \theta_{funcstart\_1032,1}.p2, \theta_{funcstart\_1032,1}.p3, \theta_{funcstart\_1032,1
\rightarrow [expand definition of constant 'a2' at prang.cpp (35,26)]
[18.4] \text{ div2} == \text{div}(\mathbf{heapIs} \$ \mathbf{heap}_{funcstart\_1032,1}, \mathbf{this.\$r.value}(\mathbf{heapIs})
\theta_{funcstart\_1032,1}.p2, \theta_{funcstart} = \theta_{funcstart\_1032,1}.p2, \theta_{funcstart} = \theta_{funcstart} = \theta_{funcstart}
\rightarrow [simplify]
[18.6]~{\rm div2} == {\rm div}(\mathbf{heapIs}~\$ \mathrm{heap}_{funcstart\_1032,1},~\mathbf{this}.\$ \mathrm{r.value}(\mathbf{heapIs}
heap_{funcstart_{-1032,1}}.p2, 176
[Assume known post-assertion, class invariant or type constraint for term 18.6]
[23.0] (0 < asType<integer>(this.$r.value(heapIs
\label{eq:continuous} $\operatorname{heap}_{funcstart\_1032,1}).p2)) \&\& (\mathbf{asType}{<}\mathbf{integer}{>} (\mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})) \&\& (\mathbf{asType}{<}\mathbf{integer}{>} (\mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}))) \&\& (\mathbf{asType}{<}\mathbf{integer}{>} (\mathbf{heapIs})) \&\& (\mathbf{asType}{<}\mathbf{
\rho_{funcstart\_1032,1}.p2 < asType<integer>(\rho_{funcstart\_1032,1}.p2) < asType<integer>(\rho_{funcstart\_1032,1}.p2)
M2))
\rightarrow [simplify]
[23.2] (0 < this.r.value(heapIs \ heap_{funcstart\_1032,1}).p2) \&\&
(this.r.value(heapIs $heap_{funcstart\_1032,1}).p2 <
asType < integer > (\text{heap.class WHPrang} \in M2))
\rightarrow [const static or extern object]
[23.3] (0 < this.$r.value(heapIs heap_{funcstart\_1032,1}).p2) &&
(this.r.value(heapIs $heap_{funcstart\_1032,1}).p2 <
asType < integer > (\$heap_{init}.class WHPrang \in M2))
```

```
\rightarrow [expand definition of constant 'M2' at prang.cpp (33,26)]
[23.4] (0 < this.$r.value(heapIs \rho_{funcstart\_1032,1}).p2) &&
(this.$r.value(heapIs \rho_{funcstart\_1032,1}).p2 <
asType < integer > ((int)30307))
\rightarrow [simplify]
[23.10] (-30307 < -this.$r.value(heapIs $heap_{funcstart\_1032,1}).p2) \land (0 <
\mathbf{this.\$r.value}(\mathbf{heapIs}~\$\mathrm{heap}_{funcstart\_1032,1}).\mathrm{p2})
[Work on sub-term 2 of conjunction in term 23.10]
[24.0] 0 < this.$r.value(heapIs \theta_{funcstart\_1032,1}).p2
[Take given term]
[34.0] div3 == div(heapIs $heap<sub>funcstart_1032,1</sub>,
\mathbf{static\_cast} < \mathbf{int} > (\mathbf{operator}^*(\mathbf{heapIs} \ \$ \mathbf{heap}_{funcstart\_1032,1}, \ \mathbf{this}).\mathbf{p3}),
\mathbf{static\_cast}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_1032,1}.\mathrm{a3}))
→ [expand definition of operator '*' in class 'pointer' at built in declaration]
[34.1] \operatorname{div3} == \operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_1032,1},
static\_cast < int > (this. r.value(heapIs  heap_{funcstart\_1032,1}).p3),
\mathbf{static\_cast} < \mathbf{int} > (\$ \mathbf{heap}_{funcstart\_1032,1}.\mathbf{a3}))
\rightarrow [simplify]
[34.2] div3 == div(heapIs heapIs  heap_{funcstart\_1032,1}, this.r.value(heapIs)
\theta_{funcstart\_1032,1}, p3, static_cast<int>(\theta_{funcstart\_1032,1})
\rightarrow [const static or extern object]
[34.3]~{\rm div3} == {\rm div}(\mathbf{heapIs}~\$\mathrm{heap}_{funcstart\_1032,1},~\mathbf{this}.\$\mathrm{r.value}(\mathbf{heapIs}
\theta_{funcstart\_1032,1}.p3, \theta_{funcstart\_1032,1}.p4, \theta_{funcstart\_1032,1}.p4, \theta_{funcstart\_1032,1}.p4, \theta_{funcstart\_1032,1}.p4, \theta_{funcstart\_1032,1}.p4, \theta_{funcstart\_1032,1}.p5, \theta_{funcstart\_1032,1}.p5, \theta_{funcstart\_1032,1}.p5, \theta_{funcstart\_1032,1}.p5, \theta_{funcstart\_1032,1}.p5, \theta_{funcstart\_1032,1}.p5, \theta_{funcstart\_1032,1}.p5, \theta_{funcstart\_1032,1}.p5, \theta_{funcstart\_1032,1
\rightarrow [expand definition of constant 'a3' at prang.cpp (40,26)]
[34.4] div3 == div(heapIs heapIs heapIs _{funcstart\_1032,1}, this.r.value(heapIs)
\label{eq:cast_int} $$ \rho_{uncstart\_1032,1}.p3, \ \mathbf{static\_cast} < \mathbf{int} > ((\mathbf{int})178)) $$
\rightarrow [simplify]
[34.6] \text{ div3} == \text{div(heapIs $heap}_{funcstart\_1032,1}, \text{ this.} \$r. value(heapIs)
heap_{funcstart_1032,1}.p3, 178)
[Assume known post-assertion, class invariant or type constraint for term 34.6]
[39.0] (0 < asType<integer>(this.$r.value(heapIs
$\text{heap}_{tuncstart_1032.1}\text{.p3})) && (asType<integer>(this.$r.value(heapIs)
\$heap_{funcstart\_1032,1}).p3) < \mathbf{asType} < \mathbf{integer} > (\$heap.\mathbf{class} \ WHPrang \in \texttt{Constart} = \texttt{Constart} =
M3))
\rightarrow [simplify]
[39.2] (0 < this.$r.value(heap
Is \rho_{funcstart\_1032,1}).p3) &&
(this.r.value(heapIs \ heap_{funcstart\_1032,1}).p3 <
```

```
asType < integer > (\text{$heap.class WHPrang} \in M3))
\rightarrow [const static or extern object]
[39.3] (0 < this.$r.value(heap
Is \rho_{uncstart\_1032,1}).p3) &&
(this.r.value(heapIs $heap_{funcstart\_1032,1}).p3 <
asType < integer > (\$heap_{init}.class WHPrang \in M3))
\rightarrow [expand definition of constant 'M3' at prang.cpp (38,26)]
[39.4] (0 < this.$r.value(heapIs \rho_{funcstart\_1032,1}).p3) &&
(this.r.value(heapIs $heap_{funcstart\_1032.1}).p3 <
asType < integer > ((int)30323))
\rightarrow [simplify]
[39.10] (-30323 < -this.$r.value(heapIs $heap_{funcstart\_1032.1}).p3) \land (0 <
this.$r.value(heapIs $heap_{funcstart_1032.1}).p3)
[Work on sub-term 2 of conjunction in term 39.10]
[40.0]~0 < {\bf this.\$r.value(heap Is}~\$heap_{funcstart\_1032,1}).p3
[Take given term]
[50.0] (($heap_tuncstart_1032,1.r1 * static_cast<signed int>(div1.rem)) -
(\text{sheap}_{funcstart\_1032,1}.\text{b1 * static\_cast} < \text{signed int} > (\text{div1.quot}))) == \text{temp1}
\rightarrow [const static or extern object]
[50.1] (($heap<sub>init</sub>.r1 * static_cast<signed int>(div1.rem)) -
(\text{sheap}_{funcstart\_1032,1}.\text{b1 * static\_cast} < \text{signed int} > (\text{div1.quot}))) == \text{temp1}
\rightarrow [expand definition of constant 'r1' at prang.cpp (29,26)]
[50.2] (((int)171 * static_cast<signed int>(div1.rem)) -
(\$heap_{funcstart\_1032,1}.b1 * \mathbf{static\_cast} < \mathbf{signed\ int} > (div1.quot))) == temp1
\rightarrow [simplify]
[50.3] ((171 * static_cast < signed int > (div1.rem)) - ($heap_funcstart_1032.1.b1
* static_cast<signed int>(div1.quot))) == temp1
\rightarrow [from term 2.6, div1 is equal to div(heapIs $heap_{funcstart\_1032,1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177)]
[50.4] ((171 * static_cast < signed int > (div(heapIs heapIs funcstart_{1032,1}),
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177).rem)) -
(\text{sheap}_{funcstart\_1032,1}.\text{b1 * static\_cast} < \text{signed int} > (\text{div1.quot}))) == \text{temp1}
\rightarrow [simplify]
[50.5] ((171 * div(heapIs $heap_{funcstart\_1032,1}, this.$r.value(heapIs)
\text{Sheap}_{funcstart\_1032,1}.p1, 177).rem) - (\text{Sheap}_{funcstart\_1032,1}.b1 *
static_cast<signed int>(div1.quot))) == temp1
\rightarrow [const static or extern object]
```

```
[50.6] ((171 * div(heapIs $heap_{funcstart\_1032,1}, this.$r.value(heapIs)
\rho_{funcstart\_1032,1}.p1, 177).rem – (\rho_{funcstart\_1032,1}.p1, 177).rem) – (\rho_{funcstart\_1032,1}.p1, 177).rem)
int>(div1.quot))) == temp1
\rightarrow [expand definition of constant 'b1' at prang.cpp (31,26)]
[50.7] ((171 * div(heapIs heap_{funcstart\_1032,1}, this.r.value(heapIs)
\theta_{funcstart\_1032,1}.p1, 177).rem - ((int)2 * static\_cast < signed)
int>(div1.quot))) == temp1
\rightarrow [simplify]
[50.8] ((171 * div(heapIs $heap_{funcstart\_1032,1}, this.$r.value(heapIs 
\rho_{tuncstart\_1032.1}, p1, 177).rem) - (2 * static_cast<signed
int>(div1.quot)) == temp1
\rightarrow [from term 2.6, div1 is equal to div(heapIs $heap_{funcstart\_1032,1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177)]
[50.9] ((171 * div(heapIs $heap_{funcstart\_1032,1}, this.$r.value(heapIs)
\theta_{funcstart\_1032,1}.p1, 177).rem - (2 * static\_cast < signed)
int>(div(heapIs \$heap_{funcstart\_1032,1}, this.\$r.value(heapIs
heap_{funcstart_{-1032,1}}.p1, 177).quot))) == temp1
\rightarrow [simplify]
[50.14] 0 == (-\text{temp1} + (-2 * \text{div}(\text{heapIs } \$\text{heap}_{funcstart\_1032,1},
this.r.value(heapIs \ensuremath{\$}heap_{funcstart\_1032,1}).p1, 177).quot) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_1032,1}, \ \mathbf{this}.\$ r. \mathbf{value}(\mathbf{heapIs}
heap_{funcstart_{-1032.1}}.p1, 177).rem
[Take given term]
[53.0] heap_{1032,1;1051,8} == heap_{funcstart\_1032,1}._replace(this.$r \rightarrow
operator*(heapIs heap_{funcstart\_1032,1}, this)._replace(p1 \rightarrow
asType < P1Type > ((\$heap_{funcstart\_1032,1}.M1 *
asType<int>(static_cast<integer>(static_cast<signed
int>(operator*(heapIs $heap_{funcstart\_1032,1}, this).p1) < (int)0))) +
temp1)))
→ [expand definition of operator '*' in class 'pointer' at built in declaration]
[53.1] heap_{1032,1;1051,8} == heap_{funcstart\_1032,1}._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow
\mathbf{asType}{<}P1\mathsf{Type}{>}((\$\mathsf{heap}_{funcstart\_1032,1}.\mathsf{M1}\ *
asType<int>(static_cast<integer>(static_cast<signed
int>(operator^*(heapIs \$heap_{funcstart\_1032,1}, this).p1) < (int)0))) +
temp1)))
\rightarrow [const static or extern object]
[53.2] heap_{1032,1;1051,8} == heap_{funcstart\_1032,1}._replace(this.r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow
asType<P1Type>(($heap<sub>init</sub>.M1 *
```

```
asType<int>(static_cast<integer>(static_cast<signed
int>(operator*(heapIs $heap_{funcstart\_1032,1}, this).p1) < (int)0))) +
temp1)))
\rightarrow [expand definition of constant 'M1' at prang.cpp (28,26)]
[53.3] heap_{1032,1;1051,8} == heap_{funcstart\_1032,1}._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow
asType<P1Type>(((int)30269 *
asType < int > (static\_cast < integer > (static\_cast < signed)
int>(operator^*(heapIs \$heap_{funcstart\_1032,1}, this).p1) < (int)0))) +
temp1)))
\rightarrow [simplify]
[53.4] heap_{1032,1;1051,8} == heap_{funcstart\_1032,1}._replace(this.r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow
asType<P1Type>((30269 *
as Type < int > (static\_cast < integer > (static\_cast < signed))
int>(operator^*(heapIs $heap_{funcstart\_1032,1}, this).p1) < (int)0))) +
temp1)))
→ [expand definition of operator '*' in class 'pointer' at built in declaration]
[53.5] heap_{1032,1;1051,8} == heap_{funcstart\_1032,1}._replace(this.$r \rightarrow
\mathbf{this.\$r.value}(\mathbf{heapIs}~\$ \mathrm{heap}_{funcstart\_1032,1}).\_\mathbf{replace}(\mathrm{p1} \rightarrow
asType<P1Type>((30269 *
asType<int>(static_cast<integer>(static_cast<signed
int>(this.\$r.value(heapIs \$heap_{funcstart\_1032,1}).p1) < (int)0))) + temp1)))
\rightarrow [simplify]
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow
\mathbf{asType} {<} P1Type {>} ((30269 * \mathbf{asType} {<} \mathbf{int} {>} (\mathbf{static\_cast} {<} \mathbf{integer} {>} (0 <
-this.r.value(heapIs heap_{funcstart\_1032,1}.p1)) + temp1)))
\rightarrow [from term 8.0, literala < -this.$r.value(heapIs $heap_{funcstart\_1032,1}).p1
is false whenever -2 < (0 + literala)
   Proof of rule precondition:
   [53.9.0] - 2 < (0 + 0)
   \rightarrow [simplify]
   [53.9.2] true
[53.10] $\text{heap}_{1032,1:1051.8} == $\text{heap}_{funcstart\_1032,1}.$\text{replace}(\text{this}.$\text{$r} \to \text{$}
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow
asType<P1Type>((30269 * asType<int>(static_cast<integer>(false)))
+ \text{temp1})))
\rightarrow [simplify]
```

```
[53.11] heap_{1032,1:1051,8} == heap_{funcstart\_1032,1}._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow
asType<P1Type>((30269 * asType<int>(([false]: 1, []: 0))) + temp1)))
\rightarrow [explicitly assert falsehood of skipped guards in subsequent guards]
[53.12] $\text{heap}_{1032,1;1051,8} == $\text{heap}_{funcstart\_1032,1}._\text{replace}(\text{this}.\text{$\frac{1}{2}r$})
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow
asType<P1Type>((30269 * asType<int>(([false]: 1, [true]: 0))) +
temp1)))
\rightarrow [simplify]
[53.15] $heap<sub>1032,1;1051,8</sub> == $heap<sub>funcstart_1032,1</sub>._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow
asType < P1Type > (0 + temp1))
\rightarrow [from term 50.14, temp1 is equal to (-2 * div(heapIs $heap_{funcstart\_1032,1},
this.$r.value(heapIs $heap_{funcstart\_1032,1}).p1, 177).quot) + (171 *
div(heapIs $heap_{tuncstart\_1032.1}, this.$r.value(heapIs
heap_{funcstart_{1032.1}}.p1, 177).rem
[53.16] heap_{1032,1;1051,8} == heap_{funcstart\_1032,1}._replace(this.$r \rightarrow
this.r.value(heapIs \ heap_{funcstart\_1032,1}).\_replace(p1 \rightarrow
asType < P1Type > (0 + ((-2 * div(heapIs $heap_{funcstart\_1032,1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177).quot) + (171 *
div(\mathbf{heapIs} \$ heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
heap_{funcstart_{1032,1}}.p1, 177).rem))))
\rightarrow [simplify]
[53.19] $heap<sub>1032,1;1051,8</sub> == $heap<sub>funcstart_1032,1</sub>._replace(this.$r \rightarrow
\textbf{this.\$r.value}(\textbf{heapIs}~\$ heap_{funcstart\_1032,1}).\_\textbf{replace}(p1 \rightarrow ((\text{-}2~*\text{div}(\textbf{heapIs}
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.}\text{\$r.value}(\text{heapIs}))
heap_{funcstart\_1032,1}.p1, 177.rem)))
[Take given term]
[54.0] (($heap_{1032,1;1051,8}.r2 * static_cast < signed int > (div2.rem)) -
(\text{sheap}_{1032,1:1051,8}.\text{b2} * \text{static\_cast} < \text{signed int} > (\text{div2.quot}))) == \text{temp2}
\rightarrow [from term 53.19, $heap_{1032,1;1051,8}$ is equal to
$heap_{funcstart\_1032,1}.$_replace(this.$r \rightarrow this.$r.value(heapIs)
heap_{funcstart\_1032,1}._replace(p1 \rightarrow (-2 * div(heapIs $heap_{funcstart\_1032,1},
this.r.value(heapIs \ \ heap_{funcstart\_1032,1}).p1,\ 177).quot) + (171 * 
div(\mathbf{heapIs} \ \$heap_{funcstart\_1032,1}, \ \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
heap_{funcstart_{1032.1}}.p1, 177).rem)))
[54.1] ((\text{$heap}_{funcstart\_1032,1}._replace(this.$r \rightarrow this.$r.value(heapIs)
heap_{funcstart\_1032,1}._replace(p1 \rightarrow ((-2 * div(heapIs heap_{funcstart\_1032,1}),
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177).quot) + (171 *
div(\mathbf{heapIs} \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
```

```
\rho_{tuncstart=1032.1}.p1, 177.rem))).r2 * static_cast < signed
int>(div2.rem)) - (\$heap_{1032,1:1051,8}.b2 * static\_cast < signed)
int>(div2.quot))) == temp2
→ [const member of object with modified fields]
[54.2] (($heap_funcstart_1032,1.r2 * static_cast<signed int>(div2.rem)) -
(\text{\$heap}_{1032,1;1051,8}.\text{b2} * \textbf{static\_cast} < \textbf{signed int} > (\text{div2.quot}))) == \text{temp2}
\rightarrow [const static or extern object]
[54.3] (($heap<sub>init</sub>.r2 * static_cast<signed int>(div2.rem)) -
(\text{sheap}_{1032,1;1051,8}.\text{b2} * \text{static\_cast} < \text{signed int} > (\text{div2.quot}))) == \text{temp2}
\rightarrow [expand definition of constant 'r2' at prang.cpp (34,26)]
[54.4] (((int)172 * static_cast<signed int>(div2.rem)) -
(\text{sheap}_{1032,1;1051,8}.\text{b2} * \text{static\_cast} < \text{signed int} > (\text{div2.quot}))) == \text{temp2}
\rightarrow [simplify]
[54.5] ((172 * static_cast<signed int>(div2.rem)) - ($heap_{1032.1:1051.8}.b2 *
static_cast<signed int>(div2.quot))) == temp2
\rightarrow [from term 18.6, div2 is equal to div(heapIs $heap_{funcstart\_1032,1},
this.r.value(heapIs $heap_{funcstart\_1032,1}).p2, 176)
[54.6] ((172 * static_cast<signed int>(div(heapIs $heap_{tuncstart\_1032,1},
this.r.value(heapIs $heap_{funcstart\_1032,1}).p2, 176).rem)) -
(\text{sheap}_{1032,1;1051,8}.\text{b2} * \text{static\_cast} < \text{signed int} > (\text{div2.quot}))) == \text{temp2}
\rightarrow [simplify]
[54.7] ((172 * div(heapIs $heap_{funcstart\_1032,1}, this.$r.value(heapIs
\text{heap}_{funcstart\_1032,1}.p2, 176).rem) - (\text{heap}_{1032,1;1051,8}.b2 *
static_cast<signed int>(div2.quot))) == temp2
\rightarrow [from term 53.19, $heap<sub>1032,1;1051,8</sub> is equal to
\$heap_{funcstart\_1032,1}.\_\textbf{replace}(\textbf{this}.\$r \rightarrow \textbf{this}.\$r.\textbf{value}(\textbf{heapIs}
heap_{funcstart\_1032,1}._replace(p1 \rightarrow (-2 * div(heapIs $heap_{funcstart\_1032,1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177).quot) + (171 *
div(heapIs $heap_funcstart_1032.1, this.$r.value(heapIs
heap_{funcstart\_1032,1}.p1, 177).rem)))
[54.8] ((172 * div(heapIs $heap_{funcstart\_1032,1}, this.$r.value(heapIs)
\rho_{funcstart\_1032,1}.p2, 176).rem – (\rho_{funcstart\_1032,1}.replace(his.replace)
div(\mathbf{heapIs} \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
\text{Sheap}_{funcstart\_1032.1}.p1, 177).quot) + (171 * div(heapIs \text{Sheap}_{funcstart\_1032.1},
this.r.value(heapIs \ heap_{funcstart\_1032.1}).p1, 177).rem)))).b2 *
static_cast<signed int>(div2.quot))) == temp2
\rightarrow [const member of object with modified fields]
[54.9] ((172 * div(heapIs \rho_{funcstart\_1032,1}, this.r.value(heapIs)
```

```
\text{Sheap}_{funcstart\_1032,1}.\text{p2}, 176).\text{rem} - (\text{Sheap}_{funcstart\_1032,1}.\text{b2} *
static_cast<signed int>(div2.quot))) == temp2
\rightarrow [const static or extern object]
[54.10] ((172 * div(heapIs $heap_{funcstart\_1032,1}, this.$r.value(heapIs
\rho_{uncstart\_1032,1}.p2, 176).rem – (\rho_{uncstart\_1032,1}.p2, 176).rem
int>(div2.quot))) == temp2
\rightarrow [expand definition of constant 'b2' at prang.cpp (36,26)]
[54.11] ((172 * div(heapIs $heap<sub>funcstart_1032.1</sub>, this.$r.value(heapIs)
\theta_{uncstart\_1032,1}.p2, 176).rem - ((int)35 * static\_cast < signed)
int>(div2.quot))) == temp2
\rightarrow [simplify]
[54.12] ((172 * div(heapIs $heap_{funcstart\_1032,1}, this.$r.value(heapIs
\rho_{funcstart\_1032.1}.p2, 176).rem) - (35 * static_cast<signed)
int>(div2.quot)) = temp2
\rightarrow [from term 18.6, div2 is equal to div(heapIs $heap_{funcstart\_1032,1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p2, 176)]
[54.13] ((172 * div(heapIs heap_{funcstart\_1032,1}, this.r.value(heapIs)
\theta_{funcstart\_1032,1}.p2, 176).rem - (35 * static\_cast < signed)
int>(div(heapIs \$heap_{funcstart\_1032,1}, this.\$r.value(heapIs
\text{Sheap}_{funcstart\_1032,1}.p2, 176).quot))) == temp2
\rightarrow [simplify]
[54.18] 0 == (-\text{temp2} + (-35 * \text{div}(\text{heapIs} \$\text{heap}_{funcstart\_1032.1})]
this.r.value(heapIs \ensuremath{\$}heap_{funcstart\_1032,1}).p2, 176).quot) + (172 *
div(heapIs $heap<sub>funcstart_1032.1</sub>, this.$r.value(heapIs
heap_{funcstart\_1032,1}.p2, 176).rem)
[Take given term]
[57.0] $\text{heap}_{1032,1;1054,8} == $\text{heap}_{1032,1;1051,8}._\text{replace}(\text{this}.$\text{$r} \to \text{
operator*(heapIs heap_{1032,1;1051,8}, this)._replace(p2 \rightarrow
asType<P2Type>(($heap<sub>1032.1:1051.8</sub>.M2 *
asType<int>(static_cast<integer>(static_cast<signed
int>(operator^*(heapIs \$heap_{1032,1;1051,8}, this).p2) < (int)(0))) + temp(2)))
\rightarrow [from term 53.19, $heap<sub>1032,1:1051,8</sub> is equal to
heap_{funcstart\_1032,1}._replace(this.r \rightarrow this.r.value(heapIs)
heap_{funcstart\_1032,1}._replace(p1 \rightarrow (-2 * div(heapIs heap_{funcstart\_1032,1}).
this.r.value(heapIs \ \ heap_{funcstart\_1032,1}).p1, \ 177).quot) + (171 *
div(\mathbf{heapIs} \ \$heap_{funcstart\_1032,1}, \ \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
heap_{funcstart\_1032,1}.p1, 177).rem)))]
[57.2] heap_{1032,1;1054,8} == heap_{funcstart\_1032,1}._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart=1032.1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
```

```
177).quot) + (171 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.} \text{\$r.value}(\text{heapIs}))
\rho_{funcstart\_1032,1}.p1, 177).rem)))).\_replace(this.\$r \rightarrow operator*(heapIs)
\rho_{funcstart\_1032,1}.\_replace(this.\rdots) + this.\rdots - this.\rdots
\rho_{tuncstart\_1032.1}._replace(p1 \rightarrow (-2 * div(heapIs \rho_{tuncstart\_1032.1}).
this.r.value(heapIs \ heap_{funcstart\_1032.1}).p1, 177).quot) + (171)
div(\mathbf{heapIs} \$ heap_{funcstart\_1032.1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
\$heap_{funcstart\_1032,1}).p1,\ 177).rem))),\ \textbf{this}).\_\textbf{replace}(p2\rightarrow
asType<P2Type>(($heap<sub>1032,1:1051,8</sub>.M2 *
asType<int>(static_cast<integer>(static_cast<signed
int > (operator^*(heapIs \$heap_{1032,1;1051,8}, this).p2) < (int)0))) + temp2)))
→ [expand definition of operator '*' in class 'pointer' at built in declaration]
[57.3] heap_{1032,1;1054,8} == heap_{funcstart\_1032,1}._replace(this.$r \rightarrow
this.$r.value(heapIs p_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
\theta_{funcstart\_1032,1}.p1, 177).rem)))).\_replace(this.\$r \rightarrow 0
this.r.value(heapIs \ heap_{funcstart\_1032,1}.\_replace(this.\rdots)
this.$r.value(heapIs heap_{funcstart\_1032.1})._replace(p1 \rightarrow ((-2 * div(heapIs
\label{eq:heapIs} $\operatorname{heap}_{funcstart\_1032,1}, \, \mathbf{this}. \\ $\operatorname{s.-value}(\mathbf{heapIs} \, \, \\ \\ \operatorname{heap}_{funcstart\_1032,1}).p1, \\
177).quot) + (171 * div(\mathbf{heapIs} \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}))
\theta_{funcstart\_1032.1}.p1, 177).rem))))._replace(p2 \rightarrow
asType<P2Type>(($heap<sub>1032,1:1051,8</sub>.M2)
asType < int > (static\_cast < integer > (static\_cast < signed)
int > (operator^*(heapIs \$heap_{1032,1;1051,8}, this).p2) < (int)0))) + temp2)))
→ [evaluate dereferenced pointer into modified heap]
this.$r.value(heapIs \rho_{tuncstart\_1032.1})._replace(p1 \rightarrow ((-2 * div(heapIs
\theta_{funcstart\_1032,1}, this.\r.value(heapIs \theta_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(\mathbf{heapIs} \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}))
\rho_{funcstart\_1032.1}.p1, 177).rem)))._replace(this.$r \rightarrow ([this.$r ==
this.$r]: this.$r.value(heapIs \rho_{funcstart\_1032,1})._replace(p1 \rightarrow (-2 *
\operatorname{div}(\mathbf{heapIs}\ \$ \mathrm{heap}_{funcstart\_1032,1},\ \mathbf{this}.\$ \mathbf{r.value}(\mathbf{heapIs}
\text{Sheap}_{funcstart\_1032,1}.p1, 177).quot) + (171 * div(heapIs \text{Sheap}_{funcstart\_1032,1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177).rem)), []:
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p2 \rightarrow
asType<P2Type>(($heap<sub>1032,1;1051,8</sub>.M2 *
as Type < int > (static\_cast < integer > (static\_cast < signed))
int>(operator^*(heapIs \$heap_{1032,1;1051,8}, this).p2) < (int)0))) + temp2)))
→ [explicitly assert falsehood of skipped guards in subsequent guards]
[57.5] heap_{1032,1;1054,8} == heap_{funcstart\_1032,1}._replace(this.$r \rightarrow
this.$r.value(heapIs \frac{1}{2} heap\frac{1}{2} line \frac{1}{2} heap\frac{1}{2} heap\frac{1}{2
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
```

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\rho_{tuncstart_1032.1}.p1, 177.rem)))._replace(this.$r \rightarrow ([this.$r ==
this.$r]: this.$r.value(heapIs \rho_{tuncstart\_1032,1})._replace(p1 \rightarrow (-2 *
div(\mathbf{heapIs} \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
\text{Sheap}_{funcstart\_1032,1}.p1, 177).quot) + (171 * div(heapIs \text{Sheap}_{funcstart\_1032,1},
this.r.value(heapIs \heap_{funcstart\_1032.1}).p1, 177).rem)), [!(this.<math>r = 
this.$r)]: this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p2 \rightarrow
asType < P2Type > ((\$heap_{1032,1;1051,8}.M2 *
asType<int>(static_cast<integer>(static_cast<signed
int>(operator^*(heapIs $heap_{1032,1:1051.8}, this).p2) < (int)(0))) + temp(2)))
[57.7] heap_{1032,1;1054,8} == heap_{funcstart\_1032,1}._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs $heap_{funcstart\_1032,1}, this.$r.value(heapIs
\label{eq:continuous_function} $ \text{heap}_{funcstart\_1032,1} . \text{p1}, 177).rem)))).$ \textbf{replace(this.} \$r \rightarrow $ \text{the properties of the prop
this.$r.value(heapIs heap_{funcstart=1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{heap}_{funcstart\_1032,1}, \text{this.}\text{\$r.value}(\text{heapIs}))
\theta_{funcstart\_1032,1}.p1, 177).rem))).\_replace(p2 \rightarrow
asType<P2Type>(($heap<sub>1032,1:1051,8</sub>.M2 *
asType<int>(static_cast<integer>(static_cast<signed
int>(operator^*(heapIs $heap_{1032,1;1051,8}, this).p2) < (int)0))) + temp2)))
\rightarrow [from term 53.19, $heap<sub>1032,1;1051,8</sub> is equal to
\$heap_{funcstart\_1032,1}.\_\textbf{replace}(\textbf{this}.\$r \rightarrow \textbf{this}.\$r.\textbf{value}(\textbf{heapIs}
heap_{funcstart\_1032,1}._replace(p1 \rightarrow (-2 * div(heapIs $heap_{funcstart\_1032,1}, 
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177).quot) + (171 *
div(\mathbf{heapIs} \ \$heap_{funcstart\_1032,1}, \ \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
heap_{funcstart_{-1032,1}}.p1, 177).rem)))
[57.8] heap_{1032,1;1054,8} == heap_{funcstart\_1032,1}._replace(this.$r \rightarrow
this.$r.value(heapIs \rho_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\theta_{funcstart\_1032,1}, this.\r.value(heapIs \theta_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs $heap_{funcstart\_1032,1}, this.$r.value(heapIs
\theta_{funcstart\_1032,1}.p1, 177).rem))))._replace(this.$r \rightarrow
this.$r.value(heapIs \rho_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs \theta_{funcstart\_1032,1}, this.r.value(heapIs)
\theta_{funcstart\_1032,1}.p1, 177).rem))).\_replace(p2 \rightarrow
asType < P2Type > ((\$heap_{tuncstart\_1032,1}.\_replace(this.\$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart_1032,1}, this.r.value(heapIs \rho_{funcstart_1032,1}).p1,
177).quot) + (171 * div(heapIs \$heap_{funcstart\_1032,1}, this.\$r.value(heapIs
heap_{funcstart_{1032,1}}.p1, 177).rem))).M2 *
asType<int>(static_cast<integer>(static_cast<signed
int>(operator^*(heapIs $heap_{1032.1:1051.8}, this).p2) < (int)(0))) + temp(2)))
```

```
\rightarrow [const member of object with modified fields]
[57.9] heap_{1032,1;1054,8} == heap_{funcstart\_1032,1}._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
$\text{heap}_{funcstart_1032.1}$, this.$\text{r.value}(\text{heapIs} \text{$heap}_{funcstart_1032.1}).p1,
177).quot) + (171 * div(heapIs heapIs = 1032,1, this.r.value(heapIs)
\theta_{funcstart\_1032,1}.p1, 177).rem)))).\_replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(\mathbf{heapIs} \ \$heap_{funcstart\_1032,1}, \ \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
\theta_{funcstart\_1032,1}.p1, 177).rem))).\_replace(p2 \rightarrow
asType<P2Type>(($heap_funcstart_1032,1.M2 *
asType < int > (static\_cast < integer > (static\_cast < signed
int>(operator^*(heapIs $heap_{1032,1;1051,8}, this).p2) < (int)0))) + temp2)))
\rightarrow [const static or extern object]
[57.10] $heap<sub>1032,1;1054,8</sub> == $heap<sub>funcstart_1032,1</sub>._replace(this.$r \rightarrow
this.$r.value(heapIs \theta_{funcstart\_1032,1})._replace(p1 \theta ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.\r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032.1}, \text{this.} \text{\$r.value}(\text{heapIs}))
\theta_{funcstart, 1032.1}.p1, 177).rem)))._replace(this.$r \rightarrow
this.$r.value(heapIs \theta_{funcstart\_1032,1})._replace(p1 \theta ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
\label{eq:condition} $\operatorname{heap}_{funcstart\_1032,1}).p1,\ 177).rem))).\_\mathbf{replace}(p2 \to
asType<P2Type>(($heap<sub>init</sub>.M2 *
asType < int > (static\_cast < integer > (static\_cast < signed)
int>(operator^*(heapIs $heap_{1032,1;1051,8}, this).p2) < (int)(0))) + temp(2)))
\rightarrow [expand definition of constant 'M2' at prang.cpp (33,26)]
[57.11] $\text{heap}_{1032,1:1054,8} == \text{$heap}_{funcstart\_1032,1}._\text{$replace}(\text{this}.\text{$r} \to \text{$r$}
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.} \text{\$r.value}(\text{heapIs}))
\theta_{funcstart\_1032,1}.p1, 177).rem)))).\_replace(this.\$r \rightarrow 0
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(\mathbf{heapIs} \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}))
\theta_{uncstart\_1032,1}.p1, 177).rem))).\_replace(p2 \rightarrow
asType < P2Type > (((int)30307 *
asType < int > (static\_cast < integer > (static\_cast < signed
int>(operator^*(heapIs \$heap_{1032,1;1051,8}, this).p2) < (int)(0))) + temp(2)))
\rightarrow [simplify]
[57.12] $\text{heap}_{1032,1;1054,8} == $\text{heap}_{funcstart\_1032,1}._\text{replace}(\text{this}.\text{$\frac{1}{2}r$})
this.$r.value(heapIs \rho_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
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177).quot) + (171 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.} \text{\$r.value}(\text{heapIs}))
\theta_{funcstart\_1032,1}.p1, 177).rem))))._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(\mathbf{heapIs} \$ heap_{funcstart\_1032,1}, \mathbf{this}.\$ r. \mathbf{value}(\mathbf{heapIs})
heap_{funcstart\_1032,1}.p1, 177).rem)))._replace(p2 \rightarrow
asType<P2Type>((30307 *
asType<int>(static_cast<integer>(static_cast<signed
int>(operator^*(heapIs $heap_{1032,1:1051.8}, this).p2) < (int)(0))) + temp(2)))
\rightarrow [from term 53.19, $heap<sub>1032,1;1051,8</sub> is equal to
$heap_{funcstart\_1032,1}.$_replace(this.$r \rightarrow this.$r.value(heapIs)
heap_{funcstart\_1032.1}._replace(p1 \rightarrow (-2 * div(heapIs p_{funcstart\_1032.1})
this.$r.value(heapIs $heap_{funcstart_1032.1}).p1, 177).quot) + (171 *
div(heapIs $heap_funcstart_1032.1, this.$r.value(heapIs
heap_{funcstart\_1032,1}.p1, 177).rem)))
[57.13] heap_{1032,1;1054,8} == heap_{funcstart\_1032,1}._replace(this.r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
\theta_{tuncstart\_1032.1}.p1, 177).rem)))).\_replace(this.\$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{tuncstart\_1032.1}, this.r.value(heapIs \rho_{tuncstart\_1032.1}).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.} \text{\$r.value}(\text{heapIs}))
\theta_{funcstart\_1032,1}.p1, 177).rem))).\_replace(p2 \rightarrow
asType<P2Type>((30307 *
asType<int>(static_cast<integer>(static_cast<signed
\mathbf{int}{>}(\mathbf{operator}^*(\mathbf{heapIs}\ \$\mathbf{heap}_{funcstart\_1032,1}.\_\mathbf{replace}(\mathbf{this}.\$\mathbf{r}\rightarrow
this.$r.value(heapIs heapIs .replace(p1 \rightarrow (-2 * div(heapIs
$\text{heap}_{funcstart=1032.1}$, this.$\text{r.value}(\text{heapIs} \text{$heap}_{funcstart=1032.1}).p1,
177).quot) + (171 * div(heapIs heapIs = 1032,1, this.r.value(heapIs = 1032,1, this.r.value(heapIs = 1032,1).
\text{Sheap}_{funcstart\_1032.1}.\text{p1}, 177).\text{rem})), \text{this}.\text{p2}) < (\text{int})0))) + \text{temp2}))
→ [expand definition of operator '*' in class 'pointer' at built in declaration]
[57.14] heap_{1032,1;1054,8} == heap_{funcstart\_1032,1}._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
\theta_{funcstart\_1032,1}.p1, 177).rem)))).\_replace(this.\$r \rightarrow 0
this.$r.value(heapIs \rho_{tuncstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\$heap_{funcstart\_1032,1},\, \textbf{this}.\$r.\textbf{value}(\textbf{heapIs}\,\,\$heap_{funcstart\_1032,1}).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032.1}, \text{this.} \text{\$r.value}(\text{heapIs}))
heap_{funcstart\_1032,1}.p1, 177).rem)))._replace(p2 \rightarrow
asType<P2Type>((30307 *
asType<int>(static_cast<integer>(static_cast<signed
int>(this.$r.value(heapIs \theta_{funcstart\_1032,1}._replace(this.$r \to
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\textbf{this.\$r.value}(\textbf{heapIs}~\$ heap_{funcstart\_1032,1}).\_\textbf{replace}(p1 \rightarrow ((-2~*div(\textbf{heapIs})))))
\rho_{tuncstart\_1032,1}, this.r.value(heapIs \rho_{tuncstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
\text{Sheap}_{funcstart\_1032,1}.\text{p1}, 177).\text{rem})))).\text{p2}) < (int)0)) + \text{temp2}))
→ [evaluate dereferenced pointer into modified heap]
[57.15] $heap<sub>1032,1;1054,8</sub> == $heap<sub>funcstart_1032,1</sub>._replace(this.$r \rightarrow
\textbf{this.}\$r.\textbf{value}(\textbf{heapIs}~\$heap_{funcstart\_1032,1}).\_\textbf{replace}(p1 \rightarrow ((\text{-}2~*\text{div}(\textbf{heapIs}
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.} \text{\$r.value}(\text{heapIs}))
\theta_{tuncstart\ 1032.1}.p1,\ 177.rem)))._replace(this.r \rightarrow
this.$r.value(heapIs p_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(\mathbf{heapIs} \ \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
\label{eq:condition} $\operatorname{heap}_{funcstart\_1032,1}).p1,\ 177).rem))).\_\mathbf{replace}(p2 \to
asType<P2Type>((30307 *
asType < int > (static\_cast < integer > (static\_cast < signed\ int > (([this.\$r])))) \\
== this.$r]: this.$r.value(heapIs \rho_{tuncstart\_1032,1})._replace(p1 \rightarrow (-2 *
div(\mathbf{heapIs} \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
\text{Sheap}_{funcstart\_1032.1}.p1, 177).quot) + (171 * div(heapIs \text{Sheap}_{funcstart\_1032.1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177).rem)), []:
this.r.value(heapIs \ heap_{funcstart\_1032.1}).p2) < (int)0)) + temp2)))
→ [explicitly assert falsehood of skipped guards in subsequent guards]
[57.16] $heap<sub>1032.1:1054.8</sub> == $heap<sub>funcstart_1032.1</sub>._replace(this.$r \rightarrow
this.$r.value(heapIs \rho_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.\r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
\theta_{tuncstart\_1032.1}.p1, 177.rem)))._replace(this.$r \rightarrow
this.$r.value(heapIs \rho_{uncstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
asType<P2Type>((30307 *
asType<int>(static_cast<integer>(static_cast<signed int>(([this.$r
== this.$r]: this.$r.value(heapIs \rho_{uncstart\_1032,1})._replace(p1 \rightarrow (-2 *
div(\mathbf{heapIs} \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
\text{Sheap}_{funcstart\_1032,1}.p1, 177).quot) + (171 * div(heapIs \text{Sheap}_{funcstart\_1032,1},
\mathbf{this.\$r.value}(\mathbf{heapIs}~\$\mathrm{heap}_{funcstart\_1032,1}).\mathrm{p1},~177).\mathrm{rem})),~[!(\mathbf{this.\$r}==
this.$r.value(heapIs \rho_{funcstart\_1032,1}).p2) < (int)0))) +
temp2)))
\rightarrow [simplify]
[57.23] $heap<sub>1032,1;1054,8</sub> == $heap<sub>funcstart_1032,1</sub>._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
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177).quot) + (171 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.} \text{\$r.value}(\text{heapIs}))
\theta_{funcstart\_1032,1}.p1, 177).rem))))._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
$heap_funcstart_1032,1, this.$r.value(heapIs $heap_funcstart_1032,1).p1,
177).quot) + (171 * div(heapIs heapIs = f_{uncstart\_1032.1}, this.r.value(heapIs)
heap_{funcstart\_1032,1}.p1, 177).rem)))._replace(p2 \rightarrow
asType<P2Type>((30307 * asType<int>(static_cast<integer>(0 <
-this.r.value(heapIs \ heap_{funcstart_1032,1}).p2))) + temp2)))
\rightarrow [from term 24.0, literala < -this.$r.value(heapIs $heap_{funcstart\_1032.1}).p2
is false whenever -2 < (0 + literala)
   Proof of rule precondition:
   [57.23.0] - 2 < (0 + 0)
   \rightarrow [simplify]
   [57.23.2] true
[57.24] $\text{heap}_{1032,1;1054,8} == $\text{heap}_{funcstart\_1032,1}._\text{replace}(\text{this}.\text{$\frac{1}{2}r$})
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{tuncstart_1032.1}, this.r.value(heapIs \rho_{tuncstart_1032.1}).p1,
177).quot) + (171 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
\theta_{funcstart\_1032,1}.p1, 177).rem))))._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs $heap<sub>funcstart_1032,1</sub>, this.$r.value(heapIs
\theta_{funcstart\_1032,1}.p1, 177).rem))).\_replace(p2 \rightarrow
asType<P2Type>((30307 * asType<int>(static_cast<integer>(false)))
+ \text{ temp2})))
\rightarrow [simplify]
[57.25] $heap<sub>1032,1;1054,8</sub> == $heap<sub>funcstart_1032,1</sub>._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs $heap<sub>funcstart_1032,1</sub>, this.$r.value(heapIs
\theta_{funcstart\_1032,1}.p1, 177).rem)))).\_replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
$\text{heap}_{funcstart_1032.1}$, this.$\text{r.value}(\text{heapIs} \text{$heap}_{funcstart_1032.1}).p1,
177).quot) + (171 * div(\mathbf{heapIs} \ \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
\theta_{funcstart\_1032,1}.p1, 177).rem))).\_replace(p2 \rightarrow
asType < P2Type > ((30307 * asType < int > (([false]: 1, []: 0))) + temp2)))
→ [explicitly assert falsehood of skipped guards in subsequent guards]
[57.26] $heap<sub>1032,1;1054,8</sub> == $heap<sub>funcstart_1032,1</sub>._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{tuncstart\_1032.1}, this.r.value(heapIs \rho_{tuncstart\_1032.1}).p1,
177).quot) + (171 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
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\theta_{funcstart=1032.1}.p1, 177).rem)))._replace(this.$r \rightarrow
this.$r.value(heapIs \frac{1}{2} heap\frac{1}{2} ._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
\theta_{funcstart\_1032,1}.p1, 177).rem)))._replace(p2 \rightarrow
asType<P2Type>((30307 * asType<int>(([false]: 1, [true]: 0))) +
temp2)))
\rightarrow [simplify]
[57.29] $heap<sub>1032,1:1054,8</sub> == $heap<sub>funcstart_1032,1</sub>._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart = 1032.1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs \theta_{funcstart\_1032,1}, this.r.value(heapIs)
\theta_{tuncstart\_1032,1}.p1, 177).rem)))).\_replace(this.$r \rightarrow
this.$r.value(heapIs $heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(\mathbf{heapIs} \$ heap_{funcstart\_1032,1}, \mathbf{this}.\$ r. \mathbf{value}(\mathbf{heapIs})
\rho_{uncstart\_1032,1}.p1, 177).rem))._replace(p2 \rightarrow asType<P2Type>(0 +
temp2)))
\rightarrow [from term 54.18, temp2 is equal to (-35 * div(heapIs $heap_{tuncstart 1032.1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p2, 176).quot) + (172 *
div(heapIs $heap_{funcstart\_1032.1}, this.$r.value(heapIs
heap_{funcstart\_1032,1}.p2, 176).rem
[57.30] $heap<sub>1032.1:1054.8</sub> == $heap<sub>funcstart_1032.1</sub>._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs \theta_{funcstart\_1032,1}, this.r.value(heapIs)
\theta_{tuncstart\_1032.1}.p1, 177.rem)))._replace(this.$r \rightarrow
this.$r.value(heapIs \rho_{uncstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.\r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs heapIs = f_{uncstart\_1032,1}, this .r.value(heapIs)
\frac{\text{sheap}_{funcstart\ 1032.1}, p1,\ 177.rem)}{\text{ceplace}(p2 \rightarrow asType < P2Type > (0 + p2))}
((-35 * div(heapIs \$heap_{funcstart\_1032,1}, this.\$r.value(heapIs
\rho_{tuncstart_1032,1}.p2, 176).quot) + \rho_{tuncstart_1032,1} + \rho_{tuncstart_1032,1}
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p2, 176).rem)))))
\rightarrow [simplify]
[57.33] $heap<sub>1032.1:1054.8</sub> == $heap<sub>funcstart_1032.1</sub>._replace(this.$r \rightarrow
this.$r.value(heapIs $heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
\theta_{tuncstart\_1032,1}.p1, 177).rem)))).\_replace(this.\$r \rightarrow
this.$r.value(heapIs \rho_{tuncstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(\mathbf{heapIs} \ \$heap_{funcstart\_1032,1}, \ \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
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\rho_{funcstart\_1032,1}.p1, 177).rem))._replace(p2 \rightarrow ((-35 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p2,
176).quot) + (172 * div(heapIs \theta_{funcstart\_1032,1}, this.r.value(heapIs)
heap_{funcstart_{1032,1}}.p2, 176).rem)))
[Take goal term]
[1.0] minof(int) \leq static_cast<integer>(static_cast<signed
int>(operator^*(heapIs $heap_{1032,1:1054.8}, this).p3) < (int)0)
\rightarrow [simplify]
[1.1] -32768 < static_cast<integer>(static_cast<signed
int>(operator^*(heapIs $heap_{1032,1:1054.8}, this).p3) < (int)0)
\rightarrow [from term 57.33, $heap<sub>1032,1;1054,8</sub> is equal to
\$heap_{funcstart\_1032,1}.\_\textbf{replace}(\textbf{this}.\$r \rightarrow \textbf{this}.\$r.\textbf{value}(\textbf{heapIs}
heap_{funcstart\_1032,1}._replace(p1 \rightarrow ((-2 * div(heapIs p_{funcstart\_1032,1}),
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177).quot) + (171 * leap_{funcstart\_1032,1}).p1, 177).quot) + (171 * leap_{funcstart\_1032,1}).quot) + (171 * leap_{funcstart\_
div(\mathbf{heapIs} \ \$heap_{funcstart\_1032,1}, \ \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
\theta_{tuncstart\_1032.1}.p1, 177).rem))))\_replace(this.\$r \rightarrow 0
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
heap_{funcstart\_1032,1}, this.r.value(heapIs heap_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(\mathbf{heapIs} \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}))
heap_{funcstart\_1032,1}.p1, 177).rem)))._replace(p2 \rightarrow (-35 * div(heapIs)))
heap_{funcstart\_1032,1}, this.r.value(heapIs heap_{funcstart\_1032,1}).p2,
(176).quot) + (172*div(\textbf{heapIs} \$heap_{funcstart\_1032,1}, \textbf{this}.\$r.\textbf{value}(\textbf{heapIs}))
heap_{funcstart_1032,1}.p2, 176).rem)))]
[1.2] -32768 \leq static_cast<integer>(static_cast<signed
int>(operator^*(heapIs \$heap_{funcstart\_1032.1}.\_replace(this.\$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
\theta_{tuncstart\_1032.1}.p1, 177).rem)))).\_replace(this.\$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\$heap_{funcstart\_1032,1},\, \textbf{this.}\$r.\textbf{value}(\textbf{heapIs}\,\,\$heap_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs $heap_{tuncstart\_1032.1}, this.$r.value(heapIs
heap_{funcstart\_1032,1}.p1, 177).rem))._replace(p2 \rightarrow (-35 * div(heapIs)
\rho_{funcstart\_1032,1}, this.\r.value(heapIs \rho_{funcstart\_1032,1}).p2,
176).quot) + (172 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
\text{heap}_{funcstart_1032,1}.p2, 176).rem)), this).p3) < (int)0)
→ [expand definition of operator '*' in class 'pointer' at built in declaration]
[1.3] -32768 \leq static_cast<integer>(static_cast<signed
int>(this.\$r.value(heapIs \$heap_{funcstart\_1032,1}.\_replace(this.\$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart_1032,1}, this. r.value(heapIs \rho_{funcstart_1032,1}).p1,
177).quot) + (171 * div(heapIs $heap<sub>funcstart_1032,1</sub>, this.$r.value(heapIs
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\theta_{funcstart=1032.1}.p1, 177).rem)))._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs $heap<sub>funcstart_1032,1</sub>, this.$r.value(heapIs
\theta_{funcstart\_1032,1}.p1, 177).rem))._replace(p2 \rightarrow ((-35 * div(heapIs
$heap_funcstart_1032,1, this.$r.value(heapIs $heap_funcstart_1032,1).p2,
176).quot) + (172 * div(heapIs $heap<sub>funcstart_1032,1</sub>, this.$r.value(heapIs
\theta_{100} = \theta_{1000} =
\rightarrow [evaluate dereferenced pointer into modified heap]
[1.4] -32768 \leq static_cast<integer>(static_cast<signed int>(([this.$r ==
this.$r]: this.$r.value(heapIs \rho_{tuncstart\_1032,1})._replace(p1 \rightarrow ((-2 *
div(\mathbf{heapIs} \$ heap_{funcstart\_1032.1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
\text{Sheap}_{funcstart\_1032,1}.p1, 177).quot) + (171 * div(heapIs \text{Sheap}_{funcstart\_1032,1},
this.$r.value(heapIs \rho_{tuncstart\_1032,1}).p1, 177).rem)))._replace(p2 \rightarrow
(-35 * div(\mathbf{heapIs} \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}))
\text{Sheap}_{funcstart\_1032,1}.p2, 176).quot) + (172 * div(heapIs \text{Sheap}_{funcstart\_1032,1},
this.$r.value(heapIs heap_{funcstart\_1032,1}).p2, 176).rem)), []:
this.$r.value(heapIs \rho_{tuncstart\_1032.1}._replace(this.$r \rightarrow
this.$r.value(heapIs \rho_{tuncstart\_1032.1})._replace(p1 \rightarrow (-2 * div(heapIs
\$heap_{funcstart\_1032,1},\, \textbf{this.}\$r.\textbf{value}(\textbf{heapIs}\,\,\$heap_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
\text{Sheap}_{funcstart\_1032,1}.p1, 177).rem)))).p3) < (int)0)
→ [explicitly assert falsehood of skipped guards in subsequent guards]
[1.5] -32768 < static_cast<integer>(static_cast<signed int>(([this.$r ==
this.$r]: this.$r.value(heapIs \rho_{tuncstart\_1032,1})._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs}\ \$ \mathrm{heap}_{funcstart\_1032,1},\ \mathbf{this}.\$ \mathbf{r.value}(\mathbf{heapIs}
\text{Sheap}_{funcstart\_1032.1}.p1, 177).quot) + (171 * div(heapIs \text{Sheap}_{funcstart\_1032.1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177).rem))).\_replace(p2 \rightarrow
(-35 * div(heapIs \$heap_{funcstart\_1032,1}, this.\$r.value(heapIs
\rho_{tuncstart_1032.1}, p2, 176).quot) + (172 * div(heapIs \rho_{tuncstart_1032.1},
this.$r.value(heapIs \theta_{tuncstart\_1032,1}).p2, 176).rem)), [!(this.$r ==
this.r.value(heapIs $heap_{funcstart\_1032,1}.\_replace(this.$r \rightarrow funcstart\_1032,1})
this.$r.value(heapIs heapIs_{1032,1})._replace(p1 \rightarrow (-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.} \text{\$r.value}(\text{heapIs}))
\mathtt{\$heap}_{funcstart\_1032,1}).\mathtt{p1},\ 177).\mathtt{rem}))))).\mathtt{p3}) < (\mathbf{int})0)
\rightarrow [simplify]
[1.13] -32768 \leq static_cast\leqinteger>(0 < -this.$r.value(heapIs
heap_{funcstart\_1032,1}.p3
\rightarrow [from term 40.0, literala < -this.$r.value(heapIs $heap_{funcstart\_1032,1}).p3
is false whenever -2 < (0 + literala)
```

Proof of rule precondition:

Proof of verification condition: Type constraint satisfied in explicit conversion from 'integer' to 'int'

In the context of class: WHPrang, declared at: C:\Escher\Customers\prang-cpp\prang.cpp (18,1)

Condition generated at: C:\Escher\Customers\prang-cpp\prang.cpp (81,18)

Condition defined at:

To prove: static_cast<integer>(static_cast<signed int>(operator*(heapIs $\alpha_{1032,1;1054,8}, this).p3$) < (int)0) α_{101} = maxof(int)

Given:

\$heap_{init}.LIMIT == (int)80 \$heap_{init}.class WHPrang \in M1 == (int)30269 \$heap_{init}.class WHPrang \in r1 == (int)171 \$heap_{init}.class WHPrang \in a1 == (int)177 \$heap_{init}.class WHPrang \in b1 == (int)2 \$heap_{init}.class WHPrang \in M2 == (int)30307 \$heap_{init}.class WHPrang \in r2 == (int)172 \$heap_{init}.class WHPrang \in a2 == (int)176 \$heap_{init}.class WHPrang \in b2 == (int)35 \$heap_{init}.class WHPrang \in M3 == (int)30323 \$heap_{init}.class WHPrang \in r3 == (int)170 \$heap_{init}.class WHPrang \in a3 == (int)178 \$heap_{init}.class WHPrang \in b3 == (int)63

```
\operatorname{div1} == \operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_1032,1},
\mathbf{static\_cast} {<} \mathbf{int} {>} (\mathbf{operator}^*(\mathbf{heapIs}\ \$\mathbf{heap}_{funcstart\_1032,1},\ \mathbf{this}).\mathtt{p1}),
\mathbf{static\_cast}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_1032,1}.\mathrm{a1}))
(\mathbf{asType} {<} \mathbf{integer} {>} (\mathbf{static\_cast} {<} \mathbf{int} {>} (\mathbf{operator}^* (\mathbf{heapIs}
heap_{funcstart\_1032,1}, this).p1) /
asType < integer > (static\_cast < int > (\$heap_{funcstart\_1032,1}.a1))) = =
asType<integer>(div1.quot)
(asType<integer>(static_cast<int>(operator*(heapIs
\theta_{funcstart\_1032,1},\, \mathbf{this}).p1)) \%
asType<integer>(static_cast<int>($heap_{funcstart_1032.1}.a1))) ==
asType<integer>(div1.rem)
(\mathbf{asType}{<}\mathbf{integer}{>}(\mathbf{operator}^*(\mathbf{heapIs}\ \$\mathbf{heap}_{funcstart\_1032,1},\ \mathbf{this}).\mathtt{p1}) <
asType < integer > ($heap_{funcstart\_1032,1}.a1)) = >
(asType<integer>(div1.rem) == asType<integer>(operator*(heapIs
heap_{funcstart\_1032,1}, this).p1)
(\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathsf{heap}_{funcstart\_1032,1}.\mathsf{a1}) \leq
\mathbf{asType} < \mathbf{integer} > (\mathbf{operator}^*(\mathbf{heapIs} \ \$ \mathbf{heap}_{funcstart\_1032,1}, \ \mathbf{this}).\mathtt{p1})) = >
!(0 == asType < integer > (div1.quot))
!(0 == asType < integer > (div1.rem)) || !(0 ==
asType<integer>(div1.quot))
div2 == div(\mathbf{heapIs} \$ heap_{funcstart\_1032,1},
\mathbf{static\_cast} {<} \mathbf{int} {>} (\mathbf{operator*}(\mathbf{heapIs}\ \$\mathbf{heap}_{funcstart\_1032,1},\ \mathbf{this}).\mathtt{p2}),
\mathbf{static\_cast}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_1032,1}.\mathrm{a2}))
(asType < integer > (static\_cast < int > (operator*(heapIs)))
heap_{funcstart\_1032,1}, this).p2) /
\mathbf{asType} < \mathbf{integer} > (\mathbf{static\_cast} < \mathbf{int} > (\$ \mathbf{heap}_{funcstart\_1032,1}.\mathbf{a2}))) = =
asType<integer>(div2.quot)
(asType < integer > (static\_cast < int > (operator*(heapIs)))
\theta_{funcstart_{1032,1}}, this).p2))
asType < integer > (static\_cast < int > (\$heap_{funcstart\_1032.1}.a2))) = =
asType<integer>(div2.rem)
(\mathbf{asType}{<}\mathbf{integer}{>}(\mathbf{operator}^*(\mathbf{heapIs}\ \$\mathbf{heap}_{funcstart\_1032,1},\ \mathbf{this}).\mathtt{p2}) <
asType < integer > (\$heap_{funcstart\_1032,1}.a2)) = >
(asType<integer>(div2.rem) == asType<integer>(operator*(heapIs
heap_{funcstart_1032.1}, this).p2)
(asType < integer > (\$heap_{funcstart\_1032,1}.a2) \le
\mathbf{asType}{<}\mathbf{integer}{>}(\mathbf{operator*}(\mathbf{heapIs}\ \$\mathbf{heap}_{funcstart\_1032,1},\ \mathbf{this}).\mathtt{p2})) =>
!(0 == asType < integer > (div2.quot))
!(0 == asType < integer > (div2.rem)) || !(0 ==
asType<integer>(div2.quot))
div3 == div(\mathbf{heapIs} \$ heap_{funcstart\_1032,1},
```

```
\mathbf{static\_cast} < \mathbf{int} > (\mathbf{operator}^*(\mathbf{heapIs}\ \$ \mathbf{heap}_{funcstart\_1032,1},\ \mathbf{this}).\mathbf{p3}),
static\_cast < int > (\$heap_{funcstart\_1032,1}.a3))
(asType < integer > (static\_cast < int > (operator*(heapIs
heap_{funcstart\_1032.1}, this).p3) /
asType < integer > (static\_cast < int > (\$heap_{funcstart\_1032.1}.a3))) = =
asType<integer>(div3.quot)
(asType<integer>(static_cast<int>(operator*(heapIs
heap_{funcstart\_1032,1}, this).p3)
asType<integer>(static_cast<int>($heap_{tuncstart=1032.1}.a3))) ==
asType<integer>(div3.rem)
(asType<integer>(operator*(heapIs $heap_{tuncstart\_1032.1}, this).p3) <
asType < integer > ($heap_{funcstart\_1032,1}.a3)) = >
(asType<integer>(div3.rem) == asType<integer>(operator*(heapIs
heap_{funcstart\_1032.1}, this).p3)
(asType < integer > (\$heap_{funcstart\_1032,1}.a3) \le
asType < integer > (operator*(heapIs $heap_{funcstart\_1032,1}, this).p3)) = >
!(0 == asType < integer > (div3.quot))
!(0 == asType < integer > (div3.rem)) || !(0 ==
asType<integer>(div3.quot))
temp1 == (\$heap_{funcstart\_1032,1}.r1 * \textbf{static\_cast} < \textbf{signed int} > (div1.rem)) -
($heap_tuncstart_1032.1.b1 * static_cast<signed int>(div1.quot))
minof(signed\ int) \le temp1
temp1 < maxof(signed int)
heap_{1032,1;1051,8} == heap_{funcstart\_1032,1}._replace(this.$r \rightarrow
operator*(heapIs heap_{funcstart\_1032,1}, this)._replace(p1 \rightarrow
asType < P1Type > ((\$heap_{funcstart\_1032,1}.M1 *
asType<int>(static_cast<integer>(static_cast<signed
int>(operator^*(heapIs $heap_{funcstart\_1032.1}, this).p1) < (int)0))) +
temp1)))
temp2 == (\$heap_{1032,1;1051,8}.r2 * static\_cast < signed int > (div2.rem)) -
(\text{sheap}_{1032,1;1051,8}.\text{b2} * \text{static\_cast} < \text{signed int} > (\text{div}2.\text{quot}))
minof(signed int) \le temp2
temp2 \le maxof(signed int)
heap_{1032,1;1054,8} == heap_{1032,1;1051,8}._replace(this.$r \rightarrow
operator*(heapIs heap_{1032,1;1051,8}, this)._replace(p2 \rightarrow
asType<P2Type>(($heap<sub>1032,1:1051,8</sub>.M2 *
as Type < int > (static\_cast < integer > (static\_cast < signed))
int>(operator^*(heapIs $heap_{1032,1;1051,8}, this).p2) < (int)0))) + temp2)))
temp3 == (\$heap_{1032,1;1054,8}.r3 * \textbf{static\_cast} < \textbf{signed int} > (div3.rem)) -
($heap<sub>1032,1:1054,8</sub>.b3 * static_cast<signed int>(div3.quot))
```

```
minof(signed int) < temp3
temp3 \le maxof(signed int)
Proof:
[Take given term]
[2.0] div1 == div(heapIs $heap_{funcstart\_1032,1},
static_cast<int>(operator*(heapIs $heap_{funcstart\_1032,1}, this).p1),
\mathbf{static\_cast}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_1032,1}.\mathrm{a1}))
→ [expand definition of operator '*' in class 'pointer' at built in declaration]
[2.1] \operatorname{div1} == \operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_1032,1},
static\_cast < int > (this. r.value(heapIs  heap_{funcstart\_1032,1}).p1),
static\_cast < int > (\$heap_{funcstart\_1032,1}.a1))
\rightarrow [simplify]
[2.2]~{\rm div1} == {\rm div}(\mathbf{heapIs}~\$ \mathrm{heap}_{funcstart\_1032,1},~\mathbf{this}.\$ \mathrm{r.value}(\mathbf{heapIs}
\theta_{funcstart\_1032,1}.p1, \theta_{funcstart\_1032,1}.a1)
\rightarrow [const static or extern object]
[2.3] \text{ div1} == \text{div(heapIs } \text{$heap}_{funcstart\_1032,1}, \text{ this.} \text{$r.value(heapIs)}
\$ heap_{funcstart\_1032,1}).p1, \ \mathbf{static\_cast} < \mathbf{int} > (\$ heap_{init}.a1))
\rightarrow [expand definition of constant 'a1' at prang.cpp (30,26)]
[2.4] \operatorname{div1} == \operatorname{div}(\mathbf{heapIs} \ \hat{\mathbf{s}}_{heap}_{funcstart\_1032,1}, \ \mathbf{this.\$r.value}(\mathbf{heapIs})
\theta_{funcstart\_1032,1}.p1, \theta_{funcstart\_1032,1}.p1, \theta_{funcstart\_1032,1}.p1, \theta_{funcstart\_1032,1}.p1, \theta_{funcstart\_1032,1}.p1, \theta_{funcstart\_1032,1}.p2, \theta_{funcstart\_1032,1}.p2, \theta_{funcstart\_1032,1}.p2, \theta_{funcstart\_1032,1}.p2, \theta_{funcstart\_1032,1}.p2, \theta_{funcstart\_1032,1}.p3, \theta_{funcstart\_1032,1}.p4, \theta_{funcstart\_1032,1}.p4, \theta_{funcstart\_1032,1}.p4, \theta_{funcstart\_1032,1}.p4, \theta_{funcstart\_1032,1}.p4, \theta_{funcstart\_1032,1}.p5, \theta_{funcstart\_1032,1
\rightarrow [simplify]
[2.6] \operatorname{div1} == \operatorname{div}(\mathbf{heapIs} \ \mathbf{\$heap}_{funcstart\_1032,1}, \ \mathbf{this}.\mathbf{\$r.value}(\mathbf{heapIs})
heap_{funcstart_{1032,1}}.p1, 177
[Assume known post-assertion, class invariant or type constraint for term 2.6]
[7.0] (0 < asType<integer>(this.$r.value(heapIs
\theta_{uncstart\_1032,1}.p1) && (asType<integer>(this.$r.value(heapIs)
\$ heap_{funcstart\_1032,1}).p1) < \mathbf{asType} < \mathbf{integer} > (\$ heap.\mathbf{class} \ WHPrang \in \texttt{Constart} = \texttt{Constart}
M1))
\rightarrow [simplify]
[7.2] (0 < this.$r.value(heapIs $heap_{funcstart\_1032,1}).p1) &&
(this.r.value(heapIs $heap_{funcstart\_1032.1}).p1 <
asType < integer > (\$heap.class WHPrang \in M1))
\rightarrow [const static or extern object]
[7.3] (0 < this.$r.value(heap
Is \rho_{funcstart\_1032,1}.p1) \ \&\&
(this.$r.value(heapIs heap_{funcstart\_1032,1}).p1 <
asType < integer > (\$heap_{init}.class WHPrang \in M1))
\rightarrow [expand definition of constant 'M1' at prang.cpp (28,26)]
```

```
[7.4] (0 < this.$r.value(heapIs $heap_{funcstart\_1032,1}).p1) &&
(this.$r.value(heapIs heap_{funcstart\_1032,1}).p1 <
asType < integer > ((int)30269))
\rightarrow [simplify]
[7.10] (-30269 < -this.$r.value(heapIs heap_{funcstart\_1032,1}).p1) \land (0 <
this.r.value(heapIs $heap_{funcstart\_1032,1}).p1)
[Work on sub-term 2 of conjunction in term 7.10]
[8.0] 0 < this.$r.value(heapIs $heap<sub>funcstart_1032,1</sub>).p1
[Take given term]
[18.0] \operatorname{div2} == \operatorname{div}(\mathbf{heapIs} \ \text{$heap}_{funcstart\_1032,1},
\mathbf{static\_cast} < \mathbf{int} > (\mathbf{operator}^*(\mathbf{heapIs} \ \$ \mathbf{heap}_{funcstart\_1032,1}, \ \mathbf{this}).\mathtt{p2}),
\mathbf{static\_cast}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_1032,1}.\mathrm{a2}))
→ [expand definition of operator '*' in class 'pointer' at built in declaration]
[18.1] \operatorname{div2} == \operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_1032,1},
static_cast<int>(this.$r.value(heapIs $heap_{tuncstart\_1032.1}).p2),
\mathbf{static\_cast}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_1032,1}.\mathrm{a2}))
\rightarrow [simplify]
[18.2] \text{div2} == \text{div}(\mathbf{heapIs} \text{\$heap}_{funcstart\_1032,1}, \mathbf{this}.\text{\$r.value}(\mathbf{heapIs})
\theta_{funcstart\_1032,1}.p2, \theta_{funcstart\_1032,1}.p2, \theta_{funcstart\_1032,1}.a2)
\rightarrow [const static or extern object]
[18.3] div2 == div(\mathbf{heapIs} \$ \mathbf{heap}_{funcstart\_1032,1}, \mathbf{this}.\$ \mathbf{r.value}(\mathbf{heapIs})
\theta_{funcstart\_1032,1}.p2, \theta_{funcstart\_1032,1
\rightarrow [expand definition of constant 'a2' at prang.cpp (35,26)]
[18.4] div2 == div(heapIs $heap_{tuncstart\_1032.1}, this.$r.value(heapIs)
\label{eq:cast_int} $$ \rho_{tuncstart\_1032,1}.p2, \ \mathbf{static\_cast} < \mathbf{int} > ((\mathbf{int})176))$$
\rightarrow [simplify]
[18.6] \text{ div2} == \text{div(heapIs $heap}_{funcstart\_1032,1}, \text{ this.} \text{\$r.value(heapIs)}
heap_{funcstart\_1032,1}.p2, 176)
[Assume known post-assertion, class invariant or type constraint for term 18.6]
[23.0] (0 < asType<integer>(this.$r.value(heapIs
$\text{heap}_{funcstart_1032.1}\text{).p2})) && (asType<integer>(this.$r.value(heapIs)
\rho_{funcstart\_1032,1}.p2 < asType<integer>(\rho_{funcstart\_1032,1}.p2) < asType<integer>(\rho_{funcstart\_1032,1}.p2)
M2))
\rightarrow [simplify]
[23.2] (0 < this.$r.value(heapIs heap_{funcstart\_1032,1}).p2) &&
(this.r.value(heapIs $heap_{funcstart\_1032,1}).p2 <
asType < integer > (\text{$heap.class WHPrang} \in M2))
```

```
\rightarrow [const static or extern object]
[23.3] (0 < this.$r.value(heapIs $heap_{funcstart\_1032,1}).p2) &&
(this.r.value(heapIs $heap_{funcstart\_1032,1}).p2 <
asType < integer > (\$heap_{init}.class WHPrang \in M2))
\rightarrow [expand definition of constant 'M2' at prang.cpp (33,26)]
[23.4] (0 < this.$r.value(heapIs heap_{funcstart\_1032,1}).p2) &&
(this.r.value(heapIs $heap_{funcstart\_1032,1}).p2 <
asType < integer > ((int)30307))
\rightarrow [simplify]
 [23.10] (-30307 < -this.$r.value(heapIs $heap_{funcstart\_1032,1}).p2) \land (0 <
\mathbf{this.\$r.value}(\mathbf{heapIs}~\$\mathbf{heap}_{funcstart\_1032,1}).\mathbf{p2})
[Work on sub-term 2 of conjunction in term 23.10]
[24.0] 0 < this.$r.value(heapIs \theta_{funcstart\_1032,1}).p2
[Take given term]
[34.0] div3 == div(heapIs $heap<sub>funcstart_1032,1</sub>,
static\_cast < int > (operator^*(heapIs \$heap_{funcstart\_1032,1}, this).p3),
\mathbf{static\_cast} < \mathbf{int} > (\$ \mathbf{heap}_{funcstart\_1032,1}.\mathbf{a3}))
\rightarrow [expand definition of operator '*' in class 'pointer' at built in declaration]
[34.1] \operatorname{div3} == \operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_1032,1},
static\_cast < int > (this. r.value(heapIs $heap_{funcstart\_1032,1}).p3),
static\_cast < int > (\$heap_{funcstart\_1032.1}.a3))
\rightarrow [simplify]
[34.2] \text{ div3} == \text{div}(\text{heapIs } \text{$heap}_{funcstart\_1032,1}, \text{this.}\text{$r.value}(\text{heapIs})
\theta_{funcstart\_1032,1}, p3, static_cast<int>(\theta_{funcstart\_1032,1})
\rightarrow [const static or extern object]
 [34.3] \text{ div3} == \text{div}(\mathbf{heapIs} \$ \mathbf{heap}_{funcstart\_1032,1}, \mathbf{this}.\$ \mathbf{r.value}(\mathbf{heapIs})
\theta_{uncstart\_1032,1}.p3, \theta_{uncstart\_1032,1}.p4, \theta_{uncstart\_1032,1}.p4, \theta_{uncstart\_1032,1}.p4, \theta_{uncstart\_1032,1}.p5, \theta_{uncstart\_1032,1}.p5, \theta_{uncstart\_1032,1}.p5, \theta_{uncstart\_1032,1}.p5, \theta_{uncstart\_1032,1}.p5, \theta_{uncstart\_1032,1}.p5, \theta_{uncstart\_1032,1}.p5, \theta_{uncstart\_1032,1}.p5, \theta_{uncstart\_1032,1}.p5, \theta_{uncstart\_1032
\rightarrow [expand definition of constant 'a3' at prang.cpp (40,26)]
[34.4] \text{ div3} == \text{div(heapIs $heap}_{funcstart\_1032,1}, \text{ this.$r.value(heapIs)}
\theta_{funcstart\_1032,1}.p3, \theta_{funcstart\_1032,1}.p4, \theta_{funcstart\_1032,1}.p4, \theta_{funcstart\_1032,1}.p4, \theta_{funcstart\_1032,1}.p4, \theta_{funcstart\_1032,1}.p5, \theta_{funcstart\_1032,1}.p5, \theta_{funcstart\_1032,1}.p5, \theta_{funcstart\_1032,1}.p5, \theta_{funcstart\_1032,1}.p5, \theta_{funcstart\_1032,1
\rightarrow [simplify]
[34.6] div3 == div(heapIs $heap_{funcstart\_1032,1}, this.$r.value(heapIs)
heap_{funcstart_{-1032,1}}.p3, 178
[Assume known post-assertion, class invariant or type constraint for term 34.6]
[39.0] (0 < asType<integer>(this.$r.value(heapIs
$heap_funcstart_1032.1).p3)) && (asType<integer>(this.$r.value(heapIs
\$heap_{funcstart\_1032,1}).p3) < \mathbf{asType} < \mathbf{integer} > (\$heap.\mathbf{class} \ WHPrang \in \texttt{Constart} = \texttt{Constart} =
```

```
M3))
\rightarrow [simplify]
[39.2] (0 < this.$r.value(heap
Is \rho_{uncstart\_1032,1}).p3) &&
(this.r.value(heapIs $heap_{funcstart\_1032,1}).p3 <
asType < integer > (\text{$heap.class WHPrang} \in M3))
\rightarrow [const static or extern object]
[39.3] (0 < this.$r.value(heapIs \rho_{funcstart\_1032,1}).p3) &&
(this.r.value(heapIs $heap_{funcstart\_1032.1}).p3 <
asType < integer > (\$heap_{init}.class WHPrang \in M3))
\rightarrow [expand definition of constant 'M3' at prang.cpp (38,26)]
[39.4] (0 < this.$r.value(heap
Is \rho_{uncstart\_1032,1}).p3) &&
(this.r.value(heapIs $heap_{funcstart\_1032,1}).p3 <
asType < integer > ((int)30323))
\rightarrow [simplify]
[39.10] (-30323 < -this.$r.value(heapIs $heap_{funcstart\_1032.1}).p3) \land (0 <
this.r.value(heapIs $heap_{funcstart\_1032,1}).p3)
[Work on sub-term 2 of conjunction in term 39.10]
[40.0] 0 < this.$r.value(heapIs $heap_{funcstart\_1032,1}).p3
[Take given term]
[50.0]\;((\$heap_{funcstart\_1032,1}.r1\;*\;\textbf{static\_cast}{<}\textbf{signed int}{>}(\text{div}1.rem))\;-
(\text{sheap}_{funcstart\_1032,1}.\text{b1 * static\_cast} < \text{signed int} > (\text{div1.quot}))) = \text{temp1}
\rightarrow [const static or extern object]
[50.1] (($heap_{init}.r1 * static_cast < signed int > (div1.rem)) -
(\text{sheap}_{funcstart\_1032,1}.\text{b1} * \text{static\_cast} < \text{signed int} > (\text{div1.quot}))) == \text{temp1}
\rightarrow [expand definition of constant 'r1' at prang.cpp (29,26)]
[50.2] (((int)171 * static_cast<signed int>(div1.rem)) -
(\text{sheap}_{funcstart\_1032,1}.\text{b1 * static\_cast} < \text{signed int} > (\text{div1.quot}))) == \text{temp1}
\rightarrow [simplify]
[50.3] ((171 * static_cast < signed int > (div1.rem)) - (\text{$heap_{funcstart\_1032,1}.b1}
* static_cast<signed int>(div1.quot))) == temp1
\rightarrow [from term 2.6, div1 is equal to div(heapIs $heap_{funcstart\_1032,1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177)
[50.4] ((171 * static_cast < signed int > (div(heapIs heapIs funcstart_{1032,1}),
this.r.value(heapIs $heap_{funcstart\_1032,1}).p1, 177).rem)) -
(\text{sheap}_{funcstart\_1032,1}.\text{b1} * \text{static\_cast} < \text{signed int} > (\text{div1.quot}))) == \text{temp1}
\rightarrow [simplify]
```

```
[50.5] ((171 * \operatorname{div}(\mathbf{heapIs} \ \mathbf{sheap}_{funcstart\_1032,1}, \mathbf{this}.\mathbf{sr.value}(\mathbf{heapIs})
\text{Sheap}_{funcstart\_1032,1}.\text{p1}, 177).\text{rem}) - (\text{Sheap}_{funcstart\_1032,1}.\text{b1} *
static_cast<signed int>(div1.quot))) == temp1
\rightarrow [const static or extern object]
[50.6] ((171 * div(heapIs \rho_{funcstart\_1032,1}, this.\r.value(heapIs
\rho_{uncstart\_1032.1}.p1, 177).rem – (\rho_{uncstart\_1032.1}.p1, 177).rem
int>(div1.quot)) == temp1
\rightarrow [expand definition of constant 'b1' at prang.cpp (31,26)]
[50.7] ((171 * div(heapIs $heap<sub>funcstart_1032,1</sub>, this.$r.value(heapIs)
\rho_{funcstart\_1032.1}.p1, 177).rem - ((int)2 * static\_cast < signed)
int>(div1.quot)) == temp1
\rightarrow [simplify]
[50.8] ((171 * div(heapIs $heap_{funcstart\_1032,1}, this.$r.value(heapIs)
\theta_{tuncstart\_1032.1}.p1, 177).rem) - (2 * static_cast<signed)
int>(div1.quot)) = temp1
\rightarrow [from term 2.6, div1 is equal to div(heapIs $heap_{funcstart\_1032,1},
\mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}~\$heap_{funcstart\_1032,1}).p1,~177)]
[50.9] ((171 * \operatorname{div}(\mathbf{heapIs} \ \mathbf{sheap}_{funcstart\_1032,1}, \ \mathbf{this}.\mathbf{sr.value}(\mathbf{heapIs})
\theta_{funcstart\_1032,1}.p1, 177).rem) - (2 * static_cast<signed
int>(div(heapIs \$heap_{funcstart\_1032,1}, this.\$r.value(heapIs
\theta_{funcstart\_1032,1}.p1, 177).quot))) == temp1
\rightarrow [simplify]
[50.14] 0 == (-\text{temp1} + (-2 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1},
this.r.value(heapIs \ensuremath{\$}heap_{funcstart\_1032,1}).p1, 177).quot) + (171 *
div(\mathbf{heapIs} \$ heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
heap_{funcstart\_1032,1}.p1, 177).rem
[Take given term]
[53.0] heap_{1032,1;1051,8} == heap_{funcstart\_1032,1}._replace(this.$r \rightarrow
operator*(heapIs heap_{funcstart\_1032,1}, this)._replace(p1 \rightarrow
asType<P1Type>(($heap<sub>funcstart_1032.1</sub>.M1 *
asType<int>(static_cast<integer>(static_cast<signed
int>(operator^*(heapIs \$heap_{funcstart\_1032,1}, this).p1) < (int)0))) +
temp1)))
→ [expand definition of operator '*' in class 'pointer' at built in declaration]
[53.1] heap_{1032,1;1051,8} == heap_{funcstart\_1032,1}._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow
asType < P1Type > ((\$heap_{funcstart\_1032,1}.M1 *
asType < int > (static\_cast < integer > (static\_cast < signed
int>(operator^*(heapIs $heap_{funcstart\_1032.1}, this).p1) < (int)0))) +
temp1)))
```

```
\rightarrow [const static or extern object]
[53.2] heap_{1032,1;1051,8} == heap_{funcstart\_1032,1}._replace(this.r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow
asType<P1Type>(($heap_{init}.M1 *
asType < int > (static\_cast < integer > (static\_cast < signed)
int>(operator^*(heapIs \$heap_{funcstart\_1032,1}, this).p1) < (int)0))) +
temp1)))
\rightarrow [expand definition of constant 'M1' at prang.cpp (28,26)]
[53.3] \text{sheap}_{1032,1;1051,8} == \text{sheap}_{funcstart\_1032,1}._replace(this.\text{sr} \rightarrow
\textbf{this}.\$r.\textbf{value}(\textbf{heapIs}~\$heap_{funcstart\_1032,1}).\_\textbf{replace}(p1 \rightarrow
asType < P1Type > (((int)30269 *
asType < int > (static\_cast < integer > (static\_cast < signed)
int>(operator^*(heapIs \$heap_{funcstart\_1032,1}, this).p1) < (int)0))) +
temp1)))
\rightarrow [simplify]
[53.4] $\text{heap}_{1032,1:1051.8} == \text{$heap}_{funcstart\_1032,1}._\text{replace}(\text{this}.\text{$r} \to \text{$}
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow
asType<P1Type>((30269 *
asType < int > (static\_cast < integer > (static\_cast < signed
int>(operator^*(heapIs $heap_{funcstart\_1032.1}, this).p1) < (int)0))) +
temp1)))
→ [expand definition of operator '*' in class 'pointer' at built in declaration]
[53.5] heap_{1032,1;1051,8} == heap_{funcstart\_1032,1}._replace(this.$r \rightarrow
\mathbf{this.\$r.value}(\mathbf{heapIs}~\$\mathbf{heap}_{funcstart\_1032,1}).\_\mathbf{replace}(\mathbf{p1} \rightarrow
asType<P1Type>((30269 *
asType < int > (static\_cast < integer > (static\_cast < signed)
int>(this.\$r.value(heapIs \$heap_{funcstart\_1032,1}).p1) < (int)0))) + temp1)))
\rightarrow [simplify]
[53.9] heap_{1032,1;1051,8} == heap_{funcstart\_1032,1}._replace(this.r \rightarrow
\textbf{this.}\$r.\textbf{value}(\textbf{heapIs}~\$heap_{funcstart\_1032,1}).\_\textbf{replace}(p1 \rightarrow
asType<P1Type>((30269 * asType<int>(static_cast<integer>(0 <
-\mathbf{this.}\$r.\mathbf{value}(\mathbf{heapIs}\ \$\mathrm{heap}_{funcstart\_1032,1}).\mathrm{p1}))) + \mathrm{temp1})))
\rightarrow [from term 8.0, literala < -this.$r.value(heapIs $heap_{tuncstart = 1032.1}).p1
is false whenever -2 < (0 + literala)
    Proof of rule precondition:
    [53.9.0] - 2 < (0 + 0)
    \rightarrow [simplify]
    [53.9.2] true
[53.10] $heap<sub>1032,1;1051,8</sub> == $heap<sub>funcstart_1032,1</sub>._replace(this.$r \rightarrow
```

```
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow
asType<P1Type>((30269 * asType<int>(static_cast<integer>(false)))
+ \text{temp1})))
\rightarrow [simplify]
[53.11] $\text{heap}_{1032,1;1051,8} == \text{$heap}_{funcstart\_1032,1}._\text{replace}(\text{this}.\text{$r} \rightarrow \text{$r$}
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow
asType<P1Type>((30269 * asType<int>(([false]: 1, []: 0))) + temp1)))
→ [explicitly assert falsehood of skipped guards in subsequent guards]
[53.12] $heap<sub>1032,1;1051,8</sub> == $heap<sub>funcstart_1032,1</sub>._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow
asType<P1Type>((30269 * asType<int>(([false]: 1, [true]: 0))) +
temp1)))
\rightarrow [simplify]
[53.15] $\text{heap}_{1032.1:1051.8} == $\text{heap}_{funcstart\_1032.1}.$\text{-replace}(\text{this}.$\text{$r} \to \text{
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow
asType < P1Type > (0 + temp1))
\rightarrow [from term 50.14, temp1 is equal to (-2 * div(heapIs $heap_{funcstart\_1032,1},
this.$r.value(heapIs $heap_{funcstart\_1032,1}).p1, 177).quot) + (171)
div(heapIs $heap_funcstart_1032.1, this.$r.value(heapIs
heap_{funcstart_{1032,1}}.p1, 177).rem
[53.16] $heap<sub>1032,1;1051,8</sub> == $heap<sub>funcstart_1032,1</sub>._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow
asType < P1Type > (0 + ((-2 * div(heapIs $heap_{funcstart\_1032,1},
\mathbf{this.\$r.value(heapIs}\ \$heap_{funcstart\_1032,1}).p1,\ 177).quot) + (171\ *
div(\mathbf{heapIs} \$ heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
heap_{funcstart\_1032,1}.p1, 177.rem))))
\rightarrow [simplify]
[53.19] $\text{heap}_{1032,1;1051,8} == \text{$heap}_{funcstart\_1032,1}._\text{replace}(\text{this}.\text{$r} \to \text{$}
this.$r.value(heapIs heapIs_{uncstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs)
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.}\text{\$r.value}(\text{heapIs}))
heap_{funcstart\_1032,1}.p1, 177.rem)))
[Take given term]
[54.0] (($heap<sub>1032.1:1051.8</sub>.r2 * static_cast<signed int>(div2.rem)) -
(\text{sheap}_{1032.1:1051.8}, \text{b2} * \text{static\_cast} < \text{signed int} > (\text{div2.quot}))) = = \text{temp2}
\rightarrow [from term 53.19, $heap_{1032,1;1051,8}$ is equal to
\$heap_{funcstart\_1032,1}.\_\textbf{replace}(\textbf{this.}\$r \rightarrow \textbf{this.}\$r.\textbf{value}(\textbf{heapIs}
heap_{funcstart\_1032,1}._replace(p1 \rightarrow (-2 * div(heapIs \$heap_{funcstart\_1032,1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177).quot) + (171 * leapIs \ heap_{funcstart\_1032,1}).p1, 177).quot)
div(\mathbf{heapIs} \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
```

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heap_{funcstart_{-1032.1}}.p1, 177).rem)))
[54.1] \; ((\$ heap_{funcstart\_1032,1}.\_\textbf{replace}(\textbf{this}.\$r \rightarrow \textbf{this}.\$r.\textbf{value}(\textbf{heapIs}))) \\
\rho_{tuncstart_1032,1}._replace(p1 \rightarrow ((-2 * div(heapIs \rho_{tuncstart_1032,1}).
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177).quot) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_1032,1}, \ \mathbf{this}.\$ r. \mathbf{value}(\mathbf{heapIs}
\label{eq:cast_signed} $$ \hat{p}_{funcstart\_1032,1}.p1,\ 177).rem))).r2** {\bf static\_cast} < {\bf signed} $$
\mathbf{int}{>}(\mathrm{div2.rem})) - (\$\mathrm{heap}_{1032,1;1051,8}.\mathrm{b2} * \mathbf{static\_cast}{<} \mathbf{signed}
int>(div2.quot))) == temp2
\rightarrow [const member of object with modified fields]
[54.2] (($heap_funcstart_1032,1.r2 * static_cast<signed int>(div2.rem)) -
(\text{sheap}_{1032,1:1051.8}.\text{b2} * \text{static\_cast} < \text{signed int} > (\text{div}2.\text{quot}))) == \text{temp}2
\rightarrow [const static or extern object]
[54.3] (($heap<sub>init</sub>.r2 * static_cast<signed int>(div2.rem)) -
(\text{sheap}_{1032,1;1051,8}.\text{b2} * \text{static\_cast} < \text{signed int} > (\text{div2.quot}))) == \text{temp2}
\rightarrow [expand definition of constant 'r2' at prang.cpp (34,26)]
[54.4] (((int)172 * static_cast<signed int>(div2.rem)) -
(\text{sheap}_{1032,1:1051,8}.\text{b2} * \text{static\_cast} < \text{signed int} > (\text{div2.quot}))) == \text{temp2}
\rightarrow [simplify]
[54.5] ((172 * static_cast<signed int>(div2.rem)) - ($heap_1032.1:1051.8.b2 *
static_cast<signed int>(div2.quot))) == temp2
\rightarrow [from term 18.6, div2 is equal to div(heapIs $heap_{funcstart\_1032,1},
this.$r.value(heapIs $heap_{funcstart\_1032,1}).p2, 176)]
[54.6] ((172 * static_cast<signed int>(div(heapIs $heap_{tuncstart\_1032,1},
this.r.value(heapIs \$heap_{funcstart\_1032,1}).p2, 176).rem)) -
(\text{sheap}_{1032,1;1051,8}.\text{b2} * \text{static\_cast} < \text{signed int} > (\text{div2.quot}))) == \text{temp2}
\rightarrow [simplify]
[54.7] ((172 * div(heapIs \$heap_{funcstart\_1032,1}, this.\$r.value(heapIs
\text{heap}_{funcstart\_1032,1}.p2, 176).rem) - (\text{heap}_{1032,1;1051,8}.b2 *
static_cast<signed int>(div2.quot))) == temp2
\rightarrow [from term 53.19, $heap<sub>1032,1;1051,8</sub> is equal to
\$heap_{funcstart\_1032,1}.\_\textbf{replace}(\textbf{this.}\$r \rightarrow \textbf{this.}\$r.\textbf{value}(\textbf{heapIs}
heap_{funcstart\_1032,1}._replace(p1 \rightarrow (-2 * div(heapIs heap_{funcstart\_1032,1}),
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177).quot) + (171 *
div(\mathbf{heapIs} \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
heap_{funcstart_{1032,1}}.p1, 177).rem)))
[54.8] ((172 * div(heapIs $heap_{funcstart\_1032,1}, this.$r.value(heapIs)]
\rho_{tuncstart\_1032,1}.p2, 176.rem) - (\rho_{tuncstart\_1032,1}.p2.replace(this.$r
\rightarrow this.$r.value(heapIs $heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 *
div(\mathbf{heapIs} \$ heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
```

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\text{Sheap}_{funcstart\_1032,1}.p1, 177).quot) + (171 * div(heapIs \text{Sheap}_{funcstart\_1032,1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177).rem)))).b2 *
static_cast<signed int>(div2.quot))) == temp2
→ [const member of object with modified fields]
[54.9] ((172 * div(heapIs $heap_{funcstart\_1032,1}, this.$r.value(heapIs)
\text{Sheap}_{funcstart\_1032.1}.p2, 176).rem) - (\text{Sheap}_{funcstart\_1032.1}.b2 *
static_cast<signed int>(div2.quot))) == temp2
\rightarrow [const static or extern object]
[54.10] ((172 * div(heapIs $heap<sub>funcstart_1032,1</sub>, this.$r.value(heapIs
\theta_{funcstart\_1032,1}.p2, 176).rem) - (\theta_{init}.b2 * static_cast<signed
int>(div2.quot)) = temp2
\rightarrow [expand definition of constant 'b2' at prang.cpp (36,26)]
[54.11] ((172 * div(heapIs $heap<sub>funcstart_1032.1</sub>, this.$r.value(heapIs)
\theta_{funcstart\_1032.1}.p2, 176).rem) - ((int)35 * static_cast<signed)
int>(div2.quot)) = temp2
\rightarrow [simplify]
[54.12] ((172 * div(heapIs $heap_{funcstart\_1032,1}, this.$r.value(heapIs
\theta_{funcstart\_1032,1}.p2, 176).rem - (35 * static\_cast < signed)
int>(div2.quot)) == temp2
\rightarrow [from term 18.6, div2 is equal to div(heapIs $heap_{funcstart\_1032,1},
this.r.value(heapIs heap_{funcstart\_1032,1}).p2, 176)]
[54.13] ((172 * div(heapIs $heap<sub>funcstart_1032,1</sub>, this.$r.value(heapIs
\rho_{tuncstart\_1032.1}.p2, 176).rem - (35 * static\_cast < signed)
int>(div(heapIs $heap_{tuncstart\_1032.1}, this.$r.value(heapIs
\theta_{funcstart\_1032,1}.p2, 176).quot))) == temp2
\rightarrow [simplify]
[54.18] 0 == (-\text{temp2} + (-35 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p2, 176).quot) + (172 *
div(\mathbf{heapIs} \$ heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
heap_{funcstart\_1032,1}.p2, 176).rem
[Take given term]
[57.0] $\text{heap}_{1032,1;1054,8} == $\text{heap}_{1032,1;1051,8}._\text{replace}(\text{this}.$\text{$r} \to \text{
\mathbf{operator}^*(\mathbf{heapIs}~\$\mathrm{heap}_{1032,1;1051,8},~\mathbf{this}).\_\mathbf{replace}(\mathrm{p2}\to
asType<P2Type>(($heap<sub>1032,1;1051,8</sub>.M2 *
asType{<}int{>}(static\_cast{<}integer{>}(static\_cast{<}signed
int>(operator^*(heapIs $heap_{1032,1;1051,8}, this).p2) < (int)0))) + temp2)))
\rightarrow [from term 53.19, $heap<sub>1032,1:1051,8</sub> is equal to
\$heap_{funcstart\_1032,1}.\_\textbf{replace}(\textbf{this}.\$r \rightarrow \textbf{this}.\$r.\textbf{value}(\textbf{heapIs}
heap_{funcstart\_1032,1}._replace(p1 \rightarrow (-2 * div(heapIs p_{funcstart\_1032,1}).
```

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this.r.value(heapIs \ \ heap_{funcstart\_1032,1}).p1, \ 177).quot) + (171 *
div(\mathbf{heapIs} \ \$heap_{funcstart\_1032,1}, \ \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
heap_{funcstart\_1032,1}.p1, 177).rem)))
[57.2] heap_{1032,1;1054,8} == heap_{funcstart\_1032,1}.\_replace(this.\$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this. r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs \theta), this.$r.value(heapIs
\hat{p}_{funcstart\_1032,1}.p1, 177).rem)))_replace(this.$r \rightarrow operator*(heapIs)
\theta_{funcstart\_1032,1}._replace(this.r \to this.r.value(heapIs)
\text{Sheap}_{funcstart\_1032,1}._replace(p1 \rightarrow (-2 * div(heapIs \text{Sheap}_{funcstart\_1032,1}),
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177).quot) + (171 *
div(\mathbf{heapIs} \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
\theta_{uncstart_1032.1}, p1, 177).rem))), this)._replace(p2 \rightarrow
asType<P2Type>(($heap<sub>1032,1:1051,8</sub>.M2 *
asType<int>(static_cast<integer>(static_cast<signed
int>(operator^*(heapIs $heap_{1032,1:1051,8}, this).p2) < (int)0))) + temp2)))
→ [expand definition of operator '*' in class 'pointer' at built in declaration]
[57.3] $heap<sub>1032,1;1054,8</sub> == $heap<sub>funcstart_1032,1</sub>._replace(this.$r \rightarrow
this.$r.value(heapIs $heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\theta_{funcstart\_1032,1}, this.r.value(heapIs \theta_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(\mathbf{heapIs} \ \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
\theta_{funcstart\_1032,1}.p1, 177).rem)))._replace(this.$r \rightarrow
this.$r.value(heapIs \rho_{funcstart\_1032,1}._replace(this.$r \rightarrow
\textbf{this.\$r.value}(\textbf{heapIs}~\$ heap_{funcstart\_1032,1}).\_\textbf{replace}(p1 \rightarrow ((-2~*div(\textbf{heapIs})))))
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs \rho_{funcstart\_1032,1}, this.r.value(heapIs)
\label{eq:condition} $\operatorname{heap}_{funcstart\_1032,1}).p1,\ 177).rem))))).\_\mathbf{replace}(p2 \to
asType<P2Type>(($heap<sub>1032,1:1051,8</sub>.M2 *
as Type < int > (static\_cast < integer > (static\_cast < signed
int>(operator^*(heapIs \$heap_{1032,1;1051,8}, this).p2) < (int)(0))) + temp(2)))
→ [evaluate dereferenced pointer into modified heap]
[57.4] heap_{1032,1;1054,8} == heap_{funcstart\_1032,1}.replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
\label{eq:continuous_funcstart_1032,1} $$ \text{heap}_{funcstart\_1032,1}.p1,\ 177).rem)))).$$ \_\textbf{replace}(\textbf{this}.\$r \to ([\textbf{this}.\$r ==
this.$r]: this.$r.value(heapIs \rho_{funcstart\_1032,1})._replace(p1 \rightarrow (-2 *
{\rm div}(\mathbf{heapIs}~\$\mathrm{heap}_{funcstart\_1032,1},~\mathbf{this}.\$\mathrm{r.value}(\mathbf{heapIs}
\text{Sheap}_{funcstart\_1032.1}.p1, 177).quot) + (171 * div(heapIs \text{Sheap}_{funcstart\_1032.1},
this.r.value(heapIs $heap_{funcstart\_1032,1}).p1, 177).rem)), []:
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p2 \rightarrow
asType<P2Type>(($heap<sub>1032,1;1051,8</sub>.M2 *
asType<int>(static_cast<integer>(static_cast<signed
```

```
int>(operator^*(heapIs \$heap_{1032,1;1051,8}, this).p2) < (int)(0))) + temp(2)))
→ [explicitly assert falsehood of skipped guards in subsequent guards]
[57.5] $heap<sub>1032,1;1054,8</sub> == $heap<sub>funcstart_1032,1</sub>._replace(this.$r \rightarrow
this.$r.value(heapIs heapIs_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this. r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs $heap<sub>funcstart_1032.1</sub>, this.$r.value(heapIs
\rho_{funcstart\_1032,1}.p1, 177).rem)))._replace(this.$r \rightarrow ([this.$r ==
this.$r]: this.$r.value(heapIs \rho_{tuncstart\_1032,1})._replace(p1 \rightarrow (-2 *
div(\mathbf{heapIs} \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
\text{Sheap}_{funcstart\ 1032.1}, p1, 177).quot) + (171 * div(heapIs \text{Sheap}_{funcstart\ 1032.1},
this.r.value(heapIs \ensuremath{\$}heap_{funcstart\_1032,1}).p1, 177).rem)), [!(this.\ensuremath{\$}r ==
this.$r.value(heapIs heapIs = f_{uncstart\_1032,1})._replace(p2 \rightarrow
asType<P2Type>(($heap<sub>1032,1;1051,8</sub>.M2 *
asType<int>(static_cast<integer>(static_cast<signed
int>(operator*(heapIs $heap_{1032,1;1051.8}, this).p2) < (int)0))) + temp2)))
\rightarrow [simplify]
[57.7] heap_{1032,1;1054,8} == heap_{funcstart\_1032,1}._replace(this.r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs $heap<sub>funcstart_1032,1</sub>, this.$r.value(heapIs
\theta_{funcstart\_1032,1}.p1, 177).rem)))).replace(this.r \rightarrow 0
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{tuncstart\_1032.1}, this.r.value(heapIs \rho_{tuncstart\_1032.1}).p1,
177).quot) + (171 * div(\mathbf{heapIs} \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}))
\theta_{funcstart\_1032,1}.p1, 177).rem))._replace(p2 \rightarrow
asType<P2Type>(($heap<sub>1032,1;1051,8</sub>.M2 *
asType<int>(static_cast<integer>(static_cast<signed
int>(operator^*(heapIs \$heap_{1032,1;1051,8}, this).p2) < (int)(0))) + temp(2)))
\rightarrow [from term 53.19, heap_{1032,1;1051,8} is equal to
$heap_{funcstart\_1032,1}$.$replace(this.$r \rightarrow this.$r.value(heapIs)
heap_{funcstart\_1032,1}._replace(p1 \rightarrow (-2 * div(heapIs \$heap_{funcstart\_1032,1}, -2))
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, \ 177).quot) + (171)
div(\textbf{heapIs}~\$heap_{funcstart\_1032,1},~\textbf{this.}\$r.\textbf{value}(\textbf{heapIs}
heap_{funcstart\_1032,1}.p1, 177).rem)))]
[57.8] heap_{1032,1;1054,8} == heap_{funcstart\_1032,1}._replace(this.r \rightarrow
this.$r.value(heapIs \rho_{uncstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs \rho_{funcstart\_1032,1}, this.r.value(heapIs)
\theta_{funcstart\_1032,1}.p1, 177).rem))))._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
heap_{funcstart\_1032,1}.p1, 177).rem)))._replace(p2 \rightarrow
```

```
asType<P2Type>((\$heap_{tuncstart\_1032.1}.\_replace(this.\$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs $heap<sub>funcstart_1032,1</sub>, this.$r.value(heapIs
$heap_funcstart_1032,1).p1, 177).rem)))).M2 *
asType < int > (static\_cast < integer > (static\_cast < signed
int>(operator^*(heapIs $heap_{1032,1:1051.8}, this).p2) < (int)(0))) + temp(2)))
\rightarrow [const member of object with modified fields]
[57.9] $heap<sub>1032,1:1054,8</sub> == $heap<sub>funcstart_1032,1</sub>._replace(this.$r \rightarrow
this.$r.value(heapIs \rho_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs \theta_{funcstart\_1032,1}, this.r.value(heapIs)
\theta_{tuncstart\_1032,1}.p1, 177).rem)))).\_replace(this.$r \rightarrow
this.$r.value(heapIs $heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(\mathbf{heapIs} \$ heap_{funcstart\_1032,1}, \mathbf{this}.\$ r. \mathbf{value}(\mathbf{heapIs})
\theta_{uncstart\_1032,1}.p1, 177).rem))).\_replace(p2 \rightarrow
asType<P2Type>(($heap<sub>funcstart_1032.1</sub>.M2 *
asType<int>(static_cast<integer>(static_cast<signed
int>(operator^*(heapIs $heap_{1032,1:1051.8}, this).p2) < (int)0))) + temp2)))
\rightarrow [const static or extern object]
[57.10] $heap<sub>1032,1;1054,8</sub> == $heap<sub>funcstart_1032,1</sub>._replace(this.$r \rightarrow
this.$r.value(heapIs \rho_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{tuncstart\_1032.1}, this.r.value(heapIs \rho_{tuncstart\_1032.1}).p1,
177).quot) + (171 * div(\mathbf{heapIs} \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}))
\theta_{funcstart\_1032,1}.p1, 177).rem)))).\_replace(this.\$r \rightarrow 0
this.$r.value(heapIs heap_{funcstart\_1032.1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.\r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs \$heap_{funcstart\_1032,1}, this.\$r.value(heapIs))
\theta_{funcstart\_1032.1}.p1, 177).rem))._replace(p2 \rightarrow
asType<P2Type>(($heap<sub>init</sub>.M2 *
asType<int>(static_cast<integer>(static_cast<signed
int>(operator^*(heapIs $heap_{1032,1;1051,8}, this).p2) < (int)(0))) + temp(2)))
\rightarrow [expand definition of constant 'M2' at prang.cpp (33,26)]
[57.11] $\text{heap}_{1032,1;1054,8} == $\text{heap}_{funcstart\_1032,1}._\text{replace}(\text{this.}\text{$\frac{1}{2}}\text{$\text{constart}_{-1032,1}._\text{$\text{replace}}(\text{this}.\text{$\text{$\text{constart}_{-1032,1}._\text{$\text{constart}_{-1032,1}._\text{$\text{constart}_{-1032,1}._\text{$\text{constart}_{-1032,1}._\text{$\text{constart}_{-1032,1}._\text{$\text{constart}_{-1032,1}._\text{$\text{constart}_{-1032,1}._\text{$\text{constart}_{-1032,1}._\text{$\text{constart}_{-1032,1}._\text{$\text{constart}_{-1032,1}._\text{$\text{constart}_{-1032,1}._\text{$\text{constart}_{-1032,1}._\text{$\text{constart}_{-1032,1}._\text{$\text{constart}_{-1032,1}._\text{$\text{constart}_{-1032,1}._\text{$\text{constart}_{-1032,1}._\text{$\text{constart}_{-1032,1}._\text{$\text{constart}_{-1032,1}._\text{$\text{constart}_{-1032,1}._\text{$\text{constart}_{-1032,1}._\text{$\text{constart}_{-1032,1}._\text{$\text{constart}_{-1032,1}._\text{$\text{constart}_{-1032,1}._\text{$\text{constart}_{-1032,1}._\text{$\text{constart}_{-1032,1}._\text{$\text{constart}_{-1032,1}._\text{$\text{constart}_{-1032,1}._\text{$\text{constart}_{-1032,1}._\text{$\text{constart}_{-1032,1}._\text{$\text{constart}_{-1032,1}._\text{$\text{constart}_{-1032,1}._\text{$\text{constart}_{-1032,1}._\text{$\text{constart}_{-1032,1}._\text{$\text{constart}_{-1032,1}._\text{$\text{constart}_{-1032,1}._\text{$\text{constart}_{-1032,1}._\text{$\text{constart}_{-1032,1}._\text{$\text{constart}_{-1032,1}._\text{$\text{constart}_{-1032,1}._\text{$\text{constart}_{-1032,1}._\text{$\text{constart}_{-1032,1}._\text{$\text{constart}_{-1032,1}._\text{$\text{constart}_{-1032,1}._\text{$\text{constart}_{-1032,1}._\text{$\text{constart}_{-1032,1}._\text{$\text{constart}_{-1032,1}._\text{$\text{constart}_{-1032,1}._\text{$\text{constart}_{-1032,1}._\text{$\text{constart}_{-1032,1}._\text{$\text{constart}_{-1032,1}._\text{$\text{constart}_{-1032,1}._\text{$\text{constart}_{-1032,1}._\text{$\text{constart}_{-1032,1}._\text{$\text{constart}_{-1032,1}._\text{$\text
this.$r.value(heapIs \rho_{uncstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs \rho_{funcstart\_1032,1}, this.r.value(heapIs)
\theta_{funcstart\_1032,1}.p1, 177).rem))))._replace(this.$r \rightarrow
this.$r.value(heapIs \rho_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
heap_{funcstart\_1032,1}.p1, 177).rem)))._replace(p2 \rightarrow
```

```
asType < P2Type > (((int)30307 *
asType<int>(static_cast<integer>(static_cast<signed
int>(operator*(heapIs $heap_{1032,1;1051.8}, this).p2) < (int)0))) + temp2)))
\rightarrow [simplify]
[57.12] $\text{heap}_{1032,1;1054,8} == $\text{heap}_{funcstart\_1032,1}._\text{replace}(\text{this}.\text{$\frac{1}{2}}\)
this.$r.value(heapIs \rho_{tuncstart\_1032.1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{heap}_{funcstart\_1032,1}, \text{this.}\text{$r.value}(\text{heapIs}))
\theta_{funcstart\_1032,1}.p1, 177).rem))))._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\ 1032.1}).replace(p1 \rightarrow ((-2 * div(heapIs
$\text{heap}_{funcstart=1032.1}$, this.$\text{r.value}(\text{heapIs} \text{$heap}_{funcstart=1032.1}).p1,
177).quot) + (171 * div(heapIs $heap<sub>funcstart_1032,1</sub>, this.$r.value(heapIs
heap_{funcstart\_1032,1}.p1, 177).rem)))._replace(p2 \rightarrow
asType < P2Type > ((30307 *
asType<int>(static_cast<integer>(static_cast<signed
int>(operator^*(heapIs $heap_{1032,1;1051,8}, this).p2) < (int)(0))) + temp(2)))
\rightarrow [from term 53.19, $heap<sub>1032.1:1051.8</sub> is equal to
$heap_{funcstart\_1032,1}.$-replace(this.$r \rightarrow this.$r.value(heapIs)
heap_{funcstart\_1032,1}._replace(p1 \rightarrow (-2 * div(heapIs $heap_{funcstart\_1032,1}, 
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177).quot) + (171 *
div(\mathbf{heapIs} \ \$heap_{funcstart\_1032,1}, \ \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
heap_{funcstart\_1032,1}.p1, 177).rem)))
[57.13] $heap<sub>1032,1:1054,8</sub> == $heap<sub>funcstart_1032,1</sub>._replace(this.$r \rightarrow
\textbf{this.}\$r.\textbf{value}(\textbf{heapIs}~\$heap_{funcstart\_1032,1}).\_\textbf{replace}(p1 \rightarrow ((\text{-}2~*\text{div}(\textbf{heapIs}
\rho_{funcstart\_1032,1}, this.\r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
\theta_{tuncstart\_1032.1}.p1, 177.rem)))._replace(this.$r \rightarrow
this.$r.value(heapIs \rho_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\theta_{funcstart\_1032,1}, this.r.value(heapIs \theta_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
heap_{funcstart\_1032,1}.p1, 177).rem))).\_replace(p2 \rightarrow
asType<P2Type>((30307 *
asType<int>(static_cast<integer>(static_cast<signed
int>(operator^*(heapIs \ heap_{funcstart\_1032,1}.\_replace(this.\$r \rightarrow
this.$r.value(heapIs \rho_{tuncstart 1032.1})._replace(p1 \rightarrow (-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs \theta_{funcstart\_1032,1}, this.r.value(heapIs)
\text{Sheap}_{funcstart\_1032,1}.\text{p1}, 177).\text{rem})), \text{this}.\text{p2}) < (\text{int})0)) + \text{temp2}))
→ [expand definition of operator '*' in class 'pointer' at built in declaration]
[57.14] $\text{heap}_{1032,1;1054,8} == \text{$heap}_{funcstart\_1032,1}._\text{replace}(\text{this}.\text{$r} \rightarrow
this.$r.value(heapIs \rho_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(\mathbf{heapIs} \ \$heap_{funcstart\_1032,1}, \ \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
```

```
\theta_{tuncstart=1032.1}.p1, 177).rem)))._replace(this.$r \rightarrow
this.$r.value(heapIs \frac{1}{2} heap\frac{1}{2} ._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs $heap<sub>funcstart_1032,1</sub>, this.$r.value(heapIs
\theta_{funcstart\_1032,1}.p1, 177).rem)))._replace(p2 \rightarrow
asType<P2Type>((30307 *
asType < int > (static\_cast < integer > (static\_cast < signed)
int>(this.r.value(heapIs \ heap_{funcstart\_1032,1}.\_replace(this.\rdotsr)
this.$r.value(heapIs \rho_{tuncstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\theta_{funcstart_{1032,1}}, this.r.value(\theta_{funcstart_{1032,1}}).p1,
177).quot) + (171 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
\theta_{funcstart\_1032,1}.p1, 177).rem)))).p2) < (int)0))) + temp2))
→ [evaluate dereferenced pointer into modified heap]
[57.15] heap_{1032,1;1054,8} == heap_{funcstart\_1032,1}._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart_1032,1}, this.r.value(heapIs \rho_{funcstart_1032,1}).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.} \text{\$r.value}(\text{heapIs}))
\theta_{funcstart\_1032,1}.p1, 177).rem))))._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this. r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs $heap<sub>funcstart_1032.1</sub>, this.$r.value(heapIs
\theta_{funcstart\_1032,1}.p1, 177).rem))).\_replace(p2 \rightarrow
asType<P2Type>((30307 *
asType < int > (static\_cast < integer > (static\_cast < signed\ int > (([this.\$r
== this.$r]: this.$r.value(heapIs \rho_{tuncstart\_1032.1})._replace(p1 \rightarrow (-2 *
div(\mathbf{heapIs} \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
\text{Sheap}_{funcstart\_1032,1}.p1, 177).quot) + (171 * div(heapIs \text{Sheap}_{funcstart\_1032,1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177).rem)), []:
this.r.value(heapIs \ heap_{funcstart \ 1032.1}).p2) < (int)0)) + temp2)))
→ [explicitly assert falsehood of skipped guards in subsequent guards]
[57.16] $heap<sub>1032,1;1054,8</sub> == $heap<sub>funcstart_1032,1</sub>._replace(this.$r \rightarrow
\textbf{this.\$r.value}(\textbf{heapIs}~\$ heap_{funcstart\_1032,1}).\_\textbf{replace}(p1 \rightarrow ((-2~*div(\textbf{heapIs})))))
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
\theta_{funcstart\_1032,1}.p1, 177).rem)))).\_replace(this.\$r \rightarrow 0
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs $heap<sub>funcstart_1032,1</sub>, this.$r.value(heapIs
\theta_{funcstart\_1032,1}.p1, 177).rem)))._replace(p2 \rightarrow
asType<P2Type>((30307 *
asType < int > (static\_cast < integer > (static\_cast < signed\ int > (([this.\$r
== this.$r]: this.$r.value(heapIs \rho_{tuncstart\_1032,1})._replace(p1 \rightarrow (-2 *
div(heapIs $heap<sub>funcstart_1032.1</sub>, this.$r.value(heapIs
\text{Sheap}_{funcstart\_1032,1}.p1, 177).quot) + (171 * div(heapIs \text{Sheap}_{funcstart\_1032,1},
```

```
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177).rem)), [!(this.<math>r = 
\mathbf{this.\$r.value}(\mathbf{heapIs}\ \$\mathbf{heap}_{funcstart\_1032,1})).\mathbf{p2}) < (\mathbf{int})0))) \ +
temp2)))
\rightarrow [simplify]
[57.23] $heap<sub>1032,1;1054,8</sub> == $heap<sub>funcstart_1032,1</sub>._replace(this.$r \rightarrow
this.$r.value(heapIs \rho_{tuncstart\_1032.1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs $heap<sub>funcstart_1032,1</sub>, this.$r.value(heapIs
\theta_{funcstart\_1032,1}.p1, 177).rem))))._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\ 1032.1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
\theta_{funcstart\_1032,1}.p1, 177).rem))).\_replace(p2 \rightarrow
asType<P2Type>((30307 * asType<int>(static_cast<integer>(0 <
-this.r.value(heapIs heap_{funcstart\_1032,1}.p2))) + temp2)))
\rightarrow [from term 24.0, literala < -this.$r.value(heapIs $heap_{funcstart\_1032.1}).p2
is false whenever -2 < (0 + literala)
   Proof of rule precondition:
   [57.23.0] - 2 < (0 + 0)
   \rightarrow [simplify]
   [57.23.2] true
[57.24] $heap<sub>1032.1:1054.8</sub> == $heap<sub>funcstart_1032.1</sub>._replace(this.$r \rightarrow
this.$r.value(heapIs \rho_{uncstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.}\text{\$r.value}(\text{heapIs}))
\theta_{tuncstart\_1032,1}.p1, 177).rem)))).\_replace(this.\$r \rightarrow
this.$r.value(heapIs heap_{funcstart = 1032.1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.}\text{\$r.value}(\text{heapIs}))
\theta_{funcstart\_1032,1}.p1, 177).rem))).\_replace(p2 \rightarrow
asType<P2Type>((30307 * asType<int>(static_cast<integer>(false)))
+ \text{temp2})))
\rightarrow [simplify]
[57.25] $heap<sub>1032,1;1054,8</sub> == $heap<sub>funcstart_1032,1</sub>._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs \theta_{funcstart\_1032,1}, this.r.value(heapIs)
\theta_{funcstart\_1032,1}.p1, 177).rem))))._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs \theta_{funcstart\_1032,1}, this.r.value(heapIs)
```

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\theta_{tuncstart_1032.1}.p1, 177).rem)))._replace(p2 \rightarrow
asType<P2Type>((30307 * asType<int>(([false]: 1, []: 0))) + temp2)))
→ [explicitly assert falsehood of skipped guards in subsequent guards]
[57.26] $heap<sub>1032,1;1054,8</sub> == $heap<sub>funcstart_1032,1</sub>._replace(this.$r \rightarrow
\textbf{this.}\$r.\textbf{value}(\textbf{heapIs}~\$heap_{funcstart\_1032,1}).\_\textbf{replace}(p1 \rightarrow ((\text{-}2~*\text{div}(\textbf{heapIs}
\rho_{funcstart_1032,1}, this. r.value(heapIs \rho_{funcstart_1032,1}).p1,
177).quot) + (171 * div(heapIs $heap<sub>funcstart_1032,1</sub>, this.$r.value(heapIs
\theta_{funcstart\_1032,1}.p1, 177).rem))))._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\$heap_{funcstart\_1032,1},\, \textbf{this}.\$r.\textbf{value}(\textbf{heapIs}\,\,\$heap_{funcstart\_1032.1}).p1,
177).quot) + (171 * div(heapIs $heap<sub>funcstart_1032,1</sub>, this.$r.value(heapIs
\theta_{funcstart\_1032,1}.p1, 177).rem))).\_replace(p2 \rightarrow
asType<P2Type>((30307 * asType<int>(([false]: 1, [true]: 0))) +
temp2)))
\rightarrow [simplify]
[57.29] heap_{1032,1;1054,8} == heap_{funcstart\_1032,1}._replace(this.r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(\mathbf{heapIs} \$ heap_{funcstart\_1032,1}, \mathbf{this}.\$ r. \mathbf{value}(\mathbf{heapIs})
\theta_{tuncstart\_1032,1}.p1, 177).rem)))).\_replace(this.\$r \rightarrow
this.$r.value(heapIs p_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs $heap<sub>funcstart_1032,1</sub>, this.$r.value(heapIs
\frac{\text{sheap}_{funcstart\_1032.1}.p1, 177.rem)}{\text{ce}}._replace(p2 \rightarrow asType<P2Type>(0 +
temp2)))
\rightarrow [from term 54.18, temp2 is equal to (-35 * div(heapIs $heap_{funcstart\_1032.1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p2, 176).quot) + (172 *
div(\mathbf{heapIs} \ \$heap_{funcstart\_1032,1}, \ \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
heap_{funcstart\_1032,1}.p2, 176).rem
[57.30] $heap<sub>1032,1;1054,8</sub> == $heap<sub>funcstart_1032,1</sub>._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{tuncstart\_1032.1}, this.r.value(heapIs \rho_{tuncstart\_1032.1}).p1,
177).quot) + (171 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
\label{eq:continuous_function} $ \text{heap}_{funcstart\_1032,1} . \text{p1}, 177).rem)))).$ \_\textbf{replace}(\textbf{this}.\$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart_{-1032,1}}, this. r.value(heapIs \rho_{funcstart_{-1032,1}}).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{heap}_{funcstart\_1032,1}, \text{this.}\text{$r.value}(\text{heapIs}))
\rho_{funcstart\_1032,1}.p1, 177).rem))._replace(p2 \rightarrow asType<P2Type>(0 +
((-35 * div(\mathbf{heapIs} \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}))
\rho_{funcstart\_1032,1}.p2, 176).quot + (172 * div(heapIs $heap_{funcstart\_1032,1})
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p2, 176).rem)))))
\rightarrow [simplify]
```

```
[57.33] $\text{heap}_{1032,1;1054,8} == \text{$heap}_{funcstart\_1032,1}.$\text{-replace}(\text{this}.\text{$r} \to \text{$}
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
\theta_{tuncstart\_1032,1}.p1, 177).rem)))).\_replace(this.\$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032.1}, \text{this.} \text{\$r.value}(\text{heapIs}))
\rho_{uncstart\_1032,1}.p1, 177).rem))._replace(p2 \rightarrow ((-35 * div(heapIs
\label{eq:heapIs} \$ heap_{funcstart\_1032,1}, \ \mathbf{this}.\$ r. \mathbf{value} (\mathbf{heapIs} \ \$ heap_{funcstart\_1032,1}). p2,
176).quot) + (172 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.} \text{\$r.value}(\text{heapIs}))
\text{\$heap}_{funcstart\_1032,1}).\text{p2},\ 176).\text{rem}))))
[Take goal term]
[1.0] static_cast<integer>(static_cast<signed int>(operator*(heapIs
\text{$heap}_{1032,1;1054,8}, \, \text{this}).p3) < (\text{int})0) \le \text{maxof}(\text{int})
\rightarrow [from term 57.33, $heap<sub>1032.1:1054.8</sub> is equal to
heap_{funcstart\_1032.1}._replace(this.r \rightarrow this.r.value(heapIs)
heap_{funcstart\_1032.1}._replace(p1 \rightarrow ((-2 * div(heapIs $heap_{funcstart\_1032.1},
div(\textbf{heapIs}~\$heap_{funcstart\_1032,1},~\textbf{this.}\$r.\textbf{value}(\textbf{heapIs}
\theta_{tuncstart\_1032,1}.p1, 177).rem))))_replace(this.$r \rightarrow
this.r.value(heapIs \ heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs))
\$heap_{funcstart\_1032,1},\ \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}\ \$heap_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(\mathbf{heapIs} \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}))
\rho_{funcstart\_1032,1}.p1, 177).rem))).\_replace(p2 \rightarrow (-35 * div(heapIs))).
heap_{funcstart\_1032,1}, this.r.value(heapIs heap_{funcstart\_1032,1}).p2,
176).quot) + (172 * div(heapIs $heap<sub>funcstart_1032,1</sub>, this.$r.value(heapIs
heap_{funcstart_{1032,1}}.p2, 176).rem)))
[1.1] static_cast<integer>(static_cast<signed int>(operator*(heapIs
\$heap_{funcstart\_1032,1}.\_\textbf{replace}(\textbf{this}.\$r \rightarrow \textbf{this}.\$r.\textbf{value}(\textbf{heapIs}
heap_{funcstart\_1032,1}._replace(p1 \rightarrow ((-2 * div(heapIs heap_{funcstart\_1032,1}),
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177).quot) + (171 *
div(\mathbf{heapIs} \$ heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
\theta_{tuncstart\_1032,1}.p1, 177).rem)))).\_replace(this.\$r \rightarrow
this.$r.value(heapIs \rho_{uncstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs)
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs \theta_{funcstart\_1032,1}, this.r.value(heapIs)
\rho_{funcstart\_1032.1}.p1, 177).rem)...replace(p2 \rightarrow (-35 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p2,
176).quot) + (172 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.} \text{\$r.value}(\text{heapIs}))
\text{Sheap}_{funcstart\_1032.1}.\text{p2}, 176).\text{rem})), \text{this}.\text{p3}) < (\text{int})0) \leq \text{maxof}(\text{int})
→ [expand definition of operator '*' in class 'pointer' at built in declaration]
[1.2] static_cast<integer>(static_cast<signed int>(this.$r.value(heapIs
```

```
\theta_{funcstart\_1032,1}-replace(this.r \to this.r.value(heapIs)
\text{Sheap}_{funcstart\_1032,1}._replace(p1 \rightarrow ((-2 * div(heapIs \text{Sheap}_{funcstart\_1032,1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177).quot) + (171 *
div(\mathbf{heapIs} \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
\theta_{funcstart\_1032,1}.p1, 177).rem))))._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032.1}, \text{this.} \text{\$r.value}(\text{heapIs}))
\rho_{funcstart\_1032,1}.p1, 177).rem))._replace(p2 \rightarrow ((-35 * div(heapIs
\label{eq:heapIs} \$ heap_{funcstart\_1032,1}, \ \mathbf{this}.\$ r. \mathbf{value} (\mathbf{heapIs} \ \$ heap_{funcstart\_1032,1}). p2,
176).quot) + (172 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.} \text{\$r.value}(\text{heapIs}))
\text{Sheap}_{funcstart\_1032,1}.\text{p2}, 176).\text{rem})))).\text{p3}) < (int)0) \leq \max(int)
→ [evaluate dereferenced pointer into modified heap]
[1.3] static_cast<integer>(static_cast<signed int>(([this.$r == this.$r]:
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart_1032,1}, this.r.value(heapIs \rho_{funcstart_1032,1}).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.} \text{\$r.value}(\text{heapIs}))
\rho_{uncstart\_1032,1}.p1, 177).rem))._replace(p2 \rightarrow (-35 * div(heapIs)
176).quot) + (172 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
\rho_{tuncstart\_1032.1}, p2, 176).rem)), []: this.$r.value(heapIs)
\theta_{funcstart\_1032,1}._replace(this.r \to this.r.value(heapIs)
\text{Sheap}_{funcstart\_1032,1}._replace(p1 \rightarrow (-2 * div(heapIs \text{Sheap}_{funcstart\_1032,1}),
this.r.value(heapIs \heap_{funcstart\_1032,1}).p1, 177).quot) + (171)^2
div(heapIs $heap<sub>funcstart_1032.1</sub>, this.$r.value(heapIs
\text{Sheap}_{funcstart\_1032,1}.\text{p1}, 177).\text{rem})))).\text{p3}) < (\text{int})0) \leq \text{maxof}(\text{int})
→ [explicitly assert falsehood of skipped guards in subsequent guards]
[1.4] static_cast<integer>(static_cast<signed int>(([this.$r == this.$r]:
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
$heap_funcstart_1032.1, this.$r.value(heapIs $heap_funcstart_1032.1).p1,
177).quot) + (171 * div(heapIs $heap_{tuncstart\_1032.1}, this.$r.value(heapIs
\rho_{uncstart\_1032,1}.p1, 177).rem))).\_replace(p2 \rightarrow (-35 * div(heapIs))).
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p2,
176).quot) + (172 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.} \text{\$r.value}(\text{heapIs}))
\frac{\text{sheap}_{funcstart\_1032,1}.p2, 176).rem}{\text{rem}}, [!(\mathbf{this.\$r} == \mathbf{this.\$r})]:
this.r.value(heapIs \ heap_{funcstart\_1032,1}.\_replace(this.\rdotsr) \rightarrow
this.$r.value(heapIs heapIs_{funcstart\_1032,1})._replace(p1 \rightarrow (-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.}\text{\$r.value}(\text{heapIs}))
\$ heap_{funcstart\_1032,1}).p1,\,177).rem))))).p3) < (\mathbf{int})0) \le \mathbf{maxof}(\mathbf{int})
\rightarrow [simplify]
[1.12] static_cast<integer>(0 < -this.$r.value(heapIs
\$ heap_{funcstart\_1032,1}).p3) \le \mathbf{maxof(int)}
```

```
\rightarrow [from term 40.0, literala < -this.$r.value(heapIs $heap_{funcstart\_1032,1}).p3
is false whenever -2 < (0 + literala)
   Proof of rule precondition:
   [1.12.0] - 2 < (0 + 0)
   \rightarrow [simplify]
   [1.12.2] true
[1.13] static_cast<integer>(false) \leq maxof(int)
\rightarrow [simplify]
[1.14] ([false]: 1, []: 0) \leq \maxof(int)
\rightarrow [explicitly assert falsehood of skipped guards in subsequent guards]
[1.15] ([false]: 1, [true]: 0) \leq maxof(int)
\rightarrow [simplify]
[1.18] true
Proof of verification condition: Arithmetic result of operator '*' is within
limit of type 'signed int'
In the context of class: WHPrang, declared at:
C:\Escher\Customers\prang-cpp\prang.cpp (18,1)
Condition generated at: C:\Escher\Customers\prang-cpp\prang.cpp
(81,32)
Condition defined at:
To prove: minof(signed int) \leq ($heap<sub>1032,1;1054,8</sub>.M3 *
asType<int>(static_cast<integer>(static_cast<signed
int>(operator^*(heapIs $heap_{1032,1;1054,8}, this).p3) < (int)0)))
Given:
heap_{init}.LIMIT == (int)80
heap_{init}.class WHPrang \in M1 == (int)30269
heap_{init}.class WHPrang \in r1 == (int)171
heap_{init}.class WHPrang \in a1 == (int)177
heap_{init}.class WHPrang \in b1 == (int)2
heap_{init}.class WHPrang \in M2 == (int)30307
heap_{init}.class WHPrang \in r2 == (int)172
heap_{init}.class WHPrang \in a2 == (int)176
heap_{init}.class WHPrang \in b2 == (int)35
```

```
heap_{init}.class WHPrang \in M3 == (int)30323
heap_{init}.class WHPrang \in r3 == (int)170
heap_{init}.class WHPrang \in a3 == (int)178
heap_{init}.class WHPrang \in b3 == (int)63
\operatorname{div1} == \operatorname{div}(\mathbf{heapIs} \ \operatorname{\$heap}_{funcstart\_1032,1},
\mathbf{static\_cast} {<} \mathbf{int} {>} (\mathbf{operator^*(heapIs}\ \$heap_{funcstart\_1032,1},\ \mathbf{this}).p1),
\mathbf{static\_cast}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_1032,1}.\mathrm{a1}))
(asType<integer>(static_cast<int>(operator*(heapIs
heap_{funcstart\_1032,1}, this).p1) /
\mathbf{asType}{<}\mathbf{integer}{>}(\mathbf{static\_cast}{<}\mathbf{int}{>}(\$\mathbf{heap}_{funcstart\_1032,1}.\mathbf{a1}))) = =
asType<integer>(div1.quot)
(asType < integer > (static\_cast < int > (operator*(heapIs)))
heap_{funcstart\_1032.1}, this).p1)
asType < integer > (static\_cast < int > (\$heap_{funcstart\_1032.1}.a1))) = =
asType<integer>(div1.rem)
(asType < integer > (operator*(heapIs $heap_{funcstart\_1032,1}, this).p1) < footnote{the content of the conte
asType < integer > ($heap_{funcstart\_1032,1}.a1)) = >
(asType<integer>(div1.rem) == asType<integer>(operator*(heapIs
heap_{funcstart\_1032,1}, this).p1)
(\mathbf{asType} < \mathbf{integer} > (\$ \mathbf{heap}_{funcstart\_1032,1}.\mathbf{a1}) \le
asType < integer > (operator*(heapIs $heap_{funcstart\_1032,1}, this).p1)) = > funcstart\_1032,1, this)
!(0 == asType < integer > (div1.quot))
!(0 == asType < integer > (div1.rem)) || !(0 ==
asType<integer>(div1.quot))
\label{eq:div2} \text{div2} == \text{div}(\mathbf{heapIs} \ \$ \text{heap}_{funcstart\_1032,1},
\mathbf{static\_cast} < \mathbf{int} > (\mathbf{operator}^*(\mathbf{heapIs}\ \$ \mathbf{heap}_{funcstart\_1032,1},\ \mathbf{this}).\mathbf{p2}),
\mathbf{static\_cast}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_1032,1}.\mathrm{a2}))
(asType<integer>(static_cast<int>(operator*(heapIs
heap_{funcstart\_1032,1}, this).p2) /
\mathbf{asType} < \mathbf{integer} > (\mathbf{static\_cast} < \mathbf{int} > (\$ \mathbf{heap}_{funcstart\_1032,1}.\mathbf{a2}))) = =
asType<integer>(div2.quot)
(asType < integer > (static\_cast < int > (operator*(heapIs
heap_{funcstart\_1032,1}, this).p2)
asType<integer>(static_cast<int>($heap_{tuncstart | 1032,1}.a2))) ==
asType<integer>(div2.rem)
(\mathbf{asType}{<}\mathbf{integer}{>}(\mathbf{operator*}(\mathbf{heapIs}\ \$\mathbf{heap}_{funcstart\_1032,1},\ \mathbf{this}).\mathbf{p2})<
asType < integer > ($heap_{funcstart\_1032,1}.a2)) = >
(asType<integer>(div2.rem) == asType<integer>(operator*(heapIs
heap_{funcstart\_1032,1}, this).p2)
(asType < integer > (\$heap_{funcstart\_1032,1}.a2) \le
```

```
asType<integer>(operator*(heapIs $heap_{tuncstart\_1032,1}, this).p2)) =>
!(0 == asType < integer > (div2.quot))
!(0 == asType < integer > (div2.rem)) || !(0 ==
asType<integer>(div2.quot))
div3 == div(\mathbf{heapIs} \$ heap_{funcstart\_1032,1},
static_cast<int>(operator*(heapIs $heap_{funcstart\_1032,1}, this).p3),
static\_cast < int > (\$heap_{funcstart\_1032,1}.a3))
(asType<integer>(static_cast<int>(operator*(heapIs
heap_{funcstart_1032,1}, this).p3) /
asType < integer > (static\_cast < int > (\$heap_{funcstart\_1032,1}.a3))) = =
asType<integer>(div3.quot)
(asType<integer>(static_cast<int>(operator*(heapIs
heap_{funcstart\ 1032.1}, this).p3)
asType < integer > (static\_cast < int > (\$heap_{funcstart\_1032.1}.a3))) = =
asType<integer>(div3.rem)
(asType<integer>(operator*(heapIs $heap_{funcstart\_1032.1}, this).p3) <
asType < integer > (\$heap_{funcstart\_1032,1}.a3)) = >
(asType<integer>(div3.rem) == asType<integer>(operator*(heapIs
heap_{funcstart_1032,1}, this).p3)
(\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathsf{heap}_{funcstart\_1032,1}.\mathsf{a3}) \leq
asType < integer > (operator^*(heapIs \$heap_{funcstart\_1032,1}, this).p3)) = >
!(0 == asTvpe < integer > (div3.quot))
!(0 == asType < integer > (div3.rem)) || !(0 ==
asType<integer>(div3.quot))
temp1 == (\$heap_{funcstart\_1032,1}.r1 * \textbf{static\_cast} < \textbf{signed int} > (div1.rem)) - (div1.rem) + (div1.r
($heap_funcstart_1032,1.b1 * static_cast<signed int>(div1.quot))
minof(signed\ int) \le temp1
temp1 \le maxof(signed int)
\theta_{1032,1:1051,8} == \theta_{1032
operator*(heapIs heap_{funcstart\_1032,1}, this)._replace(p1 \rightarrow
\mathbf{asType}{<}\text{P1Type}{>}((\$\text{heap}_{funcstart\_1032,1}.\text{M1} *
asType<int>(static_cast<integer>(static_cast<signed
int>(operator^*(heapIs $heap_{funcstart\_1032,1}, this).p1) < (int)0))) +
temp1)))
temp2 == (\$heap_{1032,1;1051,8}.r2 * \textbf{static\_cast} < \textbf{signed int} > (div2.rem)) - \\
($heap<sub>1032,1:1051,8</sub>.b2 * static_cast<signed int>(div2.quot))
minof(signed\ int) \le temp2
temp2 < maxof(signed int)
\theta_{1032,1;1054,8} == \theta_{1032,1;1051,8}. replace(this.$r \to
```

```
operator*(heapIs heap_{1032,1;1051,8}, this)._replace(p2 \rightarrow
asType<P2Type>(($heap<sub>1032,1:1051,8</sub>.M2 *
as Type < int > (static\_cast < integer > (static\_cast < signed))
int>(operator*(heapIs $heap_{1032,1;1051,8}, this).p2) < (int)0))) + temp2)))
temp3 == (\$heap_{1032.1:1054.8}.r3 * static\_cast < signed int > (div3.rem)) -
(\text{sheap}_{1032,1:1054.8}.\text{b3} * \text{static\_cast} < \text{signed int} > (\text{div}3.\text{quot}))
minof(signed\ int) \le temp3
temp3 \le maxof(signed int)
Proof:
[Take given term]
[2.0] \text{ div1} == \text{div}(\mathbf{heapIs} \$ heap_{funcstart\_1032,1},
static\_cast < int > (operator*(heapIs $heap_{funcstart\_1032,1}, this).p1),
\mathbf{static\_cast}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_1032,1}.\mathrm{a1}))
→ [expand definition of operator '*' in class 'pointer' at built in declaration]
[2.1] \operatorname{div1} == \operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_1032,1},
\mathbf{static\_cast} < \mathbf{int} > (\mathbf{this.\$r.value}(\mathbf{heapIs} \ \$ \mathbf{heap}_{funcstart\_1032,1}).\mathbf{p1}),
\mathbf{static\_cast}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_1032,1}.\mathrm{a1}))
\rightarrow [simplify]
[2.2]~{\rm div1} == {\rm div}(\mathbf{heapIs}~\$ \mathrm{heap}_{funcstart\_1032,1},~\mathbf{this}.\$ \mathrm{r.value}(\mathbf{heapIs}
\theta_{funcstart\_1032,1}, p1, static_cast<int>(\theta_{funcstart\_1032,1})
\rightarrow [const static or extern object]
[2.3] \text{ div1} == \text{div(heapIs } \text{$heap}_{funcstart\_1032,1}, \text{ this.} \text{$r.value(heapIs)}
\theta_{tuncstart\_1032,1}.p1, \theta_{tuncstart\_1032,1}.p2, \theta_{tuncstart\_1032,1}.p2, \theta_{tuncstart\_1032,1}.p2, \theta_{tuncstart\_1032,1}.p2, \theta_{tuncstart\_1032,1}.p2, \theta_{tuncstart\_1032,1}.p2, \theta_{tuncstart\_1032,1}.p2, \theta_{tuncstart\_1032,1}.p3, \theta_{tuncstart\_1032,1}.p4, \theta_{tuncstart\_1032,1}.p4, \theta_{tuncstart\_1032,1
\rightarrow [expand definition of constant 'a1' at prang.cpp (30,26)]
[2.4] \text{ div1} == \text{div}(\text{heapIs } \text{heap}_{funcstart\_1032,1}, \text{this.}\text{\$r.value}(\text{heapIs})
\$ heap_{funcstart\_1032,1}).p1, \ \mathbf{static\_cast} < \mathbf{int} > ((\mathbf{int})177))
\rightarrow [simplify]
[2.6] \operatorname{div1} == \operatorname{div}(\mathbf{heapIs} \ \mathbf{\$heap}_{funcstart\_1032,1}, \ \mathbf{this}.\mathbf{\$r.value}(\mathbf{heapIs})
heap_{funcstart_{-1032,1}}.p1, 177
[Assume known post-assertion, class invariant or type constraint for term 2.6]
[7.0] (0 < asType<integer>(this.$r.value(heapIs
\$ heap_{funcstart\_1032,1}).p1)) \ \&\& \ (\textbf{asType} < \textbf{integer} > (\textbf{this}.\$r.\textbf{value}(\textbf{heapIs}))) \}
\theta_{uncstart\_1032,1}.p1) < asType<integer>(\theta_{uncstart\_1032,1}).p1) < asType<integer>(\theta_{uncstart\_1032,1}).p1)
M1))
\rightarrow [simplify]
[7.2] (0 < this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1) \&\&
(this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1 <
```

```
asType < integer > (\text{$heap.class WHPrang} \in M1))
\rightarrow [const static or extern object]
[7.3] (0 < this.$r.value(heap
Is \rho_{funcstart\_1032,1}).p1) &&
(this.$r.value(heapIs heap_{funcstart\_1032,1}).p1 <
asType < integer > (\text{$heap}_{init}.class WHPrang \in M1))
\rightarrow [expand definition of constant 'M1' at prang.cpp (28,26)]
[7.4] (0 < this.$r.value(heapIs \theta_{funcstart\_1032,1}).p1) &&
(this.r.value(heapIs $heap_{funcstart\_1032.1}).p1 <
asType < integer > ((int)30269))
\rightarrow [simplify]
[7.10] (-30269 < -this.$r.value(heap
Is \rho_{funcstart\_1032,1}.p1) \land (0 < 0.00)
this.$r.value(heapIs $heap_{funcstart\_1032.1}).p1)
[Work on sub-term 2 of conjunction in term 7.10]
[8.0] 0 < this.$r.value(heap
Is $heap_{funcstart\_1032,1}).p1
[Take given term]
[18.0] \operatorname{div2} == \operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_1032,1},
static_cast<int>(operator*(heapIs $heap_{funcstart\_1032,1}, this).p2),
\mathbf{static\_cast} < \mathbf{int} > (\$ \mathbf{heap}_{funcstart\_1032,1}.\mathbf{a2}))
→ [expand definition of operator '*' in class 'pointer' at built in declaration]
[18.1] \operatorname{div2} == \operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_1032,1},
static_cast<int>(this.$r.value(heapIs $heap_{funcstart\_1032,1}).p2),
static\_cast < int > (\$heap_{funcstart\_1032,1}.a2))
\rightarrow [simplify]
[18.2] div2 == div(heapIs $heap_{funcstart\_1032,1}, this.$r.value(heapIs)
\verb|\ensuremath{"heap}_{funcstart\_1032,1}|.p2, \ \textbf{static\_cast} < \textbf{int} > (\verb|\ensuremath{"heap}_{funcstart\_1032,1}|.a2))
\rightarrow [const static or extern object]
[18.3] div2 == div(\mathbf{heapIs} \ \mathbf{sheap}_{funcstart\_1032,1}, \ \mathbf{this}.\mathbf{sr.value}(\mathbf{heapIs})
\$ heap_{funcstart\_1032,1}).p2, \ \mathbf{static\_cast} < \mathbf{int} > (\$ heap_{init}.a2))
\rightarrow [expand definition of constant 'a2' at prang.cpp (35,26)]
[18.4] \text{ div2} == \text{div}(\text{heapIs } \text{$heap}_{funcstart\_1032,1}, \text{this.}\text{$r.value}(\text{heapIs})
heap_{funcstart\_1032,1}.p2, static\_cast < int > ((int)176)
\rightarrow [simplify]
[18.6] div2 == div(heapIs $heap<sub>funcstart_1032,1</sub>, this.$r.value(heapIs)
heap_{funcstart_{1032,1}}.p2, 176
[Assume known post-assertion, class invariant or type constraint for term 18.6]
[23.0] (0 < asType<integer>(this.$r.value(heapIs
```

```
\label{eq:linear_funcstart} $$ $ p_{funcstart\_1032,1}.p2) $ \& \& (asType < integer > (this. r.value (heapIs)) $$ $ extraction of the substantial properties of the substantial properties
\label{eq:class} \$ heap_{funcstart\_1032,1}).p2) < \mathbf{asType} < \mathbf{integer} > (\$ heap.\mathbf{class} \ \mathbf{WHPrang} \in \texttt{Constart} = \texttt{Con
M2))
\rightarrow [simplify]
[23.2] (0 < this.r.value(heapIs \ heap_{funcstart\_1032,1}).p2) \&\&
(this.r.value(heapIs $heap_{funcstart\_1032.1}).p2 <
asType < integer > (\$heap.class WHPrang \in M2))
\rightarrow [const static or extern object]
[23.3] (0 < this.$r.value(heap
Is $heap_{funcstart\_1032,1}).p2) &&
(this.r.value(heapIs $heap_{funcstart\_1032,1}).p2 <
asType < integer > (\$heap_{init}.class WHPrang \in M2))
\rightarrow [expand definition of constant 'M2' at prang.cpp (33,26)]
[23.4] (0 < this.\$r.value(heapIs \$heap_{tuncstart\_1032.1}).p2) &&
(this.r.value(heapIs $heap_{funcstart\_1032.1}).p2 <
asType < integer > ((int)30307))
\rightarrow [simplify]
[23.10] (-30307 < -this.$r.value(heapIs $heap_{funcstart\_1032,1}).p2) \land (0 <
this.r.value(heapIs $heap_{funcstart\_1032,1}).p2)
[Work on sub-term 2 of conjunction in term 23.10]
[24.0] 0 < this.$r.value(heapIs $heap_{funcstart\_1032,1}).p2
[Take given term]
[34.0] div3 == div(heapIs $heap<sub>funcstart_1032,1</sub>,
static\_cast < int > (operator*(heapIs $heap_{funcstart\_1032,1}, this).p3),
\mathbf{static\_cast}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_1032,1}.\mathrm{a3}))
\rightarrow [expand definition of operator '*' in class 'pointer' at built in declaration]
[34.1] \operatorname{div3} == \operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_1032,1},
static\_cast < int > (this. r.value(heapIs \\ heap_{funcstart\_1032,1}).p3),
static\_cast < int > (\$heap_{funcstart\_1032,1}.a3))
\rightarrow [simplify]
[34.2] div3 == div(heapIs heapIs heapIs this.r.value(heapIs
\theta_{funcstart\_1032,1}.p3, \theta_{funcstart\_1032,1}.p3, \theta_{funcstart\_1032,1}.a3))
\rightarrow [const static or extern object]
[34.3] div3 == div(\mathbf{heapIs} \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
\label{eq:cast_int} $$ heap_{funcstart\_1032,1}).p3, $ static\_cast < int > ($heap_{init}.a3)) $$
\rightarrow [expand definition of constant 'a3' at prang.cpp (40,26)]
[34.4] div3 == div(heapIs $heap<sub>funcstart_1032,1</sub>, this.$r.value(heapIs)
\theta_{funcstart\_1032,1}.p3, static_cast<int>((int)178))
```

```
\rightarrow [simplify]
[34.6] \text{ div3} == \text{div(heapIs $heap}_{funcstart\_1032,1}, \text{ this.} \$r. value(heapIs)
heap_{funcstart_{-1032,1}}.p3, 178
[Assume known post-assertion, class invariant or type constraint for term 34.6]
[39.0] (0 < asType<integer>(this.$r.value(heapIs
$heap_funcstart_1032.1).p3)) && (asType<integer>(this.$r.value(heapIs
\text{Sheap}_{funcstart\_1032,1}).p3) < asType<integer>(\text{Sheap.class WHPrang} \in
M3))
\rightarrow [simplify]
[39.2] (0 < this.$r.value(heap
Is \rho_{funcstart\_1032,1}).p3) &&
(this.$r.value(heapIs heap_{funcstart\_1032,1}).p3 <
asType < integer > (\text{$heap.class WHPrang} \in M3))
\rightarrow [const static or extern object]
[39.3] (0 < this.$r.value(heap
Is $heap_{funcstart\_1032,1}).p3) &&
(this.r.value(heapIs $heap_{funcstart\_1032,1}).p3 <
asType < integer > (\$heap_{init}.class WHPrang \in M3))
\rightarrow [expand definition of constant 'M3' at prang.cpp (38,26)]
[39.4] (0 < this.$r.value(heapIs heap_{funcstart\_1032,1}).p3) &&
(this.$r.value(heapIs \theta_{funcstart\_1032,1}).p3 <
asType < integer > ((int)30323))
\rightarrow [simplify]
[39.10] (-30323 < -this.$r.value(heapIs \rho_{funcstart\_1032,1}).p3) \wedge (0 <
this.r.value(heapIs $heap_{funcstart\_1032,1}).p3)
[Work on sub-term 2 of conjunction in term 39.10]
[40.0] 0 < this.$r.value(heapIs $heap_{funcstart\_1032,1}).p3
[Take given term]
[50.0] \; ((\$ heap_{funcstart\_1032,1}.r1 \; * \; \textbf{static\_cast} < \textbf{signed int} > (\text{div1.rem})) \; - \; \text{div1.rem})) \; - \; \text{div1.rem}) \; + \; \text{div
(\text{\$heap}_{funcstart\_1032,1}.\text{b1 * static\_cast} < \text{signed int} > (\text{div1.quot}))) = \text{temp1}
\rightarrow [const static or extern object]
[50.1] (($heap<sub>init</sub>.r1 * static_cast<signed int>(div1.rem)) -
(\text{\$heap}_{funcstart\_1032,1}.\text{b1 * static\_cast} < \text{signed int} > (\text{div1.quot}))) == \text{temp1}
\rightarrow [expand definition of constant 'r1' at prang.cpp (29,26)]
[50.2] (((int)171 * static_cast<signed int>(div1.rem)) -
(\text{sheap}_{funcstart\_1032,1}.\text{b1} * \text{static\_cast} < \text{signed int} > (\text{div1.quot}))) == \text{temp1}
\rightarrow [simplify]
[50.3] \; ((171 * \mathbf{static\_cast} < \mathbf{signed\ int} > (\text{div}1.\text{rem})) - (\$ \text{heap}_{funcstart\_1032,1}.\text{b}1)) + (\$ \text{heap}_{funcstart\_1032,1}.\text{b}1) + (\$ \text{heap}_{funcstart\_
* static_cast<signed int>(div1.quot))) == temp1
```

```
\rightarrow [from term 2.6, div1 is equal to div(heapIs $heap_{funcstart\_1032,1},
this.r.value(heapIs \ \$heap_{funcstart\_1032,1}).p1, \ 177)]
[50.4] ((171 * static_cast<signed int>(div(heapIs \theta_{funcstart\_1032,1}),
this.r.value(heapIs $heap_{funcstart\_1032,1}).p1, 177).rem)) -
($heap_tuncstart_1032.1.b1 * static_cast<signed int>(div1.quot))) == temp1
\rightarrow [simplify]
[50.5] ((171 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs = f_{uncstart\_1032,1})
heap_{funcstart_1032,1}.p1, 177.rem) - (heap_{funcstart_1032,1}.b1 *
static_cast<signed int>(div1.quot))) == temp1
\rightarrow [const static or extern object]
[50.6] ((171 * \mathrm{div}(\mathbf{heapIs}\ \$\mathrm{heap}_{funcstart\_1032,1},\ \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}\ 
\rho_{funcstart\_1032,1}.p1, 177).rem – (\rho_{funcstart\_1032,1}.p1, 177).rem) – (\rho_{funcstart\_1032,1}.p1, 177).rem) – (\rho_{funcstart\_1032,1}.p1, 177).rem)
int>(div1.quot)) == temp1
\rightarrow [expand definition of constant 'b1' at prang.cpp (31,26)]
[50.7] ((171 * \operatorname{div}(\mathbf{heapIs} \ \mathbf{heap}_{funcstart\_1032,1}, \ \mathbf{this}.\mathbf{r.value}(\mathbf{heapIs})
\theta_{uncstart\_1032,1}.p1, 177).rem - ((int)2 * static\_cast < signed)
int>(div1.quot)) == temp1
\rightarrow [simplify]
[50.8] ((171 * div(heapIs \$heap_{funcstart\_1032,1}, this.\$r.value(heapIs
\theta_{funcstart\_1032,1}.p1, 177).rem - (2 * static\_cast < signed)
int>(div1.quot)) == temp1
\rightarrow [from term 2.6, div1 is equal to div(heapIs $heap_{funcstart\_1032,1},
this.$r.value(heapIs $heap_{tuncstart\_1032.1}).p1, 177)]
[50.9] ((171 * \mathrm{div}(\mathbf{heapIs}\ \$\mathrm{heap}_{funcstart\_1032,1},\ \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}
\theta_{funcstart\_1032,1}.p1, 177).rem) - (2 * static_cast<signed)
int>(div(heapIs \$heap_{tuncstart\_1032,1}, this.\$r.value(heapIs
\text{Sheap}_{funcstart\_1032,1}).p1, 177).quot))) == temp1
\rightarrow [simplify]
[50.14] 0 == (-\text{temp1} + (-2 * \text{div}(\text{heapIs} \$\text{heap}_{funcstart\_1032.1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177).quot) + (171 *
div(\mathbf{heapIs} \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
heap_{funcstart\_1032,1}.p1, 177).rem
[Take given term]
[53.0] \theta_{1032,1;1051,8} == \theta_{1032,1;1051,8} = \theta_{1032,1;1051,8} == \theta
operator*(heapIs heap_{funcstart\_1032,1}, this)._replace(p1 \rightarrow
asType<P1Type>(($heap<sub>funcstart_1032,1</sub>.M1 *
asType<int>(static_cast<integer>(static_cast<signed
int>(operator*(heapIs $heap_{funcstart\_1032,1}, this).p1) < (int)0))) +
temp1)))
```

```
→ [expand definition of operator '*' in class 'pointer' at built in declaration]
[53.1] \theta_{1032,1;1051,8} == \theta_{1032,1;1051,8} = \theta_{1032,1;1051,8} == \theta
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow
asType < P1Type > ((\$heap_{funcstart\_1032,1}.M1 *
asType<int>(static_cast<integer>(static_cast<signed
int>(operator^*(heapIs $heap_{funcstart\_1032.1}, this).p1) < (int)0))) +
temp1)))
\rightarrow [const static or extern object]
[53.2] heap_{1032,1;1051,8} == heap_{funcstart\_1032,1}._replace(this.r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow
asType < P1Type > ((\$heap_{init}.M1 *
asType < int > (static\_cast < integer > (static\_cast < signed)
int>(operator^*(heapIs \$heap_{funcstart\_1032,1}, this).p1) < (int)0))) +
temp1)))
\rightarrow [expand definition of constant 'M1' at prang.cpp (28,26)]
[53.3] $\text{heap}_{1032,1:1051.8} == \text{$heap}_{funcstart\_1032,1}._\text{replace}(\text{this}.\text{$r} \to \text{$}
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow
asType<P1Type>(((int)30269 *
asType<int>(static_cast<integer>(static_cast<signed
int>(operator^*(heapIs \$heap_{tuncstart\_1032.1}, this).p1) < (int)0))) +
temp1)))
\rightarrow [simplify]
[53.4] $heap<sub>1032,1;1051,8</sub> == $heap<sub>funcstart_1032,1</sub>._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow
asType<P1Type>((30269 *
asType < int > (static\_cast < integer > (static\_cast < signed)
int>(operator^*(heapIs \$heap_{funcstart\_1032,1}, this).p1) < (int)0))) +
temp1)))
→ [expand definition of operator '*' in class 'pointer' at built in declaration]
[53.5] $heap<sub>1032,1;1051,8</sub> == $heap<sub>funcstart_1032,1</sub>._replace(this.$r \rightarrow
this.r.value(heapIs \ heap_{funcstart\_1032,1}).\_replace(p1 \rightarrow funcstart\_1032,1)
asType<P1Type>((30269 *
as Type < int > (static\_cast < integer > (static\_cast < signed))
\mathbf{int} > (\mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}~\$\mathrm{heap}_{funcstart\_1032,1}).\mathrm{p1}) < (\mathbf{int})0))) + \mathrm{temp1})))
\rightarrow [simplify]
[53.9] $\text{heap}_{1032,1;1051,8} == \text{$heap}_{funcstart\_1032,1}._\text{replace}(\text{this}.\text{$r} \to \text{$r$}
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow
\mathbf{asType} {<} \mathrm{P1Type} {>} ((30269 \ ^* \ \mathbf{asType} {<} \mathbf{int} {>} (\mathbf{static\_cast} {<} \mathbf{integer} {>} (0 <
-\mathbf{this.\$r.value}(\mathbf{heapIs}\ \$\mathrm{heap}_{funcstart\_1032,1}).\mathrm{p1}))) + \mathrm{temp1})))
\rightarrow [from term 8.0, literala < -this.$r.value(heapIs $heap_{funcstart\_1032,1}).p1
is false whenever -2 < (0 + literala)
```

```
Proof of rule precondition:
```

```
[53.9.0] - 2 < (0 + 0)
    \rightarrow [simplify]
    [53.9.2] true
[53.10] $\text{heap}_{1032,1;1051,8} == $\text{heap}_{funcstart\_1032,1}._\text{replace}(\text{this}.\text{$\frac{1}{2}r$})
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow
\mathbf{asType} \small{<} P1Type \small{>} ((30269 * \mathbf{asType} \small{<} \mathbf{int} \small{>} (\mathbf{static\_cast} \small{<} \mathbf{integer} \small{>} (\mathbf{false})))
+ \text{temp1})))
\rightarrow [simplify]
[53.11] heap_{1032,1:1051,8} == heap_{funcstart\_1032,1}._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow
asType < P1Type > ((30269 * asType < int > (([false]: 1, []: 0))) + temp1)))
→ [explicitly assert falsehood of skipped guards in subsequent guards]
[53.12] $\text{heap}_{1032,1;1051,8} == $\text{heap}_{funcstart\_1032,1}._\text{replace}(\text{this}.\text{$\frac{1}{2}r$})
this.$r.value(heapIs heap_{funcstart\_1032.1})._replace(p1 \rightarrow
asType<P1Type>((30269 * asType<int>(([false]: 1, [true]: 0))) +
temp1)))
\rightarrow [simplify]
[53.15] $heap<sub>1032,1;1051,8</sub> == $heap<sub>funcstart_1032,1</sub>._replace(this.$r \rightarrow
this.$r.value(heapIs \rho_{funcstart\_1032,1})._replace(p1 \rightarrow
asType < P1Type > (0 + temp1))
\rightarrow [from term 50.14, temp1 is equal to (-2 * div(heapIs $heap_{tuncstart\_1032.1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, \ 177).quot) + (171 \ *funcstart\_1032,1).p1
div(\mathbf{heapIs} \ \$heap_{funcstart\_1032,1}, \ \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
heap_{funcstart\_1032,1}.p1, 177).rem
[53.16] $heap<sub>1032.1:1051.8</sub> == $heap<sub>funcstart_1032.1</sub>._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow
asType < P1Type > (0 + ((-2 * div(heapIs $heap_{funcstart\_1032,1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177).quot) + (171 *
div(\mathbf{heapIs} \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
heap_{funcstart\_1032,1}.p1, 177).rem))))
\rightarrow [simplify]
[53.19] \theta_{1032,1;1051,8} == \theta_{1032,1;1051,8} == \theta_{1032,1}.replace(this.$r \to
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{tuncstart\_1032.1}, this.r.value(heapIs \rho_{tuncstart\_1032.1}).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.} \text{\$r.value}(\text{heapIs}))
heap_{funcstart\_1032,1}.p1, 177.rem)))
[Take given term]
[54.0] (($heap<sub>1032.1:1051.8</sub>.r2 * static_cast<signed int>(div2.rem)) -
```

```
(\text{sheap}_{1032,1:1051,8}.\text{b2} * \text{static\_cast} < \text{signed int} > (\text{div2.quot}))) == \text{temp2}
\rightarrow [from term 53.19, $heap<sub>1032,1:1051,8</sub> is equal to
\$heap_{funcstart\_1032,1}.\_\textbf{replace}(\textbf{this}.\$r \rightarrow \textbf{this}.\$r.\textbf{value}(\textbf{heapIs}
heap_{funcstart\_1032.1}._replace(p1 \rightarrow (-2 * div(heapIs p_{funcstart\_1032.1})
this.r.value(heapIs \ \ heap_{funcstart\_1032.1}).p1, 177).quot) + (171 *
div(\mathbf{heapIs} \ \$heap_{funcstart\_1032,1}, \ \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
heap_{funcstart_{1032,1}}.p1, 177).rem)))
[54.1] \; ((\$ heap_{funcstart\_1032,1}.\_\textbf{replace}(\textbf{this}.\$r \rightarrow \textbf{this}.\$r.\textbf{value}(\textbf{heapIs}))) \\
\rho_{uncstart\_1032,1}._replace(p1 \rightarrow ((-2 * div(heapIs $heap_{uncstart\_1032,1}), heap_{uncstart\_1032,1}).
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177).quot) + (171 *
div(\mathbf{heapIs} \$ heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
\rho_{funcstart\_1032,1}.p1, 177).rem))).r2 * static\_cast < signed
int>(div2.rem)) - (\$heap_{1032,1:1051,8}.b2 * static\_cast < signed
int>(div2.quot)) == temp2
→ [const member of object with modified fields]
[54.2] \; ((\$heap_{funcstart\_1032,1}.r2 * \textbf{static\_cast} < \textbf{signed int} > (\text{div}2.rem)) \; - \\
(\text{sheap}_{1032,1;1051,8}.\text{b2} * \text{static\_cast} < \text{signed int} > (\text{div2.quot}))) == \text{temp2}
\rightarrow [const static or extern object]
[54.3]\;((\$\mathrm{heap}_{init}.\mathrm{r2}\;\ast\;\mathbf{static\_cast}{<}\mathbf{signed\;int}{>}(\mathrm{div2.rem}))\;-
(\text{sheap}_{1032,1;1051,8}.\text{b2} * \text{static\_cast} < \text{signed int} > (\text{div2.quot}))) == \text{temp2}
\rightarrow [expand definition of constant 'r2' at prang.cpp (34,26)]
[54.4] (((int)172 * static_cast<signed int>(div2.rem)) -
(\text{sheap}_{1032,1:1051,8}.\text{b2} * \text{static\_cast} < \text{signed int} > (\text{div}2.\text{quot}))) = = \text{temp}2
\rightarrow [simplify]
[54.5] ((172 * static_cast < signed int > (div2.rem)) - ($heap_{1032,1:1051,8}.b2 *
static_cast<signed int>(div2.quot))) == temp2
\rightarrow [from term 18.6, div2 is equal to div(heapIs $heap_{funcstart\_1032,1},
this.r.value(heapIs $heap_{funcstart\_1032,1}).p2, 176)
[54.6] ((172 * static_cast<signed int>(div(heapIs $heap_{tuncstart\_1032.1})
this.r.value(heapIs \$heap_{funcstart\_1032.1}).p2, 176).rem)) -
(\text{sheap}_{1032,1;1051,8}.\text{b2} * \text{static\_cast} < \text{signed int} > (\text{div2.quot}))) == \text{temp2}
\rightarrow [simplify]
[54.7] \; ((172 \; * \; \mathrm{div}(\mathbf{heapIs} \; \$ \mathrm{heap}_{funcstart\_1032,1}, \; \mathbf{this}.\$ r. \mathbf{value}(\mathbf{heapIs} \;
\text{Sheap}_{funcstart\_1032,1}.p2, 176).rem) - (\text{Sheap}_{1032,1;1051,8}.b2 *
static_cast<signed int>(div2.quot))) == temp2
\rightarrow [from term 53.19, $heap<sub>1032,1:1051,8</sub> is equal to
$heap_{funcstart\_1032,1}.$_replace(this.$r \rightarrow this.$r.value(heapIs)
heap_{funcstart\_1032,1}._replace(p1 \rightarrow (-2 * div(heapIs p_{funcstart\_1032,1}).
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177).quot) + (171 \ function for the first substitution of the first
```

```
div(\mathbf{heapIs} \ \$heap_{funcstart\_1032,1}, \ \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
heap_{funcstart\_1032,1}.p1, 177).rem)))]
[54.8] ((172 * div(heapIs \rho_{funcstart\_1032,1}, this.r.value(heapIs)
\rho_{uncstart\_1032,1}.p2, 176).rem – (\rho_{uncstart\_1032,1}.p2, 176).rem
div(\mathbf{heapIs} \$ heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
\text{Sheap}_{funcstart\_1032,1}.p1, 177).quot) + (171 * div(heapIs \text{Sheap}_{funcstart\_1032,1},
this.r.value(heapIs \ensuremath{\$}heap_{funcstart\_1032,1}).p1, 177).rem)))).b2 *
static_cast<signed int>(div2.quot))) == temp2
\rightarrow [const member of object with modified fields]
[54.9] ((172 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs = f_{uncstart\_1032,1})
heap_{funcstart\_1032,1}.p2, 176).rem – (partial_{funcstart\_1032,1}.p2 *
static_cast<signed int>(div2.quot))) == temp2
\rightarrow [const static or extern object]
[54.10] ((172 * div(heapIs $heap_{funcstart\_1032,1}, this.$r.value(heapIs)]
\rho_{uncstart\_1032.1}.p2, 176).rem – (\rho_{uncstart\_1032.1}.p2, 176).rem
int>(div2.quot)) = temp2
\rightarrow [expand definition of constant 'b2' at prang.cpp (36,26)]
[54.11] ((172 * div(heapIs $heap<sub>funcstart_1032,1</sub>, this.$r.value(heapIs)
\rho_{funcstart\_1032.1}.p2, 176).rem - ((int)35 * static\_cast < signed)
int>(div2.quot)) == temp2
\rightarrow [simplify]
[54.12] ((172 * div(heapIs heap_{funcstart\_1032,1}, this.r.value(heapIs)
\theta_{tuncstart\_1032,1}.p2, 176).rem) - (35 * static_cast<signed)
int>(div2.quot)) == temp2
\rightarrow [from term 18.6, div2 is equal to div(heapIs $heap_{funcstart\_1032,1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p2, 176)]
[54.13] ((172 * div(heapIs $heap_{funcstart\_1032,1}, this.$r.value(heapIs
\theta_{tuncstart_1032,1}.p2, 176).rem) - (35 * static_cast<signed)
\mathbf{int}{>}(\mathrm{div}(\mathbf{heapIs}\ \$\mathrm{heap}_{funcstart\_1032,1},\ \mathbf{this}.\$\mathrm{r.value}(\mathbf{heapIs}
\$ \mathrm{heap}_{funcstart\_1032,1}).\mathrm{p2},\, 176).\mathrm{quot}))) == \, \mathrm{temp2}
\rightarrow [simplify]
[54.18] 0 == (-\text{temp2} + (-35 * \text{div}(\text{heapIs } \text{$heap}_{funcstart\_1032,1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p2, 176).quot) + (172 *
div(\mathbf{heapIs} \$ heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
heap_{funcstart_{-1032,1}}.p2, 176).rem
[Take given term]
[57.0] $\text{heap}_{1032,1;1054,8} == $\text{heap}_{1032,1;1051,8}.$\text{replace}(\text{this}.$\text{$r} \to \text{
operator*(heapIs heap_{1032,1;1051,8}, this)._replace(p2 \rightarrow
```

```
asType<P2Type>(($heap<sub>1032.1:1051.8</sub>.M2 *
as Type < int > (static\_cast < integer > (static\_cast < signed))
int>(operator^*(heapIs $heap_{1032,1;1051,8}, this).p2) < (int)(0))) + temp(2)))
\rightarrow [from term 53.19, $heap<sub>1032.1:1051.8</sub> is equal to
heap_{funcstart\_1032.1}._replace(this.r \rightarrow this.r.value(heapIs)
heap_{funcstart\_1032,1}._replace(p1 \rightarrow (-2 * div(heapIs heap_{funcstart\_1032,1}),
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, \ 177).quot) + (171 * leap_{funcstart\_1032,1}).p1 + (171 * leap_{func
div(\mathbf{heapIs} \ \$heap_{funcstart\_1032,1}, \ \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
heap_{funcstart_{1032.1}}.p1, 177).rem)))
[57.2] \theta_{1032,1;1054,8} == \theta_{1032,1;1054,8} = \theta_{1032,1;1054,8} == \theta
this.$r.value(heapIs \frac{1}{2} heap\frac{1}{2} heap\frac{1}{2}
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs $heap<sub>funcstart_1032,1</sub>, this.$r.value(heapIs
\rho_{funcstart\_1032,1}.p1, 177).rem)))._replace(this.$r \rightarrow operator*(heapIs)
{\rm heap}_{funcstart\_1032,1}.{\rm replace}({\rm this.\$r} \to {\rm this.\$r.value}({\rm heapIs})
\rho_{funcstart_1032,1}._replace(p1 \rightarrow (-2 * div(heapIs \rho_{funcstart_1032,1}).
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177).quot) + (171 *
div(\mathbf{heapIs} \$ heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
\label{eq:continuous_function} $\operatorname{heap}_{funcstart\_1032,1}).p1,\ 177).rem))),\ \mathbf{this}).\_\mathbf{replace}(p2 \to
asType<P2Type>(($heap<sub>1032.1:1051.8</sub>.M2 *
asType<int>(static_cast<integer>(static_cast<signed
int>(operator^*(heapIs \$heap_{1032,1;1051,8}, this).p2) < (int)(0))) + temp(2)))
→ [expand definition of operator '*' in class 'pointer' at built in declaration]
[57.3] heap_{1032,1;1054,8} == heap_{funcstart\_1032,1}.\_replace(this.$r \to 1000)
\textbf{this.}\$r.\textbf{value}(\textbf{heapIs}~\$heap_{funcstart\_1032,1}).\_\textbf{replace}(p1 \rightarrow ((-2~*div(\textbf{heapIs})))))
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs $heap<sub>funcstart_1032.1</sub>, this.$r.value(heapIs
\theta_{funcstart\_1032.1}.p1, 177).rem)))._replace(this.r \rightarrow
\textbf{this.\$r.value}(\textbf{heapIs}~\$ heap_{funcstart\_1032,1}.\_\textbf{replace}(\textbf{this.\$r} \rightarrow
this.$r.value(heapIs \rho_{tuncstart\_1032.1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs \theta_{funcstart\_1032,1}, this.r.value(heapIs)
\theta_{uncstart\_1032,1}.p1, 177).rem)))))._replace(p2 \rightarrow
asType<P2Type>(($heap<sub>1032,1:1051,8</sub>.M2 *
asType<int>(static_cast<integer>(static_cast<signed
int>(operator^*(heapIs $heap_{1032,1;1051,8}, this).p2) < (int)0))) + temp2)))
→ [evaluate dereferenced pointer into modified heap]
[57.4] heap_{1032,1;1054,8} == heap_{funcstart\_1032,1}._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs $heap<sub>funcstart_1032,1</sub>, this.$r.value(heapIs
\label{eq:continuous_funcstart_1032,1} $$ \operatorname{heap}_{funcstart_1032,1}.p1,\ 177).rem)))).$$ $$ $$ replace(this.$r \to ([this.$r == ]]) $$
this.$r]: this.$r.value(heapIs \rho_{tuncstart\_1032,1})._replace(p1 \rightarrow (-2 *
```

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div(\mathbf{heapIs} \$ heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
\text{Sheap}_{funcstart\_1032,1}.\text{p1}, 177).\text{quot} + (171 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_1032,1}),
this.r.value(heapIs $heap_{funcstart\_1032,1}).p1, 177).rem)), []:
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p2 \rightarrow
asType<P2Type>(($heap<sub>1032,1;1051,8</sub>.M2 *
asType < int > (static\_cast < integer > (static\_cast < signed
int>(operator^*(heapIs $heap_{1032,1:1051.8}, this).p2) < (int)(0))) + temp(2)))
→ [explicitly assert falsehood of skipped guards in subsequent guards]
[57.5] $heap<sub>1032,1:1054,8</sub> == $heap<sub>funcstart_1032,1</sub>._replace(this.$r \rightarrow
this.$r.value(heapIs \rho_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs \theta_{funcstart\_1032,1}, this.r.value(heapIs)
\rho_{tuncstart\_1032,1}.p1, 177).rem)))).\_replace(this.$r \rightarrow ([this.$r ==
this.$r]: this.$r.value(heapIs \rho_{funcstart\_1032,1})._replace(p1 \rightarrow (-2 *
\operatorname{div}(\mathbf{heapIs}\ \$ \mathrm{heap}_{funcstart\_1032,1},\ \mathbf{this}.\$ \mathbf{r.value}(\mathbf{heapIs}
\text{Sheap}_{funcstart\_1032,1}.p1, 177).quot) + (171 * div(heapIs \text{Sheap}_{funcstart\_1032,1},
this.r.value(heapIs \heap_{funcstart\_1032,1}).p1, 177).rem)), [!(this.<math>r = 
this.$r.value(heapIs heap_{funcstart\_1032.1})._replace(p2 \rightarrow
asType<P2Type>(($heap<sub>1032,1;1051,8</sub>.M2 *
asType < int > (static\_cast < integer > (static\_cast < signed
int>(operator^*(heapIs $heap_{1032.1:1051.8}, this).p2) < (int)(0))) + temp(2)))
\rightarrow [simplify]
[57.7] $heap<sub>1032.1:1054.8</sub> == $heap<sub>funcstart_1032.1</sub>._replace(this.$r \rightarrow
this.$r.value(heapIs \rho_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(\mathbf{heapIs} \ \$heap_{funcstart\_1032,1}, \ \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
\theta_{tuncstart\_1032.1}.p1, 177.rem)))._replace(this.$r \rightarrow
this.$r.value(heapIs \rho_{uncstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(\mathbf{heapIs} \ \$heap_{funcstart\_1032,1}, \ \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
\theta_{funcstart\_1032,1}.p1, 177).rem))._replace(p2 \rightarrow
asType<P2Type>(($heap<sub>1032,1:1051,8</sub>.M2 *
asType<int>(static_cast<integer>(static_cast<signed
int>(operator^*(heapIs $heap_{1032,1;1051,8}, this).p2) < (int)(0))) + temp(2)))
\rightarrow [from term 53.19, $heap<sub>1032,1;1051,8</sub> is equal to
$heap_{funcstart\_1032,1}.$_replace(this.$r \rightarrow this.$r.value(heapIs)
heap_{funcstart\_1032.1}._replace(p1 \rightarrow (-2 * div(heapIs \$heap_{funcstart\_1032.1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177).quot) + (171 *
div(\mathbf{heapIs} \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
heap_{funcstart_{1032.1}}.p1, 177).rem)))
[57.8] heap_{1032,1;1054,8} == heap_{funcstart\_1032,1}._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
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177).quot) + (171 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.} \text{\$r.value}(\text{heapIs}))
\theta_{funcstart\_1032,1}.p1, 177).rem))))._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.}\text{\$r.value}(\text{heapIs}))
heap_{funcstart\_1032,1}.p1, 177).rem)))._replace(p2 \rightarrow
asType < P2Type > ((\$heap_{funcstart\_1032,1}.\_replace(this.\$r \rightarrow funcstart\_1032,1))
this.$r.value(heapIs \rho_{tuncstart_1032.1})._replace(p1 \rightarrow ((-2 * div(heapIs
\$heap_{funcstart\_1032,1},\, \textbf{this}.\$r.\textbf{value}(\textbf{heapIs}\,\,\$heap_{funcstart\_1032.1}).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.}\text{\$r.value}(\text{heapIs}))
heap_{funcstart\_1032,1}.p1, 177).rem))).M2 *
asType<int>(static_cast<integer>(static_cast<signed
int>(operator^*(heapIs \$heap_{1032,1;1051,8}, this).p2) < (int)(0))) + temp(2)))
\rightarrow [const member of object with modified fields]
[57.9] \rho_{1032,1;1054,8} == \rho_{1032,1;1054,8} = \rho_{1032,1;1054,8} == \rho
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032.1}, \text{this.} \text{\$r.value}(\text{heapIs}))
\theta_{funcstart\_1032,1}.p1, 177).rem))))._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{tuncstart\_1032.1}, this.r.value(heapIs \rho_{tuncstart\_1032.1}).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032.1}, \text{this.} \text{\$r.value}(\text{heapIs}))
\theta_{funcstart\_1032,1}.p1, 177).rem))).\_replace(p2 \rightarrow
asType<P2Type>(($heap_funcstart_1032,1.M2 *
asType<int>(static_cast<integer>(static_cast<signed
int>(operator*(heapIs $heap_{1032,1;1051,8}, this).p2) < (int)0))) + temp2)))
\rightarrow [const static or extern object]
[57.10] $\text{heap}_{1032,1;1054,8} == $\text{heap}_{funcstart\_1032,1}._\text{replace}(\text{this.}\text{$\frac{1}{2}}\text{$\text{constart}_{funcstart}_{funcstart}}]
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{tuncstart_{-1032.1}}, this.r.value(heapIs \rho_{tuncstart_{-1032.1}}).p1,
177).quot) + (171 * div(\mathbf{heapIs} \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}))
\label{eq:continuous_function} $ \text{heap}_{funcstart\_1032,1} . \text{p1}, 177).rem)))).\_\textbf{replace}(\textbf{this}.\$r \rightarrow
this.$r.value(heapIs \theta_{funcstart\_1032,1})._replace(p1 \theta ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{heap}_{funcstart\_1032,1}, \text{this.} \text{$r.value}(\text{heapIs}))
\theta_{funcstart\_1032,1}.p1, 177).rem))).\_replace(p2 \rightarrow
asType < P2Type > ((\$heap_{init}.M2 *
as Type < int > (static\_cast < integer > (static\_cast < signed))
int>(operator^*(heapIs $heap_{1032,1;1051,8}, this).p2) < (int)(0))) + temp(2)))
\rightarrow [expand definition of constant 'M2' at prang.cpp (33,26)]
[57.11] heap_{1032,1;1054,8} == heap_{funcstart\_1032,1}.replace(this.r \to tart_{1032,1;1054,8} == tart_{1032,1;1054,8}
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, his. r.value(heapIs \rho_{funcstart\_1032,1}).p1,
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177).quot) + (171 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.} \text{\$r.value}(\text{heapIs}))
\theta_{funcstart\_1032,1}.p1, 177).rem))))._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.}\text{\$r.value}(\text{heapIs}))
heap_{funcstart\_1032,1}.p1, 177).rem)))._replace(p2 \rightarrow
asType<P2Type>(((int)30307 *
asType<int>(static_cast<integer>(static_cast<signed
int>(operator^*(heapIs $heap_{1032,1:1051.8}, this).p2) < (int)(0))) + temp(2)))
[57.12] $heap<sub>1032,1;1054,8</sub> == $heap<sub>funcstart_1032,1</sub>._replace(this.$r \rightarrow
this.$r.value(heapIs \rho_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs $heap_{funcstart\_1032,1}, this.$r.value(heapIs
\theta_{funcstart\_1032,1}.p1, 177).rem)))).\_replace(this.\$r \rightarrow 0
this.$r.value(heapIs heap_{funcstart=1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(\mathbf{heapIs} \$ heap_{funcstart\_1032,1}, \mathbf{this}.\$ r. \mathbf{value}(\mathbf{heapIs})
\theta_{funcstart\_1032,1}.p1, 177).rem))).\_replace(p2 \rightarrow
asType<P2Type>((30307 *
asType < int > (static\_cast < integer > (static\_cast < signed
int>(operator^*(heapIs $heap_{1032,1;1051,8}, this).p2) < (int)0))) + temp2)))
\rightarrow [from term 53.19, $heap<sub>1032,1:1051,8</sub> is equal to
\$heap_{funcstart\_1032,1}.\_\textbf{replace}(\textbf{this}.\$r \rightarrow \textbf{this}.\$r.\textbf{value}(\textbf{heapIs}
heap_{funcstart\_1032,1}._replace(p1 \rightarrow (-2 * div(heapIs p_{funcstart\_1032,1}).
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177).quot) + (171 * leapIs \ heap_{funcstart\_1032,1}).p1, 177).quot)
div(\mathbf{heapIs} \ \$heap_{funcstart\_1032,1}, \ \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
heap_{funcstart_{1032,1}}.p1, 177).rem)))]
[57.13] $heap<sub>1032,1;1054,8</sub> == $heap<sub>funcstart_1032,1</sub>._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032.1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{tuncstart\_1032,1}, this.r.value(heapIs \rho_{tuncstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs $heap_{funcstart\_1032,1}, this.$r.value(heapIs
\label{eq:continuous_function} $ \text{heap}_{funcstart\_1032,1}.\text{p1, 177}.\text{rem})))).$ \_\textbf{replace}(\textbf{this}.\$\text{r} \rightarrow
this.$r.value(heapIs \rho_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs \theta_{funcstart\_1032,1}, this.r.value(heapIs)
\theta_{funcstart\_1032,1}.p1, 177).rem))).\_replace(p2 \rightarrow
asType<P2Type>((30307 *
asType<int>(static_cast<integer>(static_cast<signed
\mathbf{int}{>}(\mathbf{operator}^*(\mathbf{heapIs}\ \$\mathbf{heap}_{funcstart\_1032,1}.\_\mathbf{replace}(\mathbf{this}.\$\mathbf{r}\rightarrow
this.$r.value(heapIs heapIs ._replace(p1 \rightarrow (-2 * div(heapIs
$\text{heap}_{funcstart_1032.1}$, this.$\text{r.value}(\text{heapIs} \text{$heap}_{funcstart_1032.1}).p1,
177).quot) + (171 * div(heapIs $heap<sub>funcstart_1032.1</sub>, this.$r.value(heapIs
\text{Sheap}_{funcstart\_1032,1}.\text{p1}, 177).\text{rem})), \text{this}.\text{p2}) < (\text{int})0))) + \text{temp2}))
```

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→ [expand definition of operator '*' in class 'pointer' at built in declaration]
[57.14] $heap<sub>1032,1;1054,8</sub> == $heap<sub>funcstart_1032,1</sub>._replace(this.$r \rightarrow
this.$r.value(heapIs $heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
\theta_{funcstart\_1032,1}.p1, 177).rem)))).\_replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs)
\rho_{funcstart\_1032,1}, this.\r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs $heap_{funcstart\_1032,1}, this.$r.value(heapIs
\theta_{funcstart\_1032,1}.p1, 177).rem))).\_replace(p2 \rightarrow
asType<P2Type>((30307 *
asType < int > (static\_cast < integer > (static\_cast < signed
int>(this.\$r.value(heapIs \$heap_{funcstart\_1032.1}.\_replace(this.\$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\label{eq:heapIs} $\operatorname{heap}_{funcstart\_1032,1},\ \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}\ \$\operatorname{heap}_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs $heap<sub>funcstart_1032,1</sub>, this.$r.value(heapIs
\text{Sheap}_{funcstart\_1032,1}.\text{p1}, 177).\text{rem})))).\text{p2}) < (int)0))) + \text{temp2}))
\rightarrow [evaluate dereferenced pointer into modified heap]
[57.15] $heap<sub>1032,1;1054,8</sub> == $heap<sub>funcstart_1032,1</sub>._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs $heap<sub>funcstart_1032,1</sub>, this.$r.value(heapIs
\label{eq:continuous_function} $ \text{heap}_{funcstart\_1032,1}.\text{p1, 177}.\text{rem})))).$ \_\textbf{replace}(\textbf{this}.\$\text{r} \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(\mathbf{heapIs} \ \$heap_{funcstart\_1032,1}, \ \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
\$heap_{funcstart\_1032,1}).p1,\ 177).rem))).\_\textbf{replace}(p2 \rightarrow
asType<P2Type>((30307 *
asType < int > (static\_cast < integer > (static\_cast < signed\ int > (([this.\$r])))) \\
== this.$r]: this.$r.value(heapIs \rho_{tuncstart\_1032.1})._replace(p1 \rightarrow (-2 *
div(\mathbf{heapIs} \$ heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
\text{Sheap}_{funcstart\_1032,1}.p1, 177).quot) + (171 * div(heapIs \text{Sheap}_{funcstart\_1032,1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177).rem)), []:
this.r.value(heapIs \ heap_{funcstart\_1032.1}).p2) < (int)0))) + temp2)))
→ [explicitly assert falsehood of skipped guards in subsequent guards]
[57.16] $heap<sub>1032,1;1054,8</sub> == $heap<sub>funcstart_1032,1</sub>._replace(this.$r \rightarrow
this.$r.value(heapIs $heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs heapIs = 1032,1, this.r.value(heapIs)
\theta_{uncstart\_1032,1}.p1, 177).rem)))).\_replace(this.$r \rightarrow
this.$r.value(heapIs \rho_{uncstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs)
\rho_{funcstart\_1032,1}, this.\r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032.1}, \text{this.} \text{\$r.value}(\text{heapIs}))
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\label{eq:proposed_policy} $\operatorname{heap}_{funcstart\_1032,1}).p1,\ 177).rem))).\_\mathbf{replace}(p2 \to
asType<P2Type>((30307 *
as Type < int > (static\_cast < integer > (static\_cast < signed\ int > (([this.\$r])))) \\
== this.$r]: this.$r.value(heapIs \rho_{funcstart\_1032,1})._replace(p1 \rightarrow (-2 *
div(\mathbf{heapIs} \$ heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
\rho_{tuncstart_{1032.1}, 177, quot} + (171 * div(heapIs $heap_{tuncstart_{1032.1}, quot})
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177).rem)), [!(this.<math>r = 
this.$r.value(heapIs \rho_{tuncstart_1032.1}).p2) < (int)0))) +
temp2)))
\rightarrow [simplify]
[57.23] $heap<sub>1032,1;1054,8</sub> == $heap<sub>funcstart_1032,1</sub>._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
\theta_{funcstart_{1032,1}}.p1, 177).rem))))._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.} \text{\$r.value}(\text{heapIs}))
\theta_{funcstart\_1032,1}.p1, 177).rem))).\_replace(p2 \rightarrow
asType<P2Type>((30307 * asType<int>(static_cast<integer>(0 <
-this.r.value(heapIs heap_{funcstart\_1032,1}.p2))) + temp2)))
\rightarrow [from term 24.0, literala < -this.$r.value(heapIs $heap_{funcstart\_1032,1}).p2
is false whenever -2 < (0 + literala)
    Proof of rule precondition:
    [57.23.0] - 2 < (0 + 0)
    \rightarrow [simplify]
    [57.23.2] true
[57.24] $\text{heap}_{1032,1;1054,8} == $\text{heap}_{funcstart\_1032,1}._\text{replace}(\text{this}.\text{$\frac{1}{2}r$})
this.$r.value(heapIs \theta_{funcstart\_1032,1})._replace(p1 \theta ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs $heap<sub>funcstart_1032,1</sub>, this.$r.value(heapIs
\theta_{funcstart\_1032,1}.p1, 177).rem)))).replace(this.r \rightarrow 0
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\$heap_{funcstart\_1032,1},\, \textbf{this}.\$r.\textbf{value}(\textbf{heapIs}\,\,\$heap_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs \rho_{funcstart\_1032,1}, this.r.value(heapIs)
\theta_{funcstart\_1032,1}.p1, 177).rem))).\_replace(p2 \rightarrow
asType<P2Type>((30307 * asType<int>(static_cast<integer>(false)))
+ \text{ temp2})))
\rightarrow [simplify]
[57.25] $\text{heap}_{1032,1;1054,8} == $\text{heap}_{funcstart\_1032,1}._\text{replace}(\text{this}.\text{$\frac{1}{2}r$})
this.$r.value(heapIs heapIs_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
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\rho_{funcstart=1032,1}, this.r.value(heapIs \rho_{funcstart=1032,1}).p1,
177).quot) + (171 * div(heapIs \theta_{funcstart\_1032,1}, this.r.value(heapIs)
\theta_{funcstart\_1032,1}.p1, 177).rem))))._replace(this.$r \rightarrow
this.$r.value(heapIs \frac{1}{2} heap\frac{1}{2} line \frac{1}{2} heap\frac{1}{2} heap\frac{1}{2
\$heap_{funcstart\_1032,1},\, \textbf{this}.\$r.\textbf{value}(\textbf{heapIs}\,\,\$heap_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs $heap<sub>funcstart_1032,1</sub>, this.$r.value(heapIs
heap_{funcstart\_1032,1}.p1, 177).rem)))._replace(p2 \rightarrow
asType<P2Type>((30307 * asType<int>(([false]: 1, []: 0))) + temp2)))
→ [explicitly assert falsehood of skipped guards in subsequent guards]
[57.26] $heap<sub>1032,1;1054,8</sub> == $heap<sub>funcstart_1032,1</sub>._replace(this.$r \rightarrow
\textbf{this.\$r.value}(\textbf{heapIs}~\$ heap_{funcstart\_1032,1}).\_\textbf{replace}(p1 \rightarrow ((-2~*div(\textbf{heapIs})))))
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
\theta_{funcstart\_1032,1}.p1, 177).rem)))).\_replace(this.\$r \rightarrow 0
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart_1032,1}, this.r.value(heapIs \rho_{funcstart_1032,1}).p1,
177).quot) + (171 * div(heapIs \theta_{funcstart\_1032,1}, this.r.value(heapIs)
\theta_{funcstart\_1032.1}.p1, 177).rem)))._replace(p2 \rightarrow
asType<P2Type>((30307 * asType<int>(([false]: 1, [true]: 0))) +
temp2)))
\rightarrow [simplify]
[57.29] $heap<sub>1032,1;1054,8</sub> == $heap<sub>funcstart_1032,1</sub>._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(\mathbf{heapIs} \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}))
\theta_{funcstart\_1032,1}.p1, 177).rem)))).\_replace(this.\$r \rightarrow 0
this.$r.value(heapIs heap_{funcstart\_1032.1})._replace(p1 \rightarrow ((-2 * div(heapIs
\theta_{funcstart\_1032,1}, this.r.value(heapIs \theta_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs \$heap_{funcstart\_1032,1}, this.\$r.value(heapIs))
\rho_{uncstart\_1032.1}.p1, 177).rem))._replace(p2 \rightarrow asType<P2Type>(0 +
temp2)))
\rightarrow [from term 54.18, temp2 is equal to (-35 * div(heapIs $heap_{funcstart\_1032,1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p2, \ 176).quot) + (172 \ *funcstart\_1032,1)
div(\mathbf{heapIs} \ \$heap_{funcstart\_1032,1}, \ \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
heap_{funcstart\_1032,1}.p2, 176).rem
[57.30] $heap<sub>1032,1;1054,8</sub> == $heap<sub>funcstart_1032,1</sub>._replace(this.$r \rightarrow
\textbf{this.}\$r.\textbf{value}(\textbf{heapIs}~\$heap_{funcstart\_1032,1}).\_\textbf{replace}(p1 \rightarrow ((\text{-}2~*\text{div}(\textbf{heapIs}
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
\theta_{tuncstart\_1032,1}.p1, 177).rem)))).\_replace(this.\$r \rightarrow
this.$r.value(heapIs \rho_{tuncstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(\mathbf{heapIs} \ \$heap_{funcstart\_1032,1}, \ \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
```

```
\rho_{uncstart\_1032,1}.p1, 177).rem))).\_replace(p2 \rightarrow asType < P2Type > (0 + p2).replace(p2 \rightarrow asType = (p2).replace(p2).replace(p2).replace(p2).replace(p2).replace(p2).replace(p2).replace(p2).replace(p2).replace(p2).replace(p2).replace(p2).replace(p2).replace(p2).replace(p2).replace(p2).replace(p2).replace(p2).replace(p2).replace(p2).replace(p2).replace(p2).replace(p2).replace(p2).replace(p2).replace(p2).replace(p2).replace(p2).replace(p2).replace(p2).replace(p2).replace(p2).replace(p2).replace(p2).replace(p2).replace(p2).replace(p2).replace(p2).replace(p2).replace(p2).replace(p2).replace(p2).replace(p2).replace(p2).replace(p2).replace(p2).replace(p2).replace(p2).replace(p2).replace(p2).replace(p2).replace(p2).replace(p2).replace(p2).replace(p2).replace(p2).replace(p2).replace(p2).replace(p2).replace(p2).replace(p2).replace(p2).replace(p2).replace(p2).replace(p2).replace(p2).replace(p2).replace(p2).replace(p2).replace(p2).replace(p2).replace(p2).replace(p2).replace(p2).replace(p2).replace(p2).replace(p2).replace(p2).replace(p2).replace(p2).replace(p2).replace(p2).replace(p2).replace(p2).replace(p2).replace(p2).replace(p2).replace(p2).replace(p2).replace(p2).replace(p2).replace(p2).replace(p2).replace(p2).replace(p2).replace(p2).replace(p2).replace(p2).replace(p2).replace(p2).replace(p2).replace(p2).replace(p2).replace(p2).replace(p2).replace(p2).replace(p2).replace(p2).replace(p2).replace(p2).replace(p2).replace(p2).replace(p2).replace(p2).replace(p2).replace(p2).replace(p2).replace(p2).replace(p2).replace(p2).replace(p2).replace(p2).replace(p2).replace(p2).replace(p2).replace(p2).replace(p2).replace(p2).replace(p2).replace(p2).replace(p2).replace(p2).replace(p2).replace(p2).replace(p2).replace(p2).replace(p2).replace(p2).replace(p2).replace(p2).replace(p2).replace(p2).replace(p2).replace(p2).replace(p2).replace(p2).replace(p2).replace(p2).replace(p2).replace(p2).replace(p2).replace(p2).replace(p2).replace(p2).replace(p2).replace(p2).replace(p2).replace(p2).replace(p2).replace(p2).replace(p2).replace(p2).replace(
((-35 * div(heapIs $heap_{funcstart\_1032,1}, this.$r.value(heapIs)]
\text{Sheap}_{funcstart\_1032,1}.p2, 176).quot) + (172 * div(heapIs \text{Sheap}_{funcstart\_1032,1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p2, 176).rem))))
\rightarrow [simplify]
[57.33] $heap<sub>1032,1;1054,8</sub> == $heap<sub>funcstart_1032,1</sub>._replace(this.$r \rightarrow
this.$r.value(heapIs \rho_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs $heap<sub>funcstart_1032,1</sub>, this.$r.value(heapIs
\theta_{tuncstart\ 1032.1}.p1,\ 177.rem)))._replace(this.r \rightarrow
this.$r.value(heapIs \frac{1}{2} heap\frac{1}{2} heap\frac{1}{2}
\theta_{funcstart\_1032,1}, this.r.value(heapIs \theta_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs $heap<sub>funcstart_1032,1</sub>, this.$r.value(heapIs
\theta_{funcstart\_1032,1}.p1, 177).rem))._replace(p2 \rightarrow ((-35 * div(heapIs
\rho_{funcstart_1032,1}, this.r.value(heapIs \rho_{funcstart_1032,1}).p2,
176).quot) + (172 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.}\text{\$r.value}(\text{heapIs}))
heap_{funcstart\_1032,1}.p2, 176).rem)))
[Take goal term]
[1.0] minof(signed int) \leq ($heap<sub>1032.1:1054.8</sub>.M3 *
asType<int>(static_cast<integer>(static_cast<signed
int>(operator^*(heapIs $heap_{1032,1;1054,8}, this).p3) < (int)0)))
\rightarrow [simplify]
[1.1] -32768 \leq ($heap<sub>1032,1;1054,8</sub>.M3 *
asType<int>(static_cast<integer>(static_cast<signed
int>(operator^*(heapIs $heap_{1032.1:1054.8}, this).p3) < (int)0)))
\rightarrow [from term 57.33, $heap<sub>1032.1:1054.8</sub> is equal to
$heap_{funcstart\_1032,1}.$replace(this.$r \rightarrow this.$r.value(heapIs)
heap_{funcstart\_1032,1}._replace(p1 \rightarrow ((-2 * div(heapIs heap_{funcstart\_1032,1}),
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177).quot) + (171 * leapIs \ heap_{funcstart\_1032,1}).p1, 177).quot) + (171 * leapIs \ heapIs \ heap_{funcstart\_1032,1}).p1, 177).quot) + (171 * leapIs \ heapIs \ hea
div(heapIs $heap_{funcstart\_1032,1}, this.$r.value(heapIs)
\theta_{funcstart\_1032,1}.p1, 177).rem)))).\_replace(this.\$r \rightarrow 0
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
heap_{funcstart\_1032,1}, this.r.value(heapIs heap_{funcstart\_1032,1}).p1,
 (177).quot + (171 * div(\mathbf{heapIs} \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}))
\rho_{funcstart\_1032,1}.p1, 177).rem))).\_replace(p2 \rightarrow (-35 * div(heapIs))).
heap_{funcstart\_1032,1}, this.r.value(heapIs heap_{funcstart\_1032,1}).p2,
176).quot) + (172 * div(heapIs $heap_{tuncstart_1032.1}, this.$r.value(heapIs
heap_{funcstart_{1032,1}}.p2, 176).rem)))]
[1.2] -32768 \le (\$heap_{funcstart\_1032,1}.\_replace(this.\$r \rightarrow this.\$r.value(heapIs))
\text{Sheap}_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs \text{Sheap}_{funcstart\_1032,1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177).quot) + (171 *
div(\mathbf{heapIs} \$ heap_{funcstart\_1032.1}, \mathbf{this.}\$r.\mathbf{value}(\mathbf{heapIs})
```

```
\theta_{funcstart=1032.1}.p1, 177).rem)))._replace(this.$r \rightarrow
this.$r.value(heapIs \frac{1}{2} heap\frac{1}{2} heap\frac{1}{2}
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs $heap<sub>funcstart_1032,1</sub>, this.$r.value(heapIs
\rho_{funcstart\_1032,1}.p1, 177).rem))._replace(p2 \rightarrow ((-35 * div(heapIs
$heap_funcstart_1032,1, this.$r.value(heapIs $heap_funcstart_1032,1).p2,
176).quot) + (172 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
$heap_tuncstart_1032.1).p2, 176).rem)))).M3 *
asType<int>(static_cast<integer>(static_cast<signed
int>(operator^*(heapIs $heap_{1032,1;1054,8}, this).p3) < (int)0)))
→ [const member of object with modified fields]
[1.4] -32768 \leq ($heap<sub>funcstart_1032,1</sub>.M3 *
asType<int>(static_cast<integer>(static_cast<signed
int>(operator^*(heapIs $heap_{1032,1;1054,8}, this).p3) < (int)0)))
\rightarrow [const static or extern object]
[1.5] -32768 \le (\$heap_{init}.M3 *
asType<int>(static_cast<integer>(static_cast<signed
\mathbf{int}{>}(\mathbf{operator}^*(\mathbf{heapIs}\ \$\mathrm{heap}_{1032,1;1054,8},\ \mathbf{this}).\mathrm{p3})<(\mathbf{int})0)))
\rightarrow [expand definition of constant 'M3' at prang.cpp (38,26)]
[1.6] -32768 \leq ((int)30323 *
asType<int>(static_cast<integer>(static_cast<signed
int>(operator^*(heapIs $heap_{1032.1:1054.8}, this).p3) < (int)0)))
\rightarrow [simplify]
[1.7] -32768 < (30323 *
asType{<}int{>}(static\_cast{<}integer{>}(static\_cast{<}signed
int>(operator^*(heapIs $heap_{1032,1;1054,8}, this).p3) < (int)0)))
\rightarrow [from term 57.33, $heap<sub>1032.1:1054.8</sub> is equal to
$heap_{funcstart\_1032,1}.$_replace(this.$r \rightarrow this.$r.value(heapIs)
heap_{funcstart\_1032,1}._replace(p1 \rightarrow ((-2 * div(heapIs $heap_{funcstart\_1032,1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177).quot) + (171 * leapIs \ heap_{funcstart\_1032,1}).p1, 177).quot)
div(heapIs $heap_{funcstart_1032.1}, this.$r.value(heapIs
\theta_{funcstart\_1032,1}.p1, 177).rem)))).\_replace(this.\$r \rightarrow 0
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs) + (-2 * div(heapIs) + (
heap_{funcstart\_1032,1}, this.r.value(heapIs heap_{funcstart\_1032,1}).p1,
 177).quot) + (171 * div(\textbf{heapIs} \$heap_{funcstart\_1032,1}, \textbf{this}.\$r.\textbf{value}(\textbf{heapIs}))
heap_{funcstart\_1032,1}.p1, 177).rem)))._replace(p2 \rightarrow (-35 * div(heapIs)))._replace(p2 \rightarrow (-35 * div(heapIs))))._replace(p2 \rightarrow (-35 * div(heapIs))))
$heap_funcstart_1032,1, this.$r.value(heapIs $heap_funcstart_1032,1).p2,
 176).quot) + (172 * div(\textbf{heapIs } \$heap_{funcstart\_1032,1}, \textbf{this.}\$r.\textbf{value}(\textbf{heapIs}
heap_{funcstart\_1032,1}.p2, 176).rem)))
[1.8] - 32768 < (30323 *
asType<int>(static_cast<integer>(static_cast<signed
```

```
int>(operator^*(heapIs \$heap_{funcstart\_1032,1}.\_replace(this.\$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
\theta_{tuncstart\_1032,1}.p1, 177).rem)))).\_replace(this.\$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032.1}, \text{this.} \text{\$r.value}(\text{heapIs}))
\$heap_{funcstart\_1032,1}).p1,\ 177).rem))).\_\mathbf{replace}(p2 \to (-35\ *\ div(\mathbf{heapIs}
\label{eq:heapIs} $\operatorname{heap}_{funcstart\_1032,1},\ \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}\ \$\operatorname{heap}_{funcstart\_1032,1}).p2,
176).quot) + (172 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.} \text{\$r.value}(\text{heapIs}))
\text{Sheap}_{funcstart\_1032,1}.p2, 176).rem))), this).p3) < (int)0)))
\rightarrow [expand definition of operator '*' in class 'pointer' at built in declaration]
[1.9] -32768 \le (30323 *
asType<int>(static_cast<integer>(static_cast<signed
\mathbf{int}{>}(\mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}~\$\mathbf{heap}_{funcstart\_1032,1}.\_\mathbf{replace}(\mathbf{this}.\$\mathbf{r}\rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(\mathbf{heapIs} \ \$heap_{funcstart\_1032,1}, \ \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
\theta_{tuncstart\_1032.1}.p1, 177).rem)))).\_replace(this.\$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{tuncstart\_1032.1}, this.r.value(heapIs \rho_{tuncstart\_1032.1}).p1,
177).quot) + (171 * div(\mathbf{heapIs} \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}))
\rho_{tuncstart_1032.1}, this.r.value(heapIs \rho_{tuncstart_1032.1}).p2,
(176).\text{quot} + (172 * \text{div}(\text{heapIs } \text{heap}_{funcstart\_1032,1}, \text{this.}\text{$r.value}(\text{heapIs}))
\text{Sheap}_{funcstart\_1032,1}.p2, 176).rem)))).p3) < (int)0)))
→ [evaluate dereferenced pointer into modified heap]
[1.10] -32768 < (30323 *
asType<int>(static_cast<integer>(static_cast<signed int>(([this.$r
== this.$r]: this.$r.value(heapIs \rho_{tuncstart 1032.1})._replace(p1 \rightarrow ((-2
* div(\mathbf{heapIs} \$ heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
\text{Sheap}_{funcstart\_1032,1}.p1, 177).quot) + (171 * div(heapIs \text{Sheap}_{funcstart\_1032,1},
this.r.value(heapIs \ heap_{funcstart\_1032.1}).p1, 177).rem))).\_replace(p2 \rightarrow
(-35 * div(heapIs \$heap_{funcstart\_1032,1}, this.\$r.value(heapIs
\text{Sheap}_{funcstart\_1032,1}.p2, 176).quot) + (172 * div(heapIs \text{Sheap}_{funcstart\_1032,1},
this.$r.value(heapIs heap_{funcstart\_1032,1}).p2, 176).rem)), []:
this.$r.value(heapIs heap_{funcstart\_1032,1}._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow (-2 * div(heapIs
\rho_{funcstart_1032,1}, this.r.value(heapIs \rho_{funcstart_1032,1}).p1,
177).quot) + (171 * div(\mathbf{heapIs} \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}))
\text{Sheap}_{funcstart\_1032.1}.p1, 177).rem)))).p3) < (int)0)))
→ [explicitly assert falsehood of skipped guards in subsequent guards]
```

```
[1.11] -32768 < (30323 *
asType<int>(static_cast<integer>(static_cast<signed int>(([this.$r
== this.$r]: this.$r.value(heapIs \theta_{funcstart\_1032,1})._replace(p1 \theta ((-2)
* div(\mathbf{heapIs} \ \mathbf{\$} heap_{funcstart\_1032,1}, \ \mathbf{this}.\mathbf{\$} r.\mathbf{value}(\mathbf{heapIs})
\textbf{this.\$r.value(heapIs \$heap}_{funcstart\_1032,1}).p1,\ 177).rem))).\_\textbf{replace}(p2 \rightarrow
(-35 * div(heapIs \$heap_{funcstart\_1032.1}, this.\$r.value(heapIs
\text{Sheap}_{funcstart\_1032.1}, p2, 176).quot) + (172 * div(heapIs \text{Sheap}_{funcstart\_1032.1},
this.r.value(heapIs \heap_{funcstart\_1032.1}).p2, 176).rem)), [!(this.<math>r = 
this.r.value(heapIs $heap_{funcstart\_1032,1}.\_replace(this.$r \rightarrow funcstart\_1032,1})
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow (-2 * div(heapIs
\rho_{tuncstart\_1032.1}, this.r.value(heapIs \rho_{tuncstart\_1032.1}).p1,
177).quot) + (171 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
\text{Sheap}_{funcstart\_1032,1}.\text{p1}, 177).\text{rem})))).\text{p3}) < (int)0)))
\rightarrow [simplify]
[1.19] -32768 \leq (30323 * asType<int>(static_cast<integer>(0 <
-this.$r.value(heapIs \theta_{funcstart\_1032,1}).p3)))
\rightarrow [from term 40.0, literala < -this.$r.value(heapIs $heap_{funcstart\_1032.1}).p3
is false whenever -2 < (0 + literala)
   Proof of rule precondition:
   [1.19.0] - 2 < (0 + 0)
   \rightarrow [simplify]
   [1.19.2] true
[1.20] -32768 \leq (30323 * asType<int>(static_cast<integer>(false)))
\rightarrow [simplify]
[1.21] - 32768 < (30323 * asType < int > (([false]: 1, []: 0)))
\rightarrow [explicitly assert falsehood of skipped guards in subsequent guards]
[1.22] -32768 \leq (30323 * asType<int>(([false]: 1, [true]: 0)))
\rightarrow [simplify]
[1.26] true
Proof of verification condition: Arithmetic result of operator '*' is within
```

limit of type 'signed int'

In the context of class: WHPrang, declared at: C:\Escher\Customers\prang-cpp\prang.cpp (18,1)

Condition generated at: C:\Escher\Customers\prang-cpp\prang.cpp (81,32)

Condition defined at:

```
To prove: ($heap<sub>1032,1:1054,8</sub>.M3 *
asType{<}int{>}(static\_cast{<}integer{>}(static\_cast{<}signed
\mathbf{int}{>}(\mathbf{operator}^*(\mathbf{heapIs}\ \$\mathrm{heap}_{1032,1;1054,8},\ \mathbf{this}).\mathrm{p3})<(\mathbf{int})0)))\leq
maxof(signed int)
Given:
heap_{init}.LIMIT == (int)80
heap_{init}.class WHPrang \in M1 == (int)30269
heap_{init}.class WHPrang \in r1 == (int)171
heap_{init}.class WHPrang \in a1 == (int)177
heap_{init}.class WHPrang \in b1 == (int)2
heap_{init}.class WHPrang \in M2 == (int)30307
heap_{init}.class WHPrang \in r2 == (int)172
heap_{init}.class WHPrang \in a2 == (int)176
heap_{init}.class WHPrang \in b2 == (int)35
\text{$heap}_{init}.\mathbf{class} \text{ WHPrang} \in M3 == (\mathbf{int})30323
heap_{init}.class WHPrang \in r3 == (int)170
heap_{init}.class WHPrang \in a3 == (int)178
heap_{init}.class WHPrang \in b3 == (int)63
\operatorname{div1} == \operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_1032,1},
static\_cast < int > (operator*(heapIs $heap_{funcstart\_1032,1}, this).p1),
static\_cast < int > (\$heap_{funcstart\_1032,1}.a1))
(asType<integer>(static_cast<int>(operator*(heapIs
heap_{funcstart\_1032,1}, this).p1) /
\mathbf{asType} < \mathbf{integer} > (\mathbf{static\_cast} < \mathbf{int} > (\$ \operatorname{heap}_{funcstart\_1032,1}.a1))) = =
asType<integer>(div1.quot)
(asType < integer > (static\_cast < int > (operator*(heapIs)))
heap_{funcstart\_1032,1}, this).p1) %
asType < integer > (static\_cast < int > (\$heap_{funcstart\_1032,1}.a1))) = =
asType<integer>(div1.rem)
(\mathbf{asType}{<}\mathbf{integer}{>}(\mathbf{operator}^*(\mathbf{heapIs}\ \$\mathbf{heap}_{funcstart\_1032,1},\ \mathbf{this}).\mathtt{p1}) <
asType < integer > (\$heap_{funcstart\_1032,1}.a1)) = >
(asType<integer>(div1.rem) == asType<integer>(operator*(heapIs
heap_{funcstart\_1032,1}, this).p1)
(\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathsf{heap}_{funcstart\_1032,1}.\mathsf{a1}) \leq
\mathbf{asType} < \mathbf{integer} > (\mathbf{operator}^*(\mathbf{heapIs} \ \$ \mathbf{heap}_{funcstart\_1032,1}, \ \mathbf{this}).\mathtt{p1})) = >
!(0 == asType < integer > (div1.quot))
!(0 == asType < integer > (div1.rem)) || !(0 ==
```

```
asType<integer>(div1.quot))
\operatorname{div2} == \operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_1032,1},
\mathbf{static\_cast} {<} \mathbf{int} {>} (\mathbf{operator^*(heapIs}\ \$heap_{funcstart\_1032,1},\ \mathbf{this}).p2),
\mathbf{static\_cast}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_1032,1}.\mathrm{a2}))
(asType<integer>(static_cast<int>(operator*(heapIs
heap_{funcstart_1032.1}, this).p2)
\mathbf{asType} < \mathbf{integer} > (\mathbf{static\_cast} < \mathbf{int} > (\$ \mathbf{heap}_{funcstart\_1032,1}.\mathbf{a2}))) = =
asType<integer>(div2.quot)
(asType < integer > (static\_cast < int > (operator*(heapIs)))
heap_{funcstart\_1032,1}, this).p2)
asType < integer > (static\_cast < int > (\$heap_{funcstart\_1032.1}.a2))) = =
asType<integer>(div2.rem)
(\mathbf{asType}{<}\mathbf{integer}{>}(\mathbf{operator}^*(\mathbf{heapIs}\ \$\mathbf{heap}_{funcstart\_1032,1},\ \mathbf{this}).\mathtt{p2}) <
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathrm{heap}_{funcstart\_1032,1}.\mathrm{a2})) =>
(\mathbf{asType} {<} \mathbf{integer} {>} (\mathbf{div2.rem}) == \mathbf{asType} {<} \mathbf{integer} {>} (\mathbf{operator}^* (\mathbf{heapIs}
heap_{funcstart\_1032,1}, this).p2)
(\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathrm{heap}_{funcstart\_1032,1}.\mathrm{a2}) \leq
\mathbf{asType} \small{<} \mathbf{integer} \small{>} (\mathbf{operator}^*(\mathbf{heapIs} \ \$ \mathbf{heap}_{funcstart\_1032,1}, \ \mathbf{this}).\mathtt{p2})) = >
!(0 == asType < integer > (div2.quot))
!(0 == asType < integer > (div2.rem)) || !(0 ==
asType<integer>(div2.quot))
div3 == div(\mathbf{heapIs} \$ heap_{funcstart\_1032.1},
\mathbf{static\_cast} < \mathbf{int} > (\mathbf{operator}^*(\mathbf{heapIs}\ \$ \mathbf{heap}_{funcstart\_1032,1},\ \mathbf{this}).\mathbf{p3}),
\mathbf{static\_cast}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_1032,1}.\mathrm{a3}))
(asType < integer > (static\_cast < int > (operator*(heapIs)))
heap_{funcstart\_1032,1}, this).p3)
\mathbf{asType} \small{<} \mathbf{integer} \small{>} (\mathbf{static\_cast} \small{<} \mathbf{int} \small{>} (\$ \mathbf{heap}_{funcstart\_1032,1}.\mathbf{a3}))) = =
asType<integer>(div3.quot)
(asType<integer>(static_cast<int>(operator*(heapIs
heap_{funcstart\_1032,1}, this).p3)
asType < integer > (static\_cast < int > (\$heap_{funcstart\_1032.1}.a3))) = =
asType<integer>(div3.rem)
(\mathbf{asType}{<}\mathbf{integer}{>}(\mathbf{operator}^*(\mathbf{heapIs}\ \$\mathbf{heap}_{funcstart\_1032,1},\ \mathbf{this}).\mathbf{p3}) <
asType < integer > (\$heap_{funcstart\_1032,1}.a3)) = >
(asType<integer>(div3.rem) == asType<integer>(operator*(heapIs
heap_{funcstart\_1032,1}, this).p3)
(\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathrm{heap}_{funcstart\_1032,1}.\mathrm{a3}) \leq
asType < integer > (operator*(heapIs $heap_{funcstart\_1032,1}, this).p3)) =>
!(0 == asType < integer > (div3.quot))
!(0 == asType < integer > (div3.rem)) || !(0 ==
asType<integer>(div3.quot))
```

```
temp1 == (\$heap_{funcstart\_1032,1}.r1 * \textbf{static\_cast} < \textbf{signed int} > (div1.rem)) - (div1.rem) + (div1.r
(\text{sheap}_{funcstart\_1032,1}.\text{b1} * \text{static\_cast} < \text{signed int} > (\text{div1.quot}))
minof(signed\ int) \le temp1
temp1 < maxof(signed int)
heap_{1032,1;1051,8} == heap_{funcstart\_1032,1}._replace(this.$r \rightarrow
operator*(heapIs heap_{funcstart\_1032,1}, this)._replace(p1 \rightarrow
asType<P1Type>(($heap_funcstart_1032,1.M1 *
asType < int > (static\_cast < integer > (static\_cast < signed
int>(operator^*(heapIs \$heap_{funcstart\_1032,1}, this).p1) < (int)0))) +
temp1)))
temp2 == (\$heap_{1032.1:1051.8}.r2 * static\_cast < signed int > (div2.rem)) -
(\text{\$heap}_{1032.1:1051.8}.\text{b2} * \text{static\_cast} < \text{signed int} > (\text{div2.quot}))
minof(signed int) \le temp2
temp2 < maxof(signed int)
\text{heap}_{1032,1;1054,8} == \text{heap}_{1032,1;1051,8}.\_\text{replace}(\text{this}.\$r \rightarrow
operator*(heapIs \theta_{1032,1;1051,8}, this)._replace(p2 \rightarrow
asType<P2Type>(($heap<sub>1032,1;1051,8</sub>.M2 *
asType < int > (static\_cast < integer > (static\_cast < signed
int>(operator^*(heapIs $heap_{1032,1;1051,8}, this).p2) < (int)(0))) + temp(2)))
temp3 == (\$heap_{1032,1;1054,8}.r3 * \textbf{static\_cast} < \textbf{signed int} > (div3.rem)) - (div3.rem)) + (div3.rem) + (div3.rem
(\text{sheap}_{1032.1:1054.8}.\text{b3} * \text{static\_cast} < \text{signed int} > (\text{div}3.\text{quot}))
minof(signed\ int) \le temp3
temp3 \le maxof(signed int)
Proof:
[Take given term]
[2.0] \operatorname{div1} == \operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_1032,1},
static_cast<int>(operator*(heapIs $heap_{funcstart\_1032,1}, this).p1),
\mathbf{static\_cast}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_1032,1}.\mathrm{a1}))
→ [expand definition of operator '*' in class 'pointer' at built in declaration]
[2.1] \operatorname{div1} == \operatorname{div}(\mathbf{heapIs} \ \operatorname{\$heap}_{funcstart\_1032,1},
static_cast<int>(this.$r.value(heapIs $heap_{funcstart\_1032,1}).p1),
static\_cast < int > (\$heap_{funcstart\_1032.1}.a1))
\rightarrow [simplify]
[2.2] \text{ div1} == \text{div(heapIs } \text{$heap}_{funcstart\_1032,1}, \text{this.} \text{$r.value(heapIs)}
\theta_{funcstart\_1032,1}.p1, \theta_{funcstart\_1032,1}.p1, \theta_{funcstart\_1032,1}.a1))
\rightarrow [const static or extern object]
[2.3] \operatorname{div1} == \operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_1032,1}, \mathbf{this}.\$ r. \mathbf{value}(\mathbf{heapIs})
\theta_{uncstart\_1032,1}.p1, \theta_{uncstart\_1032,1}.p2, \theta_{uncstart\_1032,1}.p3, \theta_{uncstart\_1032,1}.p4, \theta_{uncstart\_1032,1}.p4, \theta_{uncstart\_1032,1}.p4, \theta_{uncstart\_1032
```

```
\rightarrow [expand definition of constant 'a1' at prang.cpp (30,26)]
[2.4] \text{ div1} == \text{div}(\text{heapIs } \text{heap}_{funcstart\_1032,1}, \text{this.}\text{\$r.value}(\text{heapIs})
\theta_{funcstart\_1032,1}.p1, \theta_{funcstart\_1032,1}.p1, \theta_{funcstart\_1032,1}.p1, \theta_{funcstart\_1032,1}.p1, \theta_{funcstart\_1032,1}.p1, \theta_{funcstart\_1032,1}.p1, \theta_{funcstart\_1032,1}.p2, \theta_{funcstart\_1032,1}.p2, \theta_{funcstart\_1032,1}.p2, \theta_{funcstart\_1032,1}.p2, \theta_{funcstart\_1032,1}.p2, \theta_{funcstart\_1032,1}.p3, \theta_{funcstart\_1032,1}.p4, \theta_{funcstart\_1032,1}.p4, \theta_{funcstart\_1032,1}.p4, \theta_{funcstart\_1032,1}.p5, \theta_{funcstart\_1032,1
\rightarrow [simplify]
[2.6] div1 == div(heapIs $heap_{funcstart\_1032,1}, this.$r.value(heapIs)
heap_{funcstart\_1032,1}.p1, 177)
[Assume known post-assertion, class invariant or type constraint for term 2.6]
[7.0] (0 < asType<integer>(this.$r.value(heapIs
\label{eq:linear_funcstart_1032,1} $$ \operatorname{heap}_{funcstart_1032,1}.p1)) \&\& (asType < integer > (this.\$r.value(heapIs)) \\
\$ heap_{funcstart\_1032,1}).p1) < \mathbf{asType} < \mathbf{integer} > (\$ heap.\mathbf{class} \ WHPrang \in \texttt{Prang}) = \texttt{Prang} + \texttt{Prang} 
M1))
\rightarrow [simplify]
[7.2] (0 < this.$r.value(heapIs \rho_{funcstart\_1032,1}).p1) &&
(this.r.value(heapIs $heap_{funcstart\_1032,1}).p1 <
asType < integer > (\$heap.class WHPrang \in M1))
\rightarrow [const static or extern object]
[7.3] (0 < this.$r.value(heap
Is $heap_{funcstart\_1032,1}).p1) &&
(this.$r.value(heapIs heap_{funcstart\_1032,1}).p1 <
asType < integer > (\$heap_{init}.class WHPrang \in M1))
\rightarrow [expand definition of constant 'M1' at prang.cpp (28,26)]
[7.4] (0 < this.\$r.value(heapIs \$heap_{funcstart_1032.1}).p1) &&
(this.r.value(heapIs $heap_{funcstart\_1032,1}).p1 <
asType < integer > ((int)30269))
\rightarrow [simplify]
[7.10] (-30269 < -this.$r.value(heapIs heap_{funcstart\_1032,1}).p1) <math>\land (0 < 
this.r.value(heapIs $heap_{funcstart\_1032,1}).p1)
[Work on sub-term 2 of conjunction in term 7.10]
[8.0] 0 < this.$r.value(heapIs \theta_{funcstart\_1032,1}).p1
[Take given term]
[18.0] div2 == div(heapIs heap_{funcstart\_1032,1},
static_cast<int>(operator*(heapIs $heap_{funcstart\_1032,1}, this).p2),
\mathbf{static\_cast}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_1032,1}.\mathrm{a2}))
→ [expand definition of operator '*' in class 'pointer' at built in declaration]
[18.1] \operatorname{div2} == \operatorname{div}(\mathbf{heapIs} \ \operatorname{\$heap}_{funcstart\_1032,1},
static\_cast < int > (this. r.value(heapIs $heap_{funcstart\_1032,1}).p2),
static\_cast < int > (\$heap_{funcstart\_1032.1}.a2))
\rightarrow [simplify]
```

```
[18.2] \text{ div2} == \text{div}(\text{heapIs } \text{$heap}_{funcstart\_1032,1}, \text{this.}\text{$r.value}(\text{heapIs}))
\theta_{funcstart\_1032,1}.p2, \theta_{funcstart\_1032,1}.p2, \theta_{funcstart\_1032,1}.a2))
\rightarrow [const static or extern object]
[18.3] div2 == div(\mathbf{heapIs} \ \hat{\mathbf{s}}_{heap}), this. r.value(\mathbf{heapIs})
\theta_{uncstart\_1032,1}.p2, \theta_{uncstart\_1032,1}.p3, \theta_{uncstart\_1032
\rightarrow [expand definition of constant 'a2' at prang.cpp (35,26)]
[18.4] div2 == div(\mathbf{heapIs} \$ \mathbf{heap}_{funcstart\_1032,1}, \mathbf{this}.\$ \mathbf{r.value}(\mathbf{heapIs})
\theta_{tuncstart\_1032.1}.p2, static_cast<int>((int)176))
\rightarrow [simplify]
[18.6] div2 == div(heapIs $heap<sub>funcstart_1032,1</sub>, this.$r.value(heapIs)
heap_{funcstart\_1032,1}.p2, 176)
[Assume known post-assertion, class invariant or type constraint for term 18.6]
[23.0] (0 < asType<integer>(this.$r.value(heapIs
\label{eq:loss_funcstart_1032,1} $$ \operatorname{heap}_{funcstart_1032,1}.p2)) \&\& (asType < integer > (this.\$r.value(heapIs)) \\
\rho_{tuncstart\_1032.1},p2) < asType<integer>(\rho_{tuncstart\_1032.1}).p2) < asType<integer>(\rho_{tuncstart\_1032.1}).p2)
M2))
\rightarrow [simplify]
[23.2] (0 < this.$r.value(heap
Is \rho_{uncstart\_1032,1}).p2) &&
(this.r.value(heapIs $heap_{funcstart\_1032,1}).p2 <
asType < integer > (\text{$heap.class WHPrang} \in M2))
\rightarrow [const static or extern object]
[23.3] (0 < this.$r.value(heapIs $heap_{funcstart\_1032,1}).p2) &&
(this.$r.value(heapIs heap_{funcstart\_1032,1}).p2 <
asType < integer > (\$heap_{init}.class WHPrang \in M2))
\rightarrow [expand definition of constant 'M2' at prang.cpp (33,26)]
[23.4] (0 < this.$r.value(heapIs heap_{funcstart\_1032,1}).p2) &&
(this.r.value(heapIs $heap_{funcstart\_1032,1}).p2 <
asType < integer > ((int)30307))
\rightarrow [simplify]
[23.10] (-30307 < -this.$r.value(heapIs \rho_{funcstart\_1032,1}).p2) \wedge (0 <
this.r.value(heapIs $heap_{funcstart\_1032,1}).p2)
[Work on sub-term 2 of conjunction in term 23.10]
[24.0] 0 < this.$r.value(heap
Is \rho_{uncstart\_1032,1}).p2
[Take given term]
[34.0] div3 == div(heapIs heap_{funcstart\_1032,1},
static\_cast < int > (operator*(heapIs $heap_{funcstart\_1032,1}, this).p3),
static\_cast < int > (\$heap_{funcstart\_1032,1}.a3))
```

```
→ [expand definition of operator '*' in class 'pointer' at built in declaration]
[34.1] \operatorname{div3} == \operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_1032,1},
static_cast<int>(this.$r.value(heapIs $heap_{funcstart\_1032,1}).p3),
\mathbf{static\_cast}{<}\mathbf{int}{>}(\$\mathbf{heap}_{funcstart\_1032,1}.\mathbf{a3}))
\rightarrow [simplify]
[34.2] \text{ div3} == \text{div(heapIs $heap}_{funcstart\_1032,1}, \text{ this.} \$r. \text{value(heapIs)}
\theta_{funcstart\_1032,1}.p3, \theta_{funcstart\_1032,1}.a3))
\rightarrow [const static or extern object]
[34.3] div3 == div(heapIs heapIs heapIs this.r.value(heapIs
\theta_{funcstart\_1032,1}.p3, \theta_{funcstart\_1032,1}.p4, \theta_{funcstart\_1032,1}.p4, \theta_{funcstart\_1032,1}.p4, \theta_{funcstart\_1032,1
\rightarrow [expand definition of constant 'a3' at prang.cpp (40,26)]
[34.4] \text{ div3} == \text{div(heapIs $heap}_{funcstart\_1032,1}, \text{ this.} \text{\$r.value(heapIs)}
\theta_{funcstart\_1032,1}.p3, \theta_{funcstart\_1032,1}.p4, \theta_{funcstart\_1032,1}.p4, \theta_{funcstart\_1032,1}.p4, \theta_{funcstart\_1032,1}.p4, \theta_{funcstart\_1032,1}.p5, \theta_{funcstart\_1032,1}.p5, \theta_{funcstart\_1032,1}.p5, \theta_{funcstart\_1032,1}.p5, \theta_{funcstart\_1032,1}.p5, \theta_{funcstart\_1032,1}.p5, \theta_{funcstart\_1032,1}.p5, \theta_{funcstart\_1032,1
\rightarrow [simplify]
[34.6] div3 == div(heapIs $heap<sub>funcstart_1032,1</sub>, this.$r.value(heapIs)
heap_{funcstart_{-1032,1}}.p3, 178)
[Assume known post-assertion, class invariant or type constraint for term 34.6]
[39.0] (0 < asType<integer>(this.\$r.value(heapIs
\verb§heap$_{funcstart\_1032,1}).p3)) \&\& (\mathbf{asType} < \mathbf{integer} > (\mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}))) \&\& (\mathbf{asType} < \mathbf{integer} > (\mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}))) \&\& (\mathbf{asType} < \mathbf{integer} > (\mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})))) \&\& (\mathbf{asType} < \mathbf{integer} > (\mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}))))) \&\& (\mathbf{asType} < \mathbf{integer} > (\mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}))))) \&\& (\mathbf{asType} < \mathbf{integer} > (\mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}))))))
\label{eq:continuous} \$ \text{heap}_{funcstart\_1032,1}).\text{p3}) < \mathbf{asType} < \mathbf{integer} > (\$ \text{heap}.\mathbf{class} \ \text{WHPrang} \in \texttt{Continuous}) < \mathsf{class} \ \text{Continuous}
M3)
\rightarrow [simplify]
[39.2] (0 < this.$r.value(heap
Is $heap_{funcstart\_1032,1}).p3) &&
(this.r.value(heapIs $heap_{funcstart\_1032,1}).p3 <
asType < integer > (\text{$heap.class WHPrang} \in M3))
\rightarrow [const static or extern object]
[39.3] (0 < this.$r.value(heapIs \rho_{funcstart\_1032,1}).p3) &&
(this.r.value(heapIs $heap_{funcstart\_1032,1}).p3 <
asType < integer > (\$heap_{init}.class WHPrang \in M3))
\rightarrow [expand definition of constant 'M3' at prang.cpp (38,26)]
[39.4] (0 < this.$r.value(heapIs \rho_{funcstart\_1032,1}).p3) &&
(this.$r.value(heapIs heap_{funcstart\_1032,1}).p3 <
asType < integer > ((int)30323))
\rightarrow [simplify]
[39.10] (-30323 < -this.$r.value(heap
Is \rho_{uncstart\_1032,1}).p3) <math display="inline">\land (0 <
\mathbf{this.\$r.value}(\mathbf{heapIs}~\$\mathbf{heap}_{funcstart\_1032,1}).\mathbf{p3})
[Work on sub-term 2 of conjunction in term 39.10]
```

```
[40.0] 0 < this.$r.value(heapIs $heap_{tuncstart\_1032.1}).p3
[Take given term]
[50.0] (($heap<sub>funcstart_1032,1</sub>.r1 * static_cast<signed int>(div1.rem)) -
(\text{\$heap}_{funcstart\_1032,1}.\text{b1 * static\_cast} < \text{signed int} > (\text{div1.quot}))) = \text{temp1}
\rightarrow [const static or extern object]
[50.1]\;((\$\mathrm{heap}_{init}.\mathrm{r1}\; *\; \mathbf{static\_cast} {<} \mathbf{signed}\; \mathbf{int} {>} (\mathrm{div1.rem}))\; -
(\text{\$heap}_{funcstart\_1032,1}.\text{b1 * static\_cast} < \text{signed int} > (\text{div1.quot}))) == \text{temp1}
→ [expand definition of constant 'r1' at prang.cpp (29,26)]
[50.2] (((int)171 * static_cast<signed int>(div1.rem)) -
($heap_tuncstart_1032.1.b1 * static_cast<signed int>(div1.quot))) == temp1
\rightarrow [simplify]
[50.3] ((171 * static_cast < signed int > (div1.rem)) - ($heap_{funcstart\_1032,1}.b1]
* static_cast<signed int>(div1.quot))) == temp1
\rightarrow [from term 2.6, div1 is equal to div(heapIs $heap_{funcstart\_1032,1},
this.r.value(heapIs $heap_{funcstart\_1032,1}).p1, 177)]
[50.4] ((171 * static_cast<signed int>(div(heapIs $heap_{funcstart\_1032.1},
this.r.value(heapIs $heap_{funcstart\_1032,1}).p1, 177).rem)) -
(\text{sheap}_{funcstart\_1032,1}.\text{b1} * \text{static\_cast} < \text{signed int} > (\text{div1.quot}))) == \text{temp1}
\rightarrow [simplify]
[50.5] ((171 * div(heapIs \$heap_{funcstart\_1032,1}, this.\$r.value(heapIs
\rho_{funcstart\_1032,1}.p1, 177).rem - (\rho_{funcstart\_1032,1}.b1 *
static_cast<signed int>(div1.quot))) == temp1
\rightarrow [const static or extern object]
[50.6] ((171 * \mathrm{div}(\mathbf{heapIs}\ \$\mathrm{heap}_{funcstart\_1032,1},\ \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}\ 
\rho_{uncstart\_1032,1}.p1, 177).rem – (\rho_{uncstart\_1032,1}.p1, 177).rem) – (\rho_{uncstart\_1032,1}.p1, 177).rem) – (\rho_{uncstart\_1032,1}.p1, 177).rem)
int>(div1.quot)) == temp1
\rightarrow [expand definition of constant 'b1' at prang.cpp (31,26)]
[50.7] ((171 * \mathrm{div}(\mathbf{heapIs}\ \$\mathrm{heap}_{funcstart\_1032,1},\ \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}
\theta_{uncstart\_1032,1}.p1, 177).rem - ((int)2 * static\_cast < signed)
int>(div1.quot)) == temp1
\rightarrow [simplify]
[50.8] ((171 * div(heapIs \$heap_{funcstart\_1032,1}, this.\$r.value(heapIs
\theta_{funcstart\_1032,1}.p1, 177).rem - (2 * static\_cast < signed)
int > (div1.quot))) == temp1
\rightarrow [from term 2.6, div1 is equal to div(heapIs $heap_{funcstart\_1032,1},
this.r.value(heapIs \ heap_{funcstart\_1032.1}).p1, 177)
[50.9] ((171 * div(heapIs $heap<sub>funcstart_1032.1</sub>, this.$r.value(heapIs
```

```
\theta_{funcstart\_1032,1}.p1, 177).rem - (2 * static\_cast < signed)
\mathbf{int} {>} (\mathbf{div}(\mathbf{heapIs} \ \$ \mathbf{heap}_{funcstart\_1032,1}, \ \mathbf{this}.\$ \mathbf{r.value}(\mathbf{heapIs} \ \mathbf{heapIs}))
\text{Sheap}_{funcstart\_1032,1}).p1, 177).quot))) == temp1
\rightarrow [simplify]
[50.14] 0 == (-\text{temp1} + (-2 * \text{div}(\text{heapIs } \$\text{heap}_{funcstart\_1032,1},
this.r.value(heapIs \ heap_{funcstart\_1032.1}).p1, 177).quot) + (171 *
div(\mathbf{heapIs} \$ heap_{funcstart\_1032.1}, \mathbf{this.}\$r.\mathbf{value}(\mathbf{heapIs})
heap_{funcstart_1032,1}.p1, 177.rem)
[Take given term]
[53.0] heap_{1032,1;1051,8} == heap_{funcstart\_1032,1}._replace(this.$r \rightarrow
operator*(heapIs heap_{funcstart\_1032.1}, this)._replace(p1 \rightarrow
asType < P1Type > ((\$heap_{funcstart\_1032,1}.M1 *
as Type < int > (static\_cast < integer > (static\_cast < signed))
int>(operator^*(heapIs \$heap_{funcstart\_1032,1}, this).p1) < (int)0))) +
temp1)))
→ [expand definition of operator '*' in class 'pointer' at built in declaration]
[53.1] heap_{1032,1;1051,8} == heap_{funcstart\_1032,1}._replace(this.r \rightarrow
\mathbf{this.\$r.value}(\mathbf{heapIs}~\$ \mathrm{heap}_{funcstart\_1032,1}).\_\mathbf{replace}(\mathrm{p1} \rightarrow
asType < P1Type > ((\$heap_{funcstart\_1032,1}.M1 *
as Type < int > (static\_cast < integer > (static\_cast < signed))
int>(operator^*(heapIs $heap_{funcstart 1032,1}, this).p1) < (int)0))) +
temp1)))
\rightarrow [const static or extern object]
[53.2] heap_{1032,1;1051,8} == heap_{funcstart\_1032,1}._replace(this.$r \rightarrow
\mathbf{this.\$r.value}(\mathbf{heapIs}~\$\mathbf{heap}_{funcstart\_1032,1}).\_\mathbf{replace}(\mathbf{p1}\rightarrow
asType<P1Type>(($heap<sub>init</sub>.M1 *
asType<int>(static_cast<integer>(static_cast<signed
int>(operator*(heapIs $heap_{funcstart\_1032,1}, this).p1) < (int)0))) +
temp1)))
→ [expand definition of constant 'M1' at prang.cpp (28,26)]
[53.3] heap_{1032,1;1051,8} == heap_{funcstart\_1032,1}._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow
asType<P1Type>(((int)30269 *
asType<int>(static_cast<integer>(static_cast<signed
int>(operator^*(heapIs \$heap_{funcstart\_1032,1}, this).p1) < (int)0))) +
temp1)))
\rightarrow [simplify]
[53.4] heap_{1032,1;1051,8} == heap_{funcstart\_1032,1}._replace(this.$r \rightarrow
\mathbf{this.\$r.value}(\mathbf{heapIs}~\$ \mathrm{heap}_{funcstart\_1032,1}).\_\mathbf{replace}(\mathrm{p1} \rightarrow
asType<P1Type>((30269 *
asType{<}int{>}(static\_cast{<}integer{>}(static\_cast{<}signed
```

```
int>(operator^*(heapIs \$heap_{funcstart\_1032,1}, this).p1) < (int)0))) +
temp1)))
→ [expand definition of operator '*' in class 'pointer' at built in declaration]
[53.5] \theta_{1032,1;1051,8} == \theta_{1032,1;1051,8} = \theta_{1032,1;1051,8} == \theta
this.$r.value(heapIs \theta_{funcstart\_1032,1})._replace(p1 \rightarrow
asType<P1Type>((30269 *
asType<int>(static_cast<integer>(static_cast<signed
\mathbf{int} > (\mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}~\$\mathrm{heap}_{funcstart\_1032,1}).\mathrm{p1}) < (\mathbf{int})0))) + \mathrm{temp1})))
\rightarrow [simplify]
[53.9] heap_{1032,1;1051,8} == heap_{funcstart\_1032,1}._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032.1})._replace(p1 \rightarrow
asType<P1Type>((30269 * asType<int>(static_cast<integer>(0 <
-\mathbf{this.}\$r.\mathbf{value}(\mathbf{heapIs}\ \$\mathrm{heap}_{funcstart\_1032,1}).\mathrm{p1}))) + \mathrm{temp1})))
\rightarrow [from term 8.0, literala < -this.$r.value(heapIs $heap_{funcstart\_1032.1}).p1
is false whenever -2 < (0 + literala)
        Proof of rule precondition:
        [53.9.0] - 2 < (0 + 0)
        \rightarrow [simplify]
        [53.9.2] true
[53.10] $\text{heap}_{1032,1;1051,8} == $\text{heap}_{funcstart\_1032,1}._\text{replace}(\text{this}.\text{$\frac{1}{2}r$})
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow
asType<P1Type>((30269 * asType<int>(static_cast<integer>(false)))
+ temp1)))
\rightarrow [simplify]
[53.11] \theta_{1032,1;1051,8} == \theta_{1032,1;1051,8} == \theta_{1032,1}.replace(this.$r \to
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow
asType < P1Type > ((30269 * asType < int > (([false]: 1, []: 0))) + temp1)))
→ [explicitly assert falsehood of skipped guards in subsequent guards]
[53.12] $heap<sub>1032,1;1051,8</sub> == $heap<sub>funcstart_1032,1</sub>._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow
asType<P1Type>((30269 * asType<int>(([false]: 1, [true]: 0))) +
temp1)))
\rightarrow [simplify]
[53.15] $heap<sub>1032,1;1051,8</sub> == $heap<sub>funcstart_1032,1</sub>._replace(this.$r \rightarrow
this.$r.value(heap
Is $heap_{funcstart\_1032,1}).$_{\tt replace}(p1 \to
asType < P1Type > (0 + temp1))
\rightarrow [from term 50.14, temp1 is equal to (-2 * div(heapIs $heap_{funcstart\_1032,1},
this.r.value(heapIs \ \ heap_{funcstart\_1032,1}).p1, \ 177).quot) + (171 \ \ *
```

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div(\mathbf{heapIs} \ \$heap_{funcstart\_1032,1}, \ \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
heap_{funcstart\_1032,1}.p1, 177).rem
[53.16] $heap<sub>1032,1;1051,8</sub> == $heap<sub>funcstart_1032,1</sub>._replace(this.$r \rightarrow
this.$r.value(heapIs \rho_{funcstart\_1032,1})._replace(p1 \rightarrow
asType < P1Type > (0 + ((-2 * div(heapIs $heap_{funcstart\_1032.1},
this.$r.value(heapIs \rho_{tuncstart\_1032,1}).p1, 177).quot) + (171 *
div(\mathbf{heapIs} \$ heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
heap_{funcstart_{1032,1}}.p1, 177).rem))))
\rightarrow [simplify]
[53.19] $\text{heap}_{1032,1;1051,8} == $\text{heap}_{funcstart\_1032,1}._\text{replace}(\text{this.}\text{$\frac{1}{2}}\text{$\text{op}})$
this.$r.value(heapIs \theta_{funcstart\_1032,1})._replace(p1 \theta ((-2 * div(heapIs
\rho_{uncstart\_1032,1}, this.r.value(heapIs \rho_{uncstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
heap_{funcstart_{1032,1}}.p1, 177).rem)))
[Take given term]
[54.0] (($heap<sub>1032.1:1051.8</sub>.r2 * static_cast<signed int>(div2.rem)) -
(\text{sheap}_{1032,1;1051,8}.\text{b2} * \text{static\_cast} < \text{signed int} > (\text{div2.quot}))) = = \text{temp2}
\rightarrow [from term 53.19, $heap<sub>1032,1;1051,8</sub> is equal to
\$heap_{funcstart\_1032,1}.\_\textbf{replace}(\textbf{this.}\$r \rightarrow \textbf{this.}\$r.\textbf{value}(\textbf{heapIs}
heap_{funcstart\_1032,1}._replace(p1 \rightarrow (-2 * div(heapIs \$heap_{funcstart\_1032,1}, -2))
this.r.value(heapIs \ \$heap_{funcstart\_1032,1}).p1, \ 177).quot) + (171 * 
div(\mathbf{heapIs} \ \$heap_{funcstart\_1032,1}, \ \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
heap_{funcstart_{1032,1}}.p1, 177).rem)))
[54.1] (({\rm sheap}_{funcstart\_1032,1}._replace(this.{\rm sr.value}({\rm heapIs})
\rho_{uncstart\_1032,1}._replace(p1 \rightarrow ((-2 * div(heapIs \rho_{uncstart\_1032,1}).
\mathbf{this.\$r.value(heapIs}\ \$heap_{funcstart\_1032,1}).p1,\ 177).quot) + (171\ *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_1032,1}, \ \mathbf{this}. \text{\$r.value}(\mathbf{heapIs})
\label{eq:cast_signed} $$  \ensuremath{\mathtt{heap}}_{funcstart\_1032,1}).p1,\ 177).rem)))).r2 * \mathbf{static\_cast} < \mathbf{signed} $$
int>(div2.rem)) - ($heap_{1032.1:1051.8}.b2 * static_cast<signed
int>(div2.quot)) = temp2
\rightarrow [const member of object with modified fields]
[54.2]\;((\$heap_{funcstart\_1032,1}.r2\;*\;\textbf{static\_cast}{<}\textbf{signed int}{>}(\text{div}2.\text{rem}))\;-
(\text{sheap}_{1032,1;1051,8}.\text{b2} * \text{static\_cast} < \text{signed int} > (\text{div2.quot}))) == \text{temp2}
\rightarrow [const static or extern object]
[54.3]\;(({\rm \$heap}_{init}.r2\;*\;{\bf static\_cast}{<}{\bf signed\;int}{>}({\rm div}2.rem))\;-
(\text{sheap}_{1032,1;1051,8}.\text{b2} * \text{static\_cast} < \text{signed int} > (\text{div2.quot}))) == \text{temp2}
\rightarrow [expand definition of constant 'r2' at prang.cpp (34,26)]
[54.4] (((int)172 * static_cast<signed int>(div2.rem)) -
(\text{sheap}_{1032,1;1051,8}.\text{b2} * \text{static\_cast} < \text{signed int} > (\text{div2.quot}))) == \text{temp2}
\rightarrow [simplify]
```

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[54.5] ((172 * static_cast < signed int > (div2.rem)) - ($heap_{1032,1:1051,8}.b2 *
static_cast<signed int>(div2.quot))) == temp2
\rightarrow [from term 18.6, div2 is equal to div(heapIs $heap_{funcstart_1032.1},
this.r.value(heapIs $heap_{funcstart\_1032,1}).p2, 176)]
[54.6] ((172 * static_cast<signed int>(div(heapIs heap_{funcstart\_1032,1},
this.r.value(heapIs \ heap_{funcstart\_1032.1}).p2, 176).rem)) -
(\text{sheap}_{1032,1;1051,8}.\text{b2} * \text{static\_cast} < \text{signed int} > (\text{div2.quot}))) == \text{temp2}
\rightarrow [simplify]
[54.7] \; ((172 \; * \; \mathrm{div}(\mathbf{heapIs} \; \$ \mathrm{heap}_{funcstart\_1032,1}, \; \mathbf{this}.\$ r. \mathbf{value}(\mathbf{heapIs} \;
\text{heap}_{funcstart\_1032.1}.p2, 176).rem) - (\text{heap}_{1032.1:1051.8}.b2 *
static_cast<signed int>(div2.quot))) == temp2
\rightarrow [from term 53.19, $heap<sub>1032,1;1051,8</sub> is equal to
\$heap_{funcstart\_1032,1}.\_\textbf{replace}(\textbf{this}.\$r \rightarrow \textbf{this}.\$r.\textbf{value}(\textbf{heapIs}
heap_{funcstart\_1032,1}._replace(p1 \rightarrow (-2 * div(heapIs \$heap_{funcstart\_1032,1}, -2))
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177).quot) + (171)
div(heapIs $heap_{tuncstart\_1032.1}, this.$r.value(heapIs
heap_{funcstart\_1032,1}.p1, 177.rem)))
[54.8] ((172 * div(heapIs $heap_{funcstart\_1032,1}, this.$r.value(heapIs)]
\rho_{uncstart\_1032,1}.p2, 176).rem – (\rho_{uncstart\_1032,1}.p2, 176).rem
\rightarrow this.$r.value(heapIs $heap_{tuncstart\_1032,1})._replace(p1 \rightarrow ((-2 *
div(\mathbf{heapIs} \$ heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
\text{Sheap}_{funcstart\_1032.1}, p1, 177).quot) + (171 * div(heapIs \text{Sheap}_{funcstart\_1032.1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177).rem)))).b2 *
static_cast<signed int>(div2.quot))) == temp2
\rightarrow [const member of object with modified fields]
[54.9] ((172 * div(heapIs $heap<sub>funcstart_1032,1</sub>, this.$r.value(heapIs)
\text{Sheap}_{funcstart\_1032,1}.p2, 176).rem) - (\text{Sheap}_{funcstart\_1032,1}.b2 *
static_cast<signed int>(div2.quot))) == temp2
\rightarrow [const static or extern object]
[54.10]~((172~^*~{\rm div}({\bf heap Is}~\${\rm heap}_{funcstart\_1032,1},~{\bf this.}\${\rm r.value}({\bf heap Is}
\rho_{uncstart\_1032,1}.p2, 176).rem – (\rho_{uncstart\_1032,1}.p2, 176).rem
int>(div2.quot))) == temp2
\rightarrow [expand definition of constant 'b2' at prang.cpp (36,26)]
[54.11] ((172 * div(heapIs $heap<sub>funcstart 1032.1</sub>, this.$r.value(heapIs
\theta_{tuncstart 1032.1}, p2, 176).rem) - ((int)35 * static_cast<signed)
int>(div2.quot)) == temp2
\rightarrow [simplify]
[54.12] ((172 * div(heapIs $heap_{funcstart\_1032,1}, this.$r.value(heapIs
\rho_{funcstart\_1032.1}.p2, 176).rem) - (35 * static_cast<signed)
int>(div2.quot)) = temp2
```

```
\rightarrow [from term 18.6, div2 is equal to div(heapIs $heap_{tuncstart\_1032.1},
this.r.value(heapIs $heap_{funcstart\_1032,1}).p2, 176)
[54.13] ((172 * div(heapIs $heap<sub>funcstart_1032,1</sub>, this.$r.value(heapIs
\rho_{tuncstart\_1032.1}, p2, 176).rem) - (35 * static_cast<signed)
int>(div(heapIs \$heap_{funcstart\_1032,1}, this.\$r.value(heapIs
\text{Sheap}_{funcstart\_1032,1}.p2, 176).quot))) == temp2
\rightarrow [simplify]
[54.18] 0 == (-\text{temp2} + (-35 * \text{div}(\text{heapIs} \$\text{heap}_{funcstart\_1032,1})]
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p2, 176).quot) + (172 *
div(\mathbf{heapIs} \$ heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
heap_{funcstart\_1032,1}.p2, 176).rem
[Take given term]
[57.0] $heap<sub>1032,1;1054,8</sub> == $heap<sub>1032,1;1051,8</sub>._replace(this.$r \rightarrow
operator*(heapIs heap_{1032,1;1051,8}, this)._replace(p2 \rightarrow
\mathbf{asType}{<} \text{P2Type}{>} ((\$\text{heap}_{1032,1;1051,8}.\text{M2} *
asType{<}int{>}(static\_cast{<}integer{>}(static\_cast{<}signed
int>(operator^*(heapIs $heap_{1032,1;1051,8}, this).p2) < (int)0))) + temp2)))
\rightarrow [from term 53.19, $heap<sub>1032,1;1051,8</sub> is equal to
\$heap_{funcstart\_1032,1}.\_\textbf{replace}(\textbf{this.}\$r \rightarrow \textbf{this.}\$r.\textbf{value}(\textbf{heapIs}
heap_{funcstart\_1032,1}._replace(p1 \rightarrow (-2 * div(heapIs \$heap_{funcstart\_1032,1}, -2))
div(heapIs $heap_funcstart_1032.1, this.$r.value(heapIs
heap_{funcstart_{1032,1}}.p1, 177).rem)))
[57.2] heap_{1032,1;1054,8} == heap_{funcstart\_1032,1}._replace(this.$r \rightarrow
this.$r.value(heapIs \rho_{uncstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs)
\rho_{tuncstart\_1032.1}, this.r.value(heapIs \rho_{tuncstart\_1032.1}).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.} \text{\$r.value}(\text{heapIs}))
\rho_{tuncstart\_1032.1}, p_1, 177, p_1, 177).
\theta_{funcstart\_1032,1}._replace(this.r \to this.r.value(heapIs)
\text{Sheap}_{funcstart\_1032.1}._replace(p1 \rightarrow (-2 * div(heapIs \text{Sheap}_{funcstart\_1032.1}).
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177).quot) + (171)
div(\mathbf{heapIs} \$ heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
\theta_{funcstart\_1032,1}.p1, 177).rem))), this)._replace(p2 \rightarrow
asType<P2Type>(($heap<sub>1032,1;1051,8</sub>.M2 *
asType < int > (static\_cast < integer > (static\_cast < signed
int>(operator^*(heapIs $heap_{1032,1:1051,8}, this).p2) < (int)0))) + temp2)))
→ [expand definition of operator '*' in class 'pointer' at built in declaration]
[57.3] \theta_{1032,1;1054,8} == \theta_{1032,1;1054,8} = \theta_{1032,1;1054,8} == \theta
this.$r.value(heapIs $heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\$heap_{funcstart\_1032,1},\, \textbf{this}.\$r.\textbf{value}(\textbf{heapIs}\,\,\$heap_{funcstart\_1032.1}).p1,
177).quot) + (171 * div(heapIs \theta_{funcstart\_1032,1}, this.r.value(heapIs)
\theta_{tuncstart\_1032,1}.p1, 177).rem)))).\_replace(this.\$r \rightarrow 0
```

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this.r.value(heapIs \ heap_{funcstart\_1032,1}.\_replace(this.\rdotsr) \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
\theta_{funcstart\_1032,1}.p1, 177).rem)))).\_replace(p2 \rightarrow
asType<P2Type>(($heap<sub>1032,1:1051,8</sub>.M2 *
asType<int>(static_cast<integer>(static_cast<signed
int>(operator^*(heapIs $heap_{1032,1:1051.8}, this).p2) < (int)(0))) + temp(2)))
\rightarrow [evaluate dereferenced pointer into modified heap]
[57.4] $heap<sub>1032,1:1054,8</sub> == $heap<sub>funcstart_1032,1</sub>._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
\$heap_{funcstart\_1032,1}).p1,\,177).rem)))).\_\mathbf{replace}(\mathbf{this}.\$r \rightarrow ([\mathbf{this}.\$r ==
this.$r]: this.$r.value(heap
Is $heap_{funcstart\_1032,1}).$_replace(p1 \rightarrow (-2 *
div(\mathbf{heapIs} \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
\text{Sheap}_{funcstart\_1032,1}.p1, 177).quot) + (171 * div(heapIs \text{Sheap}_{funcstart\_1032,1},
this.$r.value(heapIs heap_{funcstart\_1032.1}).p1, 177).rem)), []:
asType<P2Type>(($heap<sub>1032.1:1051.8</sub>.M2 *
asType<int>(static_cast<integer>(static_cast<signed
int>(operator^*(heapIs \$heap_{1032,1;1051,8}, this).p2) < (int)(0))) + temp(2)))
→ [explicitly assert falsehood of skipped guards in subsequent guards]
[57.5] heap_{1032,1;1054,8} == heap_{funcstart\_1032,1}._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this. r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs $heap<sub>funcstart_1032.1</sub>, this.$r.value(heapIs
\theta_{uncstart\_1032,1}.p1, 177).rem))))._replace(this.$r \rightarrow ([this.$r ===
this.$r]: this.$r.value(heapIs \rho_{funcstart\_1032,1})._replace(p1 \rightarrow (-2 *
div(\mathbf{heapIs} \$ heap_{funcstart\_1032.1}, \mathbf{this.}\$ r. \mathbf{value}(\mathbf{heapIs})
\text{Sheap}_{funcstart\_1032,1}.p1, 177).quot) + (171 * div(heapIs \text{Sheap}_{funcstart\_1032,1},
\mathbf{this.\$r.value(heapIs}~\$ \mathrm{heap}_{funcstart\_1032,1}).\mathrm{p1},~177).\mathrm{rem})),~[!(\mathbf{this.\$r}==
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p2 \rightarrow
asType<P2Type>(($heap<sub>1032,1;1051,8</sub>.M2 *
asType<int>(static_cast<integer>(static_cast<signed
int>(operator^*(heapIs $heap_{1032,1;1051,8}, this).p2) < (int)0))) + temp2)))
\rightarrow [simplify]
[57.7] heap_{1032,1;1054,8} == heap_{funcstart\_1032,1}._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs $heap<sub>funcstart_1032,1</sub>, this.$r.value(heapIs
\theta_{funcstart\_1032,1}.p1, 177).rem)))).replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
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\rho_{tuncstart=1032.1}, this.$r.value(heapIs \rho_{tuncstart=1032.1}).p1,
177).quot) + (171 * div(heapIs \theta_{funcstart\_1032,1}, this.r.value(heapIs)
\theta_{funcstart\_1032,1}.p1, 177).rem))).\_replace(p2 \rightarrow
asType<P2Type>(($heap<sub>1032,1:1051,8</sub>.M2 *
asType<int>(static_cast<integer>(static_cast<signed
int>(operator^*(heapIs $heap_{1032,1:1051,8}, this).p2) < (int)0))) + temp2)))
\rightarrow [from term 53.19, $heap_{1032,1;1051,8}$ is equal to
$heap_{funcstart\_1032,1}.$_{replace(this.$r} \rightarrow this.$r.value(heapIs)$
heap_{funcstart\_1032,1}._replace(p1 \rightarrow (-2 * div(heapIs p_{funcstart\_1032,1}).
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177).quot) + (171 *
div(\mathbf{heapIs}\ \$heap_{funcstart\_1032,1},\ \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}
heap_{funcstart_{-1032.1}}.p1, 177).rem)))
[57.8] $heap<sub>1032,1:1054,8</sub> == $heap<sub>funcstart_1032,1</sub>._replace(this.$r \rightarrow
this.$r.value(heapIs p_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
\theta_{funcstart\_1032,1}.p1, 177).rem))))._replace(this.$r \rightarrow
\textbf{this.}\$r.\textbf{value}(\textbf{heapIs}~\$heap_{funcstart\_1032,1}).\_\textbf{replace}(p1 \rightarrow ((\text{-}2~*\text{div}(\textbf{heapIs}
\theta_{funcstart\_1032,1}, this.r.value(heapIs \theta_{funcstart\_1032,1}).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.} \text{\$r.value}(\text{heapIs}))
\theta_{funcstart\_1032,1}.p1, 177).rem))).\_replace(p2 \rightarrow
asType<P2Type>((\$heap_{tuncstart\_1032.1}.\_replace(this.\$r \rightarrow
\textbf{this.\$r.value}(\textbf{heapIs}~\$ heap_{funcstart\_1032,1}).\_\textbf{replace}(p1 \rightarrow ((-2~*div(\textbf{heapIs}
\rho_{funcstart\_1032,1}, this.\r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.} \text{\$r.value}(\text{heapIs}))
heap_{funcstart\_1032,1}.p1, 177).rem))).M2 *
asType{<}int{>}(static\_cast{<}integer{>}(static\_cast{<}signed
int > (operator^*(heapIs \$heap_{1032,1;1051,8}, this).p2) < (int)0))) + temp2)))
→ [const member of object with modified fields]
[57.9] heap_{1032,1;1054,8} == heap_{funcstart\_1032,1}._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\$heap_{funcstart\_1032,1},\, \textbf{this.}\$r.\textbf{value}(\textbf{heapIs}\,\,\$heap_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(\mathbf{heapIs} \ \$heap_{funcstart\_1032,1}, \ \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
\theta_{funcstart\_1032,1}.p1, 177).rem))))._replace(this.$r \rightarrow
this.$r.value(heapIs \rho_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.}\text{\$r.value}(\text{heapIs}))
\theta_{funcstart\_1032,1}.p1, 177).rem))).\_replace(p2 \rightarrow
asType<P2Type>(($heap_funcstart_1032,1.M2 *
asType < int > (static\_cast < integer > (static\_cast < signed
int>(operator^*(heapIs $heap_{1032.1:1051.8}, this).p2) < (int)(0))) + temp(2)))
\rightarrow [const static or extern object]
[57.10] $\text{heap}_{1032,1;1054,8} == $\text{heap}_{funcstart\_1032,1}._\text{replace}(\text{this}.\text{$\frac{1}{2}r$})
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this.$r.value(heapIs \rho_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
\theta_{tuncstart\_1032,1}.p1, 177).rem)))).\_replace(this.\$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs $heap<sub>funcstart_1032,1</sub>, this.$r.value(heapIs
\theta_{tuncstart_{-1032.1}}.p1, 177).rem))._replace(p2 \rightarrow
asType<P2Type>(($heap<sub>init</sub>.M2 *
asType<int>(static_cast<integer>(static_cast<signed
int > (operator^*(heapIs \$heap_{1032,1;1051,8}, this).p2) < (int)0))) + temp2)))
\rightarrow [expand definition of constant 'M2' at prang.cpp (33,26)]
[57.11] $\text{heap}_{1032,1;1054,8} == $\text{heap}_{funcstart\_1032,1}._\text{replace}(\text{this}.\text{$\frac{1}{2}r$})
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(\mathbf{heapIs} \$ heap_{funcstart\_1032,1}, \mathbf{this}.\$ r. \mathbf{value}(\mathbf{heapIs})
\theta_{funcstart\_1032,1}.p1, 177).rem))))._replace(this.$r \rightarrow
\textbf{this.}\$r.\textbf{value}(\textbf{heapIs}~\$heap_{funcstart\_1032,1}).\_\textbf{replace}(p1 \rightarrow ((\text{-}2~*\text{div}(\textbf{heapIs}
\label{eq:heapIs} $ \text{heap}_{funcstart\_1032,1}, \, \textbf{this}. \\ \$r. \textbf{value}(\textbf{heapIs} \,\, \$ \text{heap}_{funcstart\_1032,1}). \\ \text{p1},
177).quot) + (171 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.} \text{\$r.value}(\text{heapIs}))
\theta_{funcstart\_1032.1}.p1, 177).rem))._replace(p2 \rightarrow
asType < P2Type > (((int)30307 *
asType<int>(static_cast<integer>(static_cast<signed
\mathbf{int} > (\mathbf{operator}^*(\mathbf{heapIs} \ \$ \mathrm{heap}_{1032,1;1051,8}, \ \mathbf{this}).\mathrm{p2}) < (\mathbf{int})0))) + \mathrm{temp2})))
\rightarrow [simplify]
[57.12] $\text{heap}_{1032,1;1054,8} == $\text{heap}_{funcstart\_1032,1}._\text{replace}(\text{this}.\text{$\frac{1}{2}r$})
this.$r.value(heapIs \rho_{tuncstart\_1032.1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.\r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.\$r.value}(\text{heapIs}))
\theta_{funcstart_{1032,1}}.p1, 177).rem))))._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\$heap_{funcstart\_1032,1},\, \textbf{this}.\$r.\textbf{value}(\textbf{heapIs}\,\,\$heap_{funcstart\_1032,1}).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.} \text{\$r.value}(\text{heapIs}))
heap_{funcstart\_1032,1}.p1, 177).rem)))._replace(p2 \rightarrow
asType<P2Type>((30307 *
asType<int>(static_cast<integer>(static_cast<signed
int>(operator^*(heapIs $heap_{1032,1;1051,8}, this).p2) < (int)(0))) + temp(2)))
\rightarrow [from term 53.19, $heap<sub>1032.1:1051.8</sub> is equal to
$heap_{funcstart\_1032,1}.$_replace(this.$r \rightarrow this.$r.value(heapIs)
heap_{funcstart\_1032,1}._replace(p1 \rightarrow (-2 * div(heapIs p_{funcstart\_1032,1}).
\textbf{this.\$r.value(heapIs}~\$heap_{funcstart\_1032,1}).p1,~177).quot) + (171~\$
div(\mathbf{heapIs} \ \$heap_{funcstart\_1032,1}, \ \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
heap_{funcstart_{-1032,1}}.p1, 177).rem)))]
```

```
[57.13] $\text{heap}_{1032,1;1054,8} == \text{$heap}_{funcstart\_1032,1}._\text{replace}(\text{this.}\text{$r} \to \text{$}
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
\theta_{tuncstart\_1032,1}.p1, 177).rem)))).\_replace(this.\$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032.1}, \text{this.} \text{\$r.value}(\text{heapIs}))
\theta_{funcstart\_1032,1}.p1, 177).rem)))._replace(p2 \rightarrow
asType<P2Type>((30307 *
asType < int > (static\_cast < integer > (static\_cast < signed)
int>(operator^*(heapIs \$heap_{funcstart\_1032.1}.\_replace(this.\$r \rightarrow
this.$r.value(heapIs heapIs_{funcstart\_1032,1})._replace(p1 \rightarrow (-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
\text{Sheap}_{funcstart\_1032.1}.p1, 177).rem)), this).p2) < (int)0))) + temp2)))
→ [expand definition of operator '*' in class 'pointer' at built in declaration]
[57.14] $heap<sub>1032.1:1054.8</sub> == $heap<sub>funcstart_1032.1</sub>._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs $heap_{tuncstart\_1032.1}, this.$r.value(heapIs
\theta_{funcstart\_1032,1}.p1, 177).rem)))).\_replace(this.\$r \rightarrow 0
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.\r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs $heap<sub>funcstart_1032.1</sub>, this.$r.value(heapIs
\theta_{funcstart\_1032,1}.p1, 177).rem))._replace(p2 \rightarrow
asType<P2Type>((30307 *
asType{<}int{>}(static\_cast{<}integer{>}(static\_cast{<}signed
int>(this.r.value(heapIs \ heap_{funcstart \ 1032.1}.\_replace(this.\rdots \ )
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
\$ heap_{funcstart\_1032,1}).p1,\ 177).rem))))).p2) < (\mathbf{int})0))) + temp2)))
\rightarrow [evaluate dereferenced pointer into modified heap]
[57.15] $heap<sub>1032,1;1054,8</sub> == $heap<sub>funcstart_1032,1</sub>._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
\theta_{tuncstart\_1032,1}.p1, 177).rem)))).\_replace(this.\$r \rightarrow
this.$r.value(heapIs \rho_{uncstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs)
\$heap_{funcstart\_1032,1},\, \textbf{this.}\$r.\textbf{value}(\textbf{heapIs}\,\,\$heap_{funcstart\_1032,1}).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.} \text{\$r.value}(\text{heapIs}))
\theta_{funcstart\_1032,1}.p1, 177).rem))).\_replace(p2 \rightarrow
asType<P2Type>((30307 *
```

```
asType<int>(static_cast<integer>(static_cast<signed int>(([this.$r
== this.$r]: this.$r.value(heapIs \rho_{tuncstart\_1032,1})._replace(p1 \rightarrow (-2 *
div(\mathbf{heapIs} \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
\text{Sheap}_{funcstart\_1032,1}.p1, 177).quot) + (171 * div(heapIs \text{Sheap}_{funcstart\_1032,1},
this.r.value(heapIs \ heap_{funcstart\_1032.1}).p1, 177).rem)), []:
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p2) < (int)0))) + temp2)))
→ [explicitly assert falsehood of skipped guards in subsequent guards]
[57.16] $heap<sub>1032,1:1054,8</sub> == $heap<sub>funcstart_1032,1</sub>._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.} \text{\$r.value}(\text{heapIs}))
\theta_{tuncstart\_1032,1}.p1, 177).rem)))).\_replace(this.\$r \rightarrow
this.$r.value(heapIs \frac{1}{2} heap\frac{1}{2} heap\frac{1}{2}
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs \theta_{funcstart\_1032,1}, this.r.value(heapIs)
\theta_{funcstart\_1032,1}.p1, 177).rem))).\_replace(p2 \rightarrow
asType<P2Type>((30307 *
asType < int > (static\_cast < integer > (static\_cast < signed\ int > (([this.\$r
== this.$r]: this.$r.value(heapIs \rho_{tuncstart\_1032.1})._replace(p1 \rightarrow (-2 *
div(\mathbf{heapIs} \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
\text{Sheap}_{funcstart\_1032.1}.p1, 177).quot) + (171 * div(heapIs \text{Sheap}_{funcstart\_1032.1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177).rem)), [!(this.<math>r = 
this.$r.value(heapIs \rho_{tuncstart\_1032.1}).p2) < (int)0))) +
temp2)))
\rightarrow [simplify]
[57.23] $\text{heap}_{1032,1;1054,8} == $\text{heap}_{funcstart\_1032,1}._\text{replace}(\text{this}.\text{$\frac{1}{2}r$})
this.$r.value(heapIs \rho_{uncstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(\mathbf{heapIs} \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}))
\theta_{funcstart\_1032,1}.p1, 177).rem)))).\_replace(this.\$r \rightarrow 0
this.$r.value(heapIs heap_{tuncstart = 1032.1})._replace(p1 \rightarrow ((-2 * div(heapIs
\$heap_{funcstart\_1032,1},\, \textbf{this}.\$r.\textbf{value}(\textbf{heapIs}\,\,\$heap_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs \theta_{funcstart\_1032,1}, this.r.value(heapIs)
\theta_{funcstart\_1032,1}.p1, 177).rem)))._replace(p2 \rightarrow
asType<P2Type>((30307 * asType<int>(static_cast<integer>(0 <
-this.r.value(heapIs heap_{funcstart\_1032,1}.p2))) + temp2)))
\rightarrow [from term 24.0, literala < -this.$r.value(heapIs $heap_{funcstart\_1032,1}).p2
is false whenever -2 < (0 + literala)
      Proof of rule precondition:
      [57.23.0] - 2 < (0 + 0)
      \rightarrow [simplify]
      [57.23.2] true
```

```
[57.24] $\text{heap}_{1032,1;1054,8} == $\text{heap}_{funcstart\_1032,1}._\text{replace}(\text{this}.\text{$\frac{1}{2}r$})
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
\theta_{tuncstart\_1032,1}.p1, 177).rem)))).\_replace(this.\$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032.1}, \text{this.} \text{\$r.value}(\text{heapIs}))
\theta_{funcstart\_1032,1}.p1, 177).rem)))._replace(p2 \rightarrow
asType<P2Type>((30307 * asType<int>(static_cast<integer>(false)))
+ \text{temp2})))
\rightarrow [simplify]
[57.25] $heap<sub>1032,1;1054,8</sub> == $heap<sub>funcstart_1032,1</sub>._replace(this.$r \rightarrow
this.$r.value(heapIs p_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(\mathbf{heapIs} \$ heap_{funcstart\_1032,1}, \mathbf{this}.\$ r. \mathbf{value}(\mathbf{heapIs})
\theta_{funcstart\_1032,1}.p1, 177).rem))))._replace(this.$r \rightarrow
\textbf{this.}\$r.\textbf{value}(\textbf{heapIs}~\$heap_{funcstart\_1032,1}).\_\textbf{replace}(p1 \rightarrow ((\text{-}2~*\text{div}(\textbf{heapIs}
\label{eq:heapIs} $ \text{heap}_{funcstart\_1032,1}, \, \textbf{this}. \\ \$r. \textbf{value}(\textbf{heapIs} \,\, \$ \text{heap}_{funcstart\_1032,1}). \\ \text{p1}, \\
177).quot) + (171 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
\theta_{funcstart\_1032.1}.p1, 177).rem))._replace(p2 \rightarrow
asType<P2Type>((30307 * asType<int>(([false]: 1, []: 0))) + temp2)))
→ [explicitly assert falsehood of skipped guards in subsequent guards]
[57.26] $heap<sub>1032,1;1054,8</sub> == $heap<sub>funcstart_1032,1</sub>._replace(this.$r \rightarrow
this.$r.value(heapIs \rho_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.\r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032.1}, \text{this.} \text{\$r.value}(\text{heapIs}))
\theta_{funcstart\_1032.1}.p1, 177).rem)))._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
$heap_funcstart_1032.1, this.$r.value(heapIs $heap_funcstart_1032.1).p1,
177).quot) + (171 * div(\mathbf{heapIs} \$heap_{funcstart\_1032,1}, \mathbf{this.\$r.value}(\mathbf{heapIs}))
heap_{funcstart\_1032,1}.p1, 177).rem))).\_replace(p2 \rightarrow
\mathbf{asType} \hspace{-0.5em} < \hspace{-0.5em} \text{P2Type} \hspace{-0.5em} > \hspace{-0.5em} ((30307 * \mathbf{asType} \hspace{-0.5em} < \hspace{-0.5em} \mathbf{int} \hspace{-0.5em} > \hspace{-0.5em} (([\mathbf{false}] \hspace{-0.5em} : \hspace{-0.5em} 1, \hspace{-0.5em} [\mathbf{true}] \hspace{-0.5em} : \hspace{-0.5em} 0))) \hspace{0.5em} + \hspace{0.5em} ((((\mathbf{false}) \hspace{-0.5em} : \hspace{-0.5em} 1, \hspace{-0.5em} [\mathbf{true}] \hspace{-0.5em} : \hspace{-0.5em} 0))) \hspace{0.5em} + \hspace{0.5em} ((((\mathbf{false}) \hspace{-0.5em} : \hspace{-0.5em} 1, \hspace{-0.5em} [\mathbf{true}] \hspace{-0.5em} : \hspace{-0.5em} 0))) \hspace{0.5em} + \hspace{0.5em} ((((\mathbf{false}) \hspace{-0.5em} : \hspace{-0.5em} 1, \hspace{-0.5em} [\mathbf{true}] \hspace{-0.5em} : \hspace{-0.5em} 0))) \hspace{0.5em} + \hspace{0.5em} ((((\mathbf{false}) \hspace{-0.5em} : \hspace{-0.5em} 1, \hspace{-0.5em} [\mathbf{true}] \hspace{-0.5em} : \hspace{-0.5em} 0))) \hspace{0.5em} + \hspace{0.5em} ((((\mathbf{false}) \hspace{-0.5em} : \hspace{-0.5em} 1, \hspace{-0.5em} [\mathbf{true}] \hspace{-0.5em} : \hspace{-0.5em} 0))) \hspace{0.5em} + \hspace{0.5em} ((((\mathbf{false}) \hspace{-0.5em} : \hspace{-0.5em} 1, \hspace{-0.5em} [\mathbf{true}] \hspace{-0.5em} : \hspace{-0.5em} 0))) \hspace{0.5em} + \hspace{0.5em} ((((\mathbf{false}) \hspace{-0.5em} : \hspace{-0.5em} 1, \hspace{-0.5em} [\mathbf{true}] \hspace{-0.5em} : \hspace{-0.5em} 0))) \hspace{0.5em} + \hspace{0.5em} ((((\mathbf{false}) \hspace{-0.5em} : \hspace{-0.5em} 1, \hspace{-0.5em} [\mathbf{true}] \hspace{-0.5em} : \hspace{-0.5em} 0))) \hspace{0.5em} + \hspace{0.5em} ((((\mathbf{false}) \hspace{-0.5em} : \hspace{-0.5em} 1, \hspace{-0.5em} [\mathbf{true}] \hspace{-0.5em} : \hspace{-0.5em} 0))) \hspace{0.5em} + \hspace{0.5em} ((((\mathbf{false}) \hspace{-0.5em} 1, \hspace{-0.5em} [\mathbf{true}] \hspace{-0.5em} : \hspace{-0.5em} 0))) \hspace{0.5em} + \hspace{0.5em} ((((\mathbf{false}) \hspace{-0.5em} 1, \hspace{-0.5em} [\mathbf{true}] \hspace{-0.5em} : \hspace{-0.5em} 0))) \hspace{0.5em} + \hspace{0.5em} (((\mathbf{false}) \hspace{-0.5em} 1, \hspace{-0.5em} [\mathbf{true}] \hspace{-0.5em} : \hspace{-0.5em} 0)) \hspace{0.5em} + \hspace{0.5em} (((\mathbf{false}) \hspace{-0.5em} 1, \hspace{-0.5em} [\mathbf{true}] \hspace{-0.5em} : \hspace{-0.5em} 0))) \hspace{0.5em} + \hspace{0.5em} (((\mathbf{false}) \hspace{-0.5em} 1, \hspace{-0.5em} [\mathbf{true}] \hspace{-0.5em} : \hspace{-0.5em} 0))) \hspace{0.5em} + \hspace{0.5em} (((\mathbf{false}) \hspace{-0.5em} 1, \hspace{-0.5em} [\mathbf{true}] \hspace{-0.5em} : \hspace{-0.5em} (((\mathbf{false}) \hspace{-0.5em} 1, \hspace{-0.5em} [\mathbf{true}] \hspace{-0.5em} : \hspace{-0.5em} (((\mathbf{false}) \hspace{-0.5em} 1, \hspace{-0.5em} 1, \hspace{-0.5em} [\mathbf{true}] \hspace{-0.5em} : \hspace{-0.5em} (((\mathbf{false}) \hspace{-0.5em} 1, \hspace{-0.5em} 1, \hspace{-0.5em} [\mathbf{true}] \hspace{-0.5em} : \hspace{-0.5em} (((\mathbf{false}) \hspace{-0.5em} 1, \hspace{-0.5em} 1, \hspace{-0.5em} 1, \hspace{-0.5em} 1, \hspace{-0.5em} 1, \hspace{-0.5em
temp2)))
\rightarrow [simplify]
[57.29] $\text{heap}_{1032.1:1054.8} == $\text{heap}_{funcstart\_1032.1}.$\text{-replace}(\text{this}.$\text{$r} \to \text{}]
this.$r.value(heapIs $heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
\theta_{tuncstart\_1032,1}.p1, 177).rem)))).\_replace(this.\$r \rightarrow 0
this.$r.value(heapIs p_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(\mathbf{heapIs} \ \$heap_{funcstart\_1032,1}, \ \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
```

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\frac{\text{sheap}_{funcstart\_1032.1}, p_1, 177, rem)}{\text{.replace}(p_2 \rightarrow asType < P_2Type > (0 + p_2))}
temp2)))
\rightarrow [from term 54.18, temp2 is equal to (-35 * div(heapIs $heap_{funcstart\_1032,1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p2, 176).quot) + (172 \ *
div(\mathbf{heapIs} \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
heap_{funcstart\_1032,1}.p2, 176).rem
[57.30] $heap<sub>1032,1:1054,8</sub> == $heap<sub>funcstart_1032,1</sub>._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{heap}_{funcstart\_1032,1}, \text{this.}\text{$r.value}(\text{heapIs}))
\theta_{tuncstart\_1032,1}.p1, 177).rem)))).\_replace(this.\$r \rightarrow
\textbf{this.}\$r.\textbf{value}(\textbf{heapIs}~\$heap_{funcstart\_1032,1}).\_\textbf{replace}(p1 \rightarrow ((-2~*div(\textbf{heapIs})))))
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
\rho_{uncstart\_1032,1}.p1, 177).rem))).\_replace(p2 \rightarrow asType < P2Type > (0 + p2).replace(p2 \rightarrow asType > (0 + p2).replace(p2 \rightarrow a
((-35 * div(\mathbf{heapIs} \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}))
\text{Sheap}_{funcstart\_1032,1}.p2, 176).quot) + (172 * div(heapIs \text{Sheap}_{funcstart\_1032,1},
this.r.value(heapIs \ heap_{funcstart\_1032.1}).p2, 176).rem))))
\rightarrow [simplify]
[57.33] $heap<sub>1032,1;1054,8</sub> == $heap<sub>funcstart_1032,1</sub>._replace(this.$r \rightarrow
this.$r.value(heapIs \rho_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.}\text{\$r.value}(\text{heapIs}))
\theta_{funcstart\_1032,1}.p1, 177).rem))))._replace(this.$r \rightarrow
\textbf{this.}\$r.\textbf{value}(\textbf{heapIs}~\$heap_{funcstart\_1032,1}).\_\textbf{replace}(p1 \rightarrow ((-2~*div(\textbf{heapIs})))))
\rho_{funcstart\_1032,1}, this. r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.} \text{\$r.value}(\text{heapIs}))
\rho_{funcstart\_1032,1}.p1, 177).rem))._replace(p2 \rightarrow ((-35 * div(heapIs
\rho_{funcstart\_1032,1}, this.\r.value(heapIs \rho_{funcstart\_1032,1}).p2,
176).quot) + (172 * div(heapIs $heap_{tuncstart\_1032.1}, this.$r.value(heapIs
heap_{funcstart_1032,1}.p2, 176).rem)))
[Take goal term]
[1.0] ($heap<sub>1032.1:1054.8</sub>.M3 *
asType<int>(static_cast<integer>(static_cast<signed
int>(operator^*(heapIs $heap_{1032,1:1054.8}, this).p3) < (int)0))) \le
maxof(signed int)
\rightarrow [from term 57.33, $heap<sub>1032.1:1054.8</sub> is equal to
$heap_{funcstart\_1032,1}.$-replace(this.$r \rightarrow this.$r.value(heapIs)
heap_{funcstart\_1032,1}._replace(p1 \rightarrow ((-2 * div(heapIs $heap_{funcstart\_1032,1},
this.$r.value(heapIs $heap_{funcstart\_1032,1}).p1, 177).quot) + (171)
div(\mathbf{heapIs} \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
\theta_{funcstart\_1032,1}.p1, 177).rem))))_replace(this.r \rightarrow 0
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs))
```

```
heap_{funcstart\_1032,1}, this.r.value(heapIs heap_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs $heap_{funcstart\_1032,1}, this.$r.value(heapIs)
heap_{funcstart\_1032,1}.p1, 177).rem))).\_replace(p2 \rightarrow (-35 * div(heapIs))).
heap_{funcstart\_1032,1}, this.r.value(heapIs heap_{funcstart\_1032,1}).p2,
176).quot) + (172 * div(\mathbf{heapIs} \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}))
heap_{funcstart_{1032,1}}.p2, 176).rem)))
[1.1] \; (\$ heap_{funcstart\_1032,1}.\_\textbf{replace}(\textbf{this}.\$r \to \textbf{this}.\$r.\textbf{value}(\textbf{heapIs}))
\text{Sheap}_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs \text{Sheap}_{funcstart\_1032,1},
this.$r.value(heapIs \rho_{tuncstart\_1032.1}).p1, 177).quot) + (171 *
div(\mathbf{heapIs} \$ heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
\theta_{funcstart\_1032,1}.p1, 177).rem))))._replace(this.$r \rightarrow
this.$r.value(heapIs \rho_{tuncstart\_1032.1})._replace(p1 \rightarrow ((-2 * div(heapIs
\theta_{funcstart\_1032,1}, this. r.value(heapIs \theta_{funcstart\_1032,1}).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.}\text{\$r.value}(\text{heapIs}))
\rho_{funcstart\_1032,1}.p1, 177).rem))._replace(p2 \rightarrow ((-35 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p2,
(176).\text{quot} + (172 * \text{div}(\text{heapIs } \text{heap}_{funcstart\_1032,1}, \text{this.}\text{$r.value}(\text{heapIs}))
\rho_{funcstart_{1032,1}}.p2, 176).rem)))).M3 *
as Type < int > (static\_cast < integer > (static\_cast < signed))
int>(operator^*(heapIs $heap_{1032,1:1054.8}, this).p3) < (int)0))) \le
maxof(signed int)
\rightarrow [const member of object with modified fields]
[1.3] ($heap<sub>funcstart_1032,1</sub>.M3 *
asType<int>(static_cast<integer>(static_cast<signed
int>(operator^*(heapIs $heap_{1032,1:1054,8}, this).p3) < (int)0))) \le
maxof(signed int)
\rightarrow [const static or extern object]
[1.4] ($heap<sub>init</sub>.M3 *
asType<int>(static_cast<integer>(static_cast<signed
int>(operator^*(heapIs $heap_{1032,1:1054,8}, this).p3) < (int)0))) \le
maxof(signed int)
\rightarrow [expand definition of constant 'M3' at prang.cpp (38,26)]
[1.5] ((int)30323 *
asType<int>(static_cast<integer>(static_cast<signed
int>(operator^*(heapIs \ heap_{1032,1;1054,8},\ this).p3)<(int)0)))\leq
maxof(signed\ int)
\rightarrow [simplify]
[1.6] (30323 * asType<int>(static_cast<integer>(static_cast<signed)
int>(operator^*(heapIs \$heap_{1032,1:1054.8}, this).p3) < (int)0))) \le
maxof(signed int)
\rightarrow [from term 57.33, $heap<sub>1032.1:1054.8</sub> is equal to
```

```
$heap_{funcstart\_1032.1}.$-replace(this.$r \rightarrow this.$r.value(heapIs)
heap_{funcstart\_1032,1}._replace(p1 \rightarrow ((-2 * div(heapIs $heap_{funcstart\_1032,1},
this.r.value(heapIs \ heap_{funcstart\_1032.1}).p1, 177).quot) + (171)
div(heapIs $heap_{funcstart\_1032,1}, this.$r.value(heapIs)
\theta_{funcstart\_1032,1}.p1, 177).rem)))).\_replace(this.\$r \rightarrow 0
this.r.value(heapIs \ heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs))
$heap_funcstart_1032,1, this.$r.value(heapIs $heap_funcstart_1032,1).p1,
177).quot) + (171 * div(heapIs $heap_{funcstart_1032,1}, this.$r.value(heapIs)
heap_{funcstart\_1032,1}.p1, 177).rem))).\_replace(p2 \rightarrow (-35 * div(heapIs))).
\$heap_{funcstart\_1032,1},\ \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}\ \$heap_{funcstart\_1032,1}).p2,
176).quot) + (172 * div(\textbf{heapIs } \$heap_{funcstart\_1032,1}, \textbf{this.}\$r.\textbf{value}(\textbf{heapIs}))
heap_{funcstart\_1032,1}.p2, 176).rem)))]
[1.7] (30323 * asType<int>(static_cast<integer>(static_cast<signed)
int>(operator^*(heapIs \$heap_{funcstart 1032.1}.\_replace(this.\$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs $heap<sub>funcstart_1032,1</sub>, this.$r.value(heapIs
\theta_{funcstart\_1032,1}.p1, 177).rem)))).\_replace(this.\$r \rightarrow 0
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs \theta_{funcstart\_1032,1}, this.r.value(heapIs)
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p2,
176).quot) + (172 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.}\text{\$r.value}(\text{heapIs}))
\frac{\text{sheap}_{funcstart}_{1032,1},p2,176}{\text{signed}}
→ [expand definition of operator '*' in class 'pointer' at built in declaration]
[1.8] (30323 * asType<int>(static_cast<integer>(static_cast<signed
int>(this.r.value(heapIs \ heap_{funcstart\_1032,1}.\_replace(this.\rdotsr)
this.$r.value(heapIs \rho_{uncstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(\mathbf{heapIs} \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}))
\theta_{funcstart\_1032,1}.p1, 177).rem))))._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032.1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{tuncstart_{1032.1}}, this.r.value(heapIs \rho_{tuncstart_{1032.1}}).p1,
177).quot) + (171 * div(heapIs \$heap_{funcstart\_1032,1}, this.\$r.value(heapIs))
\rho_{uncstart\_1032.1}.p1, 177).rem))._replace(p2 \rightarrow ((-35 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p2,
176).quot) + (172 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.} \text{\$r.value}(\text{heapIs}))
\theta_{tuncstart\_1032,1}.p2, 176).rem)))).p3) < (int)0)) \le maxof(signed int)
→ [evaluate dereferenced pointer into modified heap]
[1.9] (30323 * asType<int>(static_cast<integer>(static_cast<signed
int>(([this.\$r == this.\$r]: this.\$r.value(heapIs))
```

```
\text{Sheap}_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs \text{Sheap}_{funcstart\_1032,1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177).quot) + (171)
div(\mathbf{heapIs} \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
\theta_{funcstart\_1032,1}.p1, 177).rem))).\_replace(p2 \rightarrow (-35 * div(heapIs))).
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p2,
176).quot) + (172 * div(heapIs $heap<sub>funcstart_1032,1</sub>, this.$r.value(heapIs
\theta_{funcstart\_1032.1}.p2, 176).rem), [: this.$r.value(heapIs)
\theta_{tuncstart_1032,1}._replace(this.r \to this.r.value(heapIs)
\rho_{tuncstart_1032,1}._replace(p1 \rightarrow (-2 * div(heapIs \rho_{tuncstart_1032,1}).
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177).quot) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_1032,1}, \ \mathbf{this}.\$ r. \mathbf{value}(\mathbf{heapIs}
\text{Sheap}_{funcstart\_1032,1}.\text{p1}, 177).\text{rem})))).\text{p3}) < (int)0))) \leq \maxof(signed int)
→ [explicitly assert falsehood of skipped guards in subsequent guards]
[1.10] (30323 * asType<int>(static_cast<integer>(static_cast<signed)
int>(([this.$r == this.$r]: this.$r.value(heapIs
\text{Sheap}_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs \text{Sheap}_{funcstart\_1032,1},
this.r.value(heapIs $heap_{funcstart\_1032,1}).p1, 177).quot) + (171)^3
div(\mathbf{heapIs} \$heap_{funcstart\_1032.1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
\rho_{uncstart\_1032,1}.p1, 177).rem))).\_replace(p2 \rightarrow (-35 * div(heapIs))).
\rho_{funcstart\_1032,1}, this. r.value(heapIs \rho_{funcstart\_1032,1}).p2,
176).quot) + (172 * div(heapIs $heap<sub>funcstart_1032.1</sub>, this.$r.value(heapIs
heap_{funcstart\_1032,1}.p2, 176).rem), [!(this.$r == this.$r)]:
this.$r.value(heapIs \rho_{funcstart\_1032,1}._replace(this.$r \rightarrow
this.$r.value(heapIs $heap_{funcstart\_1032,1})._replace(p1 \rightarrow (-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.} \text{\$r.value}(\text{heapIs}))
\{\text{heap}_{funcstart\_1032,1}\}, p1, 177).rem\}\})))).p3) < (int)0))) \leq maxof(signed int)
\rightarrow [simplify]
[1.18] (30323 * asType<int>(static_cast<integer>(0 <
-this.$r.value(heapIs \theta_{funcstart_1032.1}).p3))) \leq \max_{funcstart_1032.1}).p3)))
\rightarrow [from term 40.0, literala < -this.$r.value(heapIs $heap_{funcstart\_1032,1}).p3
is false whenever -2 < (0 + literala)
    Proof of rule precondition:
    [1.18.0] - 2 < (0 + 0)
    \rightarrow [simplify]
    [1.18.2] true
[1.19] (30323 * asType<int>(static_cast<integer>(false))) <
maxof(signed int)
\rightarrow [simplify]
{\it [1.20]}\;(30323\;*\;\mathbf{asType}{<}\mathbf{int}{>}(([\mathbf{false}]:\;1,\;[]:\;0))) \leq \mathbf{maxof}(\mathbf{signed}\;\mathbf{int})
```

```
→ [explicitly assert falsehood of skipped guards in subsequent guards]
[1.21] (30323 * asType < int > (([false]: 1, [true]: 0))) <math>\leq maxof(signed int)
\rightarrow [simplify]
[1.26] true
Proof of verification condition: Arithmetic result of operator '+' is within
limit of type 'signed int'
In the context of class: WHPrang, declared at:
C:\Escher\Customers\prang-cpp\prang.cpp (18,1)
Condition generated at: C:\Escher\Customers\prang-cpp\prang.cpp
(81,16)
Condition defined at:
To prove: minof(signed int) \leq (($heap_{1032,1:1054,8}.M3 *
asType < int > (static\_cast < integer > (static\_cast < signed)
int>(operator^*(heapIs $heap_{1032.1:1054.8}, this).p3) < (int)0))) + temp3)
Given:
heap_{init}.LIMIT == (int)80
heap_{init}.class WHPrang \in M1 == (int)30269
heap_{init}.class WHPrang \in r1 == (int)171
heap_{init}.class WHPrang \in a1 == (int)177
heap_{init}.class WHPrang \in b1 == (int)2
heap_{init}.class WHPrang \in M2 == (int)30307
heap_{init}.class WHPrang \in r2 == (int)172
heap_{init}.class WHPrang \in a2 == (int)176
heap_{init}.class WHPrang \in b2 == (int)35
heap_{init}.class WHPrang \in M3 == (int)30323
heap_{init}.class WHPrang \in r3 == (int)170
heap_{init}.class WHPrang \in a3 == (int)178
heap_{init}.class WHPrang \in b3 == (int)63
\label{eq:div1} \text{div1} == \text{div}(\mathbf{heapIs} \ \$ \text{heap}_{funcstart\_1032,1},
\mathbf{static\_cast} {<} \mathbf{int} {>} (\mathbf{operator^*(heapIs}\ \$heap_{funcstart\_1032,1},\ \mathbf{this}).p1),
static\_cast < int > (\$heap_{funcstart\_1032,1}.a1))
(asType<integer>(static_cast<int>(operator*(heapIs
heap_{funcstart\_1032,1}, this).p1) /
asType < integer > (static\_cast < int > (\$heap_{funcstart\_1032.1}.a1))) = =
```

asType<integer>(div1.quot)

```
(asType<integer>(static_cast<int>(operator*(heapIs
heap_{funcstart\_1032,1}, this).p1) %
asType < integer > (static\_cast < int > (\$heap_{funcstart\_1032.1}.a1))) = =
asType<integer>(div1.rem)
(asType<integer>(operator*(heapIs $heap_{funcstart\_1032.1}, this).p1) <
asType < integer > (\$heap_{funcstart\_1032,1}.a1)) = >
(\mathbf{asType} < \mathbf{integer} > (\mathbf{div1.rem}) = = \mathbf{asType} < \mathbf{integer} > (\mathbf{operator}^*(\mathbf{heapIs}))
heap_{funcstart\_1032,1}, this).p1)
(asType < integer > (\$heap_{funcstart\_1032,1}.a1) \le
asType < integer > (operator*(heapIs $heap_{funcstart\_1032,1}, this).p1)) =>
!(0 == asType < integer > (div1.quot))
!(0 == asType < integer > (div1.rem)) || !(0 ==
asType<integer>(div1.quot))
div2 == div(\mathbf{heapIs} \$heap_{funcstart\_1032,1},
static_cast<int>(operator*(heapIs $heap_{funcstart\_1032.1}, this).p2),
\mathbf{static\_cast}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_1032,1}.\mathrm{a2}))
(asType<integer>(static_cast<int>(operator*(heapIs
heap_{funcstart\_1032.1}, this).p2)
asType < integer > (static\_cast < int > (\$heap_{funcstart\_1032.1}.a2))) = =
asType<integer>(div2.quot)
(asType<integer>(static_cast<int>(operator*(heapIs
heap_{funcstart\_1032,1}, this).p2) %
asType < integer > (static\_cast < int > (\$heap_{funcstart\_1032.1}.a2))) = =
asType<integer>(div2.rem)
(\mathbf{asType}{<}\mathbf{integer}{>}(\mathbf{operator}^*(\mathbf{heapIs}\ \$\mathbf{heap}_{funcstart\_1032,1},\ \mathbf{this}).\mathtt{p2}) <
asType < integer > (\$heap_{funcstart\_1032.1}.a2)) = >
(asType<integer>(div2.rem) == asType<integer>(operator*(heapIs
heap_{funcstart\_1032.1}, this).p2)
(\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathsf{heap}_{funcstart\_1032,1}.\mathsf{a2}) \leq
asType<integer>(operator*(heapIs $heap_funcstart_1032,1, this).p2)) =>
!(0 == asType < integer > (div2.quot))
!(0 == asType < integer > (div2.rem)) || !(0 ==
asType<integer>(div2.quot))
div3 == div(\mathbf{heapIs} \$heap_{funcstart\_1032,1},
static\_cast < int > (operator*(heapIs $heap_{funcstart\_1032,1}, this).p3),
static\_cast < int > (\$heap_{funcstart\_1032,1}.a3))
(asType < integer > (static\_cast < int > (operator*(heapIs)))
heap_{funcstart\_1032.1}, this).p3)
asType < integer > (static\_cast < int > (\$heap_{funcstart\_1032.1}.a3))) = =
asType<integer>(div3.quot)
(asType < integer > (static\_cast < int > (operator*(heapIs)))
```

```
heap_{funcstart_{-1032.1}}, this).p3)
\mathbf{asType} < \mathbf{integer} > (\mathbf{static\_cast} < \mathbf{int} > (\$ \mathbf{heap}_{funcstart\_1032,1}.\mathbf{a3}))) = =
asType<integer>(div3.rem)
(\mathbf{asType}{<}\mathbf{integer}{>}(\mathbf{operator}^*(\mathbf{heapIs}\ \$\mathbf{heap}_{funcstart\_1032,1},\ \mathbf{this}).\mathrm{p3}) <
asType < integer > (\$heap_{funcstart\_1032.1}.a3)) = >
(asType<integer>(div3.rem) == asType<integer>(operator*(heapIs
heap_{funcstart\_1032,1}, this).p3)
(\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathsf{heap}_{funcstart\_1032,1}.\mathsf{a3}) \leq
asType < integer > (operator*(heapIs $heap_{funcstart\_1032,1}, this).p3)) = > 
!(0 == asType < integer > (div3.quot))
!(0 == asType < integer > (div3.rem)) || !(0 ==
asType<integer>(div3.quot))
temp1 == (\$heap_{funcstart\_1032,1}.r1 * static\_cast < signed int > (div1.rem)) -
(\text{\$heap}_{funcstart\_1032,1}.\text{b1 * static\_cast} < \text{signed int} > (\text{div1.quot}))
minof(signed int) < temp1
temp1 \le maxof(signed int)
\theta_{1032,1:1051,8} == \theta_{1032
operator*(heapIs heap_{funcstart\_1032,1}, this)._replace(p1 \rightarrow
asType < P1Type > ((\$heap_{funcstart\_1032,1}.M1 *
asType < int > (static\_cast < integer > (static\_cast < signed
int>(operator^*(heapIs \$heap_{funcstart\_1032,1}, this).p1) < (int)0))) +
temp1)))
temp2 == (\$heap_{1032,1;1051,8}.r2 * \textbf{static\_cast} < \textbf{signed int} > (div2.rem)) -
(\text{sheap}_{1032.1:1051.8}.\text{b2} * \text{static\_cast} < \text{signed int} > (\text{div2.quot}))
minof(signed int) \le temp2
temp2 < maxof(signed int)
\text{heap}_{1032,1;1054,8} == \text{heap}_{1032,1;1051,8}.\_\text{replace}(\text{this}.\$r \rightarrow
operator*(heapIs \theta_{1032,1;1051,8}, this)._replace(p2 \rightarrow
asType<P2Type>(($heap<sub>1032.1:1051.8</sub>.M2 *
asType<int>(static_cast<integer>(static_cast<signed
int>(operator^*(heapIs $heap_{1032,1;1051,8}, this).p2) < (int)(0))) + temp(2)))
temp3 == (\$heap_{1032,1;1054,8}.r3 * static\_cast < signed int > (div3.rem)) -
(\text{sheap}_{1032.1:1054.8}.\text{b3} * \text{static\_cast} < \text{signed int} > (\text{div}3.\text{quot}))
minof(signed int) \le temp3
temp3 < maxof(signed int)
Proof:
[Take given term]
[2.0] div1 == div(heapIs $heap_{funcstart\_1032,1},
```

```
static_cast<int>(operator*(heapIs $heap_{funcstart_1032.1}, this).p1),
static\_cast < int > (\$heap_{funcstart\_1032,1}.a1))
→ [expand definition of operator '*' in class 'pointer' at built in declaration]
[2.1] \text{ div1} == \text{div}(\mathbf{heapIs} \$ \text{heap}_{funcstart\_1032,1},
static\_cast < int > (this. r.value(heapIs  heap_{funcstart\_1032,1}).p1),
static\_cast < int > (\$heap_{funcstart\_1032.1}.a1))
\rightarrow [simplify]
[2.2] \operatorname{div1} == \operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_1032,1}, \mathbf{this}.\$ r. \mathbf{value}(\mathbf{heapIs}))
\label{eq:cast_int} $$  \parbox{$heap_{funcstart\_1032,1}.p1, static\_cast< int>($heap_{funcstart\_1032,1}.a1))} $$
\rightarrow [const static or extern object]
[2.3] \text{ div1} == \text{div(heapIs } \text{$heap}_{funcstart\_1032,1}, \text{this.} \text{$r.value(heapIs)}
\theta_{funcstart\_1032,1}.p1, \theta_{funcstart\_1032,1}.p1, \theta_{funcstart\_1032,1}.p1, \theta_{funcstart\_1032,1}.p1
\rightarrow [expand definition of constant 'a1' at prang.cpp (30,26)]
[2.4] \text{ div1} == \text{div}(\text{heapIs } \text{heap}_{funcstart\_1032,1}, \text{this.}\text{\$r.value}(\text{heapIs})
\theta_{tuncstart\_1032.1}.p1, \theta_{tuncstart}.p1, \theta_{tuncstart\_1032.1}.p1, \theta_{tuncstart}.p1, \theta_{tuncstart\_1032.1}.p1, \theta_{tuncstart\_1032.1}.p1, \theta_{tuncstart\_1032.1}.p1, \theta_{tuncstart\_1032.1}.p1, \theta_{tuncstart\_1032.1}.p1, \theta_{tuncstart\_1032.1}.p2, \theta_{tuncstart\_1032.1}.p2, \theta_{tuncstart\_1032.1}.p2, \theta_{tuncstart\_1032.1}.p2, \theta_{tuncstart\_1032.1}.p2, \theta_{tuncstart\_1032.1}.p2, \theta_{tuncstart\_1032.1}.p3, \theta_{tuncstart\_1032.1}.p2, \theta_{tuncstart\_1032.1}.p3, \theta_{tuncstart\_1032.1}.p4, \theta_{tuncstart\_1032.1}.p3, \theta_{tuncstart\_1032.1}.p3, \theta_{tuncstart\_1032.1}.p4, \theta_{tuncstart\_1032.1}.p4, \theta_{tuncstart\_1032.1}.p4, \theta_{tuncstart\_1032.1}.p5, \theta_{tuncstart\_1032.1}.p5, \theta_{tuncstart\_1032.1}.p5, \theta_{tuncstart\_1032.1}.p6, \theta_{tuncstart\_1032.1}.p6, \theta_{tuncstart\_1032.1}.p7, \theta_{tun
\rightarrow [simplify]
[2.6] \operatorname{div1} == \operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_1032,1}, \mathbf{this}.\$ r. \mathbf{value}(\mathbf{heapIs}))
heap_{funcstart_{-1032,1}}.p1, 177)
[Assume known post-assertion, class invariant or type constraint for term 2.6]
[7.0] (0 < asType<integer>(this.$r.value(heapIs
\verb§heap$_{funcstart\_1032,1}).p1)) \&\& (\mathbf{asType} < \mathbf{integer} > (\mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}))) \&\& (\mathbf{asType} < \mathbf{integer} > (\mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})))) \&\& (\mathbf{asType} < \mathbf{integer} > (\mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})))) \&\& (\mathbf{asType} < \mathbf{integer} > (\mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})))) \&\& (\mathbf{asType} < \mathbf{integer} > (\mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}))))) \&\& (\mathbf{asType} < \mathbf{integer} > (\mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})))) \&\& (\mathbf{asType} < \mathbf{integer} > (\mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}))))) \&\& (\mathbf{asType} < \mathbf{integer} > (\mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}))))) \&\& (\mathbf{asType} < \mathbf{integer} > (\mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})))) \&\& (\mathbf{asType} < \mathbf{integer} > (\mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}))))) \&\& (\mathbf{asType} < \mathbf{integer} > (\mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}))))) \&\& (\mathbf{asType} < \mathbf{integer} > (\mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})))))) \&\& (\mathbf{asType} < \mathbf{integer} > (\mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}))))))
\$heap_{funcstart\_1032,1}).p1) < \mathbf{asType} < \mathbf{integer} > (\$heap.\mathbf{class} \ WHPrang \in \texttt{Constant}) + \texttt{Constant} = \texttt{Constant} 
M1))
\rightarrow [simplify]
[7.2] (0 < this.$r.value(heapIs \rho_{funcstart\_1032,1}).p1) &&
(this.r.value(heapIs $heap_{funcstart\_1032,1}).p1 <
asType < integer > (\text{$heap.class WHPrang} \in M1))
\rightarrow [const static or extern object]
[7.3] (0 < this.$r.value(heapIs \rho_{funcstart\_1032,1}).p1) &&
(this.r.value(heapIs $heap_{funcstart\_1032,1}).p1 <
asType < integer > (\$heap_{init}.class WHPrang \in M1))
→ [expand definition of constant 'M1' at prang.cpp (28,26)]
[7.4] (0 < this.$r.value(heap
Is \rho_{funcstart\_1032,1}).p1) &&
(this.$r.value(heapIs \rho_{funcstart\_1032,1}).p1 <
asType < integer > ((int)30269))
\rightarrow [simplify]
[7.10] (-30269 < -this.$r.value(heapIs heap_{funcstart\_1032,1}).p1) \land (0 <
```

```
\mathbf{this.\$r.value}(\mathbf{heapIs}~\$\mathbf{heap}_{funcstart\_1032,1}).\mathbf{p1})
[Work on sub-term 2 of conjunction in term 7.10]
[8.0] 0 < this.$r.value(heap
Is \rho_{funcstart\_1032,1}).p1
[Take given term]
[18.0] div2 == div(heapIs heap_{funcstart\_1032,1},
static_cast<int>(operator*(heapIs $heap_{funcstart\_1032,1}, this).p2),
\mathbf{static\_cast}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_1032,1}.\mathrm{a2}))
→ [expand definition of operator '*' in class 'pointer' at built in declaration]
[18.1] \operatorname{div2} == \operatorname{div}(\mathbf{heapIs} \ \text{$heap}_{funcstart\_1032,1},
static_cast<int>(this.$r.value(heapIs $heap_{tuncstart\_1032.1}).p2),
\mathbf{static\_cast} < \mathbf{int} > (\$ \mathbf{heap}_{funcstart\_1032,1}.\mathbf{a2}))
\rightarrow [simplify]
[18.2] \text{div2} == \text{div}(\mathbf{heapIs} \text{\$heap}_{funcstart\_1032,1}, \mathbf{this}.\text{\$r.value}(\mathbf{heapIs})
\theta_{funcstart\_1032,1}.p2, \theta_{funcstart\_1032,1}.a2)
\rightarrow [const static or extern object]
[18.3] div2 == div(\mathbf{heapIs} \ \hat{\mathbf{s}}_{heap}_{funcstart\_1032,1}, \ \mathbf{this}. \hat{\mathbf{s}}_{r}. \mathbf{value}(\mathbf{heapIs})
\$ heap_{funcstart\_1032,1}).p2, \ \mathbf{static\_cast} < \mathbf{int} > (\$ heap_{init}.a2))
\rightarrow [expand definition of constant 'a2' at prang.cpp (35,26)]
[18.4] div2 == div(heapIs heapIs  heap_{funcstart\_1032,1}, this.r.value(heapIs)
\theta_{funcstart\_1032,1}.p2, \theta_{funcstart} (int)176)
\rightarrow [simplify]
[18.6] \text{ div2} == \text{div}(\mathbf{heapIs} \$ \mathbf{heap}_{funcstart\_1032,1}, \mathbf{this.\$r.value}(\mathbf{heapIs}))
heap_{funcstart_{1032,1}}.p2, 176
[Assume known post-assertion, class invariant or type constraint for term 18.6]
[23.0]~(0 < \mathbf{asType} < \mathbf{integer} > (\mathbf{this.\$r.value} (\mathbf{heapIs}
\theta_{uncstart\_1032,1}.p2) & (asType<integer>(this.$r.value(heapIs)
\$heap_{funcstart\_1032,1}).p2) < \mathbf{asType} < \mathbf{integer} > (\$heap.\mathbf{class} \ WHPrang \in \texttt{Constart} = \texttt{Constart} =
M2))
\rightarrow [simplify]
[23.2] (0 < this.$r.value(heap
Is $heap_{funcstart\_1032,1}).p2) &&
(this.r.value(heapIs $heap_{funcstart\_1032.1}).p2 <
asType < integer > (\$heap.class WHPrang \in M2))
\rightarrow [const static or extern object]
[23.3] (0 < this.$r.value(heap
Is \rho_{uncstart\_1032,1}).p2) &&
(this.r.value(heapIs $heap_{funcstart\_1032,1}).p2 <
asType < integer > (\$heap_{init}.class WHPrang \in M2))
\rightarrow [expand definition of constant 'M2' at prang.cpp (33,26)]
```

```
[23.4] (0 < this.$r.value(heapIs $heap_{funcstart\_1032,1}).p2) &&
(this.r.value(heapIs $heap_{funcstart\_1032,1}).p2 <
asType < integer > ((int)30307))
\rightarrow [simplify]
[23.10] (-30307 < -this.$r.value(heapIs $heap_{funcstart\_1032,1}).p2) \land (0 <
this.r.value(heapIs $heap_{funcstart\_1032,1}).p2)
[Work on sub-term 2 of conjunction in term 23.10]
[24.0] 0 < this.$r.value(heapIs $heap_{funcstart\_1032,1}).p2
[Take given term]
[34.0] div3 == div(heapIs heap_{funcstart\_1032,1},
static\_cast < int > (operator*(heapIs $heap_{funcstart\_1032,1}, this).p3),
\mathbf{static\_cast}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_1032,1}.\mathrm{a3}))
→ [expand definition of operator '*' in class 'pointer' at built in declaration]
[34.1] \text{ div3} == \text{div}(\mathbf{heapIs} \$ heap_{funcstart\_1032,1},
static_cast<int>(this.$r.value(heapIs $heap_{tuncstart\_1032.1}).p3),
\mathbf{static\_cast}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_1032,1}.\mathrm{a3}))
\rightarrow [simplify]
[34.2] div3 == div(heapIs heapIs heapIs this.r.value(heapIs
\theta_{funcstart\_1032,1}.p3, \theta_{funcstart\_1032,1}.p3, \theta_{funcstart\_1032,1}.a3)
\rightarrow [const static or extern object]
[34.3] \text{ div3} == \text{div(heapIs $heap}_{funcstart\_1032,1}, \text{ this.} \text{\$r.value(heapIs)}
\theta_{funcstart\_1032,1}.p3, \theta_{funcstart\_1032,1}.p4, \theta_{funcstart\_1032,1}.p4, \theta_{funcstart\_1032,1}.p4, \theta_{funcstart\_1032,1}.p5, \theta_{funcstart\_1032,1}.p5, \theta_{funcstart\_1032,1}.p5, \theta_{funcstart\_1032,1}.p5, \theta_{funcstart\_1032,1}.p5, \theta_{funcstart\_1032,1
\rightarrow [expand definition of constant 'a3' at prang.cpp (40,26)]
[34.4] div3 == div(heapIs $heap_{tuncstart\_1032.1}, this.$r.value(heapIs)
\label{eq:cast_int} $$ \rho_{tuncstart\_1032,1}.p3, \ \mathbf{static\_cast} < \mathbf{int} > ((\mathbf{int})178)) $$
\rightarrow [simplify]
 [34.6] \text{ div3} == \text{div(heapIs $heap}_{funcstart\_1032,1}, \text{ this.} \text{\$r.value(heapIs)}
heap_{funcstart\_1032,1}.p3, 178)
[Assume known post-assertion, class invariant or type constraint for term 34.6]
[39.0] (0 < asType<integer>(this.$r.value(heapIs
$\text{heap}_{funcstart_1032.1}\text{.p3})) && (asType<integer>(this.$r.value(heapIs)
\label{eq:class} \$ heap_{funcstart\_1032,1}).p3) < \mathbf{asType} < \mathbf{integer} > (\$ heap.\mathbf{class} \ \mathbf{WHPrang} \in \texttt{Constart} = \texttt{Con
M3)
\rightarrow [simplify]
[39.2] (0 < this.$r.value(heapIs heap_{funcstart\_1032,1}).p3) &&
(this.r.value(heapIs $heap_{funcstart\_1032,1}).p3 <
asType < integer > (\text{$heap.class WHPrang} \in M3))
```

```
\rightarrow [const static or extern object]
[39.3] (0 < this.$r.value(heapIs heap_{funcstart\_1032,1}).p3) &&
(this.$r.value(heapIs heap_{funcstart\_1032,1}).p3 <
asType < integer > (\$heap_{init}.class WHPrang \in M3))
\rightarrow [expand definition of constant 'M3' at prang.cpp (38,26)]
[39.4] (0 < this.$r.value(heap
Is $heap_{funcstart\_1032,1}).p3) &&
(this.r.value(heapIs $heap_{funcstart\_1032,1}).p3 <
asType<integer>((int)30323))
\rightarrow [simplify]
[39.10] (-30323 < -this.$r.value(heapIs $heap_{funcstart\_1032,1}).p3) \land (0 <
this.r.value(heapIs $heap_{funcstart\_1032,1}).p3)
[Work on sub-term 2 of conjunction in term 39.10]
[40.0] 0 < this.$r.value(heapIs \theta_{funcstart\_1032,1}).p3
[Take given term]
[50.0] \; ((\$ heap_{funcstart\_1032,1}.r1 \; * \; \textbf{static\_cast} < \textbf{signed int} > (\text{div1.rem})) \; - \; \text{div1.rem})) \; - \; \text{div1.rem})) \; - \; \text{div1.rem}) \; - \; \text{di
(\text{sheap}_{funcstart\_1032,1}.\text{b1 * static\_cast} < \text{signed int} > (\text{div1.quot}))) = = \text{temp1}
\rightarrow [const static or extern object]
[50.1] (($heap<sub>init</sub>.r1 * static_cast<signed int>(div1.rem)) -
(\text{sheap}_{funcstart\_1032,1}.\text{b1 * static\_cast} < \text{signed int} > (\text{div1.quot}))) == \text{temp1}
\rightarrow [expand definition of constant 'r1' at prang.cpp (29,26)]
[50.2] (((int)171 * static_cast<signed int>(div1.rem)) -
($heap_tuncstart_1032.1.b1 * static_cast<signed int>(div1.quot))) == temp1
\rightarrow [simplify]
[50.3] ((171 * static_cast < signed int > (div1.rem)) - ($heap_{funcstart\_1032.1}.b1
* static_cast<signed int>(div1.quot))) == temp1
\rightarrow [from term 2.6, div1 is equal to div(heapIs $heap_{funcstart\_1032,1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177)]
[50.4] ((171 * static_cast < signed int > (div(heapIs heap_{funcstart\_1032,1},
this.r.value(heapIs $heap_{funcstart\_1032,1}).p1, 177).rem)) -
(\text{sheap}_{funcstart\_1032,1}.\text{b1 * static\_cast} < \text{signed int} > (\text{div1.quot}))) == \text{temp1}
\rightarrow [simplify]
[50.5] ((171 * div(heapIs $heap_{funcstart\_1032,1}, this.$r.value(heapIs)
\text{Sheap}_{funcstart\_1032,1}.p1, 177).rem) - (\text{Sheap}_{funcstart\_1032,1}.b1 *
static_cast<signed int>(div1.quot))) == temp1
\rightarrow [const static or extern object]
[50.6] ((171 * \mathrm{div}(\mathbf{heapIs}\ \$\mathrm{heap}_{funcstart\_1032,1},\ \mathbf{this}.\$\mathrm{r.value}(\mathbf{heapIs}
\theta_{funcstart\_1032,1}.p1, 177).rem) - (\theta_{init}.b1 * static_cast<signed)
```

```
int>(div1.quot)) == temp1
\rightarrow [expand definition of constant 'b1' at prang.cpp (31,26)]
[50.7] ((171 * \operatorname{div}(\mathbf{heapIs} \ \mathbf{sheap}_{funcstart\_1032,1}, \ \mathbf{this}.\mathbf{sr.value}(\mathbf{heapIs})
\theta_{funcstart\_1032,1}.p1, 177).rem) - ((int)2 * static_cast<signed)
int>(div1.quot)) == temp1
\rightarrow [simplify]
[50.8] ((171 * div(heapIs $heap<sub>funcstart_1032,1</sub>, this.$r.value(heapIs)
\theta_{funcstart\_1032,1}.p1, 177).rem) - (2 * static_cast<signed)
int>(div1.quot)) = temp1
\rightarrow [from term 2.6, div1 is equal to div(heapIs $heap_{funcstart\_1032,1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177)]
[50.9] ((171 * div(heapIs $heap<sub>funcstart_1032,1</sub>, this.$r.value(heapIs)
\theta_{tuncstart\_1032.1}.p1, 177).rem) - (2 * static_cast<signed)
int>(div(heapIs \$heap_{funcstart\_1032,1}, this.\$r.value(heapIs
\text{Sheap}_{funcstart\_1032,1}).p1, 177).quot))) == temp1
\rightarrow [simplify]
[50.14] 0 == (-\text{temp1} + (-2 * \text{div}(\text{heapIs} \$\text{heap}_{funcstart\_1032,1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177).quot) + (171 *
div(\mathbf{heapIs} \$ heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
heap_{funcstart_{1032,1}}.p1, 177).rem
[Take given term]
[53.0] heap_{1032,1;1051,8} == heap_{funcstart\_1032,1}._replace(this.$r \rightarrow
operator*(heapIs heap_{funcstart\_1032,1}, this)._replace(p1 \rightarrow
asType < P1Type > ((\$heap_{funcstart\_1032,1}.M1 *
asType<int>(static_cast<integer>(static_cast<signed
int>(operator^*(heapIs \$heap_{funcstart\_1032,1}, this).p1) < (int)0))) +
temp1)))
→ [expand definition of operator '*' in class 'pointer' at built in declaration]
[53.1] heap_{1032,1;1051,8} == heap_{funcstart\_1032,1}._replace(this.r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow
asType < P1Type > ((\$heap_{funcstart\_1032,1}.M1 *
asType{<}int{>}(static\_cast{<}integer{>}(static\_cast{<}signed
int>(operator^*(heapIs $heap_{funcstart\_1032.1}, this).p1) < (int)0))) +
temp1)))
\rightarrow [const static or extern object]
[53.2] heap_{1032,1;1051,8} == heap_{funcstart\_1032,1}._replace(this.r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow
asType < P1Type > ((\$heap_{init}.M1 *
asType<int>(static_cast<integer>(static_cast<signed
int>(operator^*(heapIs $heap_{funcstart\_1032,1}, this).p1) < (int)0))) +
```

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temp1)))
\rightarrow [expand definition of constant 'M1' at prang.cpp (28,26)]
[53.3] heap_{1032,1;1051,8} == heap_{funcstart\_1032,1}._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow
asType<P1Type>(((int)30269 *
asType < int > (static\_cast < integer > (static\_cast < signed
int>(operator^*(heapIs \$heap_{funcstart\_1032,1}, this).p1) < (int)0))) +
temp1)))
\rightarrow [simplify]
[53.4] heap_{1032,1;1051,8} == heap_{funcstart\_1032,1}._replace(this.r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032.1})._replace(p1 \rightarrow
asType<P1Type>((30269 *
as Type < int > (static\_cast < integer > (static\_cast < signed))
int>(operator^*(heapIs \$heap_{funcstart\_1032,1}, this).p1) < (int)0))) +
temp1)))
→ [expand definition of operator '*' in class 'pointer' at built in declaration]
[53.5] heap_{1032,1;1051,8} == heap_{funcstart\_1032,1}._replace(this.$r \rightarrow
this.$r.value(heapIs $heap_{funcstart\_1032,1}).\_replace(p1 \rightarrow
asType<P1Type>((30269 *
as Type < int > (static\_cast < integer > (static\_cast < signed))
int>(this.\$r.value(heapIs \$heap_{funcstart\_1032,1}).p1) < (int)0))) + temp1)))
\rightarrow [simplify]
[53.9] $\text{heap}_{1032,1:1051,8} == $\text{heap}_{funcstart\_1032,1}._\text{replace}(\text{this}.$\text{$r} \to \text{$r$}
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow
{\bf asType}{<} P1Type{>} ((30269 * {\bf asType}{<} {\bf int}{>} ({\bf static\_cast}{<} {\bf integer}{>} (0 <
-this.r.value(heapIs heap_{funcstart\_1032,1}.p1))) + temp1)))
\rightarrow [from term 8.0, literala < -this.$r.value(heapIs $heap_{funcstart\_1032,1}).p1
is false whenever -2 < (0 + literala)
   Proof of rule precondition:
   [53.9.0] - 2 < (0 + 0)
   \rightarrow [simplify]
   [53.9.2] true
[53.10] $heap<sub>1032,1;1051,8</sub> == $heap<sub>funcstart_1032,1</sub>._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow
asType<P1Type>((30269 * asType<int>(static_cast<integer>(false)))
+ \text{temp1})))
\rightarrow [simplify]
[53.11] heap_{1032,1:1051,8} == heap_{funcstart\_1032,1}._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow
```

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asType<P1Type>((30269 * asType<int>(([false]: 1, []: 0))) + temp1)))
→ [explicitly assert falsehood of skipped guards in subsequent guards]
[53.12] $\text{heap}_{1032,1:1051.8} == $\text{heap}_{funcstart\_1032,1}.$\text{replace}(\text{this}.$\text{$r} \to \text{$}
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow
asType<P1Type>((30269 * asType<int>(([false]: 1, [true]: 0))) +
temp1)))
\rightarrow [simplify]
[53.15] $heap<sub>1032,1;1051,8</sub> == $heap<sub>funcstart_1032,1</sub>._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032.1})._replace(p1 \rightarrow
asType < P1Type > (0 + temp1))
\rightarrow [from term 50.14, temp1 is equal to (-2 * div(heapIs $heap_{tuncstart\_1032.1},
div(heapIs $heap_{funcstart\_1032.1}, this.$r.value(heapIs
heap_{funcstart_{1032,1}}.p1, 177).rem
[53.16] heap_{1032,1;1051,8} == heap_{funcstart\_1032,1}._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow
asType < P1Type > (0 + ((-2 * div(heapIs $heap_{funcstart\_1032.1},
this.$r.value(heapIs \theta_{funcstart\_1032,1}).p1, 177).quot) + (171 *
div(\mathbf{heapIs} \$ heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
heap_{funcstart_1032,1}.p1, 177.rem))))
\rightarrow [simplify]
[53.19] $heap<sub>1032.1:1051.8</sub> == $heap<sub>funcstart_1032.1</sub>._replace(this.$r \rightarrow
this.$r.value(heapIs \rho_{uncstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.}\text{\$r.value}(\text{heapIs}))
heap_{funcstart\_1032,1}.p1, 177).rem)))
[Take given term]
[54.0] (($heap<sub>1032.1:1051.8</sub>.r2 * static_cast<signed int>(div2.rem)) -
(\text{sheap}_{1032,1;1051,8}.\text{b2} * \text{static\_cast} < \text{signed int} > (\text{div2.quot}))) == \text{temp2}
\rightarrow [from term 53.19, $heap<sub>1032,1;1051,8</sub> is equal to
\$heap_{funcstart\_1032,1}.\_\textbf{replace}(\textbf{this}.\$r \rightarrow \textbf{this}.\$r.\textbf{value}(\textbf{heapIs}
heap_{funcstart\_1032,1}._replace(p1 \rightarrow (-2 * div(heapIs heap_{funcstart\_1032,1}),
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, \ 177).quot) + (171 \ *funcstart\_1032,1)
div(\mathbf{heapIs} \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
heap_{funcstart\_1032,1}.p1, 177).rem)))]
[54.1] \; ((\$ heap_{funcstart\_1032,1}.\_\textbf{replace}(\textbf{this}.\$r \rightarrow \textbf{this}.\$r.\textbf{value}(\textbf{heapIs}))) \\
\rho_{tuncstart\_1032.1}._replace(p1 \rightarrow ((-2 * div(heapIs \rho_{tuncstart\_1032.1})
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177).quot) + (171 *
div(\mathbf{heapIs} \$ heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
\theta_{funcstart\_1032,1}.p1, 177).rem))).r2 * static_cast < signed
int>(div2.rem)) - (\$heap_{1032,1:1051,8}.b2 * static\_cast < signed)
```

```
int>(div2.quot)) = temp2
→ [const member of object with modified fields]
[54.2]\;((\$heap_{funcstart\_1032,1}.r2\;*\;\textbf{static\_cast}{<}\textbf{signed int}{>}(\text{div}2.\text{rem}))\;-
(\text{sheap}_{1032,1:1051.8}.\text{b2} * \text{static\_cast} < \text{signed int} > (\text{div2.quot}))) == \text{temp2}
\rightarrow [const static or extern object]
[54.3]\;((\$\mathrm{heap}_{init}.\mathrm{r2}\;\ast\;\mathbf{static\_cast}{<}\mathbf{signed\;int}{>}(\mathrm{div2.rem}))\;-
(\text{sheap}_{1032,1;1051,8}.\text{b2} * \textbf{static\_cast} < \textbf{signed int} > (\text{div}2.\text{quot}))) == \text{temp}2
\rightarrow [expand definition of constant 'r2' at prang.cpp (34,26)]
[54.4] (((int)172 * static_cast<signed int>(div2.rem)) -
(\text{sheap}_{1032,1;1051,8}.\text{b2} * \text{static\_cast} < \text{signed int} > (\text{div2.quot}))) == \text{temp2}
\rightarrow [simplify]
[54.5] ((172 * static_cast<signed int>(div2.rem)) - ($heap_1032.1:1051.8.b2 *
static_cast<signed int>(div2.quot))) == temp2
\rightarrow [from term 18.6, div2 is equal to div(heapIs $heap_{funcstart\_1032,1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p2, 176)]
[54.6] ((172 * static_cast<signed int>(div(heapIs $heap_{funcstart\_1032,1},
this.r.value(heapIs $heap_{funcstart\_1032,1}).p2, 176).rem)) -
(\text{sheap}_{1032,1:1051,8}.\text{b2} * \text{static\_cast} < \text{signed int} > (\text{div2.quot}))) == \text{temp2}
\rightarrow [simplify]
[54.7] ((172 * div(heapIs $heap_{funcstart\_1032,1}, this.$r.value(heapIs 
\text{heap}_{funcstart\_1032,1}.p2, 176).rem) - (\text{heap}_{1032,1;1051,8}.b2 *
static_cast<signed int>(div2.quot))) == temp2
\rightarrow [from term 53.19, $heap<sub>1032.1:1051.8</sub> is equal to
$heap_{funcstart\_1032,1}.$_replace(this.$r \rightarrow this.$r.value(heapIs)
heap_{funcstart\_1032,1}._replace(p1 \rightarrow (-2 * div(heapIs \$heap_{funcstart\_1032,1}, -2))
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177).quot) + (171 *
div(\mathbf{heapIs} \ \$heap_{funcstart\_1032,1}, \ \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
heap_{funcstart\_1032,1}.p1, 177).rem)))]
[54.8] ((172 * div(heapIs $heap<sub>funcstart_1032,1</sub>, this.$r.value(heapIs)
\theta_{funcstart\_1032,1}.p2, 176).rem – (\theta_{funcstart\_1032,1}.replace)
\rightarrow this.$r.value(heap
Is \rho_{uncstart\_1032,1})._replace(p1 \rightarrow ((-2 *
div(\mathbf{heapIs} \$ heap_{funcstart\_1032.1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
\text{Sheap}_{funcstart\_1032,1}.p1, 177).quot) + (171 * div(heapIs \text{Sheap}_{funcstart\_1032,1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177).rem)))).b2 *
static_cast<signed int>(div2.quot))) == temp2
\rightarrow [const member of object with modified fields]
[54.9] ((172 * div(heapIs $heap_{tuncstart\_1032.1}, this.$r.value(heapIs
\text{Sheap}_{funcstart\_1032.1}.p2, 176).rem) - (\text{Sheap}_{funcstart\_1032.1}.b2 *
static_cast<signed int>(div2.quot))) == temp2
```

```
\rightarrow [const static or extern object]
[54.10] ((172 * div(heapIs heap_{funcstart\_1032,1}, this.r.value(heapIs)
\theta_{nit}.b2 * static_cast < signed
int>(div2.quot)) == temp2
\rightarrow [expand definition of constant 'b2' at prang.cpp (36,26)]
[54.11] ((172 * div(heapIs $heap_{funcstart\_1032,1}, this.$r.value(heapIs
\theta_{tuncstart\_1032,1}.p2, 176).rem - ((int)35 * static\_cast < signed)
int>(div2.quot)) == temp2
\rightarrow [simplify]
[54.12] ((172 * div(heapIs \rho_{funcstart\_1032,1}, this.\r.value(heapIs
\theta_{funcstart\_1032,1}.p2, 176).rem) - (35 * static_cast<signed)
int>(div2.quot)) = temp2
\rightarrow [from term 18.6, div2 is equal to div(heapIs $heap_{funcstart\_1032,1},
this.r.value(heapIs \ heap_{funcstart\_1032.1}).p2, 176)
[54.13] ((172 * div(heapIs $heap<sub>funcstart_1032,1</sub>, this.$r.value(heapIs)
\theta_{funcstart\_1032,1}.p2, 176).rem - (35 * static\_cast < signed)
int>(div(heapIs \$heap_{tuncstart\_1032,1}, this.\$r.value(heapIs
\text{Sheap}_{funcstart\_1032,1}.p2, 176).quot))) == temp2
\rightarrow [simplify]
[54.18] 0 == (-\text{temp2} + (-35 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart 1032.1})]
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p2, 176).quot) + (172 *
div(\mathbf{heapIs} \$ heap_{funcstart\_1032.1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
\$heap_{funcstart\_1032,1}).p2,\ 176).rem))
[Take given term]
[57.0] heap_{1032,1;1054,8} == heap_{1032,1;1051,8}._replace(this.$r \rightarrow
operator*(heapIs \theta_{1032,1;1051,8}, this)._replace(p2 \rightarrow
asType<P2Type>(($heap<sub>1032,1;1051,8</sub>.M2 *
asType<int>(static_cast<integer>(static_cast<signed
int>(operator^*(heapIs $heap_{1032,1:1051.8}, this).p2) < (int)(0))) + temp(2)))
\rightarrow [from term 53.19, $heap<sub>1032.1:1051.8</sub> is equal to
$heap_{funcstart\_1032,1}.$_replace(this.$r \to this.$r.value(heapIs)
heap_{funcstart\_1032,1}._replace(p1 \rightarrow (-2 * div(heapIs $heap_{funcstart\_1032,1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, \ 177).quot) + (171 * 
div(heapIs $heap_{tuncstart 1032.1}, this.$r.value(heapIs
heap_{funcstart\_1032,1}.p1, 177).rem)))
[57.2] heap_{1032,1;1054,8} == heap_{funcstart\_1032,1}._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this. r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs \$heap_{funcstart\_1032,1}, this.\$r.value(heapIs
\hat{p}_{funcstart\_1032,1}.p1, 177).rem)))._replace(this.r \to operator^*(heapIs)
```

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\theta_{funcstart\_1032,1}.\_replace(this.\$r \rightarrow this.\$r.value(heapIs)
\text{Sheap}_{funcstart\_1032,1}._replace(p1 \rightarrow (-2 * div(heapIs \text{Sheap}_{funcstart\_1032,1}).
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177).quot) + (171 *
div(\mathbf{heapIs} \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
\theta_{tuncstart_{1032,1}}.p1, 177).rem)), this).replace(p2 \rightarrow
asType<P2Type>(($heap<sub>1032,1;1051,8</sub>.M2 *
asType<int>(static_cast<integer>(static_cast<signed
int > (operator^*(heapIs \$heap_{1032,1;1051,8}, this).p2) < (int)0))) + temp2)))
→ [expand definition of operator '*' in class 'pointer' at built in declaration]
[57.3] \theta_{1032,1;1054,8} == \theta_{1032,1;1054,8} = \theta_{1032,1;1054,8} == \theta
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(\mathbf{heapIs} \ \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
\theta_{funcstart\_1032,1}.p1, 177).rem)))).\_replace(this.\$r \rightarrow 0
this.r.value(heapIs \ heap_{funcstart\_1032,1}.\_replace(this.\ r \rightarrow funcstart\_1032,1})
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs \rho_{funcstart\_1032,1}, this.r.value(heapIs)
\theta_{funcstart\_1032,1}.p1, 177).rem)))))._replace(p2 \rightarrow
asType<P2Type>(($heap<sub>1032.1:1051.8</sub>.M2 *
asType{<}int{>}(static\_cast{<}integer{>}(static\_cast{<}signed
int>(operator^*(heapIs \$heap_{1032,1;1051,8}, this).p2) < (int)(0))) + temp(2)))
→ [evaluate dereferenced pointer into modified heap]
[57.4] heap_{1032,1;1054,8} == heap_{funcstart\_1032,1}._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this. r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs $heap<sub>funcstart_1032.1</sub>, this.$r.value(heapIs
\$heap_{funcstart\_1032,1}).p1,\,177).rem)))).\_replace(this.\$r \rightarrow ([this.\$r ==
this.$r]: this.$r.value(heapIs \rho_{funcstart\_1032,1})._replace(p1 \rightarrow (-2 *
div(\mathbf{heapIs} \$ heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
\text{Sheap}_{funcstart\_1032,1}.p1, 177).quot) + (171 * div(heapIs \text{Sheap}_{funcstart\_1032,1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177).rem)), []:
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p2 \rightarrow
asType<P2Type>(($heap<sub>1032,1;1051,8</sub>.M2 *
asType<int>(static_cast<integer>(static_cast<signed
int > (operator^*(heapIs \$heap_{1032,1;1051,8}, this).p2) < (int)0))) + temp2)))
→ [explicitly assert falsehood of skipped guards in subsequent guards]
[57.5] heap_{1032,1;1054,8} == heap_{funcstart\_1032,1}._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs $heap<sub>funcstart_1032,1</sub>, this.$r.value(heapIs
\label{eq:continuous_funcstart_1032,1} $$ \operatorname{heap}_{funcstart_1032,1}.p1,\ 177).rem)))).$$ $$ $$ replace(this.$r \to ([this.$r == ]]) $$
this.$r]: this.$r.value(heapIs \rho_{tuncstart\_1032,1})._replace(p1 \rightarrow (-2 *
```

```
div(\mathbf{heapIs} \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
\text{Sheap}_{funcstart\_1032,1}.p1, 177).quot) + (171 * div(heapIs \text{Sheap}_{funcstart\_1032,1},
this.r.value(heapIs \ensuremath{\$}heap_{funcstart\_1032,1}).p1, 177).rem)), [!(this.\ensuremath{\$}r ==
this.$r)]: this.$r.value(heapIs \rho_{funcstart\_1032,1})._replace(p2 \rightarrow
asType<P2Type>(($heap<sub>1032,1:1051,8</sub>.M2 *
asType < int > (static\_cast < integer > (static\_cast < signed)
int>(operator^*(heapIs $heap_{1032,1:1051,8}, this).p2) < (int)0))) + temp2)))
\rightarrow [simplify]
[57.7] heap_{1032,1;1054,8} == heap_{funcstart\_1032,1}._replace(this.$r \rightarrow
this.$r.value(heapIs \rho_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs $heap_{funcstart\_1032,1}, this.$r.value(heapIs
\theta_{tuncstart\_1032,1}.p1, 177).rem)))).\_replace(this.$r \rightarrow
this.$r.value(heapIs $heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(\mathbf{heapIs} \$ heap_{funcstart\_1032,1}, \mathbf{this}.\$ r. \mathbf{value}(\mathbf{heapIs})
\theta_{uncstart\_1032,1}.p1, 177).rem))).\_replace(p2 \rightarrow
asType<P2Type>(($heap<sub>1032.1:1051.8</sub>.M2 *
asType<int>(static_cast<integer>(static_cast<signed
int>(operator^*(heapIs $heap_{1032,1:1051.8}, this).p2) < (int)0))) + temp2)))
\rightarrow [from term 53.19, $heap<sub>1032,1:1051,8</sub> is equal to
heap_{funcstart\_1032,1}._replace(this.r \rightarrow this.r.value(heapIs)
$heap_{funcstart_1032,1}._replace(p1 \rightarrow (-2 * div(heapIs $heap_{funcstart_1032,1}),
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177).quot) + (171 *
div(heapIs $heap_funcstart_1032.1, this.$r.value(heapIs
heap_{funcstart_{-1032.1}}.p1, 177).rem)))
[57.8] \rho_{1032,1;1054,8} == 
\textbf{this.}\$r.\textbf{value}(\textbf{heapIs}~\$heap_{funcstart\_1032,1}).\_\textbf{replace}(p1 \rightarrow ((-2~*div(\textbf{heapIs})))))
\rho_{funcstart\_1032,1}, this.\r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs heapIs = f_{uncstart\_1032,1}, this .r.value(heapIs)
\theta_{tuncstart\_1032,1}.p1, 177.rem)))).\_replace(this.$r \rightarrow
this.$r.value(heapIs \rho_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs \theta_{funcstart\_1032,1}, this.r.value(heapIs)
\theta_{funcstart\_1032,1}.p1, 177).rem))).\_replace(p2 \rightarrow
asType < P2Type > ((\$heap_{funcstart\_1032,1}.\_replace(this.\$r \rightarrow funcstart\_1032,1))
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.}\text{\$r.value}(\text{heapIs}))
heap_{funcstart_{-1032,1}}.p1, 177).rem))).M2 *
asType<int>(static_cast<integer>(static_cast<signed
int>(operator^*(heapIs $heap_{1032.1:1051.8}, this).p2) < (int)(0))) + temp(2)))
→ [const member of object with modified fields]
```

```
[57.9] heap_{1032,1;1054,8} == heap_{funcstart\_1032,1}._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
\theta_{tuncstart\_1032,1}.p1, 177).rem)))).\_replace(this.\$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032.1}, \text{this.} \text{\$r.value}(\text{heapIs}))
\theta_{funcstart\_1032,1}.p1, 177).rem)))._replace(p2 \rightarrow
asType<P2Type>(($heap_tuncstart_1032,1.M2 *
asType < int > (static\_cast < integer > (static\_cast < signed)
int>(operator^*(heapIs \$heap_{1032,1;1051,8}, this).p2) < (int)(0))) + temp(2)))
\rightarrow [const static or extern object]
[57.10] $\text{heap}_{1032,1;1054,8} == $\text{heap}_{funcstart\_1032,1}$._\text{replace}(\text{this}.$\text{$r} \to \text{
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart_1032,1}, this.r.value(heapIs \rho_{funcstart_1032,1}).p1,
177).quot) + (171 * div(\mathbf{heapIs} \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}))
\theta_{funcstart\_1032,1}.p1, 177).rem))))._replace(this.$r \rightarrow
this.$r.value(heapIs \rho_{tuncstart\_1032.1})._replace(p1 \rightarrow ((-2 * div(heapIs
\$heap_{funcstart\_1032,1},\, \textbf{this.}\$r.\textbf{value}(\textbf{heapIs}\,\,\$heap_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs $heap<sub>funcstart_1032.1</sub>, this.$r.value(heapIs
\theta_{funcstart\_1032.1}.p1, 177).rem)))._replace(p2 \rightarrow
asType < P2Type > ((\$heap_{init}.M2 *
asType < int > (static\_cast < integer > (static\_cast < signed
int > (operator^*(heapIs \$heap_{1032,1;1051,8}, this).p2) < (int)0))) + temp2)))
\rightarrow [expand definition of constant 'M2' at prang.cpp (33,26)]
[57.11] $\text{heap}_{1032,1;1054,8} == \text{$heap}_{funcstart\_1032,1}._\text{replace}(\text{this}.\text{$r} \rightarrow \text{$r$}
\textbf{this.}\$r.\textbf{value}(\textbf{heapIs}~\$heap_{funcstart\_1032,1}).\_\textbf{replace}(p1 \rightarrow ((-2~*div(\textbf{heapIs})))))
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
\theta_{\text{funcstart}} = 1032.1 \cdot \text{p1}, 177 \cdot \text{rem} = 1032.1 \cdot \text{p1}, 177 \cdot \text{rem} = 1032.1 \cdot \text{p1}, 177 \cdot \text{rem} = 1032.1 \cdot \text{p1}
this.$r.value(heapIs \rho_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
\theta_{funcstart\_1032,1}.p1, 177).rem))).\_replace(p2 \rightarrow
asType<P2Type>(((int)30307 *
asType < int > (static\_cast < integer > (static\_cast < signed
\mathbf{int} > (\mathbf{operator}^*(\mathbf{heapIs} \ \$ \mathrm{heap}_{1032,1;1051,8}, \ \mathbf{this}).p2) < (\mathbf{int})0))) \ + \ \mathrm{temp}2)))
\rightarrow [simplify]
[57.12] heap_{1032,1;1054,8} == heap_{funcstart\_1032,1}._replace(this.r \rightarrow
this.$r.value(heapIs \rho_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
```

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\theta_{tuncstart=1032.1}.p1, 177).rem)))._replace(this.$r \rightarrow
this.$r.value(heapIs p_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs $heap<sub>funcstart_1032,1</sub>, this.$r.value(heapIs
\theta_{funcstart\_1032,1}.p1, 177).rem)))._replace(p2 \rightarrow
asType<P2Type>((30307 *
asType<int>(static_cast<integer>(static_cast<signed
int > (operator^*(heapIs \$heap_{1032,1;1051,8}, this).p2) < (int)0))) + temp2)))
\rightarrow [from term 53.19, $heap<sub>1032.1:1051.8</sub> is equal to
$heap_{funcstart\_1032,1}.$replace(this.$r \rightarrow this.$r.value(heapIs)
heap_{funcstart\_1032,1}._replace(p1 \rightarrow (-2 * div(heapIs $heap_{funcstart\_1032,1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177).quot) + (171 *
div(heapIs $heap_{funcstart_1032.1}, this.$r.value(heapIs
$heap_{uncstart_1032.1}.p1, 177).rem)))]
[57.13] $heap<sub>1032,1;1054,8</sub> == $heap<sub>funcstart_1032,1</sub>._replace(this.$r \rightarrow
this.$r.value(heapIs $heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\$heap_{funcstart\_1032,1},\, \textbf{this}.\$r.\textbf{value}(\textbf{heapIs}\,\,\$heap_{funcstart\_1032,1}).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{heap}_{funcstart\_1032,1}, \text{this.}\text{\$r.value}(\text{heapIs}))
\theta_{funcstart\_1032,1}.p1, 177).rem)))).\_replace(this.\$r \rightarrow 0
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
$heap_tuncstart_1032.1, this.$r.value(heapIs $heap_tuncstart_1032.1).p1,
177).quot) + (171 * div(heapIs $heap<sub>funcstart_1032.1</sub>, this.$r.value(heapIs
\theta_{funcstart\_1032,1}.p1, 177).rem))).\_replace(p2 \rightarrow
asType<P2Type>((30307 *
asType<int>(static_cast<integer>(static_cast<signed
int>(operator^*(heapIs \$heap_{funcstart\_1032,1}.\_replace(this.\$r \rightarrow funcstart\_1032,1})
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow (-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
\text{Sheap}_{funcstart\_1032,1}.\text{p1}, 177).\text{rem})), \text{this}.\text{p2}) < (\text{int})0)) + \text{temp2}))
→ [expand definition of operator '*' in class 'pointer' at built in declaration]
[57.14] $heap<sub>1032,1;1054,8</sub> == $heap<sub>funcstart_1032,1</sub>._replace(this.$r \rightarrow
\textbf{this.\$r.value}(\textbf{heapIs}~\$ heap_{funcstart\_1032,1}).\_\textbf{replace}(p1 \rightarrow ((\text{-}2~*\text{div}(\textbf{heapIs}
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{heap}_{funcstart\_1032,1}, \text{this.} \text{$r.value}(\text{heapIs}))
\theta_{funcstart\_1032,1}.p1, 177).rem)))).\_replace(this.\$r \rightarrow 0
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.}\text{\$r.value}(\text{heapIs}))
heap_{funcstart\_1032,1}.p1, 177).rem))).\_replace(p2 \rightarrow
asType<P2Type>((30307 *
asType<int>(static_cast<integer>(static_cast<signed
int>(this.\$r.value(heapIs \$heap_{funcstart\_1032.1}.\_replace(this.\$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs))
```

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\rho_{tuncstart=1032.1}, this.r.value(heapIs \rho_{tuncstart=1032.1}).p1,
177).quot) + (171 * div(heapIs \theta_{funcstart\_1032,1}, this.r.value(heapIs)
\text{Sheap}_{funcstart\_1032,1}.\text{p1}, 177).\text{rem})))).\text{p2}) < (int)0)) + \text{temp2}))
→ [evaluate dereferenced pointer into modified heap]
[57.15] $heap<sub>1032,1;1054,8</sub> == $heap<sub>funcstart_1032,1</sub>._replace(this.$r \rightarrow
this.$r.value(heapIs \rho_{tuncstart\_1032.1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{heap}_{funcstart\_1032,1}, \text{this.}\text{$r.value}(\text{heapIs}))
\theta_{funcstart\_1032,1}.p1, 177).rem))))._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\ 1032.1}).replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
heap_{funcstart\_1032,1}.p1, 177).rem)))._replace(p2 \rightarrow
asType<P2Type>((30307 *
asType<int>(static_cast<integer>(static_cast<signed int>(([this.$r
== this.$r]: this.$r.value(heapIs \rho_{tangle} = 1032,1)._replace(p1 \rho (-2 *
div(\mathbf{heapIs} \$ heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
\text{Sheap}_{funcstart\_1032.1}).p1, 177).quot) + (171 * div(heapIs \text{Sheap}_{funcstart\_1032.1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177).rem)), []:
this.r.value(heapIs \ heap_{funcstart\_1032.1}).p2) < (int)0))) + temp2)))
→ [explicitly assert falsehood of skipped guards in subsequent guards]
[57.16] $heap<sub>1032,1;1054,8</sub> == $heap<sub>funcstart_1032,1</sub>._replace(this.$r \rightarrow
this.$r.value(heapIs \rho_{tuncstart\_1032.1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{tuncstart\_1032.1}, this.r.value(heapIs \rho_{tuncstart\_1032.1}).p1,
177).quot) + (171 * div(\mathbf{heapIs} \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}))
\theta_{funcstart\_1032,1}.p1, 177).rem)))).\_replace(this.\$r \rightarrow 0
this.$r.value(heapIs heap_{funcstart\_1032.1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs \$heap_{funcstart\_1032,1}, this.\$r.value(heapIs))
\theta_{funcstart\_1032,1}.p1, 177).rem))).\_replace(p2 \rightarrow
asType<P2Type>((30307 *
asType<int>(static_cast<integer>(static_cast<signed int>(([this.$r
== this.$r]: this.$r.value(heapIs \rho_{funcstart\_1032,1})._replace(p1 \rightarrow (-2 *
div(\mathbf{heapIs} \$ heap_{funcstart\_1032.1}, \mathbf{this.}\$r.\mathbf{value}(\mathbf{heapIs})
\text{Sheap}_{funcstart\_1032.1}.p1, 177).quot) + (171 * div(heapIs \text{Sheap}_{funcstart\_1032.1},
\mathbf{this.\$r.value(heapIs}~\$ \mathrm{heap}_{funcstart\_1032,1}).\mathrm{p1},~177).\mathrm{rem})),~[!(\mathbf{this.\$r}==
this.$r.value(heapIs \rho_{funcstart\_1032,1}).p2) < (int)0))) +
temp2)))
\rightarrow [simplify]
[57.23] $heap<sub>1032,1;1054,8</sub> == $heap<sub>funcstart_1032,1</sub>._replace(this.$r \rightarrow
this.$r.value(heapIs \rho_{tuncstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
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\theta_{funcstart=1032.1}.p1, 177).rem)))._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
\theta_{funcstart\_1032,1}.p1, 177).rem)))._replace(p2 \rightarrow
{\bf asType} < P2Type > ((30307 * {\bf asType} < {\bf int} > ({\bf static\_cast} < {\bf integer} > (0 < {\bf output})) < {\bf output} > ({\bf output}) < {\bf o
-this.r.value(heapIs heap_{funcstart\_1032,1}.p2))) + temp2)))
\rightarrow [from term 24.0, literala < -this.$r.value(heapIs $heap_{funcstart\_1032.1}).p2
is false whenever -2 < (0 + literala)
         Proof of rule precondition:
         [57.23.0] - 2 < (0 + 0)
         \rightarrow [simplify]
         [57.23.2] true
[57.24] $\text{heap}_{1032,1:1054.8} == $\text{heap}_{funcstart\_1032,1}.$\text{-replace}(\text{this}.$\text{$r} \to \text{
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.\r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
\theta_{funcstart\_1032,1}.p1, 177).rem))))._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs))
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs $heap<sub>funcstart 1032.1</sub>, this.$r.value(heapIs
\theta_{funcstart\_1032,1}.p1, 177).rem))).\_replace(p2 \rightarrow
asType<P2Type>((30307 * asType<int>(static_cast<integer>(false)))
+ \text{temp2})))
\rightarrow [simplify]
[57.25] $heap<sub>1032,1;1054,8</sub> == $heap<sub>funcstart_1032,1</sub>._replace(this.$r \rightarrow
this.$r.value(heapIs $heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.}\text{\$r.value}(\text{heapIs}))
\theta_{funcstart\_1032,1}.p1, 177).rem)))).\_replace(this.$r \rightarrow
this.$r.value(heapIs \frac{1}{2} heap\frac{1}{2} heap\frac{1}{2}
\rho_{funcstart_1032,1}, this.r.value(heapIs \rho_{funcstart_1032,1}).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.} \text{\$r.value}(\text{heapIs}))
\theta_{funcstart\_1032.1}.p1, 177).rem))).\_replace(p2 \rightarrow
asType<P2Type>((30307 * asType<int>(([false]: 1, []: 0))) + temp2)))
→ [explicitly assert falsehood of skipped guards in subsequent guards]
[57.26] $heap<sub>1032,1;1054,8</sub> == $heap<sub>funcstart_1032,1</sub>._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs))
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(\mathbf{heapIs} \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}))
```

```
this.$r.value(heapIs \rho_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs \theta_{funcstart\_1032,1}, this.r.value(heapIs)
\theta_{funcstart\_1032,1}.p1, 177).rem)))._replace(p2 \rightarrow
asType<P2Type>((30307 * asType<int>(([false]: 1, [true]: 0))) +
temp2)))
\rightarrow [simplify]
[57.29] $heap<sub>1032,1;1054,8</sub> == $heap<sub>funcstart_1032,1</sub>._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(\mathbf{heapIs} \$ heap_{funcstart\_1032,1}, \mathbf{this}.\$ r. \mathbf{value}(\mathbf{heapIs})
\theta_{tuncstart\_1032,1}.p1, 177).rem)))).\_replace(this.\$r \rightarrow
this.$r.value(heapIs p_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs \theta_{funcstart\_1032,1}, this.r.value(heapIs)
\rho_{funcstart\_1032,1}.p1, 177).rem))._replace(p2 \rightarrow asType<P2Type>(0 +
temp2)))
\rightarrow [from term 54.18, temp2 is equal to (-35 * div(heapIs $heap_{tuncstart\_1032.1},
this. $r.value(heapIs $heap_{funcstart = 1032.1}).p2, 176).quot) + (172)
div(\mathbf{heapIs}\ \$heap_{funcstart\_1032,1},\ \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}
heap_{funcstart_1032,1}.p2, 176).rem
[57.30] heap_{1032,1;1054,8} == heap_{funcstart\_1032,1}._replace(this.r \rightarrow
this.$r.value(heapIs \rho_{tuncstart\_1032.1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(\mathbf{heapIs} \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}))
\theta_{funcstart\_1032,1}.p1, 177).rem)))).\_replace(this.\$r \rightarrow 0
this.$r.value(heapIs heap_{funcstart\_1032.1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs \$heap_{funcstart\_1032,1}, this.\$r.value(heapIs))
\rho_{tuncstart=1032.1}.p1, 177).rem))._replace(p2 \rightarrow asType<P2Type>(0 +
((-35 * div(heapIs \$heap_{funcstart\_1032,1}, this.\$r.value(heapIs
\text{Sheap}_{funcstart\_1032,1}.p2, 176).quot) + (172 * div(heapIs \text{Sheap}_{funcstart\_1032,1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p2, 176).rem)))))
\rightarrow [simplify]
[57.33] $heap<sub>1032,1;1054,8</sub> == $heap<sub>funcstart_1032,1</sub>._replace(this.$r \rightarrow
this.$r.value(heapIs \rho_{uncstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs \theta_{funcstart\_1032,1}, this.r.value(heapIs)
\theta_{funcstart\_1032,1}.p1, 177).rem))))._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
\rho_{uncstart\_1032,1}.p1, 177).rem))).\_replace(p2 \rightarrow ((-35 * div(heapIs)))._replace(p2 \rightarrow ((-35 * div(heapIs))))._replace(p3 + div(heapIs)))
```

```
\rho_{tuncstart_1032.1}, this.r.value(heapIs \rho_{tuncstart_1032.1}).p2,
176).quot) + (172 * div(heapIs \theta), this.$r.value(heapIs
heap_{funcstart\_1032,1}.p2, 176).rem)))
[Take given term]
[58.0] (($heap<sub>1032,1;1054,8</sub>.r3 * static_cast<signed int>(div3.rem)) -
(\text{sheap}_{1032,1:1054.8}.\text{b3} * \text{static\_cast} < \text{signed int} > (\text{div3.quot}))) == \text{temp3}
\rightarrow [from term 57.33, $heap<sub>1032,1;1054,8</sub> is equal to
\$heap_{funcstart\_1032,1}.\_\textbf{replace}(\textbf{this.}\$r \rightarrow \textbf{this.}\$r.\textbf{value}(\textbf{heapIs}
heap_{funcstart\_1032,1}._replace(p1 \rightarrow ((-2 * div(heapIs $heap_{funcstart\_1032,1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177).quot) + (171)
div(\mathbf{heapIs} \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
\theta_{funcstart\_1032,1}.p1, 177).rem)))).\_replace(this.\$r \rightarrow 0
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
$heap_{tuncstart_1032.1}$, this.$r.value(heapIs $heap_{tuncstart_1032.1}).p1,
177).quot) + (171 * div(\mathbf{heapIs} * heap_{funcstart\_1032,1}, \mathbf{this}. * r.value(\mathbf{heapIs} 
heap_{funcstart\_1032,1}.p1, 177).rem))).\_replace(p2 \rightarrow (-35 * div(heapIs))).
heap_{funcstart\_1032,1}, this.r.value(heapIs heap_{funcstart\_1032,1}).p2,
176).quot) + (172 * div(heapIs $heap_{funcstart\_1032.1}, this.$r.value(heapIs
heap_{funcstart\_1032,1}.p2, 176).rem)))]
[58.1] \; ((\$ heap_{funcstart\_1032,1}.\_\textbf{replace}(\textbf{this}.\$r \rightarrow \textbf{this}.\$r.\textbf{value}(\textbf{heapIs}))) \\
\rho_{tuncstart_1032,1}._replace(p1 \rightarrow ((-2 * div(heapIs \rho_{tuncstart_1032,1}).
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177).quot) + (171)
div(\mathbf{heapIs} \$heap_{funcstart\_1032.1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
\theta_{funcstart\_1032,1}.p1, 177).rem)))).\_replace(this.\$r \rightarrow 0
\textbf{this.}\$r.\textbf{value}(\textbf{heapIs}~\$heap_{funcstart\_1032,1}).\_\textbf{replace}(p1 \rightarrow ((-2~*div(\textbf{heapIs})))))
\rho_{funcstart\_1032,1}, this. r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{heap}_{funcstart\_1032,1}, \text{this.} \text{$r.value}(\text{heapIs}))
heap_{funcstart\_1032,1}.p1, 177).rem)._replace(p2 \rightarrow ((-35 * div(heapIs)))._
\rho_{funcstart\_1032,1}, this.\r.value(heapIs \rho_{funcstart\_1032,1}).p2,
176).quot) + (172 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
\theta_{uncstart\_1032,1}.p2, 176).rem))).r3 * static_cast < signed
\mathbf{int}{>}(\mathrm{div3.rem})) - (\$\mathrm{heap}_{1032,1;1054,8}.\mathrm{b3} * \mathbf{static\_cast}{<} \mathbf{signed}
int>(div3.quot))) == temp3
\rightarrow [const member of object with modified fields]
[58.3]\;((\$heap_{funcstart\_1032,1}.r3\;*\;\textbf{static\_cast} < \textbf{signed int} > (\text{div3.rem}))\;-
(\text{sheap}_{1032.1:1054.8}.\text{b3} * \text{static\_cast} < \text{signed int} > (\text{div3.quot}))) == \text{temp3}
\rightarrow [const static or extern object]
[58.4] (($heap<sub>init</sub>.r3 * static_cast<signed int>(div3.rem)) -
(\text{sheap}_{1032,1:1054.8}.\text{b3} * \text{static\_cast} < \text{signed int} > (\text{div3.quot}))) == \text{temp3}
\rightarrow [expand definition of constant 'r3' at prang.cpp (39.26)]
[58.5] (((int)170 * static_cast<signed int>(div3.rem)) -
```

```
(\text{sheap}_{1032,1;1054,8}.\text{b3} * \text{static\_cast} < \text{signed int} > (\text{div3.quot}))) == \text{temp3}
\rightarrow [simplify]
[58.6] ((170 * static_cast<signed int>(div3.rem)) - ($heap_{1032.1:1054.8}.b3 *
static_cast<signed int>(div3.quot))) == temp3
\rightarrow [from term 34.6, div3 is equal to div(heapIs $heap_{funcstart\_1032,1},
this.r.value(heapIs $heap_{funcstart\_1032,1}).p3, 178)
[58.7] ((170 * static_cast < signed int > (div(heapIs heapIs funcstart_{1032,1}),
this.r.value(heapIs \ heap_{funcstart\_1032.1}).p3, 178).rem)) -
(\text{sheap}_{1032,1:1054.8}.\text{b3} * \text{static\_cast} < \text{signed int} > (\text{div3.quot}))) == \text{temp3}
\rightarrow [simplify]
[58.8] ((170 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs = f_{uncstart\_1032,1})
\text{heap}_{funcstart\_1032.1}.p3, 178).rem) - (\text{heap}_{1032.1:1054.8}.b3 *
static_cast<signed int>(div3.quot))) == temp3
\rightarrow [from term 57.33, $heap<sub>1032,1:1054,8</sub> is equal to
\$heap_{funcstart\_1032,1}.\_\textbf{replace}(\textbf{this}.\$r \rightarrow \textbf{this}.\$r.\textbf{value}(\textbf{heapIs}
heap_{funcstart\_1032,1}._replace(p1 \rightarrow ((-2 * div(heapIs $heap_{funcstart\_1032,1},
this.r.value(heapIs \ \ heap_{funcstart\_1032.1}).p1, \ 177).quot) + (171)^2
div(heapIs $heap_{tuncstart_1032.1}, this.$r.value(heapIs)
\theta_{tuncstart\_1032,1}.p1, 177).rem)))).\_replace(this.\$r \rightarrow 0
this.$r.value(heapIs heap_{funcstart=1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
heap_{funcstart\_1032,1}, this.r.value(heapIs heap_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(\textbf{heapIs} \$heap_{funcstart\_1032,1}, \textbf{this}.\$r.\textbf{value}(\textbf{heapIs}))
heap_{funcstart\_1032,1}.p1, 177).rem))).\_replace(p2 \rightarrow (-35 * div(heapIs))).
heap_{funcstart\_1032,1}, this.r.value(heapIs heap_{funcstart\_1032,1}).p2,
176).quot) + (172 * div(\textbf{heapIs } \$heap_{funcstart\_1032,1}, \textbf{this.}\$r.\textbf{value}(\textbf{heapIs}))
heap_{funcstart\_1032,1}.p2, 176).rem)))]
[58.9] ((170 * div(heap
Is \rho_{funcstart\_1032,1}, this.\r.value(heap
Is
\rho_{funcstart\_1032,1}.p3, 178).rem – (\rho_{funcstart\_1032,1}.replace)
\rightarrow this.$r.value(heapIs $heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 *
\mathrm{div}(\mathbf{heapIs}\ \$\mathrm{heap}_{funcstart\_1032,1},\ \mathbf{this}.\$\mathrm{r.value}(\mathbf{heapIs}
\text{Sheap}_{funcstart\_1032,1}.\text{p1}, 177).\text{quot} + (171 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_1032,1},
this.$r.value(heapIs $heap_funcstart_1032,1).p1, 177).rem))))._replace(this.$r
\rightarrow this.$r.value(heap
Is $heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 *
div(\mathbf{heapIs} \$ heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
\text{Sheap}_{funcstart\_1032,1}.p1, 177).quot) + (171 * div(heapIs \text{Sheap}_{funcstart\_1032,1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177).rem))).\_replace(p2 \rightarrow
((-35 * div(heapIs $heap_{funcstart\_1032,1}, this.$r.value(heapIs
\text{Sheap}_{funcstart\_1032,1}.\text{p2}, 176).\text{quot} + (172 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_1032,1},
this.r.value(heapIs \ensuremath{\$heap}_{funcstart\_1032,1}).p2, 176).rem)))).b3 *
static_cast<signed int>(div3.quot))) == temp3
→ [const member of object with modified fields]
```

```
[58.11] ((170 * \operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_1032,1}, \ \mathbf{this}.\$ r. \mathbf{value}(\mathbf{heapIs})
\text{Sheap}_{funcstart\_1032,1}.\text{p3}, 178).\text{rem}) - (\text{Sheap}_{funcstart\_1032,1}.\text{b3} *
static_cast<signed int>(div3.quot))) == temp3
\rightarrow [const static or extern object]
[58.12] ((170 * div(heapIs heap_{funcstart\_1032,1}, this.r.value(heapIs)
\rho_{tuncstart\_1032.1}, p3, 178).rem) - (\rho_{tuncstart\_1032.1}).p3, 178).rem) - (\rho_{tuncstart\_1032.1}).p3, 178).rem)
int>(div3.quot))) == temp3
\rightarrow [expand definition of constant 'b3' at prang.cpp (41,26)]
[58.13] ((170 * div(heapIs \$heap_{funcstart\_1032,1}, this.\$r.value(heapIs
\rho_{tuncstart\_1032.1}, p3, 178).rem) - ((int)63 * static_cast<signed)
int>(div3.quot)) == temp3
\rightarrow [simplify]
[58.14] ((170 * div(heapIs heap_{funcstart\_1032,1}, this.r.value(heapIs)
\theta_{tuncstart\_1032.1}.p3, 178).rem) - (63 * static_cast<signed)
int>(div3.quot)) = temp3
\rightarrow [from term 34.6, div3 is equal to div(heapIs $heap_{funcstart\_1032,1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p3, 178)]
[58.15] ((170 * div(heapIs $heap_{funcstart\_1032,1}, this.$r.value(heapIs
\theta_{funcstart\_1032,1}.p3, 178).rem) - (63 * static_cast<signed
\mathbf{int}{>}(\mathrm{div}(\mathbf{heapIs}\ \$\mathrm{heap}_{funcstart\_1032,1},\ \mathbf{this}.\$\mathrm{r.value}(\mathbf{heapIs}\ \mathsf{heap}))
\theta_{funcstart\_1032,1}.p3, 178).quot))) == temp3
\rightarrow [simplify]
[58.20] 0 == (-\text{temp3} + (-63 * \text{div}(\mathbf{heapIs} \$\text{heap}_{funcstart\_1032,1},
this.r.value(heapIs \ensuremath{\$}heap_{funcstart\_1032,1}).p3, 178).quot) + (170 *
div(\mathbf{heapIs} \$ heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
heap_{funcstart_{1032,1}}.p3, 178).rem
[Take given term]
[59.0] minof(signed int) \leq temp3
\rightarrow [simplify]
[59.3] - 32769 < \text{temp3}
\rightarrow [from term 58.20, temp3 is equal to (-63 * div(heapIs $heap_{funcstart\_1032.1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p3, 178).quot) + (170 *
div(heapIs $heap_{funcstart\_1032,1}, this.$r.value(heapIs)
heap_{funcstart\_1032,1}.p3, 178).rem
[59.4] -32769 < ((-63 * div(heap
Is \rho_{funcstart\_1032,1},\ this.\r.value(heap
Is
\rho_{tuncstart_{1032.1}, p3, 178} = 178 \cdot (170 * div(heapIs \$heap_{tuncstart_{1032.1}, p3, 178}) \cdot (170 * di
this.r.value(heapIs \ heap_{funcstart\_1032.1}).p3, 178).rem))
[Take goal term]
```

```
[1.0] minof(signed int) < (($heap_{1032,1:1054,8}.M3 *
asType<int>(static_cast<integer>(static_cast<signed
int>(operator*(heapIs $heap_{1032,1:1054.8}, this).p3) < (int)0))) + temp3)
\rightarrow [simplify]
[1.1] -32768 \leq (($heap<sub>1032,1;1054,8</sub>.M3 *
asType < int > (static\_cast < integer > (static\_cast < signed
int>(operator*(heapIs $heap_{1032,1:1054.8}, this).p3) < (int)0))) + temp3)
\rightarrow [from term 57.33, \rho_{1032,1;1054,8} is equal to
heap_{funcstart\_1032,1}._replace(this.r \rightarrow this.r.value(heapIs)
heap_{funcstart\_1032,1}._replace(p1 \rightarrow ((-2 * div(heapIs $heap_{funcstart\_1032,1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177).quot) + (171 *
div(\mathbf{heapIs}\ \$heap_{funcstart\_1032,1},\ \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}
\theta_{tuncstart\_1032.1}.p1, 177).rem))))_replace(this.r \rightarrow 0
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
heap_{funcstart\_1032.1}, this.r.value(heapIs heap_{funcstart\_1032.1}).p1,
177).quot) + (171 * div(\mathbf{heapIs} \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}))
heap_{funcstart\_1032,1}.p1, 177).rem))).\_replace(p2 \rightarrow (-35 * div(heapIs))).
heap_{funcstart\_1032.1}, this.r.value(heapIs \ heap_{funcstart\_1032.1}).p2,
176).quot) + (172 * div(\mathbf{heapIs} \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}))
heap_{funcstart\_1032,1}.p2, 176).rem)))]
[1.2] -32768 \le ((\$heap_{funcstart\_1032,1}.\_replace(this.\$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{tuncstart_{1032.1}}, this.$r.value(heapIs \rho_{tuncstart_{1032.1}}).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.} \text{\$r.value}(\text{heapIs}))
\label{eq:continuous_function} $ \text{heap}_{funcstart\_1032,1} . \text{p1, 177}.rem)))).$ \_\textbf{replace}(\textbf{this}.\$r \rightarrow
\textbf{this.}\$r.\textbf{value}(\textbf{heapIs}~\$heap_{funcstart\_1032,1}).\_\textbf{replace}(p1 \rightarrow ((\text{-}2~*\text{div}(\textbf{heapIs}
\rho_{tuncstart\_1032.1}, this.r.value(heapIs \rho_{tuncstart\_1032.1}).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.} \text{\$r.value}(\text{heapIs}))
\theta_{funcstart\_1032,1}.p1, 177).rem))._replace(p2 \rightarrow ((-35 * div(heapIs
\rho_{tuncstart_{-1032.1}}, this.r.value(heapIs \rho_{tuncstart_{-1032.1}}).p2,
176).quot) + (172 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.} \text{\$r.value}(\text{heapIs}))
\rho_{funcstart_{1032,1}}.p2, 176).rem)))).M3 *
asType<int>(static_cast<integer>(static_cast<signed
int>(operator*(heapIs $heap_{1032,1:1054.8}, this).p3) < (int)0))) + temp3)
→ [const member of object with modified fields]
[1.4] -32768 \leq (($heap_{funcstart_1032,1}.M3 *
asType<int>(static_cast<integer>(static_cast<signed
int>(operator*(heapIs $heap_{1032,1:1054.8}, this).p3) < (int)0))) + temp3)
\rightarrow [const static or extern object]
[1.5] -32768 \le ((\$heap_{init}.M3 *
asType < int > (static\_cast < integer > (static\_cast < signed)
int>(operator*(heapIs $heap_{1032,1:1054.8}, this).p3) < (int)0))) + temp3)
```

```
\rightarrow [expand definition of constant 'M3' at prang.cpp (38,26)]
[1.6] -32768 \leq (((int)30323 *
asType < int > (static\_cast < integer > (static\_cast < signed)
int>(operator^*(heapIs $heap_{1032.1:1054.8}, this).p3) < (int)0))) + temp3)
\rightarrow [simplify]
[1.7] - 32768 \le ((30323)^*)
asType<int>(static_cast<integer>(static_cast<signed
int>(operator*(heapIs $heap_{1032,1:1054.8}, this).p3) < (int)0))) + temp3)
\rightarrow [from term 57.33, $heap<sub>1032.1:1054.8</sub> is equal to
heap_{funcstart\_1032.1}._replace(this.r \rightarrow this.r.value(heapIs)
heap_{funcstart\_1032.1}._replace(p1 \rightarrow ((-2 * div(heapIs $heap_{funcstart\_1032.1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, \ 177).quot) + (171 *
div(heapIs $heap_funcstart_1032.1, this.$r.value(heapIs
\$heap_{funcstart\_1032,1}).p1,\ 177).rem)))).\_\textbf{replace(this.}\$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
heap_{funcstart\_1032,1}, this.r.value(heapIs heap_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs heapIs = 1032,1, this.r.value(heapIs)
\rho_{uncstart\_1032,1}.p1, 177).rem))).\_replace(p2 \rightarrow (-35 * div(heapIs))).
heap_{funcstart\_1032,1}, this.r.value(heapIs heap_{funcstart\_1032,1}).p2,
176).quot) + (172 * div(\textbf{heapIs} \$heap_{funcstart\_1032,1}, \textbf{this}.\$r.\textbf{value}(\textbf{heapIs}))
heap_{funcstart_1032,1}.p2, 176).rem)))
[1.8] -32768 \le ((30323 *
asType<int>(static_cast<integer>(static_cast<signed
int>(operator^*(heapIs \$heap_{funcstart\_1032,1}.\_replace(this.\$r \rightarrow
this.$r.value(heapIs \frac{1}{2} heap\frac{1}{2} heap\frac{1}{2}
\$heap_{funcstart\_1032,1},\, \textbf{this}.\$r.\textbf{value}(\textbf{heapIs}\,\,\$heap_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(\mathbf{heapIs} \ \$heap_{funcstart\_1032,1}, \ \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
\theta_{funcstart\_1032,1}.p1, 177).rem))))._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs $heap<sub>funcstart_1032,1</sub>, this.$r.value(heapIs
\rho_{funcstart_1032,1}, this.r.value(heapIs \rho_{funcstart_1032,1}).p2,
176).quot) + (172 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.\$r.value}(\text{heapIs}))
\frac{\text{sheap}_{funcstart\_1032,1}.p2, 176).rem)}{\text{this}.p3} < (int)0)) + temp3}
→ [expand definition of operator '*' in class 'pointer' at built in declaration]
[1.9] -32768 \le ((30323 *
asType<int>(static_cast<integer>(static_cast<signed
int>(this.r.value(heapIs \ heap_{funcstart\_1032,1}.\_replace(this.\rdotsr)
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
$heap_tuncstart_1032.1, this.$r.value(heapIs $heap_tuncstart_1032.1).p1,
177).quot) + (171 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
\theta_{funcstart\_1032,1}.p1, 177).rem)))).\_replace(this.\$r \rightarrow 0
```

```
this.$r.value(heapIs \rho_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs \theta_{funcstart\_1032,1}, this.r.value(heapIs)
\rho_{funcstart\_1032,1}.p1, 177).rem))._replace(p2 \rightarrow ((-35 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p2,
176).quot) + (172 * div(heapIs $heap<sub>funcstart_1032,1</sub>, this.$r.value(heapIs
\text{Sheap}_{funcstart_1032,1}.\text{p2}, 176).\text{rem})))).\text{p3} < (int)0)) + \text{temp3}
\rightarrow [evaluate dereferenced pointer into modified heap]
[1.10] -32768 \le ((30323)^*)
asType<int>(static_cast<integer>(static_cast<signed int>(([this.$r
== this.$r]: this.$r.value(heapIs \theta_{funcstart\_1032.1})._replace(p1 \theta ((-2)
* div(\mathbf{heapIs} \ \mathbf{\$} heap_{funcstart\_1032,1}, \ \mathbf{this}.\mathbf{\$} r.\mathbf{value}(\mathbf{heapIs})
\text{Sheap}_{funcstart\_1032,1}.p1, 177).quot) + (171 * div(heapIs \text{Sheap}_{funcstart\_1032,1},
this.$r.value(heapIs \rho_{tuncstart\_1032,1}).p1, 177).rem)))._replace(p2 \rightarrow
(-35 * div(heapIs \$heap_{funcstart\_1032,1}, this.\$r.value(heapIs
\text{Sheap}_{funcstart\_1032,1}.p2, 176).quot) + (172 * div(heapIs \text{Sheap}_{funcstart\_1032,1},
this.$r.value(heapIs heap_{funcstart\_1032,1}).p2, 176).rem)), []:
this.$r.value(heapIs \rho_{tuncstart\_1032.1}._replace(this.$r \rightarrow
this.$r.value(heapIs \rho_{tuncstart\_1032.1})._replace(p1 \rightarrow (-2 * div(heapIs
\rho_{tuncstart\_1032.1}, this.r.value(heapIs \rho_{tuncstart\_1032.1}).p1,
177).quot) + (171 * div(heapIs $heap<sub>funcstart_1032,1</sub>, this.$r.value(heapIs
\text{Sheap}_{funcstart\_1032,1}.\text{p1}, 177).\text{rem})))).\text{p3}) < (int)0))) + \text{temp3})
→ [explicitly assert falsehood of skipped guards in subsequent guards]
[1.11] -32768 < ((30323 *
asType < int > (static\_cast < integer > (static\_cast < signed\ int > (([this.\$r
== this.$r|: this.$r.value(heapIs \rho_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2
* div(heapIs $heap<sub>funcstart_1032.1</sub>, this.$r.value(heapIs
\text{Sheap}_{funcstart\_1032,1}.p1, 177).quot) + (171 * div(heapIs \text{Sheap}_{funcstart\_1032,1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177).rem))).\_replace(p2 \rightarrow
(-35 * div(heapIs \$heap_{funcstart\_1032,1}, this.\$r.value(heapIs
\text{Sheap}_{funcstart\_1032,1}.\text{p2}, 176).\text{quot} + (172 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_1032,1},
this.r.value(heapIs \ensuremath{\$}heap_{funcstart\_1032,1}).p2, 176).rem)), [!(this.\ensuremath{\$}r ==
this.r.value(heapIs $heap_{funcstart\_1032,1}.\_replace(this.$r \rightarrow funcstart\_1032,1})
this.$r.value(heapIs heapIs $heapfuncstart_1032,1)._replace(p1 \rightarrow (-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs \theta_{funcstart\_1032,1}, this.r.value(heapIs)
\text{Sheap}_{funcstart\_1032,1}.\text{p1}, 177).\text{rem})))).\text{p3} < (\text{int})0)) + \text{temp3}
\rightarrow [simplify]
[1.19] -32768 \leq ((30323 * asType<int>(static_cast<integer>(0 <
-this.$r.value(heapIs \theta_{funcstart\_1032,1}).p3))) + temp3)
\rightarrow [from term 40.0, literala < -this.$r.value(heapIs $heap_{funcstart\_1032,1}).p3
is false whenever -2 < (0 + literala)
```

```
Proof of rule precondition:
```

```
[1.19.0] - 2 < (0 + 0)
    \rightarrow [simplify]
    [1.19.2] true
[1.20] -32768 \leq ((30323 * asType<int>(static_cast<integer>(false))) +
temp3)
\rightarrow [simplify]
[1.21] -32768 \leq ((30323 * asType < int > (([false]: 1, []: 0))) + temp3)
→ [explicitly assert falsehood of skipped guards in subsequent guards]
[1.22] -32768 \leq ((30323 * asType<int>(([false]: 1, [true]: 0))) + temp3)
\rightarrow [simplify]
[1.25] -32768 \le (0 + \text{temp3})
\rightarrow [from term 58.20, temp3 is equal to (-63 * div(heapIs $heap_{funcstart\_1032,1},
this.r.value(heapIs \ \ heap_{funcstart\_1032,1}).p3, \ 178).quot) + (170 \ \ *
div(\mathbf{heapIs} \ \$heap_{funcstart\_1032,1}, \ \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
heap_{funcstart\_1032,1}.p3, 178).rem
[1.26] -32768 \leq (0 + ((-63 * div(heapIs $heap_{funcstart\_1032,1},
this.$r.value(heapIs heap_{funcstart\_1032,1}).p3, 178).quot) + (170 *
div(\mathbf{heapIs} \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
heap_{funcstart\_1032,1}.p3, 178).rem)
\rightarrow [simplify]
[1.30] \ -32769 < ((-63 \ * \ \mathrm{div}(\mathbf{heapIs} \ \$ \mathrm{heap}_{funcstart\_1032,1}, \ \mathbf{this}.\$ r. \mathbf{value}(\mathbf{heapIs}))
\text{Sheap}_{funcstart\_1032,1}.p3, 178).quot) + (170 * div(heapIs \text{Sheap}_{funcstart\_1032,1},
this.r.value(heapIs $heap_{funcstart\_1032,1}).p3, 178).rem))
\rightarrow [from term 59.4, literala < ((-63 * div(heapIs $heap_{funcstart\_1032,1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p3, \ 178).quot) + (170 \ *
div(\textbf{heapIs}~\$heap_{funcstart\_1032,1},~\textbf{this}.\$r.\textbf{value}(\textbf{heapIs}
\rho_{uncstart\_1032,1}.p3, 178).rem is true whenever (-1 + literala) < -32769
    Proof of rule precondition:
    [1.30.0](-32769 + -1) < -32769
    \rightarrow [simplify]
    [1.30.2] true
[1.31] true
```

Proof of verification condition: Arithmetic result of operator '+' is within limit of type 'signed int'

```
In the context of class: WHPrang, declared at:
C:\Escher\Customers\prang-cpp\prang.cpp (18,1)
Condition generated at: C:\Escher\Customers\prang-cpp\prang.cpp
(81,16)
Condition defined at:
To prove: (($heap<sub>1032,1:1054,8</sub>.M3 *
asType<int>(static_cast<integer>(static_cast<signed
maxof(signed int)
Given:
heap_{init}.LIMIT == (int)80
heap_{init}.class WHPrang \in M1 == (int)30269
heap_{init}.class WHPrang \in r1 == (int)171
heap_{init}.class WHPrang \in a1 == (int)177
heap_{init}.class WHPrang \in b1 == (int)2
heap_{init}.class WHPrang \in M2 == (int)30307
heap_{init}.class WHPrang \in r2 == (int)172
heap_{init}.class WHPrang \in a2 == (int)176
heap_{init}.class WHPrang \in b2 == (int)35
\text{$heap}_{init}.\mathbf{class} \text{ WHPrang} \in M3 == (\mathbf{int})30323
heap_{init}.class WHPrang \in r3 == (int)170
heap_{init}.class WHPrang \in a3 == (int)178
heap_{init}.class WHPrang \in b3 == (int)63
\operatorname{div1} == \operatorname{div}(\mathbf{heapIs} \ \operatorname{\$heap}_{funcstart\_1032,1},
static\_cast < int > (operator*(heapIs $heap_{funcstart\_1032,1}, this).p1),
\mathbf{static\_cast}{<}\mathbf{int}{>}(\$\mathsf{heap}_{funcstart\_1032,1}.\mathtt{a1}))
(asType < integer > (static\_cast < int > (operator*(heapIs)))
heap_{funcstart\_1032,1}, this).p1)
asType < integer > (static\_cast < int > (\$heap_{funcstart\_1032,1}.a1))) = =
asType<integer>(div1.quot)
(asType < integer > (static\_cast < int > (operator*(heapIs)))
heap_{funcstart\_1032,1}, this).p1) %
asType < integer > (static\_cast < int > (\$heap_{funcstart\_1032.1}.a1))) = =
asType<integer>(div1.rem)
(\mathbf{asType}{<}\mathbf{integer}{>}(\mathbf{operator}^*(\mathbf{heapIs}\ \$\mathbf{heap}_{funcstart\_1032,1},\ \mathbf{this}).\mathbf{p1}) <
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathrm{heap}_{funcstart\_1032,1}.\mathrm{a1})) =>
(asType<integer>(div1.rem) == asType<integer>(operator*(heapIs
```

```
heap_{funcstart_1032,1}, this).p1)
(asType < integer > (\$heap_{funcstart\_1032,1}.a1) \le
\mathbf{asType} < \mathbf{integer} > (\mathbf{operator}^*(\mathbf{heapIs} \ \$ \mathbf{heap}_{funcstart\_1032,1}, \ \mathbf{this}).\mathtt{p1})) = >
!(0 == asType < integer > (div1.quot))
!(0 == asType < integer > (div1.rem)) || !(0 ==
asType<integer>(div1.quot))
\operatorname{div2} == \operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_1032,1},
\mathbf{static\_cast} < \mathbf{int} > (\mathbf{operator}^*(\mathbf{heapIs}\ \$ \mathbf{heap}_{funcstart\_1032,1},\ \mathbf{this}).\mathbf{p2}),
\mathbf{static\_cast}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_1032,1}.\mathrm{a2}))
(asType<integer>(static_cast<int>(operator*(heapIs
heap_{funcstart_1032.1}, this).p2)
\mathbf{asType} < \mathbf{integer} > (\mathbf{static\_cast} < \mathbf{int} > (\$ \mathbf{heap}_{funcstart\_1032,1}.\mathbf{a2}))) = =
asType<integer>(div2.quot)
(asType < integer > (static\_cast < int > (operator*(heapIs
heap_{funcstart\_1032.1}, this).p2)
asType < integer > (static\_cast < int > (\$heap_{funcstart\_1032.1}.a2))) = =
asType<integer>(div2.rem)
(\mathbf{asType}{<}\mathbf{integer}{>}(\mathbf{operator}^*(\mathbf{heapIs}\ \$\mathbf{heap}_{funcstart\_1032,1},\ \mathbf{this}).\mathtt{p2}) <
asType < integer > (\$heap_{funcstart\_1032,1}.a2)) = >
(asType < integer > (div2.rem) == asType < integer > (operator*(heapIs))
heap_{funcstart\ 1032.1}, this).p2)
(\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathrm{heap}_{funcstart\_1032,1}.\mathrm{a2}) \leq
asType<integer>(operator*(heapIs $heap_{tuncstart\_1032,1}, this).p2)) =>
!(0 == asType < integer > (div2.quot))
!(0 == asType < integer > (div2.rem)) || !(0 ==
asType<integer>(div2.quot))
div3 == div(\mathbf{heapIs} \$ heap_{funcstart\_1032,1},
static\_cast < int > (operator*(heapIs $heap_{funcstart\_1032,1}, this).p3),
\mathbf{static\_cast} < \mathbf{int} > (\$ \mathbf{heap}_{funcstart\_1032,1}.\mathbf{a3}))
(asType<integer>(static_cast<int>(operator*(heapIs
heap_{funcstart\_1032,1}, this).p3) /
asType < integer > (static\_cast < int > (\$heap_{funcstart\_1032,1}.a3))) = =
asType<integer>(div3.quot)
(asType<integer>(static_cast<int>(operator*(heapIs
\theta_{funcstart\_1032,1}, this).p3)) \%
asType < integer > (static\_cast < int > (\$heap_{funcstart\_1032,1}.a3))) = =
asType<integer>(div3.rem)
(\mathbf{asType}{<}\mathbf{integer}{>}(\mathbf{operator}^*(\mathbf{heapIs}\ \$\mathbf{heap}_{funcstart\_1032,1},\ \mathbf{this}).\mathrm{p3}) <
asType < integer > (\$heap_{funcstart\_1032,1}.a3)) = >
(asType<integer>(div3.rem) == asType<integer>(operator*(heapIs
heap_{funcstart\_1032,1}, this).p3)
```

```
(asType < integer > (\$heap_{funcstart\_1032,1}.a3) \le
asType < integer > (operator*(heapIs $heap_{funcstart\_1032,1}, this).p3)) = >
!(0 == asType < integer > (div3.quot))
!(0 == asType < integer > (div3.rem)) || !(0 ==
asType<integer>(div3.quot))
temp1 == (\$heap_{funcstart\_1032,1}.r1 * static\_cast < signed int > (div1.rem)) -
($heap_funcstart_1032,1.b1 * static_cast<signed int>(div1.quot))
minof(signed int) \le temp1
temp1 < maxof(signed int)
heap_{1032,1;1051,8} == heap_{funcstart\_1032,1}._replace(this.r \rightarrow replace)
\mathbf{operator}^*(\mathbf{heapIs}~\$ \mathrm{heap}_{funcstart\_1032,1},~\mathbf{this}).\_\mathbf{replace}(\mathrm{p1} \rightarrow
asType<P1Type>(($heap<sub>funcstart_1032,1</sub>.M1 *
asType<int>(static_cast<integer>(static_cast<signed
int>(operator^*(heapIs \$heap_{funcstart\_1032,1}, this).p1) < (int)0))) +
temp1)))
temp2 == (\$heap_{1032,1;1051,8}.r2 * static\_cast < signed int > (div2.rem)) -
(\text{sheap}_{1032,1:1051.8}.\text{b2} * \text{static\_cast} < \text{signed int} > (\text{div}2.\text{quot}))
minof(signed\ int) \le temp2
temp2 \le maxof(signed int)
heap_{1032,1;1054,8} == heap_{1032,1;1051,8}.replace(this.$r \rightarrow
operator*(heapIs heap_{1032,1;1051,8}, this)._replace(p2 \rightarrow
asType<P2Type>(($heap<sub>1032,1:1051,8</sub>.M2 *
as Type < int > (static\_cast < integer > (static\_cast < signed))
int>(operator*(heapIs $heap_{1032,1;1051,8}, this).p2) < (int)0))) + temp2)))
temp3 == (\$heap_{1032,1;1054,8}.r3 * static\_cast < signed int > (div3.rem)) -
(\text{sheap}_{1032.1:1054.8}.\text{b3} * \text{static\_cast} < \text{signed int} > (\text{div}3.\text{quot}))
minof(signed int) \le temp3
temp3 < maxof(signed int)
Proof:
[Take given term]
[2.0] \operatorname{div1} == \operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_1032,1},
static_cast<int>(operator*(heapIs $heap_{funcstart\_1032,1}, this).p1),
\mathbf{static\_cast}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_1032,1}.\mathrm{a1}))
\rightarrow [expand definition of operator '*' in class 'pointer' at built in declaration]
[2.1] \operatorname{div1} == \operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_1032,1},
\mathbf{static\_cast} < \mathbf{int} > (\mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}~\$ \mathbf{heap}_{funcstart\_1032,1}).\mathbf{p1}),
static\_cast < int > (\$heap_{funcstart\_1032,1}.a1))
\rightarrow [simplify]
```

```
[2.2] \operatorname{div1} == \operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_1032,1}, \mathbf{this}.\$ \mathbf{r.value}(\mathbf{heapIs})
\theta_{funcstart\_1032,1}.p1, \theta_{funcstart\_1032,1}.a1)
\rightarrow [const static or extern object]
[2.3] div1 == div(\mathbf{heapIs} \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
\label{eq:cast} $$ \theta_{funcstart\_1032,1}.p1, \ \mathbf{static\_cast} < \mathbf{int} > (\theta_{init}.a1))$
\rightarrow [expand definition of constant 'a1' at prang.cpp (30,26)]
[2.4] \operatorname{div1} == \operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_1032,1}, \mathbf{this}.\$ r. \mathbf{value}(\mathbf{heapIs})
\theta_{tuncstart\_1032.1}.p1, static_cast<int>((int)177))
\rightarrow [simplify]
[2.6] div1 == div(heapIs $heap_{funcstart\_1032,1}, this.$r.value(heapIs)
heap_{funcstart\_1032,1}.p1, 177)
[Assume known post-assertion, class invariant or type constraint for term 2.6]
[7.0] (0 < asType<integer>(this.$r.value(heapIs
\rho_{tuncstart\_1032.1}).p1) < asType<integer>(\rho_{tuncstart\_1032.1}).p1) < asType<integer>(\rho_{tuncstart\_1032.1}).p1)
M1))
\rightarrow [simplify]
[7.2] (0 < this.$r.value(heap
Is $heap_{funcstart\_1032,1}).p1) &&
(this.r.value(heapIs $heap_{funcstart\_1032,1}).p1 <
asType < integer > (\text{$heap.class WHPrang} \in M1))
\rightarrow [const static or extern object]
[7.3] (0 < this.$r.value(heapIs \rho_{funcstart\_1032,1}).p1) &&
(this.$r.value(heapIs heap_{funcstart\_1032,1}).p1 <
asType < integer > (\$heap_{init}.class WHPrang \in M1))
\rightarrow [expand definition of constant 'M1' at prang.cpp (28,26)]
[7.4] (0 < this.\$r.value(heapIs \$heap_{funcstart\_1032.1}).p1) &&
(this.r.value(heapIs $heap_{funcstart\_1032,1}).p1 <
asType < integer > ((int)30269))
\rightarrow [simplify]
[7.10] (-30269 < -this.$r.value(heapIs heap_{funcstart\_1032,1}).p1) \land (0 <
this.r.value(heapIs $heap_{funcstart\_1032,1}).p1)
[Work on sub-term 2 of conjunction in term 7.10]
[8.0] 0 < this.$r.value(heap
Is \rho_{funcstart\_1032,1}).p1
[Take given term]
[18.0] \operatorname{div2} == \operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_1032,1},
static\_cast < int > (operator*(heapIs $heap_{funcstart\_1032,1}, this).p2),
static\_cast < int > (\$heap_{funcstart\_1032,1}.a2))
```

```
→ [expand definition of operator '*' in class 'pointer' at built in declaration]
[18.1] \operatorname{div2} == \operatorname{div}(\mathbf{heapIs} \ \operatorname{\$heap}_{funcstart\_1032,1},
static_cast<int>(this.$r.value(heapIs $heap_{funcstart\_1032,1}).p2),
\mathbf{static\_cast}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_1032,1}.\mathrm{a2}))
\rightarrow [simplify]
[18.2] \text{ div2} == \text{div}(\text{heapIs } \text{$heap}_{funcstart\_1032,1}, \text{this.}\text{$r.value}(\text{heapIs}))
\theta_{funcstart\_1032,1}.p2, \theta_{funcstart\_1032,1}.a2)
\rightarrow [const static or extern object]
[18.3] div2 == div(\mathbf{heapIs} \ \hat{\mathbf{s}}_{heap} \mathbf{I}_{sat}, \mathbf{this.} \hat{\mathbf{s}}_{r.} \mathbf{value}(\mathbf{heapIs})
\theta_{funcstart\_1032,1}.p2, \theta_{funcstart\_1032,1}.p3, \theta_{funcstart\_1032,1}.p2, \theta_{funcstart\_1032,1}.p2, \theta_{funcstart\_1032,1}.p3, \theta_{funcstart\_1032,1}.p2, \theta_{funcstart\_1032,1}.p3, \theta_{funcstart\_1032,1}.p4, \theta_{funcstart\_1032,1}.p4, \theta_{funcstart\_1032,1}.p4, \theta_{funcstart\_1032,1
\rightarrow [expand definition of constant 'a2' at prang.cpp (35,26)]
[18.4] div2 == div(\mathbf{heapIs} \ \mathbf{sheap}_{funcstart\_1032,1}, \ \mathbf{this}.\mathbf{sr.value}(\mathbf{heapIs})
\theta_{funcstart\_1032,1}.p2, \theta_{funcstart} (int)176)
\rightarrow [simplify]
[18.6] div2 == div(\mathbf{heapIs} \$ \mathbf{heap}_{funcstart\_1032,1}, \mathbf{this}.\$ \mathbf{r.value}(\mathbf{heapIs})
heap_{funcstart_{-1032,1}}.p2, 176
[Assume known post-assertion, class invariant or type constraint for term 18.6]
[23.0] (0 < asType<integer>(this.\$r.value(heapIs
\verb§heap$_{funcstart\_1032,1}).p2)) \&\& (\mathbf{asType} < \mathbf{integer} > (\mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}))) \&\& (\mathbf{asType} < \mathbf{integer} > (\mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}))) \&\& (\mathbf{asType} < \mathbf{integer} > (\mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})))) \&\& (\mathbf{asType} < \mathbf{integer} > (\mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}))))) \&\& (\mathbf{asType} < \mathbf{integer} > (\mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})))))
\label{eq:continuous_function} \$ \operatorname{heap}_{funcstart\_1032,1}).p2) < \mathbf{asType} < \mathbf{integer} > (\$ \operatorname{heap}.\mathbf{class} \ \mathrm{WHPrang} \in \mathbb{R}^{n})
M2))
\rightarrow [simplify]
[23.2] (0 < this.$r.value(heap
Is $heap_{funcstart\_1032,1}).p2) &&
(this.r.value(heapIs $heap_{funcstart\_1032.1}).p2 <
asType < integer > (\text{$heap.class WHPrang} \in M2))
\rightarrow [const static or extern object]
[23.3] (0 < this.$r.value(heapIs \rho_{funcstart\_1032,1}).p2) &&
(this.r.value(heapIs $heap_{funcstart\_1032,1}).p2 <
asType < integer > (\$heap_{init}.class WHPrang \in M2))
\rightarrow [expand definition of constant 'M2' at prang.cpp (33,26)]
[23.4] (0 < this.$r.value(heapIs \rho_{funcstart\_1032,1}).p2) &&
(this.$r.value(heapIs \rho_{funcstart\_1032,1}).p2 <
asType < integer > ((int)30307))
\rightarrow [simplify]
[23.10] (-30307 < -this.$r.value(heapIs $heap_{funcstart\_1032,1}).p2) \land (0 <
\mathbf{this.\$r.value}(\mathbf{heapIs}~\$\mathbf{heap}_{funcstart\_1032,1}).\mathbf{p2})
[Work on sub-term 2 of conjunction in term 23.10]
```

```
[24.0] 0 < this.$r.value(heapIs $heap_{tuncstart\_1032.1}).p2
[Take given term]
[34.0] div3 == div(heapIs heap_{funcstart\_1032,1},
static\_cast < int > (operator*(heapIs $heap_{funcstart\_1032,1}, this).p3),
\mathbf{static\_cast}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_1032,1}.\mathrm{a3}))
→ [expand definition of operator '*' in class 'pointer' at built in declaration]
[34.1] \text{ div3} == \text{div}(\mathbf{heapIs} \$ heap_{funcstart\_1032,1},
static\_cast < int > (this. r.value(heapIs  heap_{funcstart\_1032,1}).p3),
static\_cast < int > (\$heap_{funcstart\_1032.1}.a3))
\rightarrow [simplify]
 [34.2] \text{ div3} == \text{div}(\mathbf{heapIs} \$ \mathbf{heap}_{funcstart\_1032,1}, \mathbf{this}.\$ \mathbf{r.value}(\mathbf{heapIs})
\rho_{tuncstart\_1032.1}, p3, static_cast<int>(\rho_{tuncstart\_1032.1})
\rightarrow [const static or extern object]
[34.3] div3 == div(heapIs heapIs  heap_{funcstart\_1032,1}, this.r.value(heapIs)
\theta_{funcstart\_1032.1}.p3, \theta_{funcstart\_1032.1}.p4, \theta_{funcstart\_1032.1}.p4, \theta_{funcstart\_1032.1}.p4, \theta_{funcstart\_1032.1}.p4, \theta_{funcstart\_1032.1}.p5, \theta_{funcstart\_1032.1}.p5, \theta_{funcstart\_1032.1}.p5, \theta_{funcstart\_1032.1}.p5, \theta_{funcstart\_1032.1}.p5, \theta_{funcstart\_1032.1}.p5, \theta_{funcstart\_1032.1}.p5, \theta_{funcstart\_1032.1
\rightarrow [expand definition of constant 'a3' at prang.cpp (40,26)]
[34.4] \text{ div3} == \text{div}(\text{heapIs } \text{$heap}_{funcstart\_1032,1}, \text{this.}\text{$r.value}(\text{heapIs})
\theta_{funcstart\_1032,1}.p3, \theta_{funcstart\_1032,1}.p3, \theta_{funcstart\_1032,1}.p3
\rightarrow [simplify]
[34.6] div3 == div(heapIs heapIs  heap_{funcstart\_1032,1}, this.r.value(heapIs)
heap_{funcstart_{1032,1}}.p3, 178
[Assume known post-assertion, class invariant or type constraint for term 34.6]
[39.0] (0 < asType<integer>(this.$r.value(heapIs
\label{eq:continuous} $\operatorname{heap}_{funcstart\_1032,1}).p3)) \&\& (\mathbf{asType}{<}\mathbf{integer}{>} (\mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})) \&\& (\mathbf{asType}{<}\mathbf{integer}{>} (\mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}))) \&\& (\mathbf{asType}{<}\mathbf{integer}{>} (\mathbf{heapIs})) \&\& (\mathbf{asType}{<}\mathbf{
\theta_{funcstart\_1032,1}.p3 < asType<integer>(\theta_{funcstart\_1032,1}.p3) < asType<integer>(\theta_{funcstart\_1032,1}.p3)
M3))
\rightarrow [simplify]
[39.2] (0 < this.$r.value(heap
Is $heap_{funcstart\_1032,1}).p3) &&
(this.$r.value(heapIs \theta_{funcstart\_1032,1}).p3 <
asType < integer > (\$heap.class WHPrang \in M3))
\rightarrow [const static or extern object]
[39.3] (0 < this.$r.value(heapIs heap_{funcstart\_1032,1}).p3) &&
(this.$r.value(heapIs heap_{funcstart\_1032,1}).p3 <
asType < integer > (\$heap_{init}.class WHPrang \in M3))
\rightarrow [expand definition of constant 'M3' at prang.cpp (38,26)]
[39.4] (0 < this.\$r.value(heapIs \$heap_{funcstart_{-1032,1}}).p3) &&
(this.r.value(heapIs \ heap_{funcstart\_1032,1}).p3 <
```

```
asType < integer > ((int)30323))
\rightarrow [simplify]
[39.10] (-30323 < -this.$r.value(heap
Is \rho_{uncstart\_1032,1}).p3) <math display="inline">\land (0 <
this.r.value(heapIs $heap_{funcstart\_1032,1}).p3)
[Work on sub-term 2 of conjunction in term 39.10]
[40.0] 0 < this.$r.value(heapIs $heap_{funcstart\_1032,1}).p3
[Take given term]
[50.0] \; ((\$ heap_{funcstart\_1032,1}.r1 * \textbf{static\_cast} < \textbf{signed int} > (div1.rem)) \; - \;
(\text{\$heap}_{funcstart\_1032,1}.\text{b1 * static\_cast} < \text{signed int} > (\text{div1.quot}))) = \text{temp1}
\rightarrow [const static or extern object]
[50.1] ((\theta_{init}.r1 * static_cast<signed int>(div1.rem)) -
(\$heap_{funcstart\_1032,1}.b1 * \textbf{static\_cast} < \textbf{signed int} > (div1.quot))) == temp1
\rightarrow [expand definition of constant 'r1' at prang.cpp (29,26)]
[50.2] (((int)171 * static_cast<signed int>(div1.rem)) -
(\$heap_{funcstart\_1032,1}.b1 * \textbf{static\_cast} < \textbf{signed int} > (div1.quot))) == temp1
\rightarrow [simplify]
[50.3] ((171 * static_cast < signed int > (div1.rem)) - ($heap_{funcstart\_1032,1}.b1
* static_cast<signed int>(div1.quot))) == temp1
\rightarrow [from term 2.6, div1 is equal to div(heapIs $heap_{funcstart\_1032,1},
this.r.value(heapIs \ heap_{funcstart\_1032.1}).p1, 177)
[50.4] ((171 * static_cast<signed int>(div(heapIs heap_{funcstart\_1032,1},
this.r.value(heapIs $heap_{funcstart\_1032,1}).p1, 177).rem)) -
(\text{sheap}_{funcstart\_1032,1}.\text{b1 * static\_cast} < \text{signed int} > (\text{div1.quot}))) == \text{temp1}
\rightarrow [simplify]
[50.5] ((171 * div(heapIs heapIs  heap_{funcstart\_1032,1}, this.r.value(heapIs)
\text{Sheap}_{funcstart\_1032,1}.\text{p1}, 177).\text{rem} - (\text{Sheap}_{funcstart\_1032,1}.\text{b1} *
static_cast<signed int>(div1.quot))) == temp1
\rightarrow [const static or extern object]
[50.6] ((171 * \mathrm{div}(\mathbf{heapIs}\ \$\mathrm{heap}_{funcstart\_1032,1},\ \mathbf{this}.\$\mathrm{r.value}(\mathbf{heapIs}
\rho_{uncstart\_1032,1}.p1,\ 177).rem) — ( \rho_{unit}.b1 * static\_cast < signed)
int>(div1.quot)) == temp1
\rightarrow [expand definition of constant 'b1' at prang.cpp (31,26)]
[50.7] ((171 * \operatorname{div}(\mathbf{heapIs} \ \mathbf{sheap}_{funcstart\_1032,1}, \mathbf{this}.\mathbf{sr.value}(\mathbf{heapIs})
int>(div1.quot)) == temp1
\rightarrow [simplify]
```

```
[50.8] ((171 * \operatorname{div}(\mathbf{heapIs} \ \mathbf{sheap}_{funcstart\_1032,1}, \ \mathbf{this}.\mathbf{sr.value}(\mathbf{heapIs})
\theta_{funcstart\_1032,1}.p1, 177).rem - (2 * static\_cast < signed)
int>(div1.quot))) == temp1
\rightarrow [from term 2.6, div1 is equal to div(heapIs $heap_{funcstart\_1032.1},
this.r.value(heapIs \ heap_{funcstart\_1032.1}).p1, 177)
[50.9] ((171 * div(heapIs $heap<sub>funcstart_1032,1</sub>, this.$r.value(heapIs)
\theta_{funcstart\_1032,1}.p1, 177).rem - (2 * static\_cast < signed)
int>(div(heapIs \$heap_{tuncstart\_1032.1}, this.\$r.value(heapIs
\text{Sheap}_{funcstart\_1032,1}).p1, 177).quot))) == temp1
\rightarrow [simplify]
[50.14] 0 == (-\text{temp1} + (-2 * \text{div}(\text{heapIs } \text{$heap}_{funcstart\_1032.1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177).quot) + (171 * 
div(\mathbf{heapIs} \$ heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
heap_{funcstart\_1032,1}.p1, 177).rem
[Take given term]
[53.0] heap_{1032,1;1051,8} == heap_{funcstart\_1032,1}._replace(this.$r \rightarrow
operator*(heapIs heap_{funcstart\_1032,1}, this)._replace(p1 \rightarrow
asType < P1Type > ((\$heap_{funcstart\_1032,1}.M1 *
as Type < int > (static\_cast < integer > (static\_cast < signed))
int>(operator^*(heapIs \$heap_{funcstart\_1032,1}, this).p1) < (int)0))) +
→ [expand definition of operator '*' in class 'pointer' at built in declaration]
[53.1] heap_{1032,1;1051,8} == heap_{funcstart\_1032,1}._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow
asType<P1Type>(($heap_funcstart_1032,1.M1 *
asType<int>(static_cast<integer>(static_cast<signed
int>(operator^*(heapIs $heap_{funcstart\_1032,1}, this).p1) < (int)0))) +
temp1)))
\rightarrow [const static or extern object]
[53.2] heap_{1032,1;1051,8} == heap_{funcstart\_1032,1}._replace(this.r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow
asType<P1Type>(($heap<sub>init</sub>.M1 *
asType < int > (static\_cast < integer > (static\_cast < signed)
int>(operator^*(heapIs \$heap_{funcstart\_1032,1}, this).p1) < (int)0))) +
temp1)))
\rightarrow [expand definition of constant 'M1' at prang.cpp (28,26)]
[53.3] heap_{1032,1;1051,8} == heap_{funcstart\_1032,1}._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow
asType<P1Type>(((int)30269 *
asType < int > (static\_cast < integer > (static\_cast < signed
int>(operator^*(heapIs $heap_{funcstart\_1032,1}, this).p1) < (int)0))) +
```

```
temp1)))
\rightarrow [simplify]
[53.4] \theta_{1032,1;1051,8} == \theta_{funcstart\_1032,1}.replace(this.$r \theta
\mathbf{this.\$r.value}(\mathbf{heapIs}~\$ \mathrm{heap}_{funcstart\_1032,1}).\_\mathbf{replace}(\mathrm{p1} \rightarrow
asType<P1Type>((30269 *
asType < int > (static\_cast < integer > (static\_cast < signed)
int>(operator^*(heapIs \$heap_{funcstart\_1032,1}, this).p1) < (int)0))) +
temp1)))
→ [expand definition of operator '*' in class 'pointer' at built in declaration]
[53.5] heap_{1032,1;1051,8} == heap_{funcstart\_1032,1}._replace(this.$r \rightarrow
this.$r.value(heapIs \theta_{funcstart\_1032,1})._replace(p1 \rightarrow
asType<P1Type>((30269 *
as Type < int > (static\_cast < integer > (static\_cast < signed))
int>(this.\$r.value(heapIs \$heap_{funcstart\_1032,1}).p1) < (int)0))) + temp1)))
\rightarrow [simplify]
[53.9] heap_{1032,1;1051,8} == heap_{funcstart\_1032,1}._replace(this.$r \rightarrow
this.$r.value(heapIs $heap_{funcstart\_1032,1})._replace(p1 \rightarrow asType<P1Type>((30269 * asType<int>(static_cast<integer>(0 <
-this.r.value(heapIs heap_{funcstart\_1032,1}.p1))) + temp1)))
\rightarrow [from term 8.0, literala < -this.$r.value(heapIs $heap_{funcstart\_1032,1}).p1
is false whenever -2 < (0 + literala)
    Proof of rule precondition:
    [53.9.0] - 2 < (0 + 0)
    \rightarrow [simplify]
    [53.9.2] true
[53.10] $\text{heap}_{1032,1:1051.8} == $\text{heap}_{funcstart\_1032,1}.$\text{-replace}(\text{this}.$\text{$r} \to \text{
this.r.value(heapIs \ heap_{funcstart\_1032,1}).\_replace(p1 \rightarrow
asType<P1Type>((30269 * asType<int>(static_cast<integer>(false)))
+ \text{ temp1})))
\rightarrow [simplify]
[53.11] $\text{heap}_{1032,1;1051,8} == $\text{heap}_{funcstart\_1032,1}.$\text{-replace}(\text{this}.$\text{$r} \to \text{
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow
asType<P1Type>((30269 * asType<int>(([false]: 1, []: 0))) + temp1)))
→ [explicitly assert falsehood of skipped guards in subsequent guards]
[53.12] $heap<sub>1032,1;1051,8</sub> == $heap<sub>funcstart_1032,1</sub>._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow
asType<P1Type>((30269 * asType<int>(([false]: 1, [true]: 0))) +
temp1)))
```

```
\rightarrow [simplify]
[53.15] $heap<sub>1032,1;1051,8</sub> == $heap<sub>funcstart_1032,1</sub>._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow
asType < P1Type > (0 + temp1))
\rightarrow [from term 50.14, temp1 is equal to (-2 * div(heapIs $heap_{funcstart\_1032,1},
this.r.value(heapIs \ heap_{funcstart\_1032.1}).p1, 177).quot) + (171 *
div(heapIs $heap_funcstart_1032.1, this.$r.value(heapIs
$heap_{uncstart=1032.1}).p1, 177).rem)]
[53.16] $heap<sub>1032,1;1051,8</sub> == $heap<sub>funcstart_1032,1</sub>._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow
asType < P1Type > (0 + ((-2 * div(heapIs $heap_{funcstart\_1032,1},
this.$r.value(heapIs heap_{funcstart\_1032,1}).p1, 177).quot) + (171 *
div(\mathbf{heapIs} \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
heap_{funcstart_{1032.1}}.p1, 177).rem))))
\rightarrow [simplify]
[53.19] $heap<sub>1032.1:1051.8</sub> == $heap<sub>funcstart_1032.1</sub>._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.\r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(\mathbf{heapIs} \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}))
heap_{funcstart\_1032.1}.p1, 177).rem)))
[Take given term]
[54.0] (($heap<sub>1032.1:1051.8</sub>.r2 * static_cast<signed int>(div2.rem)) -
(\text{sheap}_{1032,1:1051.8}.\text{b2} * \text{static\_cast} < \text{signed int} > (\text{div}2.\text{quot}))) == \text{temp}2
\rightarrow [from term 53.19, $heap<sub>1032,1;1051,8</sub> is equal to
\$heap_{funcstart\_1032,1}.\_\textbf{replace}(\textbf{this}.\$r \rightarrow \textbf{this}.\$r.\textbf{value}(\textbf{heapIs}
heap_{funcstart\_1032,1}._replace(p1 \rightarrow (-2 * div(heapIs \$heap_{funcstart\_1032,1}, -2))
this. $r.value(heapIs heap_{funcstart\_1032,1}).p1, 177).quot) + (171 heapIs
div(\mathbf{heapIs} \ \$heap_{funcstart\_1032,1}, \ \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
heap_{funcstart\_1032,1}.p1, 177).rem)))
[54.1] \; ((\$ heap_{funcstart\_1032,1}.\_\mathbf{replace}(\mathbf{this}.\$r \to \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}))) \\
\text{Sheap}_{funcstart\_1032.1})._replace(p1 \rightarrow ((-2 * div(heapIs \text{Sheap}_{funcstart\_1032.1}),
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177).quot) + (171 *
div(\mathbf{heapIs} \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
\theta_{funcstart\_1032,1}.p1, 177).rem)))).r2 * static_cast < signed
int>(div2.rem)) - (\$heap_{1032,1:1051,8}.b2 * static\_cast < signed
int>(div2.quot)) == temp2
\rightarrow [const member of object with modified fields]
[54.2] \; ((\$heap_{funcstart\_1032,1}.r2 * \textbf{static\_cast} < \textbf{signed int} > (\text{div}2.rem)) \; - \\
(\text{\$heap}_{1032,1;1051,8}.\text{b2} * \textbf{static\_cast} < \textbf{signed int} > (\text{div2.quot}))) == \text{temp2}
\rightarrow [const static or extern object]
```

```
[54.3] (($heap<sub>init</sub>.r2 * static_cast<signed int>(div2.rem)) -
(\text{sheap}_{1032.1:1051.8}, \text{b2} * \text{static\_cast} < \text{signed int} > (\text{div2.quot}))) = = \text{temp2}
\rightarrow [expand definition of constant 'r2' at prang.cpp (34,26)]
[54.4] (((int)172 * static_cast<signed int>(div2.rem)) -
(\text{sheap}_{1032.1:1051.8}.\text{b2} * \text{static\_cast} < \text{signed int} > (\text{div2.quot}))) == \text{temp2}
\rightarrow [simplify]
[54.5] ((172 * static_cast<signed int>(div2.rem)) - ($heap_{1032.1:1051.8}.b2 *
static_cast<signed int>(div2.quot))) == temp2
\rightarrow [from term 18.6, div2 is equal to div(heapIs $heap_{funcstart\_1032,1},
this.r.value(heapIs $heap_{funcstart\_1032,1}).p2, 176)]
[54.6] ((172 * static_cast<signed int>(div(heapIs $heap_{funcstart\_1032.1},
this.r.value(heapIs $heap_{funcstart\_1032,1}).p2, 176).rem)) -
(\text{sheap}_{1032,1;1051,8}.\text{b2} * \text{static\_cast} < \text{signed int} > (\text{div2.quot}))) == \text{temp2}
\rightarrow [simplify]
[54.7] ((172 * div(heapIs \$heap_{funcstart\_1032,1}, this.\$r.value(heapIs
\text{Sheap}_{funcstart\_1032.1}.p2, 176).rem) - (\text{Sheap}_{1032.1:1051.8}.b2 *
static_cast<signed int>(div2.quot))) == temp2
\rightarrow [from term 53.19, p_{1032,1;1051,8} is equal to
\$heap_{funcstart\_1032,1}.\_\textbf{replace(this.}\$r \rightarrow \textbf{this.}\$r.\textbf{value(heapIs}
heap_{funcstart\_1032,1}._replace(p1 \rightarrow (-2 * div(heapIs p_{funcstart\_1032,1}).
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177).quot) + (171 \ function for the first substitution of the first 
div(heapIs $heap_funcstart_1032,1, this.$r.value(heapIs
heap_{funcstart\_1032,1}.p1, 177).rem)))
[54.8] ((172 * div(heapIs $heap<sub>funcstart_1032.1</sub>, this.$r.value(heapIs
\rho_{tuncstart\_1032.1}.p2, 176).rem) - (\rho_{tuncstart\_1032.1}._replace(this.$r

ightarrow this.$r.value(heapIs $heap_{funcstart\_1032,1})._replace(p1 
ightarrow ((-2 *
{\rm div}(\mathbf{heapIs}~\$\mathrm{heap}_{funcstart\_1032,1},~\mathbf{this}.\$\mathrm{r.value}(\mathbf{heapIs}
\text{Sheap}_{funcstart\_1032,1}.p1, 177).quot) + (171 * div(heapIs \text{Sheap}_{funcstart\_1032,1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177).rem)))).b2
static_cast<signed int>(div2.quot))) == temp2
→ [const member of object with modified fields]
[54.9] \; ((172 \; * \; \mathrm{div}(\mathbf{heapIs} \; \$ \mathrm{heap}_{funcstart\_1032,1}, \; \mathbf{this}.\$ r. \mathbf{value}(\mathbf{heapIs} \;
\text{Sheap}_{funcstart_1032.1}.p2, 176).rem) - (\text{Sheap}_{funcstart_1032.1}.b2 *
static_cast<signed int>(div2.quot))) == temp2
\rightarrow [const static or extern object]
[54.10] ((172 * div(heapIs heap_{funcstart\_1032,1}, this.r.value(heapIs)
\rho_{uncstart\_1032.1}.p2, 176).rem – (\rho_{uncstart\_1032.1}.p2, 176).rem
int>(div2.quot)) == temp2
\rightarrow [expand definition of constant 'b2' at prang.cpp (36,26)]
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[54.11] ((172 * div(heapIs \$heap_{funcstart\_1032,1}, this.\$r.value(heapIs
\theta_{uncstart\_1032,1}.p2, 176).rem - ((int)35 * static\_cast < signed
int>(div2.quot)) == temp2
\rightarrow [simplify]
[54.12] ((172 * div(heapIs heap_{funcstart\_1032,1}, this.r.value(heapIs)
\rho_{funcstart\_1032.1}.p2, 176).rem) - (35 * static_cast<signed)
int>(div2.quot)) == temp2
\rightarrow [from term 18.6, div2 is equal to div(heapIs $heap_{funcstart\_1032,1},
this.r.value(heapIs $heap_{funcstart\_1032,1}).p2, 176)]
[54.13] ((172 * div(heapIs heap_{funcstart\_1032,1}, this.r.value(heapIs)
\rho_{funcstart\_1032.1}.p2, 176).rem) - (35 * static_cast<signed)
int>(div(heapIs \$heap_{funcstart\_1032,1}, this.\$r.value(heapIs
\text{Sheap}_{funcstart\_1032,1}.p2, 176).quot))) == temp2
\rightarrow [simplify]
[54.18] 0 == (-\text{temp2} + (-35 * \text{div}(\text{heapIs } \$\text{heap}_{funcstart\_1032,1}),
this.$r.value(heapIs heap_{funcstart\_1032,1}).p2, 176).quot) + (172 *
div(\mathbf{heapIs} \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
heap_{funcstart\_1032,1}.p2, 176).rem
[Take given term]
[57.0] $\text{heap}_{1032,1;1054,8} == $\text{heap}_{1032,1;1051,8}._\text{replace}(\text{this}.$\text{$r} \to \text{
operator*(heapIs heap_{1032,1:1051.8}, this)._replace(p2 \rightarrow
asType<P2Type>(($heap<sub>1032.1:1051.8</sub>.M2 *
asType<int>(static_cast<integer>(static_cast<signed
int>(operator^*(heapIs $heap_{1032,1;1051,8}, this).p2) < (int)(0))) + temp(2)))
\rightarrow [from term 53.19, $heap<sub>1032,1;1051,8</sub> is equal to
$heap_{funcstart\_1032,1}.$_replace(this.$r \rightarrow this.$r.value(heapIs)
heap_{funcstart\_1032.1}._replace(p1 \rightarrow (-2 * div(heapIs p_{funcstart\_1032.1})
this.r.value(heapIs \ \ heap_{funcstart\_1032,1}).p1, \ 177).quot) + (171 \ \ *
div(\mathbf{heapIs}\ \$heap_{funcstart\_1032,1},\ \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}
heap_{funcstart_{1032,1}}.p1, 177).rem)))
[57.2] heap_{1032,1;1054,8} == heap_{funcstart\_1032,1}._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\$heap_{funcstart\_1032,1},\, \textbf{this}.\$r.\textbf{value}(\textbf{heapIs}\,\,\$heap_{funcstart\_1032.1}).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.} \text{\$r.value}(\text{heapIs}))
\rho_{funcstart\_1032,1}.p1, 177).rem)))._replace(this.$r \rightarrow operator*(heapIs)
\$ heap_{funcstart\_1032,1}.\_\textbf{replace}(\textbf{this}.\$r \rightarrow \textbf{this}.\$r.\textbf{value}(\textbf{heapIs}
\rho_{uncstart\_1032,1}._replace(p1 \rightarrow (-2 * div(heapIs $heap_{funcstart\_1032,1}).
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177).quot) + (171 *
div(\mathbf{heapIs} \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
\theta_{uncstart\_1032.1}, p1, 177).rem))), this)._replace(p2 \rightarrow
asType<P2Type>(($heap<sub>1032.1:1051.8</sub>.M2 *
```

```
asType<int>(static_cast<integer>(static_cast<signed
int > (operator^*(heapIs \$heap_{1032,1;1051,8}, this).p2) < (int)0))) + temp2)))
→ [expand definition of operator '*' in class 'pointer' at built in declaration]
[57.3] heap_{1032,1;1054,8} == heap_{funcstart\_1032,1}._replace(this.$r \rightarrow
\textbf{this.}\$r.\textbf{value}(\textbf{heapIs}~\$heap_{funcstart\_1032,1}).\_\textbf{replace}(p1 \rightarrow ((-2~*div(\textbf{heapIs})))))
\rho_{funcstart_1032,1}, this.\r.value(heapIs \rho_{funcstart_1032,1}).p1,
177).quot) + (171 * div(heapIs $heap<sub>funcstart_1032,1</sub>, this.$r.value(heapIs
\theta_{funcstart\_1032,1}.p1, 177).rem))))._replace(this.$r \rightarrow
this.$r.value(heapIs \rho_{funcstart\_1032,1}._replace(this.$r \rightarrow
\textbf{this.}\$r.\textbf{value}(\textbf{heapIs}~\$heap_{funcstart\_1032,1}).\_\textbf{replace}(p1 \rightarrow ((\text{-}2~*\text{div}(\textbf{heapIs}
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs \theta_{funcstart\_1032,1}, this.r.value(heapIs)
\theta_{funcstart\_1032,1}.p1, 177).rem))))._replace(p2 \rightarrow
asType<P2Type>(($heap<sub>1032,1:1051,8</sub>.M2 *
asType<int>(static_cast<integer>(static_cast<signed
int > (operator^*(heapIs \$heap_{1032,1;1051,8}, this).p2) < (int)0))) + temp2)))
→ [evaluate dereferenced pointer into modified heap]
[57.4] heap_{1032,1;1054,8} == heap_{funcstart\_1032,1}.replace(this.$r \rightarrow
this.$r.value(heapIs $heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart_{1032,1}}, this.r.value(heapIs \rho_{funcstart_{1032,1}}).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.}\text{\$r.value}(\text{heapIs}))
\theta_{funcstart\_1032,1}.p1, 177).rem))))._replace(this.$r \rightarrow ([this.$r ===
this.$r]: this.$r.value(heapIs \rho_{funcstart\_1032,1})._replace(p1 \rightarrow (-2 *
div(\mathbf{heapIs} \$heap_{funcstart\_1032.1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
\text{Sheap}_{funcstart\_1032,1}.p1, 177).quot) + (171 * div(heapIs \text{Sheap}_{funcstart\_1032,1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177).rem)), []:
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p2 \rightarrow
asType<P2Type>(($heap<sub>1032,1:1051,8</sub>.M2 *
asType < int > (static\_cast < integer > (static\_cast < signed
int>(operator^*(heapIs $heap_{1032.1:1051.8}, this).p2) < (int)(0))) + temp(2)))
→ [explicitly assert falsehood of skipped guards in subsequent guards]
[57.5] $heap<sub>1032.1:1054.8</sub> == $heap<sub>funcstart_1032.1</sub>._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.\r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.} \text{\$r.value}(\text{heapIs}))
\rho_{funcstart\_1032.1}.p1, 177).rem)))._replace(this.$r \rightarrow ([this.$r ==
this.$r]: this.$r.value(heap
Is \rho_{tart\_1032,1}).\_replace(p1 \rightarrow (-2 * label{eq:this.}))
div(\mathbf{heapIs} \$ heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
\text{Sheap}_{funcstart\_1032,1}.p1, 177).quot) + (171 * div(heapIs \text{Sheap}_{funcstart\_1032,1},
this.r.value(heapIs \heap_{funcstart\_1032.1}).p1, 177).rem)), [!(this.<math>r = 
this.$r)]: this.$r.value(heapIs \theta_{funcstart\_1032,1})._replace(p2 \rightarrow
asType<P2Type>(($heap<sub>1032,1;1051,8</sub>.M2 *
asType<int>(static_cast<integer>(static_cast<signed
```

```
int>(operator^*(heapIs \$heap_{1032,1;1051,8}, this).p2) < (int)(0))) + temp(2)))
\rightarrow [simplify]
[57.7] heap_{1032,1;1054,8} == heap_{funcstart\_1032,1}._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs \$heap_{funcstart\_1032,1}, this.\$r.value(heapIs
\theta_{funcstart\_1032,1}.p1, 177).rem)))).\_replace(this.\$r \rightarrow 0
this.$r.value(heapIs \rho_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs $heap<sub>funcstart 1032.1</sub>, this.$r.value(heapIs
\theta_{funcstart\_1032,1}.p1, 177).rem))).\_replace(p2 \rightarrow
asType<P2Type>(($heap<sub>1032,1;1051,8</sub>.M2 *
asType<int>(static_cast<integer>(static_cast<signed
int>(operator*(heapIs $heap_{1032,1;1051,8}, this).p2) < (int)0))) + temp2)))
\rightarrow [from term 53.19, $heap<sub>1032,1;1051,8</sub> is equal to
\$heap_{funcstart\_1032,1}.\_\textbf{replace}(\textbf{this.}\$r \rightarrow \textbf{this.}\$r.\textbf{value}(\textbf{heapIs}
heap_{funcstart\_1032.1}._replace(p1 \rightarrow (-2 * div(heapIs * heap_{funcstart\_1032.1}, + div(heapIs * heap_{funcstart\_1032.1}, 
div(heapIs $heap_{funcstart\_1032,1}, this.$r.value(heapIs)
heap_{funcstart\_1032,1}.p1, 177).rem)))
[57.8] heap_{1032,1;1054,8} == heap_{funcstart\_1032,1}._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{tuncstart\_1032.1}, this.r.value(heapIs \rho_{tuncstart\_1032.1}).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{heap}_{funcstart\_1032,1}, \text{this.} \text{$r.value}(\text{heapIs}))
\label{eq:continuous_function} $ \text{heap}_{funcstart\_1032,1}.\text{p1},\ 177).\text{rem})))).$ $$\_\textbf{replace}(\textbf{this}.\$r \rightarrow
\textbf{this.}\$r.\textbf{value}(\textbf{heapIs}~\$heap_{funcstart\_1032,1}).\_\textbf{replace}(p1 \rightarrow ((\text{-}2~*\text{div}(\textbf{heapIs}
\rho_{tuncstart\_1032.1}, this.r.value(heapIs \rho_{tuncstart\_1032.1}).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.} \text{\$r.value}(\text{heapIs}))
\theta_{funcstart\_1032,1}.p1, 177).rem))._replace(p2 \rightarrow
asType < P2Type > ((\$heap_{tuncstart\_1032.1}.\_replace(this.\$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(\mathbf{heapIs} \ \$heap_{funcstart\_1032,1}, \ \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
heap_{funcstart\_1032,1}.p1, 177).rem))).M2 *
asType<int>(static_cast<integer>(static_cast<signed
int>(operator^*(heapIs $heap_{1032,1;1051,8}, this).p2) < (int)0))) + temp2)))
→ [const member of object with modified fields]
[57.9] heap_{1032,1;1054,8} == heap_{funcstart\_1032,1}._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs $heap<sub>funcstart_1032,1</sub>, this.$r.value(heapIs
\theta_{funcstart\_1032,1}.p1, 177).rem)))).replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
```

```
\rho_{funcstart=1032,1}, this.r.value(heapIs \rho_{funcstart=1032,1}).p1,
177).quot) + (171 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
heap_{funcstart\_1032,1}.p1, 177).rem))._replace(p2 \rightarrow
asType<P2Type>(($heap<sub>funcstart_1032,1</sub>.M2 *
asType<int>(static_cast<integer>(static_cast<signed
int>(operator^*(heapIs $heap_{1032,1;1051,8}, this).p2) < (int)(0))) + temp(2)))
\rightarrow [const static or extern object]
[57.10] $heap<sub>1032,1;1054,8</sub> == $heap<sub>funcstart_1032,1</sub>._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
$\text{heap}_{funcstart=1032.1}$, this.$\text{r.value}(\text{heapIs} \text{$heap}_{funcstart=1032.1}).p1,
177).quot) + (171 * div(\mathbf{heapIs} \$ heap_{funcstart\_1032,1}, \mathbf{this}.\$ r. \mathbf{value}(\mathbf{heapIs})
\theta_{tuncstart\_1032,1}.p1, 177).rem)))).\_replace(this.\$r \rightarrow
this.$r.value(heapIs p_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
\theta_{funcstart\_1032,1}.p1, 177).rem))).\_replace(p2 \rightarrow
asType < P2Type > ((\$heap_{init}.M2))
asType < int > (static\_cast < integer > (static\_cast < signed)
int>(operator^*(heapIs $heap_{1032,1;1051,8}, this).p2) < (int)0))) + temp2)))
\rightarrow [expand definition of constant 'M2' at prang.cpp (33,26)]
[57.11] \rho_{1032,1;1054,8} == \rho_{1032,1;1054,8} = \rho_{1032,1;1054,
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{tuncstart_{1032.1}}, this.$r.value(heapIs \rho_{tuncstart_{1032.1}}).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.} \text{\$r.value}(\text{heapIs}))
\label{eq:continuous_function} $ \text{heap}_{funcstart\_1032,1} . \text{p1}, 177).rem)))).$ \_\textbf{replace}(\textbf{this}.\$r \rightarrow
\textbf{this.}\$r.\textbf{value}(\textbf{heapIs}~\$heap_{funcstart\_1032,1}).\_\textbf{replace}(p1 \rightarrow ((\text{-}2~*\text{div}(\textbf{heapIs}
\rho_{tuncstart\_1032.1}, this.r.value(heapIs \rho_{tuncstart\_1032.1}).p1,
177).quot) + (171 * div(\mathbf{heapIs} \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}))
\theta_{funcstart\_1032,1}.p1, 177).rem))._replace(p2 \rightarrow
\mathbf{asType} {<} P2Type {>} (((\mathbf{int})30307 *
asType<int>(static_cast<integer>(static_cast<signed
int>(operator^*(heapIs $heap_{1032,1;1051,8}, this).p2) < (int)(0))) + temp(2)))
\rightarrow [simplify]
[57.12] \theta_{1032,1;1054,8} == \theta_{1032,1;1054,8} == \theta_{1032,1}.replace(this.$r \to
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart_1032,1}, this.r.value(heapIs \rho_{funcstart_1032,1}).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{heap}_{funcstart\_1032,1}, \text{this.}\text{$r.value}(\text{heapIs}))
\theta_{funcstart\_1032,1}.p1, 177).rem)))._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs $heap<sub>funcstart_1032,1</sub>, this.$r.value(heapIs
\theta_{funcstart\_1032,1}.p1, 177).rem))).\_replace(p2 \rightarrow
asType<P2Type>((30307 *
```

```
asType<int>(static_cast<integer>(static_cast<signed
int>(operator^*(heapIs $heap_{1032,1;1051,8}, this).p2) < (int)(0))) + temp(2)))
\rightarrow [from term 53.19, $heap<sub>1032,1;1051,8</sub> is equal to
heap_{funcstart\_1032.1}._replace(this.r \rightarrow this.r.value(heapIs)
heap_{funcstart\_1032.1}._replace(p1 \rightarrow (-2 * div(heapIs p_{funcstart\_1032.1})
this.r.value(heapIs \ \$heap_{funcstart\_1032,1}).p1, \ 177).quot) + (171 * 
div(\mathbf{heapIs}\ \$heap_{funcstart\_1032,1},\ \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}
heap_{funcstart\_1032,1}.p1, 177).rem)))
[57.13] $heap<sub>1032,1:1054,8</sub> == $heap<sub>funcstart_1032,1</sub>._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
\theta_{tuncstart\_1032,1}.p1, 177).rem)))).\_replace(this.$r \rightarrow
this.$r.value(heapIs $heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(\mathbf{heapIs} \$ heap_{funcstart\_1032,1}, \mathbf{this}.\$ r. \mathbf{value}(\mathbf{heapIs})
\theta_{uncstart\_1032,1}.p1, 177).rem))).\_replace(p2 \rightarrow
asType<P2Type>((30307 *
asType<int>(static_cast<integer>(static_cast<signed
\mathbf{int}{>}(\mathbf{operator^*}(\mathbf{heapIs}\ \$\mathbf{heap}_{funcstart\_1032,1}.\_\mathbf{replace}(\mathbf{this}.\$\mathbf{r}\rightarrow
this.$r.value(heapIs \rho_{tuncstart\_1032.1})._replace(p1 \rightarrow (-2 * div(heapIs
\rho_{tuncstart\_1032.1}, this.r.value(heapIs \rho_{tuncstart\_1032.1}).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.} \text{\$r.value}(\text{heapIs}))
\frac{\text{heap}_{funcstart_1032,1}.p1, 177.rem)}{\text{this}.p2} < (int)0)) + temp2))}
→ [expand definition of operator '*' in class 'pointer' at built in declaration]
[57.14] \theta_{1032,1;1054,8} == \theta_{funcstart\_1032,1}._replace(this.$r \to
this.$r.value(heapIs \rho_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{tuncstart\_1032.1}, this.r.value(heapIs \rho_{tuncstart\_1032.1}).p1,
177).quot) + (171 * div(\mathbf{heapIs} \ \$heap_{funcstart\_1032,1}, \ \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
\theta_{funcstart\_1032,1}.p1, 177).rem)))).replace(this.r \rightarrow 0
this.$r.value(heapIs \rho_{tuncstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs \theta_{funcstart\_1032,1}, this.r.value(heapIs)
heap_{funcstart\_1032,1}.p1, 177).rem)))._replace(p2 \rightarrow
asType<P2Type>((30307 *
asType<int>(static_cast<integer>(static_cast<signed
\mathbf{int}{>}(\mathbf{this.\$r.value}(\mathbf{heapIs}\ \$\mathbf{heap}_{funcstart\_1032,1}.\mathbf{\_replace}(\mathbf{this.\$r} \rightarrow
this.$r.value(heapIs \rho_{tuncstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart_{1032,1}}, this.r.value(heapIs \rho_{funcstart_{1032,1}}).p1,
177).quot) + (171 * div(heapIs $heap<sub>funcstart_1032,1</sub>, this.$r.value(heapIs
\text{Sheap}_{funcstart\_1032.1}.\text{p1}, 177).\text{rem})))).\text{p2}) < (int)0))) + \text{temp2}))
\rightarrow [evaluate dereferenced pointer into modified heap]
[57.15] $heap<sub>1032,1;1054,8</sub> == $heap<sub>funcstart_1032,1</sub>._replace(this.$r \rightarrow
```

```
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
\theta_{tuncstart\_1032,1}.p1, 177).rem)))).\_replace(this.\$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(\mathbf{heapIs} \ \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
heap_{funcstart=1032.1}, p1, 177).rem)))._replace(p2 \rightarrow
asType<P2Type>((30307 *
asType<int>(static_cast<integer>(static_cast<signed int>(([this.$r
== this.$r]: this.$r.value(heapIs \rho_{tangle} = 1032,1)._replace(p1 \rho (-2 *
div(heapIs $heap<sub>funcstart_1032.1</sub>, this.$r.value(heapIs
\text{Sheap}_{funcstart\_1032,1}.p1, 177).quot) + (171 * div(heapIs \text{Sheap}_{funcstart\_1032,1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177).rem)), []:
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p2) < (int)0))) + temp2)))
→ [explicitly assert falsehood of skipped guards in subsequent guards]
[57.16] $heap<sub>1032,1;1054,8</sub> == $heap<sub>funcstart_1032,1</sub>._replace(this.$r \rightarrow
this.$r.value(heapIs \rho_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\label{eq:heapIs} $ \text{heap}_{funcstart\_1032,1}, \, \textbf{this}. \\ \$r. \textbf{value}(\textbf{heapIs} \,\, \$ \text{heap}_{funcstart\_1032,1}). \\ \text{p1},
177).quot) + (171 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.} \text{\$r.value}(\text{heapIs}))
\theta_{tuncstart\_1032.1}.p1, 177).rem)))._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
\theta_{funcstart\_1032.1}.p1, 177).rem)))._replace(p2 \rightarrow
asType<P2Type>((30307 *
asType < int > (static\_cast < integer > (static\_cast < signed\ int > ((|this.\$r
== this.$r]: this.$r.value(heapIs \rho_{uncstart\_1032,1})._replace(p1 \rightarrow (-2 *
{\rm div}(\mathbf{heapIs}\ \$ \mathrm{heap}_{funcstart\_1032,1},\ \mathbf{this}.\$ \mathrm{r.value}(\mathbf{heapIs}
\text{Sheap}_{funcstart\_1032,1}.p1, 177).quot) + (171 * div(heapIs \text{Sheap}_{funcstart\_1032,1},
this.r.value(heapIs \ensuremath{\$}heap_{funcstart\_1032,1}).p1, 177).rem)), [!(this.\ensuremath{\$}r ==
\textbf{this.\$r.} \textbf{value}(\textbf{heapIs} \ \$ heap_{funcstart\_1032,1})).p2) < (\textbf{int})0))) + \\
temp2)))
\rightarrow [simplify]
[57.23] heap_{1032,1;1054,8} == heap_{funcstart\_1032,1}._replace(this.r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
\theta_{tuncstart\_1032,1}.p1, 177).rem)))).\_replace(this.\$r \rightarrow 0
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\$heap_{funcstart\_1032,1},\, \textbf{this.}\$r.\textbf{value}(\textbf{heapIs}\,\,\$heap_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(\mathbf{heapIs} \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}))
\theta_{tuncstart = 1032.1}, p1, 177).rem)))._replace(p2 \rightarrow
asType<P2Type>((30307 * asType<int>(static_cast<integer>(0 <
```

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\rightarrow [from term 24.0, literala < -this.$r.value(heapIs $heap_{funcstart\_1032,1}).p2
is false whenever -2 < (0 + literala)
    Proof of rule precondition:
    [57.23.0] - 2 < (0 + 0)
    \rightarrow [simplify]
    [57.23.2] true
[57.24] $heap<sub>1032,1;1054,8</sub> == $heap<sub>funcstart_1032,1</sub>._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{tuncstart\_1032.1}, this.r.value(heapIs \rho_{tuncstart\_1032.1}).p1,
177).quot) + (171 * div(\mathbf{heapIs} \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}))
\theta_{tuncstart\_1032.1}.p1, 177).rem)))).\_replace(this.\$r \rightarrow
this.$r.value(heapIs heap_{tuncstart\_1032.1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.} \text{\$r.value}(\text{heapIs}))
heap_{funcstart\_1032,1}.p1, 177).rem))._replace(p2 \rightarrow
asType<P2Type>((30307 * asType<int>(static_cast<integer>(false)))
+ \text{ temp2})))
\rightarrow [simplify]
[57.25] $heap<sub>1032,1;1054,8</sub> == $heap<sub>funcstart_1032,1</sub>._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{heap}_{funcstart\_1032,1}, \text{this.}\text{\$r.value}(\text{heapIs}))
\theta_{funcstart\_1032,1}.p1, 177).rem))))._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.} \text{\$r.value}(\text{heapIs}))
\label{eq:condition} $\operatorname{heap}_{funcstart\_1032,1}).p1,\ 177).rem))).\_\mathbf{replace}(p2 \to
asType < P2Type > ((30307 * asType < int > (([false]: 1, []: 0))) + temp2)))
→ [explicitly assert falsehood of skipped guards in subsequent guards]
[57.26] $heap<sub>1032,1;1054,8</sub> == $heap<sub>funcstart_1032,1</sub>._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
$\text{heap}_{funcstart=1032,1}$, this.$\text{r.value}(\text{heapIs} \text{$heap}_{funcstart=1032,1}).p1,
177).quot) + (171 * div(heapIs $heap<sub>funcstart_1032,1</sub>, this.$r.value(heapIs
\theta_{funcstart\_1032,1}.p1, 177).rem)))).replace(this.r \rightarrow 0
this.$r.value(heapIs p_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\$ heap_{funcstart\_1032,1}, \ \mathbf{this}.\$ r. \mathbf{value} (\mathbf{heapIs} \ \$ heap_{funcstart\_1032,1}).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.} \text{\$r.value}(\text{heapIs}))
\label{eq:place} $\operatorname{heap}_{funcstart\_1032,1}).p1,\ 177).rem))).\_\mathbf{replace}(p2 \to
asType<P2Type>((30307 * asType<int>(([false]: 1, [true]: 0))) +
temp2)))
```

-this.r.value(heapIs $heap_{funcstart_1032,1}.p2))) + temp2)))$

```
\rightarrow [simplify]
[57.29] $heap<sub>1032,1;1054,8</sub> == $heap<sub>funcstart_1032,1</sub>._replace(this.$r \rightarrow
\textbf{this.\$r.value}(\textbf{heapIs}~\$ heap_{funcstart\_1032,1}).\_\textbf{replace}(p1 \rightarrow ((-2~*div(\textbf{heapIs})))))
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
\theta_{funcstart\_1032,1}.p1, 177).rem)))).\_replace(this.$r \rightarrow
\textbf{this.}\$r.\textbf{value}(\textbf{heapIs}~\$heap_{funcstart\_1032,1}).\_\textbf{replace}(p1 \rightarrow ((-2~*div(\textbf{heapIs})))))
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs $heap_{funcstart\_1032,1}, this.$r.value(heapIs
\rho_{funcstart\_1032,1}.p1, 177).rem))._replace(p2 \rightarrow asType<P2Type>(0 +
temp2)))
\rightarrow [from term 54.18, temp2 is equal to (-35 * div(heapIs $heap_{funcstart\_1032.1},
div(\mathbf{heapIs}\ \$heap_{funcstart\_1032,1},\ \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}
heap_{funcstart\_1032,1}.p2, 176).rem
[57.30] $heap<sub>1032,1;1054,8</sub> == $heap<sub>funcstart_1032,1</sub>._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{tuncstart=1032.1}, this.r.value(heapIs \rho_{tuncstart=1032.1}).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.}\text{\$r.value}(\text{heapIs}))
\theta_{funcstart\_1032,1}.p1, 177).rem)))).\_replace(this.\$r \rightarrow 0
this.$r.value(heapIs \rho_{uncstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs)
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
\rho_{tuncstart\_1032,1}.p1, 177).rem))._replace(p2 \rightarrow asType<P2Type>(0 +
((-35 * div(\mathbf{heapIs} \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}))
\text{Sheap}_{funcstart\_1032.1}, p2, 176).quot) + (172 * div(heapIs \text{Sheap}_{funcstart\_1032.1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p2, 176).rem)))))
\rightarrow [simplify]
[57.33] heap_{1032,1;1054,8} == heap_{funcstart\_1032,1}._replace(this.$r \rightarrow
\textbf{this.}\$r.\textbf{value}(\textbf{heapIs}~\$heap_{funcstart\_1032,1}).\_\textbf{replace}(p1 \rightarrow ((\text{-}2~*\text{div}(\textbf{heapIs}
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs $heap<sub>funcstart_1032,1</sub>, this.$r.value(heapIs
\theta_{funcstart=1032,1}.p1, 177).rem)))).\_replace(this.\$r \rightarrow 0
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\theta_{funcstart\_1032,1}, this.r.value(heapIs \theta_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs $heap<sub>funcstart_1032.1</sub>, this.$r.value(heapIs
\rho_{funcstart\_1032.1}.p1, 177).rem)._replace(p2 \rightarrow ((-35 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p2,
176).quot) + (172 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.} \text{\$r.value}(\text{heapIs}))
heap_{funcstart\_1032,1}.p2, 176).rem)))
[Take given term]
[58.0] \; ((\$heap_{1032,1;1054,8}.r3 * \mathbf{static\_cast} < \mathbf{signed int} > (\text{div}3.rem)) \; - \\
(\text{sheap}_{1032,1;1054,8}.\text{b3 * static\_cast} < \text{signed int} > (\text{div3.quot}))) == \text{temp3}
```

```
\rightarrow [from term 57.33, $heap<sub>1032.1:1054.8</sub> is equal to
\$heap_{funcstart\_1032,1}.\_\textbf{replace}(\textbf{this}.\$r \rightarrow \textbf{this}.\$r.\textbf{value}(\textbf{heapIs}
heap_{funcstart\_1032,1}._replace(p1 \rightarrow ((-2 * div(heapIs $heap_{funcstart\_1032,1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, \ 177).quot) + (171)
div(heapIs $heap_funcstart_1032.1, this.$r.value(heapIs
\theta_{funcstart\_1032,1}.p1, 177).rem)))).\_replace(this.\$r \rightarrow 0
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
heap_{funcstart\_1032,1}, this.r.value(heapIs heap_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs \$heap_{funcstart\_1032,1}, this.\$r.value(heapIs))
\rho_{tuncstart_{-1032,1}}.p1, 177).rem))._replace\rho_{tuncstart_{-1032,1}}.p1, 177).rem))._replace
heap_{funcstart\_1032,1}, this.r.value(heapIs heap_{funcstart\_1032,1}).p2,
176).quot) + (172 * div(heapIs $heap_{funcstart\_1032.1}, this.$r.value(heapIs
heap_{funcstart\_1032,1}.p2, 176).rem)))]
[58.1] \; ((\$ heap_{funcstart\_1032,1}.\_\textbf{replace}(\textbf{this}.\$r \rightarrow \textbf{this}.\$r.\textbf{value}(\textbf{heapIs}))) \\
\rho_{tuncstart\_1032.1}._replace(p1 \rightarrow ((-2 * div(heapIs \rho_{tuncstart\_1032.1})
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177).quot) + (171 *
div(\mathbf{heapIs} \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
\theta_{funcstart\_1032,1}.p1, 177).rem)))).\_replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\theta_{funcstart\_1032,1}, this.r.value(\theta_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs \theta_{funcstart\_1032,1}, this.r.value(heapIs)
\rho_{uncstart_1032,1}.p1, 177).rem))._replace(p2 \rightarrow ((-35 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p2,
176).quot) + (172 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
\theta_{funcstart\_1032,1}.p2, 176).rem))).r3 * static_cast < signed
int>(div3.rem)) - (\$heap_{1032.1:1054.8}.b3 * static\_cast < signed
int>(div3.quot))) == temp3
→ [const member of object with modified fields]
[58.3] \; ((\$heap_{funcstart\_1032,1}.r3 \; * \; \textbf{static\_cast} < \textbf{signed int} > (\text{div3.rem})) \; - \; \text{div3.rem})) \; - \; \text{div3.rem}) \; + \; \text{div3
(\text{sheap}_{1032.1:1054.8}.\text{b3 * static\_cast} < \text{signed int} > (\text{div3.quot}))) = \text{temp3}
\rightarrow [const static or extern object]
[58.4] (($heap<sub>init</sub>.r3 * static_cast<signed int>(div3.rem)) -
(\text{sheap}_{1032,1;1054,8}.\text{b3} * \text{static\_cast} < \text{signed int} > (\text{div}3.\text{quot}))) == \text{temp}_3
\rightarrow [expand definition of constant 'r3' at prang.cpp (39,26)]
[58.5] (((int)170 * static_cast<signed int>(div3.rem)) -
(\text{sheap}_{1032,1:1054,8}.\text{b3 * static\_cast} < \text{signed int} > (\text{div3.quot}))) == \text{temp3}
\rightarrow [simplify]
[58.6] ((170 * static_cast<signed int>(div3.rem)) - ($heap_1032.1:1054.8.b3 *
static_cast<signed int>(div3.quot))) == temp3
\rightarrow [from term 34.6, div3 is equal to div(heapIs $heap_{funcstart\_1032.1},
this.$r.value(heapIs $heap_{funcstart\_1032,1}).p3, 178)]
```

```
[58.7] ((170 * static_cast<signed int>(div(heapIs $heap_{tuncstart_1032.1},
\mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}~\$\mathrm{heap}_{funcstart\_1032,1}).\mathrm{p3},~178).\mathrm{rem})) \ \text{-}
(\text{sheap}_{1032,1:1054,8}.\text{b3} * \text{static\_cast} < \text{signed int} > (\text{div3.quot}))) == \text{temp3}
\rightarrow [simplify]
[58.8] ((170 * div(heapIs $heap_{funcstart\_1032,1}, this.$r.value(heapIs
\text{Sheap}_{funcstart\_1032,1}.p3, 178).rem) - (\text{Sheap}_{1032,1;1054,8}.b3 *
static_cast<signed int>(div3.quot))) == temp3
\rightarrow [from term 57.33, $heap<sub>1032,1:1054,8</sub> is equal to
$heap_{funcstart\_1032,1}$.\_replace(this.$r \rightarrow this.$r.value(heapIs)
heap_{funcstart\_1032,1}._replace(p1 \rightarrow ((-2 * div(heapIs $heap_{funcstart\_1032,1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177).quot) + (171 *
div(\mathbf{heapIs}\ \$heap_{funcstart\_1032,1},\ \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}
\theta_{tuncstart\_1032.1}.p1, 177).rem))))_replace(this.r \rightarrow 0
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
heap_{funcstart\_1032,1}, this.r.value(heapIs heap_{funcstart\_1032,1}).p1,
 177).quot) + (171 * div(\mathbf{heapIs} \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}))
\rho_{funcstart\_1032.1}.p1, 177).rem))).\_replace(p2 \rightarrow (-35 * div(heapIs))).
heap_{funcstart\_1032,1}, this.r.value(heapIs heap_{funcstart\_1032,1}).p2,
 176).quot) + (172 * div(\textbf{heapIs} \$heap_{funcstart\_1032,1}, \textbf{this}.\$r.\textbf{value}(\textbf{heapIs}))
heap_{funcstart\_1032,1}.p2, 176).rem)))]
[58.9] ((170 * \mathrm{div}(\mathbf{heapIs}\ \$\mathrm{heap}_{funcstart\_1032,1},\ \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}
\rho_{uncstart\_1032,1}.p3, 178.rem – (\rho_{uncstart\_1032,1}.p_{uncstart\_1032,1}.p_{uncstart\_1032,1}.p_{uncstart\_1032,1}.p_{uncstart\_1032,1}.p_{uncstart\_1032,1}.p_{uncstart\_1032,1}.p_{uncstart\_1032,1}.p_{uncstart\_1032,1}.p_{uncstart\_1032,1}.p_{uncstart\_1032,1}.p_{uncstart\_1032,1}.p_{uncstart\_1032,1}.p_{uncstart\_1032,1}.p_{uncstart\_1032,1}.p_{uncstart\_1032,1}.p_{uncstart\_1032,1}.p_{uncstart\_1032,1}.p_{uncstart\_1032,1}.p_{uncstart\_1032,1}.p_{uncstart\_1032,1}.p_{uncstart\_1032,1}.p_{uncstart\_1032,1}.p_{uncstart\_1032,1}.p_{uncstart\_1032,1}.p_{uncstart\_1032,1}.p_{uncstart\_1032,1}.p_{uncstart\_1032,1}.p_{uncstart\_1032,1}.p_{uncstart\_1032,1}.p_{uncstart\_1032,1}.p_{uncstart\_1032,1}.p_{uncstart\_1032,1}.p_{uncstart\_1032,1}.p_{uncstart\_1032,1}.p_{uncstart\_1032,1}.p_{uncstart\_1032,1}.p_{uncstart\_1032,1}.p_{uncstart\_1032,1}.p_{uncstart\_1032,1}.p_{uncstart\_1032,1}.p_{uncstart\_1032,1}.p_{uncstart\_1032,1}.p_{uncstart\_1032,1}.p_{uncstart\_1032,1}.p_{uncstart\_1032,1}.p_{uncstart\_1032,1}.p_{uncstart\_1032,1}.p_{uncstart\_1032,1}.p_{uncstart\_1032,1}.p_{uncstart\_1032,1}.p_{uncstart\_1032,1}.p_{uncstart\_1032,1}.p_{uncstart\_1032,1}.p_{uncstart\_1032,1}.p_{uncstart\_1032,1}.p_{uncstart\_1032,1}.p_{uncstart\_1032,1}.p_{uncstart\_1032,1}.p_{uncstart\_1032,1}.p_{uncstart\_1032,1}.p_{uncstart\_1032,1}.p_{uncstart\_1032,1}.p_{uncstart\_1032,1}.p_{uncstart\_1032,1}.p_{uncstart\_1032,1}.p_{uncstart\_1032,1}.p_{uncstart\_1032,1}.p_{uncstart\_1032,1}.p_{uncstart\_1032,1}.p_{uncstart\_1032,1}.p_{uncstart\_1032,1}.p_{uncstart\_1032,1}.p_{uncstart\_1032,1}.p_{uncstart\_1032,1}.p_{uncstart\_1032,1}.p_{uncstart\_1032,1}.p_{uncstart\_1032,1}.p_{uncstart\_1032,1}.p_{uncstart\_1032,1}.p_{uncstart\_1032,1}.p_{uncstart\_1032,1}.p_{uncstart\_1032,1}.p_{uncstart\_1032,1}.p_{uncstart\_1032,1}.p_{uncstart\_1032,1}.p_{uncstart\_1032,1}.p_{uncstart\_1032,1}.p_{uncstart\_1032,1}.p_{uncstart\_1032,1}.p_{uncstart\_1032,1}.p_{uncstart\_1032,1}.p_{uncstart\_1032,1}.p_{uncstart\_1032,1}.p_{uncstart\_1032,1}.p_{uncstart\_1032,1}.p_{uncstart\_1032,1}.p_{uncstart\_1032,1}.p_{uncstart\_1032,1}.p_{uncstart\_1032,1}.p_{uncs
\rightarrow this.$r.value(heapIs $heap_{tuncstart\_1032.1})._replace(p1 \rightarrow ((-2 *
div(\mathbf{heapIs} \$heap_{funcstart\_1032.1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
\text{Sheap}_{funcstart\_1032,1}.p1, 177).quot) + (171 * div(heapIs \text{Sheap}_{funcstart\_1032,1},
this.r.value(heapIs \theta_{funcstart\_1032,1}).p1, 177).rem)))).replace(this. replace(this. replace(thi
\rightarrow this.$r.value(heapIs $heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 *
div(\mathbf{heapIs} \$ heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
\text{Sheap}_{funcstart\_1032,1}.p1, 177).quot) + (171 * div(heapIs \text{Sheap}_{funcstart\_1032,1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177).rem))).\_replace(p2 \rightarrow
((-35 * div(heapIs \$heap_{funcstart\_1032,1}, this.\$r.value(heapIs
\text{Sheap}_{funcstart\_1032,1}.p2, 176).quot) + (172 * div(heapIs \text{Sheap}_{funcstart\_1032,1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p2, 176).rem)))).b3 *
static_cast<signed int>(div3.quot))) == temp3
\rightarrow [const member of object with modified fields]
[58.11] ((170 * div(heapIs $heap_{funcstart\_1032,1}, this.$r.value(heapIs)]
\text{Sheap}_{funcstart\_1032,1}.p3, 178).rem) - (\text{Sheap}_{funcstart\_1032,1}.b3 *
static_cast<signed int>(div3.quot))) == temp3
\rightarrow [const static or extern object]
[58.12] ((170 * {\rm div}(\mathbf{heapIs}\ \$ \mathrm{heap}_{funcstart\_1032,1},\ \mathbf{this}.\$ \mathrm{r.value}(\mathbf{heapIs}\ 
\rho_{uncstart_{1032,1}}.p3, 178).rem – (\rho_{uncstart_{1032,1}}.p3, 178).rem
int>(div3.quot))) == temp3
```

```
\rightarrow [expand definition of constant 'b3' at prang.cpp (41,26)]
[58.13] ((170 * div(heapIs \$heap_{funcstart\_1032,1}, this.\$r.value(heapIs
\theta_{funcstart\_1032,1}.p3, 178).rem - ((int)63 * static\_cast < signed)
int>(div3.quot)) == temp3
\rightarrow [simplify]
[58.14] ((170 * div(heapIs \rho_{funcstart\_1032,1}, this.\r.value(heapIs
\theta_{funcstart\_1032,1}.p3, 178).rem) - (63 * static_cast<signed
int>(div3.quot)) == temp3
\rightarrow [from term 34.6, div3 is equal to div(heapIs $heap_{funcstart\_1032,1},
this.r.value(heapIs $heap_{funcstart\_1032,1}).p3, 178)]
[58.15] ((170 * div(heapIs $heap<sub>funcstart_1032,1</sub>, this.$r.value(heapIs)
\theta_{funcstart\_1032,1}.p3, 178).rem) - (63 * static_cast<signed
int>(div(heapIs \$heap_{funcstart\_1032,1}, this.\$r.value(heapIs
\text{Sheap}_{funcstart\_1032,1}.p3, 178).quot))) == temp3
\rightarrow [simplify]
[58.20] 0 == (-\text{temp3} + (-63 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1},
this.$r.value(heapIs heap_{funcstart\_1032,1}).p3, 178).quot) + (170 *
div(\mathbf{heapIs} \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
heap_{funcstart_{-1032,1}}.p3, 178).rem
[Take given term]
[60.0] temp3 \leq maxof(signed int)
\rightarrow [simplify]
[60.9] - 32768 < -\text{temp3}
\rightarrow [from term 58.20, temp3 is equal to (-63 * div(heapIs $heap_{funcstart\_1032.1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p3, 178).quot) + (170 \ *
div(\mathbf{heapIs} \ \$heap_{funcstart\_1032,1}, \ \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
heap_{funcstart\_1032.1}.p3, 178).rem)
[60.10] -32768 < -((-63 * div(\mathbf{heapIs} \$heap_{funcstart\_1032,1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p3, 178).quot) + (170 *
div(\mathbf{heapIs} \$ heap_{funcstart\_1032.1}, \mathbf{this.}\$r.\mathbf{value}(\mathbf{heapIs})
heap_{funcstart\_1032,1}.p3, 178).rem))
\rightarrow [simplify]
[60.13] -32768 < ((63 * div(heapIs $heap_{funcstart\_1032,1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p3, 178).quot) + (-170 *
div(\mathbf{heapIs} \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
heap_{funcstart\_1032,1}.p3, 178).rem
[Take goal term]
[1.0] (($heap<sub>1032,1:1054,8</sub>.M3 *
```

```
asType<int>(static_cast<integer>(static_cast<signed
int>(operator^*(heapIs \$heap_{1032,1:1054,8}, this).p3) < (int)0))) + temp3) \le
maxof(signed int)
\rightarrow [from term 57.33, $heap<sub>1032.1:1054.8</sub> is equal to
heap_{funcstart\_1032.1}._replace(this.r \rightarrow this.r.value(heapIs)
heap_{funcstart\_1032,1}._replace(p1 \rightarrow ((-2 * div(heapIs heap_{funcstart\_1032,1}),
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177).quot) + (171 \ *
div(\mathbf{heapIs} \ \$heap_{funcstart\_1032,1}, \ \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
\theta_{tuncstart\_1032.1}.p1, 177).rem)))._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs)))
heap_{funcstart\_1032,1}, this.r.value(heapIs heap_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs $heap_{funcstart\_1032.1}, this.$r.value(heapIs
heap_{funcstart\_1032,1}.p1, 177).rem))).\_replace(p2 \rightarrow (-35 * div(heapIs))).
heap_{funcstart\_1032,1}, this.r.value(heapIs heap_{funcstart\_1032,1}).p2,
176).quot) + (172 * div(heapIs $heap_{funcstart\_1032,1}, this.$r.value(heapIs
heap_{funcstart\_1032,1}.p2, 176).rem)))]
[1.1] \; ((\$ heap_{funcstart\_1032,1}.\_\textbf{replace}(\textbf{this}.\$r \rightarrow \textbf{this}.\$r.\textbf{value}(\textbf{heapIs}
\rho_{tuncstart\_1032.1}._replace(p1 \rightarrow ((-2 * div(heapIs \rho_{tuncstart\_1032.1}),
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177).quot) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_1032,1}, \ \mathbf{this}.\$ r. \mathbf{value}(\mathbf{heapIs}
\theta_{funcstart\_1032,1}.p1, 177).rem)))).\_replace(this.\$r \rightarrow 0
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.\r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs \$heap_{funcstart\_1032,1}, this.\$r.value(heapIs
\rho_{uncstart_1032,1}.p1, 177).rem))._replace(p2 \rightarrow ((-35 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p2,
176).quot) + (172 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
heap_{funcstart_{1032,1}}.p2, 176).rem))).M3 *
asType<int>(static_cast<integer>(static_cast<signed
int>(operator^*(heapIs $heap_{1032.1:1054.8}, this).p3) < (int)0))) + temp3) \le
maxof(signed int)
\rightarrow [const member of object with modified fields]
[1.3] (($heap<sub>funcstart_1032,1</sub>.M3 *
asType<int>(static_cast<integer>(static_cast<signed
int>(operator^*(heapIs $heap_{1032.1:1054.8}, this).p3) < (int)0))) + temp3) \le
maxof(signed int)
\rightarrow [const static or extern object]
[1.4] (($heap<sub>init</sub>.M3 *
asType{<}int{>}(static\_cast{<}integer{>}(static\_cast{<}signed
int > (operator^*(heapIs \$heap_{1032,1;1054,8}, this).p3) < (int)0))) + temp3) \le 1
maxof(signed int)
\rightarrow [expand definition of constant 'M3' at prang.cpp (38,26)]
```

```
[1.5] (((int)30323 *
asType<int>(static_cast<integer>(static_cast<signed
int>(operator^*(heapIs \$heap_{1032,1:1054,8}, this).p3) < (int)0))) + temp3) \le
maxof(signed int)
\rightarrow [simplify]
[1.6] ((30323 * asType<int>(static_cast<integer>(static_cast<signed
int>(operator^*(heapIs \$heap_{1032,1:1054,8}, this).p3) < (int)0))) + temp3) \le
maxof(signed int)
\rightarrow [from term 57.33, \rho_{1032,1;1054,8} is equal to
heap_{funcstart\_1032,1}._replace(this.r \rightarrow this.r.value(heapIs)
heap_{funcstart\_1032,1}._replace(p1 \rightarrow ((-2 * div(heapIs $heap_{funcstart\_1032,1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177).quot) + (171 \ *
div(\mathbf{heapIs} \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
\theta_{funcstart\_1032,1}.p1, 177).rem)))).\_replace(this.\$r \rightarrow 0
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
heap_{funcstart\_1032,1}, this.r.value(heapIs heap_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(\mathbf{heapIs} \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}))
\rho_{tuncstart\_1032.1}.p1, 177).rem))).\_replace(p2 \rightarrow (-35 * div(heapIs)))
heap_{funcstart\_1032,1}, this.r.value(heapIs heap_{funcstart\_1032,1}).p2,
176).quot) + (172 * div(heapIs $heap_{funcstart\_1032,1}, this.$r.value(heapIs)
heap_{funcstart\_1032,1}.p2, 176).rem)))]
int>(operator^*(heapIs \$heap_{funcstart\_1032.1}.\_replace(this.\$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032.1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.\r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
\theta_{tuncstart\_1032.1}.p1, 177).rem)))).\_replace(this.\$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.\r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p2,
176).quot) + (172 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.}\text{\$r.value}(\text{heapIs}))
\text{Sheap}_{funcstart\_1032,1}.\text{p2}, 176).\text{rem})), \text{this}.\text{p3}) < (\text{int})0)) + \text{temp3}) \le
maxof(signed int)
→ [expand definition of operator '*' in class 'pointer' at built in declaration]
[1.8] ((30323 * asType<int>(static_cast<integer>(static_cast<signed)
\mathbf{int}{>}(\mathbf{this.\$r.value}(\mathbf{heapIs}\ \$\mathbf{heap}_{funcstart\_1032,1}.\_\mathbf{replace}(\mathbf{this.\$r} \to \mathbf{funcstart}))
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs $heap<sub>funcstart_1032,1</sub>, this.$r.value(heapIs
\theta_{funcstart\_1032,1}.p1, 177).rem)))).replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
```

```
\rho_{funcstart_1032,1}, this. r.value(heapIs \rho_{funcstart_1032,1}).p1,
177).quot) + (171 * div(heapIs \theta_{funcstart\_1032,1}, this.r.value(heapIs)
\rho_{uncstart\_1032,1}.p1, 177).rem))).\_replace(p2 \rightarrow ((-35 * div(heapIs)))._replace(p2 \rightarrow ((-35 * div(heapIs))))._replace(p3 + div(heapIs)))
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p2,
176).quot) + (172 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.}\text{\$r.value}(\text{heapIs}))
\theta_{100} = \theta_{1000} =
maxof(signed int)
→ [evaluate dereferenced pointer into modified heap]
[1.9] ((30323 * asType<int>(static_cast<integer>(static_cast<signed
int>(([this.\$r == this.\$r]: this.\$r.value(heapIs))
\rho_{tuncstart\_1032.1}._replace(p1 \rightarrow ((-2 * div(heapIs \rho_{tuncstart\_1032.1})
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177).quot) + (171 *
div(\mathbf{heapIs} \$ heap_{funcstart\_1032.1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
\$heap_{funcstart\_1032,1}).p1,\ 177).rem))).\_\textbf{replace}(p2 \rightarrow (-35\ *\ div(\textbf{heapIs}
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p2,
176).quot) + (172 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.}\text{\$r.value}(\text{heapIs}))
\theta_{funcstart\_1032,1}.p2, 176).rem), [: this.$r.value(heapIs)
\theta_{funcstart\_1032,1}-replace(this.r \to this.r.value(heapIs)
heap_{funcstart\_1032,1}._replace(p1 \rightarrow (-2 * div(heapIs p_{funcstart\_1032,1}).
this.r.value(heapIs \ heap_{funcstart\_1032.1}).p1, 177).quot) + (171 *
div(\mathbf{heapIs} \$ heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
\text{Sheap}_{funcstart\_1032,1}.\text{p1}, 177).\text{rem})))).\text{p3}) < (int)0))) + \text{temp3}) \le
maxof(signed int)
\rightarrow [explicitly assert falsehood of skipped guards in subsequent guards]
[1.10] ((30323 * asType<int>(static_cast<integer>(static_cast<signed)
int>(([this.\$r == this.\$r]: this.\$r.value(heapIs
\rho_{tuncstart\_1032,1}._replace(p1 \rightarrow ((-2 * div(heapIs $heap_{tuncstart\_1032,1}, for the div(heapIs $heap_{t
this.$r.value(heapIs heap_{funcstart\_1032,1}).p1, 177).quot) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_1032,1}, \ \mathbf{this}.\$ r. \mathbf{value}(\mathbf{heapIs}
\rho_{funcstart\_1032,1}.p1, 177).rem))).\_replace(p2 \rightarrow (-35 * div(heapIs))).
\rho_{tuncstart\_1032,1}, this.r.value(heapIs \rho_{tuncstart\_1032,1}).p2,
176).quot) + (172 * div(heapIs \rho_{funcstart\_1032,1}, this.r.value(heapIs)
\theta_{funcstart_1032,1}.p2, 176).rem), [!(this.\$r == this.\$r)]:
this.$r.value(heapIs \rho_{tuncstart\_1032,1}._replace(this.$r \rightarrow
this.$r.value(heapIs heapIs $heapfuncstart_1032,1)._replace(p1 \rightarrow (-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs \theta_{funcstart\_1032,1}, this.r.value(heapIs)
\text{Sheap}_{funcstart\_1032,1}.\text{p1}, 177).\text{rem})))).\text{p3}) < (int)0))) + \text{temp3}) \le
maxof(signed int)
\rightarrow [simplify]
[1.18] ((30323 * asType<int>(static_cast<integer>(0 <
-this.$r.value(heapIs \theta_{tuncstart\_1032,1}).p3))) + temp3) \leq
maxof(signed int)
```

```
is false whenever -2 < (0 + literala)
       Proof of rule precondition:
       [1.18.0] - 2 < (0 + 0)
       \rightarrow [simplify]
       [1.18.2] true
[1.19] ((30323 * asType<int>(static_cast<integer>(false))) + temp3) \leq
maxof(signed int)
\rightarrow [simplify]
[1.20] ((30323 * asType<int>(([false]: 1, []: 0))) + temp3) \leq maxof(signed)
→ [explicitly assert falsehood of skipped guards in subsequent guards]
[1.21] ((30323 * asType<int>(([false]: 1, [true]: 0))) + temp3) \leq
maxof(signed int)
\rightarrow [simplify]
[1.24] (0 + \text{temp3}) \le \text{maxof(signed int)}
\rightarrow [from term 58.20, temp3 is equal to (-63 * div(heapIs $heap_{funcstart\_1032,1},
this.r.value(heapIs \ \ heap_{funcstart\_1032,1}).p3, \ 178).quot) + (170 \ \ *
div(heapIs $heap_{tuncstart\_1032,1}, this.$r.value(heapIs)
heap_{funcstart\_1032,1}.p3, 178).rem
[1.25] (0 + ((-63 * div(heap
Is \rho_{funcstart\_1032,1}, this.\r.value(heap
Is
\rho_{funcstart\_1032,1}.p3, 178).quot + (170 * div(heapIs $heap_{funcstart\_1032,1}), quot) + (170 * div(heapIs $heap_{funcstart\_1032,1}), q
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p3, 178).rem))) \le maxof(signed)
int)
\rightarrow [simplify]
\lceil 1.41 \rceil -32768 < ((-170 * div(heapIs $heap_{funcstart\_1032,1},)
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p3, 178).rem) + (63 * div(heapIs \ heapIs))
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p3,
178).quot))
\rightarrow [from term 60.13, literala < ((-170 * div(heapIs $heap_{funcstart\_1032,1},
this.r.value(heapIs $heap_{funcstart\_1032,1}).p3, 178).rem) + (63 * div(heapIs)
$heap_{funcstart\_1032,1}$, this. $r.value(heapIs $heap_{funcstart\_1032,1}).p3$,
(178).quot)) is true whenever (-1 + literala) < -32768
       Proof of rule precondition:
       [1.41.0](-32768 + -1) < -32768
       \rightarrow [simplify]
```

 \rightarrow [from term 40.0, literala < -this.\$r.value(heapIs \$heap_{funcstart_1032.1}).p3

[1.41.2] **true**

[1.42] true

```
Proof of verification condition: Type constraint satisfied in implicit
conversion from 'signed int' to 'P3Type'
In the context of class: WHPrang, declared at:
C:\Escher\Customers\prang-cpp\prang.cpp (18,1)
Condition generated at: C:\Escher\Customers\prang-cpp\prang.cpp
(81,16)
Condition defined at:
To prove: minof(signed int) \leq (($heap_{1032,1;1054,8}.M3 *
as Type < int > (static\_cast < integer > (static\_cast < signed))
int>(operator^*(heapIs $heap_{1032,1;1054,8}, this).p3) < (int)0))) + temp3)
Given:
heap_{init}.LIMIT == (int)80
heap_{init}.class WHPrang \in M1 == (int)30269
heap_{init}.class WHPrang \in r1 == (int)171
heap_{init}.class WHPrang \in a1 == (int)177
heap_{init}.class WHPrang \in b1 == (int)2
heap_{init}.class WHPrang \in M2 == (int)30307
heap_{init}.class WHPrang \in r2 == (int)172
heap_{init}.class WHPrang \in a2 == (int)176
heap_{init}.class WHPrang \in b2 == (int)35
\text{$heap}_{init}.\mathbf{class} \text{ WHPrang} \in M3 == (\mathbf{int})30323
heap_{init}.class WHPrang \in r3 == (int)170
heap_{init}.class WHPrang \in a3 == (int)178
heap_{init}.class WHPrang \in b3 == (int)63
\operatorname{div1} == \operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_1032,1},
\mathbf{static\_cast} < \mathbf{int} > (\mathbf{operator}^*(\mathbf{heapIs}\ \$ \mathbf{heap}_{funcstart\_1032,1},\ \mathbf{this}).\mathtt{p1}),
\mathbf{static\_cast} < \mathbf{int} > (\$ \mathbf{heap}_{funcstart\_1032,1}.\mathbf{a1}))
(asType<integer>(static_cast<int>(operator*(heapIs
heap_{funcstart\_1032,1}, this).p1) /
asType < integer > (static\_cast < int > (\$heap_{funcstart\_1032,1}.a1))) = =
asType<integer>(div1.quot)
(asType<integer>(static_cast<int>(operator*(heapIs
heap_{funcstart\_1032.1}, this).p1)
\mathbf{asType} < \mathbf{integer} > (\mathbf{static\_cast} < \mathbf{int} > (\$ \operatorname{heap}_{funcstart\_1032,1}.a1))) = =
```

```
asType<integer>(div1.rem)
(\mathbf{asType}{<}\mathbf{integer}{>}(\mathbf{operator}^*(\mathbf{heapIs}\ \$\mathbf{heap}_{funcstart\_1032,1},\ \mathbf{this}).\mathtt{p1}) <
asType < integer > (\$heap_{funcstart\_1032,1}.a1)) = >
(asType<integer>(div1.rem) == asType<integer>(operator*(heapIs
heap_{funcstart\_1032.1}, this).p1)
(asType < integer > (\$heap_{funcstart\_1032,1}.a1) \le
asType < integer > (operator*(heapIs $heap_{funcstart\_1032,1}, this).p1)) = >
!(0 == asType < integer > (div1.quot))
!(0 == \mathbf{asType} {<} \mathbf{integer} {>} (\mathrm{div1.rem})) \ || \ !(0 ==
asType<integer>(div1.quot))
div2 == div(\mathbf{heapIs} \$ heap_{funcstart\_1032.1},
\mathbf{static\_cast} < \mathbf{int} > (\mathbf{operator}^*(\mathbf{heapIs}\ \$ \mathbf{heap}_{funcstart\_1032,1},\ \mathbf{this}).\mathbf{p2}),
\mathbf{static\_cast}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_1032,1}.\mathrm{a2}))
(asType<integer>(static_cast<int>(operator*(heapIs
heap_{funcstart\_1032.1}, this).p2)
asType < integer > (static\_cast < int > (\$heap_{funcstart\_1032.1}.a2))) = =
asType<integer>(div2.quot)
(asType<integer>(static_cast<int>(operator*(heapIs
heap_{funcstart\_1032,1}, this).p2) %
asType < integer > (static\_cast < int > (\$heap_{funcstart\_1032,1}.a2))) = =
asType<integer>(div2.rem)
(asType < integer > (operator*(heapIs $heap_{funcstart\_1032,1}, this).p2) < footnote{the content of the conte
asType < integer > (\$heap_{funcstart\_1032,1}.a2)) = >
(asType<integer>(div2.rem) == asType<integer>(operator*(heapIs
heap_{funcstart\_1032,1}, this).p2)
(asType < integer > (\$heap_{funcstart\_1032,1}.a2) \le
asType < integer > (operator*(heapIs $heap_{funcstart\_1032,1}, this).p2)) = >
!(0 == asType < integer > (div2.quot))
!(0 == asType < integer > (div2.rem)) || !(0 ==
asType<integer>(div2.quot))
div3 == div(\mathbf{heapIs} \$ heap_{funcstart\_1032,1},
static_cast<int>(operator*(heapIs $heap_{funcstart\_1032.1}, this).p3),
\mathbf{static\_cast} < \mathbf{int} > (\$ \mathbf{heap}_{funcstart\_1032,1}.\mathbf{a3}))
(asType<integer>(static_cast<int>(operator*(heapIs
heap_{funcstart\_1032,1}, this).p3)
\mathbf{asType} {<} \mathbf{integer} {>} (\mathbf{static\_cast} {<} \mathbf{int} {>} (\$ \mathbf{heap}_{funcstart\_1032,1}.\mathbf{a3}))) = =
asType<integer>(div3.quot)
(asType<integer>(static_cast<int>(operator*(heapIs
heap_{funcstart\_1032,1}, this).p3)
asType < integer > (static\_cast < int > (\$heap_{funcstart\_1032.1}.a3))) = =
asType<integer>(div3.rem)
```

```
(\mathbf{asType}{<}\mathbf{integer}{>}(\mathbf{operator}^*(\mathbf{heapIs}\ \$\mathbf{heap}_{funcstart\_1032,1},\ \mathbf{this}).\mathbf{p3}) <
asType < integer > (\$heap_{funcstart\_1032,1}.a3)) = >
(asType<integer>(div3.rem) == asType<integer>(operator*(heapIs
heap_{funcstart\_1032,1}, this).p3)
(asType < integer > (\$heap_{funcstart\_1032.1}.a3) \le
\mathbf{asType} < \mathbf{integer} > (\mathbf{operator}^*(\mathbf{heapIs} \ \$ \mathbf{heap}_{funcstart\_1032,1}, \ \mathbf{this}).\mathrm{p3})) = >
!(0 == asType < integer > (div3.quot))
!(0 == asType < integer > (div3.rem)) || !(0 ==
asType<integer>(div3.quot))
temp1 == (\$heap_{funcstart\_1032,1}.r1 * \textbf{static\_cast} < \textbf{signed int} > (div1.rem)) - (div1.rem) + (div1.r
($heap_funcstart_1032.1.b1 * static_cast<signed int>(div1.quot))
minof(signed int) < temp1
temp1 \le maxof(signed int)
heap_{1032,1;1051,8} == heap_{funcstart\_1032,1}. replace(this.r \rightarrow replace)
operator*(heapIs heap_{funcstart\_1032,1}, this)._replace(p1 \rightarrow
\mathbf{asType} \!\!<\!\! \mathtt{P1Type} \!\!>\!\! ((\$\mathtt{heap}_{funcstart\_1032,1}.\mathtt{M1} *
asType<int>(static_cast<integer>(static_cast<signed
int>(operator^*(heapIs $heap_{funcstart\_1032,1}, this).p1) < (int)0))) +
temp1)))
temp2 == (\$heap_{1032,1;1051,8}.r2 * \textbf{static\_cast} < \textbf{signed int} > (div2.rem)) - \\
(\text{sheap}_{1032,1:1051.8}.\text{b2} * \text{static\_cast} < \text{signed int} > (\text{div}2.\text{quot}))
minof(signed int) < temp2
temp2 \le maxof(signed int)
\text{heap}_{1032.1:1054.8} == \text{heap}_{1032.1:1051.8}._replace(this.$r \rightarrow
operator*(heapIs heap_{1032,1:1051.8}, this)._replace(p2 \rightarrow
asType<P2Type>(($heap<sub>1032,1;1051,8</sub>.M2 *
asType < int > (static\_cast < integer > (static\_cast < signed)
int>(operator^*(heapIs \$heap_{1032,1;1051,8}, this).p2) < (int)(0))) + temp(2)))
temp3 == (\$heap_{1032,1:1054,8}.r3 * static\_cast < signed int > (div3.rem)) -
(\text{sheap}_{1032,1:1054,8}.\text{b3} * \text{static\_cast} < \text{signed int} > (\text{div3.quot}))
minof(signed\ int) \le temp3
temp3 \le maxof(signed int)
Proof:
[Take given term]
[2.0] \operatorname{div1} == \operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_1032,1},
\mathbf{static\_cast} < \mathbf{int} > (\mathbf{operator^*(heapIs} \ \$ heap_{funcstart\_1032,1}, \ \mathbf{this}).p1),
static\_cast < int > (\$heap_{funcstart\_1032,1}.a1))
→ [expand definition of operator '*' in class 'pointer' at built in declaration]
```

```
[2.1] \operatorname{div1} == \operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_1032,1},
\mathbf{static\_cast} < \mathbf{int} > (\mathbf{this.\$r.value}(\mathbf{heapIs} \ \$ \mathbf{heap}_{funcstart\_1032,1}).\mathbf{p1}),
\mathbf{static\_cast}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_1032,1}.\mathrm{a1}))
\rightarrow [simplify]
[2.2] \operatorname{div1} == \operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_1032,1}, \mathbf{this.}\$ r.\mathbf{value}(\mathbf{heapIs})
\theta_{funcstart=1032,1}, p1, static_cast<int>(\theta_{funcstart=1032,1})
\rightarrow [const static or extern object]
[2.3] \text{ div1} == \text{div(heapIs } \text{$heap}_{funcstart\_1032.1}, \text{this.} \text{$r.value(heapIs)}
\theta_{tuncstart\_1032.1}.p1, \theta_{tuncstart\_1032.1}.p2, \theta_{tuncstart\_1032.1}.p3, \theta_{tuncstart\_1032.1}.p2, \theta_{tuncstart\_1032.1}.p3, \theta_{tuncstart\_1032.1}.p2, \theta_{tuncstart\_1032.1}.p3, \theta_{tuncstart\_1032.1}.p2, \theta_{tuncstart\_1032.1}.p3, \theta_{tuncstart\_1032.1}.p4, \theta_{tuncstart\_1032.1}.p4, \theta_{tuncstart\_1032.1}.p4, \theta_{tuncstart\_1032.1
\rightarrow [expand definition of constant 'a1' at prang.cpp (30,26)]
[2.4] \text{ div1} == \text{div}(\text{heapIs } \text{heap}_{funcstart\_1032,1}, \text{this.}\text{\$r.value}(\text{heapIs})
\theta_{tuncstart\_1032.1}.p1, \theta_{tuncstart\_1032.1}.p1, \theta_{tuncstart\_1032.1}.p1, \theta_{tuncstart\_1032.1}.p1, \theta_{tuncstart\_1032.1}.p1, \theta_{tuncstart\_1032.1}.p1, \theta_{tuncstart\_1032.1}.p2, \theta_{tuncstart\_1032.1}.p2, \theta_{tuncstart\_1032.1}.p2, \theta_{tuncstart\_1032.1}.p2, \theta_{tuncstart\_1032.1}.p2, \theta_{tuncstart\_1032.1}.p3, \theta_{tuncstart\_1032.1}.p2, \theta_{tuncstart\_1032.1}.p3, \theta_{tuncstart\_1032.1}.p4, \theta_{tuncstart\_1032.1}.p3, \theta_{tuncstart\_1032.1}.p4, \theta_{tuncstart\_1032.1}.p5, \theta_{tuncstart\_1032.1}.p5, \theta_{tuncstart\_1032.1}.p6, \theta_{tuncstart\_1032.1}.p7, \theta_{tuncstart\_1032.1
\rightarrow [simplify]
[2.6] \text{ div1} == \text{div(heapIs } \text{$heap}_{funcstart\_1032,1}, \text{this.} \text{$r.value(heapIs)}
heap_{funcstart_{-1032.1}}.p1, 177
[Assume known post-assertion, class invariant or type constraint for term 2.6]
[7.0] (0 < asType<integer>(this.$r.value(heapIs)
\label{eq:linear_funcstart} $$ \operatorname{heap}_{funcstart\_1032,1}.p1)) \&\& (asType < integer > (this.\$r.value(heapIs)) \\
\theta_{uncstart\_1032,1}.p1 < asType<integer>(\theta_{uncstart\_1032,1}.p1) < asType<integer>(\theta_{uncstart\_1032,1}.p1)
M1))
\rightarrow [simplify]
[7.2] (0 < this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1) \&\&
(this.$r.value(heapIs heap_{funcstart\_1032,1}).p1 <
asType < integer > (\text{$heap.class WHPrang} \in M1))
\rightarrow [const static or extern object]
[7.3] (0 < this.$r.value(heapIs \rho_{funcstart\_1032,1}).p1) &&
(this.r.value(heapIs $heap_{funcstart\_1032,1}).p1 <
asType < integer > (\$heap_{init}.class WHPrang \in M1))
\rightarrow [expand definition of constant 'M1' at prang.cpp (28,26)]
[7.4] (0 < this.$r.value(heapIs \theta_{funcstart\_1032,1}).p1) &&
(this.$r.value(heapIs \rho_{funcstart\_1032,1}).p1 <
asType < integer > ((int)30269))
\rightarrow [simplify]
[7.10] (-30269 < -this.$r.value(heapIs heap_{funcstart\_1032,1}).p1) <math>\land (0 < 
this.$r.value(heapIs $heap_{funcstart\_1032,1}).p1)
[Work on sub-term 2 of conjunction in term 7.10]
[8.0] 0 < this.$r.value(heapIs heap_{funcstart\_1032,1}).p1
```

```
[Take given term]
[18.0] \operatorname{div2} == \operatorname{div}(\mathbf{heapIs} \ \text{$heap}_{funcstart\_1032,1},
\mathbf{static\_cast} < \mathbf{int} > (\mathbf{operator}^*(\mathbf{heapIs} \ \$ \mathbf{heap}_{funcstart\_1032,1}, \ \mathbf{this}).\mathtt{p2}),
\mathbf{static\_cast}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_1032,1}.\mathrm{a2}))
→ [expand definition of operator '*' in class 'pointer' at built in declaration]
[18.1] \operatorname{div2} == \operatorname{div}(\mathbf{heapIs} \ \text{$heap}_{funcstart\_1032,1},
static\_cast < int > (this.\$r.value(heapIs \$heap_{funcstart\_1032,1}).p2),
static\_cast < int > (\$heap_{funcstart\_1032,1}.a2))
\rightarrow [simplify]
[18.2] div2 == div(heapIs \rho_{uncstart\_1032,1}, his.\r.value(heapIs
\theta_{funcstart\_1032,1}.p2, \theta_{funcstart\_1032,1}.a2))
\rightarrow [const static or extern object]
[18.3] div2 == div(heapIs \rho_{uncstart\_1032,1}, his.\r.value(heapIs
\theta_{funcstart\_1032,1}.p2, \theta_{funcstart\_1032,1
\rightarrow [expand definition of constant 'a2' at prang.cpp (35,26)]
[18.4] div2 == div(\mathbf{heapIs} \$ \mathbf{heap}_{funcstart\_1032,1}, \mathbf{this}.\$ \mathbf{r.value}(\mathbf{heapIs})
\theta_{funcstart\_1032,1}.p2, \theta_{funcstart\_1032,1}.p2, \theta_{funcstart\_1032,1}.p2, \theta_{funcstart\_1032,1}.p2
\rightarrow [simplify]
[18.6] div2 == div(\mathbf{heapIs} \ \hat{\mathbf{s}}_{funcstart\_1032,1}, \ \mathbf{this.\$r.value}(\mathbf{heapIs})
heap_{funcstart_{-1032,1}}.p2, 176
[Assume known post-assertion, class invariant or type constraint for term 18.6]
[23.0] (0 < asType<integer>(this.$r.value(heapIs
$heap_{tuncstart_1032.1}.p2)) && (asType<integer>(this.$r.value(heapIs
\verb§heap$_{funcstart\_1032,1}).p2) < \mathbf{asType} < \mathbf{integer} > (\$ heap.\mathbf{class} \ WHPrang \in \texttt{Prang}) = \texttt{Prang} + \texttt{Prang}
M2))
\rightarrow [simplify]
[23.2] (0 < this.r.value(heapIs \ heap_{funcstart\_1032,1}).p2) \&\&
(this.$r.value(heapIs heap_{funcstart\_1032,1}).p2 <
asType < integer > (\$heap.class WHPrang \in M2))
\rightarrow [const static or extern object]
[23.3] (0 < this.$r.value(heapIs \rho_{funcstart\_1032,1}).p2) &&
(this.$r.value(heapIs \theta_{funcstart\_1032,1}).p2 <
asType < integer > (\$heap_{init}.class WHPrang \in M2))
\rightarrow [expand definition of constant 'M2' at prang.cpp (33,26)]
[23.4] (0 < this.$r.value(heap
Is \rho_{uncstart\_1032,1}).p2) &&
(this.r.value(heapIs $heap_{funcstart\_1032.1}).p2 <
asType < integer > ((int)30307))
```

```
\rightarrow [simplify]
[23.10] (-30307 < -this.$r.value(heapIs $heap_{tuncstart\_1032.1}).p2) \land (0 <
this.r.value(heapIs $heap_{funcstart\_1032,1}).p2)
[Work on sub-term 2 of conjunction in term 23.10]
[24.0] 0 < this.$r.value(heapIs $heap_{funcstart\_1032.1}).p2
[Take given term]
[34.0] div3 == div(heapIs $heap_{funcstart\_1032,1},
static_cast<int>(operator*(heapIs $heap_{funcstart\_1032,1}, this).p3),
\mathbf{static\_cast} < \mathbf{int} > (\$ \mathbf{heap}_{funcstart\_1032,1}.\mathbf{a3}))
\rightarrow [expand definition of operator '*' in class 'pointer' at built in declaration]
[34.1] \operatorname{div3} == \operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_1032,1},
static\_cast < int > (this. r.value(heapIs $heap_{funcstart\_1032,1}).p3),
static\_cast < int > (\$heap_{funcstart\_1032,1}.a3))
\rightarrow [simplify]
[34.2] \text{ div3} == \text{div(heapIs $heap}_{funcstart\_1032,1}, \text{ this.} \text{$r.value(heapIs)}
\rho_{tuncstart_1032.1}, p3, static_cast<int>(\rho_{tuncstart_1032.1})
\rightarrow [const static or extern object]
[34.3] div3 == div(heapIs $heap_{funcstart\_1032.1}, this.$r.value(heapIs)
\$heap_{funcstart\_1032,1}).p3,\, \textbf{static\_cast} < \textbf{int} > (\$heap_{init}.a3))
\rightarrow [expand definition of constant 'a3' at prang.cpp (40,26)]
[34.4] \text{ div3} == \text{div}(\text{heapIs } \text{$heap}_{funcstart\_1032,1}, \text{this.}\text{$r.value}(\text{heapIs})
\theta_{funcstart\_1032,1}.p3, \theta_{funcstart\_1032,1}.p4, \theta_{funcstart\_1032,1}.p4, \theta_{funcstart\_1032,1}.p4, \theta_{funcstart\_1032,1}.p4, \theta_{funcstart\_1032,1}.p5, \theta_{funcstart\_1032,1}.p5, \theta_{funcstart\_1032,1}.p5, \theta_{funcstart\_1032,1}.p5, \theta_{funcstart\_1032,1}.p5, \theta_{funcstart\_1032,1}.p5, \theta_{funcstart\_1032,1}.p5, \theta_{funcstart\_1032,1
\rightarrow [simplify]
[34.6] div3 == div(heapIs $heap_{funcstart\_1032,1}, this.$r.value(heapIs)
heap_{funcstart\_1032,1}.p3, 178)
[Assume known post-assertion, class invariant or type constraint for term 34.6]
[39.0] (0 < asType<integer>(this.$r.value(heapIs
$heap_funcstart_1032.1).p3)) && (asType<integer>(this.$r.value(heapIs
\theta_{funcstart\_1032,1}.p3 < asType<integer>(\theta_{funcstart\_1032,1}.p3) < asType<integer>(\theta_{funcstart\_1032,1}.p3)
M3))
\rightarrow [simplify]
[39.2] (0 < this.$r.value(heapIs heap_{funcstart\_1032,1}).p3) &&
(this.$r.value(heapIs \theta_{funcstart\_1032,1}).p3 <
asType < integer > (\$heap.class WHPrang \in M3))
\rightarrow [const static or extern object]
[39.3] (0 < this.$r.value(heapIs heap_{funcstart\_1032,1}).p3) &&
(this.r.value(heapIs \ heap_{funcstart\_1032,1}).p3 <
```

```
asType < integer > (\$heap_{init}.class WHPrang \in M3))
\rightarrow [expand definition of constant 'M3' at prang.cpp (38,26)]
[39.4] (0 < this.$r.value(heapIs heap_{funcstart\_1032,1}).p3) &&
(this.r.value(heapIs $heap_{funcstart\_1032,1}).p3 <
asType < integer > ((int)30323))
\rightarrow [simplify]
[39.10] (-30323 < -this.$r.value(heapIs \rho_{funcstart\_1032,1}).p3) \wedge (0 <
this.r.value(heapIs $heap_{funcstart\_1032.1}).p3)
[Work on sub-term 2 of conjunction in term 39.10]
[40.0] 0 < this.$r.value(heapIs $heap_{funcstart\_1032,1}).p3
[Take given term]
[50.0]\;((\$heap_{funcstart\_1032,1}.r1\;*\;\textbf{static\_cast}{<}\textbf{signed int}{>}(\text{div}1.rem))\;-
(\text{sheap}_{funcstart\_1032,1}.\text{b1 * static\_cast} < \text{signed int} > (\text{div1.quot}))) == \text{temp1}
\rightarrow [const static or extern object]
[50.1] \; ((\$ heap_{init}.r1 * \mathbf{static\_cast} < \mathbf{signed int} > (div1.rem)) \; - \\
(\text{sheap}_{funcstart\_1032,1}.\text{b1} * \text{static\_cast} < \text{signed int} > (\text{div1.quot}))) == \text{temp1}
\rightarrow [expand definition of constant 'r1' at prang.cpp (29,26)]
[50.2] (((int)171 * static_cast<signed int>(div1.rem)) -
(\text{sheap}_{funcstart\_1032,1}.\text{b1 * static\_cast} < \text{signed int} > (\text{div1.quot}))) == \text{temp1}
\rightarrow [simplify]
[50.3] ((171 * static_cast < signed int > (div1.rem)) - ($heap_{funcstart\_1032,1}.b1]
* static_cast<signed int>(div1.quot))) == temp1
\rightarrow [from term 2.6, div1 is equal to div(heapIs $heap_{funcstart\_1032,1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177)]
[50.4] ((171 * static_cast < signed int > (div(heapIs heapIs funcstart_{1032,1},
this.r.value(heapIs $heap_{funcstart\_1032,1}).p1, 177).rem)) -
(\text{sheap}_{funcstart\_1032,1}.\text{b1 * static\_cast} < \text{signed int} > (\text{div1.quot}))) == \text{temp1}
\rightarrow [simplify]
[50.5] ((171 * \mathrm{div}(\mathbf{heapIs}\ \$\mathrm{heap}_{funcstart\_1032,1},\ \mathbf{this}.\$\mathrm{r.value}(\mathbf{heapIs}
\text{Sheap}_{funcstart\_1032,1}.\text{p1}, 177).\text{rem} - (\text{Sheap}_{funcstart\_1032,1}.\text{b1} *
static_cast<signed int>(div1.quot))) == temp1
\rightarrow [const static or extern object]
[50.6] ((171 * div(heapIs $heap_{funcstart\_1032,1}, this.$r.value(heapIs)
\theta_{uncstart\_1032,1}.p1, 177).rem) - (\theta_{unit}.b1 * static_cast<signed
int>(div1.quot)) == temp1
\rightarrow [expand definition of constant 'b1' at prang.cpp (31,26)]
```

```
[50.7] ((171 * \operatorname{div}(\mathbf{heapIs} \ \mathbf{sheap}_{funcstart\_1032,1}, \ \mathbf{this}.\mathbf{sr.value}(\mathbf{heapIs})
\theta_{funcstart\_1032,1}.p1, 177).rem) - ((int)2 * static_cast<signed)
int>(div1.quot))) == temp1
\rightarrow [simplify]
[50.8] ((171 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs = f_{uncstart\_1032,1})
\rho_{tuncstart_1032.1}, p1, 177).rem) - (2 * static_cast<signed
int>(div1.quot))) == temp1
\rightarrow [from term 2.6, div1 is equal to div(heapIs $heap_{funcstart\_1032,1},
this.r.value(heapIs $heap_{funcstart\_1032,1}).p1, 177)]
[50.9] ((171 * div(heapIs $heap_{funcstart\_1032,1}, this.$r.value(heapIs
\rho_{tuncstart\_1032.1}, p1, 177).rem) - (2 * static_cast<signed
int>(div(heapIs \$heap_{funcstart\_1032,1}, this.\$r.value(heapIs
\text{Sheap}_{funcstart\_1032,1}).p1, 177).quot))) == temp1
\rightarrow [simplify]
[50.14] 0 == (-\text{temp1} + (-2 * \text{div}(\text{heapIs } \$\text{heap}_{funcstart\_1032,1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177).quot) + (171 *
div(\mathbf{heapIs} \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
heap_{funcstart\_1032,1}.p1, 177).rem
[Take given term]
[53.0] heap_{1032,1;1051,8} == heap_{funcstart\_1032,1}._replace(this.$r \rightarrow
operator*(heapIs heap_{funcstart\_1032,1}, this)._replace(p1 \rightarrow
asType<P1Type>(($heap<sub>funcstart_1032.1</sub>.M1 *
asType<int>(static_cast<integer>(static_cast<signed
int>(operator^*(heapIs \$heap_{funcstart\_1032,1}, this).p1) < (int)0))) +
temp1)))
→ [expand definition of operator '*' in class 'pointer' at built in declaration]
[53.1] heap_{1032,1;1051,8} == heap_{funcstart\_1032,1}._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow
asType < P1Type > ((\$heap_{funcstart\_1032,1}.M1 *
asType<int>(static_cast<integer>(static_cast<signed
int>(operator^*(heapIs \$heap_{funcstart\_1032,1}, this).p1) < (int)0))) +
temp1)))
\rightarrow [const static or extern object]
[53.2] $\text{heap}_{1032,1:1051,8} == \text{$heap}_{funcstart\_1032,1}._\text{replace}(\text{this}.\text{$r} \to \text{$}
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow
asType < P1Type > ((\$heap_{init}.M1 *
asType<int>(static_cast<integer>(static_cast<signed
int>(operator^*(heapIs $heap_{funcstart\_1032,1}, this).p1) < (int)0))) +
temp1)))
→ [expand definition of constant 'M1' at prang.cpp (28,26)]
```

```
[53.3] \rho_{1032,1;1051,8} == \rho_{1032,1;1051,8} = \rho_{1032,1;1051,8} == \rho
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow
asType<P1Type>(((int)30269 *
asType < int > (static\_cast < integer > (static\_cast < signed)
int>(operator^*(heapIs \$heap_{funcstart\_1032,1}, this).p1) < (int)0))) +
temp1)))
\rightarrow [simplify]
[53.4] heap_{1032,1;1051,8} == heap_{funcstart\_1032,1}._replace(this.r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow
asType<P1Type>((30269 *
asType<int>(static_cast<integer>(static_cast<signed
\mathbf{int}{>}(\mathbf{operator}^*(\mathbf{heapIs}\ \$\mathbf{heap}_{funcstart\_1032,1},\ \mathbf{this}).\mathrm{p1}) < (\mathbf{int})0))) \ +
temp1)))
→ [expand definition of operator '*' in class 'pointer' at built in declaration]
[53.5] $heap<sub>1032,1;1051,8</sub> == $heap<sub>funcstart_1032,1</sub>._replace(this.$r \rightarrow
\mathbf{this.\$r.value}(\mathbf{heapIs}~\$ \mathrm{heap}_{funcstart\_1032,1}).\_\mathbf{replace}(\mathrm{p1} \rightarrow
asType<P1Type>((30269 *
asType{<}int{>}(static\_cast{<}integer{>}(static\_cast{<}signed
int>(this.\$r.value(heapIs \$heap_{funcstart\_1032,1}).p1) < (int)0))) + temp1)))
\rightarrow [simplify]
[53.9] heap_{1032,1;1051,8} == heap_{funcstart\_1032,1}._replace(this.$r \rightarrow
\mathbf{this.\$r.value}(\mathbf{heapIs}~\$ \mathrm{heap}_{funcstart\_1032,1}).\_\mathbf{replace}(\mathrm{p1} \rightarrow
asType<P1Type>((30269 * asType<int>(static_cast<integer>(0 <
-\mathbf{this.\$r.value}(\mathbf{heapIs}\ \$\mathbf{heap}_{funcstart\_1032,1}).\mathbf{p1}))) + \mathbf{temp1})))
\rightarrow [from term 8.0, literala < -this.$r.value(heapIs $heap_{funcstart\_1032,1}).p1
is false whenever -2 < (0 + literala)
       Proof of rule precondition:
       [53.9.0] - 2 < (0 + 0)
       \rightarrow [simplify]
       [53.9.2] true
[53.10] $heap<sub>1032,1;1051,8</sub> == $heap<sub>funcstart_1032,1</sub>._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow
asType<P1Type>((30269 * asType<int>(static_cast<integer>(false)))
+ \text{temp1})))
\rightarrow [simplify]
[53.11] $\text{heap}_{1032,1;1051,8} == $\text{heap}_{funcstart\_1032,1}._\text{replace}(\text{this.}\text{$\frac{1}{2}}\text{$\text{op}}]$
\textbf{this}.\$r.\textbf{value}(\textbf{heapIs}~\$heap_{funcstart\_1032,1}).\_\textbf{replace}(p1 \rightarrow
asType<P1Type>((30269 * asType<int>(([false]: 1, []: 0))) + temp1)))
→ [explicitly assert falsehood of skipped guards in subsequent guards]
```

```
[53.12] $\text{heap}_{1032,1;1051,8} == $\text{heap}_{funcstart\_1032,1}.$\text{-replace}(\text{this}.$\text{$r} \to \text{
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow
asType<P1Type>((30269 * asType<int>(([false]: 1, [true]: 0))) +
temp1)))
\rightarrow [simplify]
[53.15] $heap<sub>1032,1;1051,8</sub> == $heap<sub>funcstart_1032,1</sub>._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow
asType < P1Type > (0 + temp1))
\rightarrow [from term 50.14, temp1 is equal to (-2 * div(heapIs $heap_{funcstart\_1032,1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177).quot) + (171)
div(\mathbf{heapIs} \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
heap_{funcstart\_1032.1}.p1, 177).rem)
[53.16] $heap<sub>1032,1;1051,8</sub> == $heap<sub>funcstart_1032,1</sub>._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow
asType<P1Type>(0 + ((-2 * div(heapIs $heap_{funcstart\_1032.1},
\mathbf{this.\$r.value(heapIs}\ \$heap_{funcstart\_1032,1}).p1,\ 177).quot) + (171\ *
div(\mathbf{heapIs} \$ heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
heap_{funcstart\_1032,1}.p1, 177).rem))))
\rightarrow [simplify]
[53.19] $heap<sub>1032,1;1051,8</sub> == $heap<sub>funcstart_1032,1</sub>._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{tuncstart = 1032.1})._replace(p1 \rightarrow ((-2 * div(heapIs
\$heap_{funcstart\_1032,1},\, \textbf{this}.\$r.\textbf{value}(\textbf{heapIs}\,\,\$heap_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs \theta_{funcstart\_1032,1}, this.r.value(heapIs)
heap_{funcstart\_1032,1}.p1, 177).rem)))
[Take given term]
[54.0] (($heap<sub>1032,1:1051,8</sub>.r2 * static_cast<signed int>(div2.rem)) -
(\text{sheap}_{1032,1;1051,8}.\text{b2} * \text{static\_cast} < \text{signed int} > (\text{div2.quot}))) == \text{temp2}
\rightarrow [from term 53.19, $heap<sub>1032,1;1051,8</sub> is equal to
heap_{funcstart\_1032.1}._replace(this.r \rightarrow this.r.value(heapIs)
heap_{funcstart\_1032,1}._replace(p1 \rightarrow (-2 * div(heapIs heap_{funcstart\_1032,1}),
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177).quot) + (171 *
div(\mathbf{heapIs} \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
heap_{funcstart\_1032,1}.p1, 177.rem)))
[54.1] \; ((\$ heap_{funcstart\_1032,1}.\_\textbf{replace}(\textbf{this}.\$r \rightarrow \textbf{this}.\$r.\textbf{value}(\textbf{heapIs}))) \\
\rho_{tuncstart\_1032.1}._replace(p1 \rightarrow ((-2 * div(heapIs \rho_{tuncstart\_1032.1})
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177).quot) + (171 *
\operatorname{div}(\mathbf{heapIs}\ \$ \mathbf{heap}_{funcstart\_1032,1},\ \mathbf{this}.\$ \mathbf{r.value}(\mathbf{heapIs}
\rho_{funcstart\_1032,1}.p1, 177).rem))).r2 * static_cast < signed
int>(div2.rem)) - (\$heap_{1032,1;1051,8}.b2 * static\_cast < signed
int>(div2.quot)) == temp2
\rightarrow [const member of object with modified fields]
```

```
[54.2] \; ((\$heap_{funcstart\_1032,1}.r2 * \textbf{static\_cast} < \textbf{signed int} > (\text{div}2.rem)) \; - \\
(\text{sheap}_{1032,1:1051,8}.\text{b2} * \text{static\_cast} < \text{signed int} > (\text{div2.quot}))) == \text{temp2}
\rightarrow [const static or extern object]
[54.3] (($heap<sub>init</sub>.r2 * static_cast<signed int>(div2.rem)) -
(\text{sheap}_{1032,1;1051,8}.\text{b2} * \text{static\_cast} < \text{signed int} > (\text{div2.quot}))) == \text{temp2}
\rightarrow [expand definition of constant 'r2' at prang.cpp (34,26)]
[54.4] (((int)172 * static_cast<signed int>(div2.rem)) -
(\text{sheap}_{1032.1:1051.8}.\text{b2} * \text{static\_cast} < \text{signed int} > (\text{div2.quot}))) == \text{temp2}
\rightarrow [simplify]
[54.5] ((172 * static_cast < signed int > (div2.rem)) - ($heap_{1032,1:1051,8}.b2 *
static_cast<signed int>(div2.quot))) == temp2
\rightarrow [from term 18.6, div2 is equal to div(heapIs $heap_{funcstart\_1032,1},
this.r.value(heapIs $heap_{funcstart\_1032,1}).p2, 176)]
[54.6] ((172 * static_cast<signed int>(div(heapIs $heap_{tuncstart\_1032.1})
this.r.value(heapIs \ heap_{funcstart\_1032.1}).p2, 176).rem)) -
(\text{sheap}_{1032,1;1051,8}.\text{b2} * \text{static\_cast} < \text{signed int} > (\text{div2.quot}))) == \text{temp2}
\rightarrow [simplify]
[54.7] ((172 * div(heapIs $heap<sub>funcstart_1032,1</sub>, this.$r.value(heapIs)
\text{Sheap}_{funcstart\_1032,1}.\text{p2}, 176).\text{rem} - (\text{Sheap}_{1032,1;1051,8}.\text{b2})
static_cast<signed int>(div2.quot))) == temp2
\rightarrow [from term 53.19, $heap_{1032,1;1051,8}$ is equal to
heap_{funcstart\_1032,1}._replace(this.r \rightarrow this.r.value(heapIs)
heap_{funcstart\_1032,1}._replace(p1 \rightarrow (-2 * div(heapIs $heap_{funcstart\_1032,1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, \ 177).quot) + (171)
div(heapIs $heap_funcstart_1032.1, this.$r.value(heapIs
heap_{funcstart\_1032,1}.p1, 177).rem)))]
[54.8] ((172 * div(heapIs \rho_{funcstart\_1032,1}, this.\r.value(heapIs
\rho_{uncstart\_1032,1}.p2, 176).rem – (\rho_{uncstart\_1032,1}.p2, 176).rem
\rightarrow this.$r.value(heapIs $heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 *
div(heapIs $heap<sub>funcstart_1032.1</sub>, this.$r.value(heapIs
\text{Sheap}_{funcstart\_1032,1}.p1, 177).quot) + (171 * div(heapIs \text{Sheap}_{funcstart\_1032,1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177).rem)))).b2 *
static_cast<signed int>(div2.quot))) == temp2
\rightarrow [const member of object with modified fields]
[54.9] ((172 * div(heapIs $heap<sub>funcstart_1032.1</sub>, this.$r.value(heapIs
\text{Sheap}_{funcstart\_1032.1}.p2, 176).rem) - (\text{Sheap}_{funcstart\_1032.1}.b2 *
static_cast<signed int>(div2.quot))) == temp2
\rightarrow [const static or extern object]
[54.10] ((172 * div(heapIs $heap<sub>funcstart_1032,1</sub>, this.$r.value(heapIs
```

```
\rho_{uncstart_{1032,1}}.p2, 176).rem – (\rho_{uncstart_{1032,1}}.p2, 176).rem
int>(div2.quot)) == temp2
\rightarrow [expand definition of constant 'b2' at prang.cpp (36,26)]
[54.11] ((172 * div(heapIs $heap_{funcstart\_1032,1}, this.$r.value(heapIs
\rho_{funcstart\_1032,1}.p2, 176).rem - ((int)35 * static\_cast < signed)
int>(div2.quot)) == temp2
\rightarrow [simplify]
[54.12] ((172 * div(heapIs heap_{funcstart\_1032,1}, this.r.value(heapIs)
\rho_{funcstart\_1032.1}.p2, 176).rem) - (35 * static_cast<signed)
int>(div2.quot)) == temp2
\rightarrow [from term 18.6, div2 is equal to div(heapIs $heap_{funcstart\_1032,1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p2, 176)
[54.13] ((172 * div(heapIs heap_{funcstart\_1032,1}, this.r.value(heapIs)
\theta_{tuncstart\_1032.1}.p2, 176).rem) - (35 * static_cast<signed)
int>(div(heapIs \$heap_{funcstart\_1032,1}, this.\$r.value(heapIs
\theta_{funcstart\_1032,1}.p2, 176).quot))) == temp2
\rightarrow [simplify]
[54.18] 0 == (-\text{temp2} + (-35 * \text{div}(\text{heapIs } \text{$heap}_{funcstart\_1032,1},
this.$r.value(heapIs heap_{funcstart\_1032,1}).p2, 176).quot) + (172 *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_1032,1}, \ \mathbf{this}.\$ r. \mathbf{value}(\mathbf{heapIs}
heap_{funcstart\_1032,1}.p2, 176).rem
[Take given term]
[57.0] $\text{heap}_{1032,1;1054,8} == $\text{heap}_{1032,1;1051,8}._\text{replace}(\text{this}.$\text{$r} \to \text{
operator*(heapIs heap_{1032,1:1051.8}, this)._replace(p2 \rightarrow
asType<P2Type>(($heap<sub>1032,1:1051,8</sub>.M2 *
asType<int>(static_cast<integer>(static_cast<signed
int>(operator^*(heapIs \$heap_{1032,1;1051,8}, this).p2) < (int)(0))) + temp(2)))
\rightarrow [from term 53.19, $heap<sub>1032,1:1051,8</sub> is equal to
$heap_{funcstart\_1032,1}.$_replace(this.$r \rightarrow this.$r.value(heapIs)
heap_{funcstart\_1032,1}._replace(p1 \rightarrow (-2 * div(heapIs p_{funcstart\_1032,1}).
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177).quot) + (171 *
div(\mathbf{heapIs}\ \$heap_{funcstart\_1032,1},\ \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}
heap_{funcstart_{1032,1}}.p1, 177).rem)))
[57.2] heap_{1032,1;1054,8} == heap_{funcstart\_1032,1}._replace(this.$r \rightarrow
this.$r.value(heapIs \frac{1}{2} heap\frac{1}{2} heap\frac{1}{2}
\$heap_{funcstart\_1032,1},\, \textbf{this}.\$r.\textbf{value}(\textbf{heapIs}\,\,\$heap_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(\mathbf{heapIs} \$heap_{funcstart\_1032.1}, \mathbf{this.\$r.value}(\mathbf{heapIs}))
\rho_{funcstart\_1032,1}.p1, 177).rem)))).\_replace(this.\$r \rightarrow operator*(heapIs)
\theta_{funcstart\_1032,1}.\_replace(this.\$r \rightarrow this.\$r.value(heapIs)
heap_{funcstart\_1032,1}._replace(p1 \rightarrow (-2 * div(heapIs p_{funcstart\_1032,1}).
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177).quot) + (171 *
```

```
div(\mathbf{heapIs} \$ heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
heap_{funcstart\_1032,1}.p1, 177).rem)), this)._replace(p2 \rightarrow
asType<P2Type>(($heap<sub>1032,1;1051,8</sub>.M2 *
asType<int>(static_cast<integer>(static_cast<signed
int>(operator^*(heapIs $heap_{1032,1:1051,8}, this).p2) < (int)0))) + temp2)))
→ [expand definition of operator '*' in class 'pointer' at built in declaration]
[57.3] heap_{1032,1;1054,8} == heap_{funcstart\_1032,1}._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.} \text{\$r.value}(\text{heapIs}))
\theta_{funcstart\_1032,1}.p1, 177).rem)))).\_replace(this.$r \rightarrow
this.$r.value(heapIs \rho_{tuncstart\_1032,1}._replace(this.$r \rightarrow
this.$r.value(heapIs \frac{1}{2} heap\frac{1}{2} heap\frac{1}{2}
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
heap_{funcstart\_1032,1}.p1, 177).rem))))).\_replace(p2 \rightarrow
asType<P2Type>(($heap<sub>1032,1;1051,8</sub>.M2 *
asType < int > (static\_cast < integer > (static\_cast < signed)
int>(operator^*(heapIs $heap_{1032,1;1051,8}, this).p2) < (int)0))) + temp2)))
→ [evaluate dereferenced pointer into modified heap]
[57.4] heap_{1032,1;1054,8} == heap_{funcstart\_1032,1}._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{tuncstart_{1032.1}}, this.r.value(heapIs \rho_{tuncstart_{1032.1}}).p1,
177).quot) + (171 * div(heapIs $heap_{funcstart\_1032,1}, this.$r.value(heapIs)
\rho_{funcstart\_1032,1}.p1, 177).rem)))._replace(this.$r \rightarrow ([this.$r ==
this.$r]: this.$r.value(heapIs \rho_{funcstart\_1032,1})._replace(p1 \rightarrow (-2 *
div(\mathbf{heapIs} \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
\text{Sheap}_{funcstart\_1032,1}.p1, 177).quot) + (171 * div(heapIs \text{Sheap}_{funcstart\_1032,1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177).rem)), []:
\textbf{this.}\$r.\textbf{value}(\textbf{heapIs}~\$heap_{funcstart\_1032,1})).\_\textbf{replace}(p2 \rightarrow
asType<P2Type>(($heap<sub>1032,1:1051,8</sub>.M2 *
asType<int>(static_cast<integer>(static_cast<signed
int>(operator^*(heapIs $heap_{1032,1;1051,8}, this).p2) < (int)(0))) + temp(2)))
→ [explicitly assert falsehood of skipped guards in subsequent guards]
[57.5] $heap<sub>1032,1;1054,8</sub> == $heap<sub>funcstart_1032,1</sub>._replace(this.$r \rightarrow
this.$r.value(heapIs \theta_{funcstart\_1032,1})._replace(p1 \theta ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs \rho_{funcstart\_1032,1}, this.r.value(heapIs)
\label{eq:continuous_funcstart_1032,1} $$ \operatorname{heap}_{funcstart_1032,1}.p1,\ 177).rem)))).$$ $$ $$ replace(this.$r \to ([this.$r == ]]) $$
this.$r]: this.$r.value(heapIs \rho_{funcstart\_1032.1})._replace(p1 \rightarrow (-2 *
div(\mathbf{heapIs} \$ heap_{funcstart\_1032.1}, \mathbf{this.}\$r.\mathbf{value}(\mathbf{heapIs})
\text{Sheap}_{funcstart\_1032.1}.p1, 177).quot) + (171 * div(heapIs \text{Sheap}_{funcstart\_1032.1},
this.r.value(heapIs \theta_{funcstart\_1032.1}).p1, 177).rem)), [!(this. r ==
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this.$r)]: this.$r.value(heapIs \rho_{funcstart=1032,1})._replace(p2 \rightarrow
asType<P2Type>(($heap<sub>1032,1;1051,8</sub>.M2 '
as Type < int > (static\_cast < integer > (static\_cast < signed))
int>(operator^*(heapIs $heap_{1032,1;1051,8}, this).p2) < (int)(0))) + temp(2)))
\rightarrow [simplify]
[57.7] heap_{1032,1;1054,8} == heap_{funcstart\_1032,1}._replace(this.$r \rightarrow
this.$r.value(heapIs \rho_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.} \text{\$r.value}(\text{heapIs}))
\theta_{tuncstart\ 1032.1}.p1,\ 177.rem)))._replace(this.r \rightarrow
this.$r.value(heapIs \frac{1}{2} heap\frac{1}{2} line \frac{1}{2} heap\frac{1}{2} heap\frac{1}{2
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(\mathbf{heapIs} \ \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
\theta_{funcstart\_1032,1}.p1, 177).rem))).\_replace(p2 \rightarrow
asType<P2Type>(($heap<sub>1032,1:1051,8</sub>.M2 *
as Type < int > (static\_cast < integer > (static\_cast < signed))
int>(operator^*(heapIs $heap_{1032,1;1051,8}, this).p2) < (int)0))) + temp2)))
\rightarrow [from term 53.19, $heap<sub>1032.1:1051.8</sub> is equal to
heap_{funcstart\ 1032.1}-replace(this.r \rightarrow this.r.value(heapIs)
heap_{funcstart\_1032,1}._replace(p1 \rightarrow (-2 * div(heapIs $heap_{funcstart\_1032,1}).
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177).quot) + (171 *
div(\mathbf{heapIs} \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
heap_{funcstart_{1032,1}}.p1, 177).rem)))
[57.8] \rho_{1032,1;1054,8} == 
\textbf{this.}\$r.\textbf{value}(\textbf{heapIs}~\$heap_{funcstart\_1032,1}).\_\textbf{replace}(p1 \rightarrow ((\text{-}2~*\text{div}(\textbf{heapIs}
\rho_{funcstart\_1032,1}, this.\r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{heap}_{funcstart\_1032.1}, \text{this.} \text{$r.value}(\text{heapIs}))
\theta_{funcstart\_1032.1}.p1, 177).rem)))._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
$heap_funcstart_1032.1, this.$r.value(heapIs $heap_funcstart_1032.1).p1,
177).quot) + (171 * div(\mathbf{heapIs} \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}))
\label{eq:continuous_function} $\operatorname{heap}_{funcstart\_1032,1}).p1,\ 177).rem))).\_\mathbf{replace}(p2 \to
asType < P2Type > ((\$heap_{funcstart\_1032,1}.\_replace(this.\$r \rightarrow funcstart\_1032,1))
this.$r.value(heapIs \rho_{uncstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs)
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
\theta_{funcstart_{1032,1}}.p1, 177).rem))).M2 *
asType < int > (static\_cast < integer > (static\_cast < signed)
int>(operator^*(heapIs $heap_{1032,1;1051,8}, this).p2) < (int)(0))) + temp(2)))
→ [const member of object with modified fields]
[57.9] $heap<sub>1032,1:1054,8</sub> == $heap<sub>funcstart_1032,1</sub>._replace(this.$r \rightarrow
this.$r.value(heapIs \rho_{uncstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs)
\$heap_{funcstart\_1032,1},\, \textbf{this}.\$r.\textbf{value}(\textbf{heapIs}\,\,\$heap_{funcstart\_1032.1}).p1,
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177).quot) + (171 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.} \text{\$r.value}(\text{heapIs}))
\theta_{funcstart\_1032,1}.p1, 177).rem))))._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.}\text{\$r.value}(\text{heapIs}))
heap_{funcstart\_1032,1}.p1, 177).rem)))._replace(p2 \rightarrow
asType < P2Type > ((\$heap_{funcstart\_1032,1}.M2 *
asType<int>(static_cast<integer>(static_cast<signed
int>(operator^*(heapIs $heap_{1032,1:1051.8}, this).p2) < (int)0))) + temp2)))
\rightarrow [const static or extern object]
[57.10] $heap<sub>1032,1;1054,8</sub> == $heap<sub>funcstart_1032,1</sub>._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
\label{eq:continuous_function} $ \text{heap}_{funcstart\_1032,1} . \text{p1}, 177).rem)))).$ \textbf{replace(this.} \$r \rightarrow $ \text{the properties of the prop
this.$r.value(heapIs heap_{funcstart=1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{heap}_{funcstart\_1032.1}, \text{this.} \text{$r.value}(\text{heapIs}))
\theta_{funcstart\_1032,1}.p1, 177).rem))).\_replace(p2 \rightarrow
asType<P2Type>(($heap<sub>init</sub>.M2 *
asType{<}int{>}(static\_cast{<}integer{>}(static\_cast{<}signed
int>(operator^*(heapIs \$heap_{1032,1;1051,8}, this).p2) < (int)(0))) + temp(2)))
\rightarrow [expand definition of constant 'M2' at prang.cpp (33,26)]
[57.11] $heap<sub>1032,1;1054,8</sub> == $heap<sub>funcstart_1032,1</sub>._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.\r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032.1}, \text{this.} \text{\$r.value}(\text{heapIs}))
\theta_{funcstart\_1032.1}.p1, 177).rem)))._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
$heap_funcstart_1032.1, this.$r.value(heapIs $heap_funcstart_1032.1).p1,
177).quot) + (171 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
\label{eq:condition} $\operatorname{heap}_{funcstart\_1032,1}).p1,\ 177).rem))).$\_\mathbf{replace}(p2 \to
asType<P2Type>(((int)30307 *
asType<int>(static_cast<integer>(static_cast<signed
int>(operator^*(heapIs $heap_{1032,1:1051.8}, this).p2) < (int)0))) + temp2)))
\rightarrow [simplify]
[57.12] $heap<sub>1032,1;1054,8</sub> == $heap<sub>funcstart_1032,1</sub>._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.}\text{\$r.value}(\text{heapIs}))
\theta_{tuncstart\_1032,1}.p1, 177).rem)))).\_replace(this.\$r \rightarrow
this.$r.value(heapIs \rho_{uncstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs)
\label{eq:heapIs} $ \text{heap}_{funcstart\_1032,1}, \, \textbf{this}. \\ \$r. \textbf{value}(\textbf{heapIs} \,\, \$ \text{heap}_{funcstart\_1032,1}). \\ \texttt{p1}, \\
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177).quot) + (171 * \text{div}(\text{heapIs } \text{heap}_{funcstart\_1032.1}, \text{this.}\text{$\$r.value}(\text{heapIs}))
\theta_{funcstart\_1032,1}.p1, 177).rem)))._replace(p2 \rightarrow
asType<P2Type>((30307 *
asType<int>(static_cast<integer>(static_cast<signed
int>(operator^*(heapIs $heap_{1032,1;1051,8}, this).p2) < (int)(0))) + temp(2)))
\rightarrow [from term 53.19, $heap<sub>1032,1;1051,8</sub> is equal to
$heap_{funcstart\_1032,1}.$_{replace}$ (this.$r \to this.$r.value(heapIs) 
heap_{funcstart\_1032,1}._replace(p1 \rightarrow (-2 * div(heapIs $heap_{funcstart\_1032,1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, \ 177).quot) + (171 \ *funcstart\_1032,1)
div(\mathbf{heapIs} \ \$heap_{funcstart\_1032,1}, \ \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
heap_{funcstart\_1032,1}.p1, 177).rem)))]
[57.13] heap_{1032,1;1054,8} == heap_{funcstart\_1032,1}._replace(this.r \rightarrow
this.$r.value(heapIs $heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
heap_{funcstart\_1032,1}, this.r.value(heapIs heap_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
\theta_{funcstart\_1032,1}.p1, 177).rem)))).\_replace(this.\$r \rightarrow 0
this.$r.value(heapIs \rho_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
$heap_tuncstart_1032.1, this.$r.value(heapIs $heap_tuncstart_1032.1).p1,
177).quot) + (171 * div(heapIs \rho_{funcstart\_1032,1}, this.r.value(heapIs)
\theta_{funcstart\_1032,1}.p1, 177).rem))).\_replace(p2 \rightarrow
asType<P2Type>((30307 *
asType<int>(static_cast<integer>(static_cast<signed
int>(operator^*(heapIs \$heap_{funcstart\_1032,1}.\_replace(this.\$r \rightarrow
this.$r.value(heapIs heapIs_{funcstart\_1032,1})._replace(p1 \rightarrow (-2 * div(heapIs
\rho_{tuncstart_{-1032.1}}, this.r.value(heapIs \rho_{tuncstart_{-1032.1}}).p1,
(177).quot + (171 * div(heapIs $heap_{funcstart\_1032,1}, this.$r.value(heapIs)
\text{Sheap}_{funcstart\_1032.1}.\text{p1}, 177).\text{rem})), \text{this}.\text{p2}) < (\text{int})0))) + \text{temp2}))
→ [expand definition of operator '*' in class 'pointer' at built in declaration]
[57.14] $heap<sub>1032,1;1054,8</sub> == $heap<sub>funcstart_1032,1</sub>._replace(this.$r \rightarrow
this.$r.value(heapIs \rho_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs \theta_{funcstart\_1032,1}, this.r.value(heapIs)
\theta_{funcstart\_1032,1}.p1, 177).rem)))).\_replace(this.\$r \rightarrow 0
this.$r.value(heapIs $heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs \theta_{funcstart\_1032,1}, this.r.value(heapIs)
\theta_{funcstart\_1032,1}.p1, 177).rem))).\_replace(p2 \rightarrow
asType<P2Type>((30307 *
asType<int>(static_cast<integer>(static_cast<signed
\mathbf{int}{>}(\mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}~\$\mathbf{heap}_{funcstart\_1032,1}.\_\mathbf{replace}(\mathbf{this}.\$\mathbf{r}\rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
$\text{heap}_{funcstart_1032.1}$, this.$\text{r.value}(\text{heapIs} \text{$heap}_{funcstart_1032.1}).p1,
177).quot) + (171 * div(\mathbf{heapIs} \ \$heap_{funcstart\_1032,1}, \ \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
\text{Sheap}_{funcstart\_1032.1}.\text{p1}, 177).\text{rem})))).\text{p2}) < (int)0)) + \text{temp2}))
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\rightarrow [evaluate dereferenced pointer into modified heap]
[57.15] $heap<sub>1032,1;1054,8</sub> == $heap<sub>funcstart_1032,1</sub>._replace(this.$r \rightarrow
\textbf{this.\$r.value}(\textbf{heapIs}~\$ heap_{funcstart\_1032,1}).\_\textbf{replace}(p1 \rightarrow ((-2~*div(\textbf{heapIs})))))
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.} \text{\$r.value}(\text{heapIs}))
\theta_{funcstart\_1032,1}.p1, 177).rem)))).\_replace(this.\$r \rightarrow 0
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs)
\rho_{funcstart\_1032,1}, this.\r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs $heap_{funcstart\_1032,1}, this.$r.value(heapIs
\label{eq:place} $\operatorname{heap}_{funcstart\_1032,1}).p1,\ 177).rem))).\_\mathbf{replace}(p2 \to
asType<P2Type>((30307 *
asType < int > (static\_cast < integer > (static\_cast < signed\ int > (([this.\$r
== this.$r]: this.$r.value(heapIs \rho_{tuncstart = 1032.1})._replace(p1 \rightarrow (-2 *
div(\mathbf{heapIs} \$ heap_{funcstart\_1032.1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
\text{Sheap}_{funcstart\_1032.1}.p1, 177).quot) + (171 * div(heapIs \text{Sheap}_{funcstart\_1032.1},
this.r.value(heapIs \ heap_{funcstart\_1032.1}).p1, 177).rem)), []:
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p2) < (int)0)) + temp2)))
→ [explicitly assert falsehood of skipped guards in subsequent guards]
[57.16] heap_{1032,1;1054,8} == heap_{funcstart\_1032,1}._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
\label{eq:continuous_function} $ \text{heap}_{funcstart\_1032,1} . \text{p1, 177}.rem)))).$ \_\textbf{replace}(\textbf{this}.\$r \rightarrow
\textbf{this.\$r.value}(\textbf{heapIs}~\$ heap_{funcstart\_1032,1}).\_\textbf{replace}(p1 \rightarrow ((-2~*div(\textbf{heapIs})))))
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(\mathbf{heapIs} \ \$heap_{funcstart\_1032,1}, \ \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
\label{eq:continuous_function} $\operatorname{heap}_{funcstart\_1032,1}).p1,\ 177).rem))).\_\mathbf{replace}(p2 \to
asType<P2Type>((30307 *
asType < int > (static\_cast < integer > (static\_cast < signed\ int > (([this.\$r
== this.$r]: this.$r.value(heapIs \rho_{tuncstart\_1032.1})._replace(p1 \rightarrow (-2 *
div(\mathbf{heapIs} \$ heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
\text{Sheap}_{funcstart\_1032,1}.p1, 177).quot) + (171 * div(heapIs \text{Sheap}_{funcstart\_1032,1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177).rem)), [!(this.<math>r = 
this.$r.value(heapIs \theta_{funcstart\_1032.1}).p2) < (int)0))) +
temp2)))
\rightarrow [simplify]
[57.23] $\text{heap}_{1032,1;1054,8} == $\text{heap}_{funcstart\_1032,1}._\text{replace}(\text{this}.\text{$\frac{1}{2}r$})
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{tuncstart\_1032.1}, this.r.value(heapIs \rho_{tuncstart\_1032.1}).p1,
177).quot) + (171 * div(heapIs $heap_{funcstart\_1032,1}, this.$r.value(heapIs)
\label{eq:continuous_function} $ \text{heap}_{funcstart\_1032,1}.\text{p1, 177}.\text{rem})))).$ \_\textbf{replace}(\textbf{this}.\$r \rightarrow
this.$r.value(heapIs \rho_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs)
\rho_{tuncstart_1032.1}, this.r.value(heapIs \rho_{tuncstart_1032.1}).p1,
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177).quot) + (171 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
\theta_{funcstart\_1032,1}.p1, 177).rem)))._replace(p2 \rightarrow
asType<P2Type>((30307 * asType<int>(static_cast<integer>(0 <
-this.$r.value(heapIs \theta_{funcstart\_1032,1}).p2))) + temp2)))
\rightarrow [from term 24.0, literala < -this.$r.value(heapIs $heap_{funcstart\_1032.1}).p2
is false whenever -2 < (0 + literala)
   Proof of rule precondition:
   [57.23.0] - 2 < (0 + 0)
   \rightarrow [simplify]
   [57.23.2] true
[57.24] $heap<sub>1032,1;1054,8</sub> == $heap<sub>funcstart_1032,1</sub>._replace(this.$r \rightarrow
this.$r.value(heapIs \theta_{funcstart\_1032,1})._replace(p1 \theta ((-2 * div(heapIs
\rho_{tuncstart\_1032.1}, this.r.value(heapIs \rho_{tuncstart\_1032.1}).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{heap}_{funcstart\_1032.1}, \text{this.} \text{$r.value}(\text{heapIs}))
\theta_{funcstart\_1032,1}.p1, 177).rem)))).\_replace(this.\$r \rightarrow 0
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
heap_{funcstart\_1032,1}.p1, 177).rem)))._replace(p2 \rightarrow
asType < P2Type > ((30307 * asType < int > (static_cast < integer > (false)))
+ \text{ temp2})))
\rightarrow [simplify]
[57.25] $heap<sub>1032,1:1054,8</sub> == $heap<sub>funcstart_1032,1</sub>._replace(this.$r \rightarrow
this.$r.value(heapIs \frac{1}{2} heap\frac{1}{2} ._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs $heap<sub>funcstart_1032,1</sub>, this.$r.value(heapIs
\theta_{funcstart\_1032,1}.p1, 177).rem)))).\_replace(this.\$r \rightarrow 0
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs $heap<sub>funcstart_1032,1</sub>, this.$r.value(heapIs
\theta_{funcstart\_1032,1}.p1, 177).rem))).\_replace(p2 \rightarrow
asType<P2Type>((30307 * asType<int>(([false]: 1, []: 0))) + temp2)))
→ [explicitly assert falsehood of skipped guards in subsequent guards]
[57.26] heap_{1032,1;1054,8} == heap_{funcstart\_1032,1}._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs \theta_{funcstart\_1032,1}, this.r.value(heapIs)
\theta_{funcstart\_1032,1}.p1, 177).rem))))._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
```

177).quot) + $(171 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart_1032,1}, \text{this.} \text{\$r.value}(\text{heapIs}))$

```
\theta_{funcstart=1032.1}.p1, 177).rem)))._replace(p2 \rightarrow
asType<P2Type>((30307 * asType<int>(([false]: 1, [true]: 0))) +
temp2)))
\rightarrow [simplify]
[57.29] $heap<sub>1032,1;1054,8</sub> == $heap<sub>funcstart_1032,1</sub>._replace(this.$r \rightarrow
this.$r.value(heapIs \rho_{tuncstart\_1032.1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{heap}_{funcstart\_1032,1}, \text{this.}\text{$r.value}(\text{heapIs}))
\theta_{funcstart\_1032,1}.p1, 177).rem))))._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\ 1032.1}).replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(\mathbf{heapIs} \$ heap_{funcstart\_1032,1}, \mathbf{this}.\$ r. \mathbf{value}(\mathbf{heapIs})
\rho_{tuncstart\_1032,1}.p1, 177).rem))._replace(p2 \rightarrow asType<P2Type>(0 +
temp2)))
\rightarrow [from term 54.18, temp2 is equal to (-35 * div(heapIs $heap_{funcstart\_1032,1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p2, 176).quot) + (172 \ function for the content of the conten
div(\mathbf{heapIs} \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
heap_{funcstart_{-1032.1}}.p2, 176).rem
[57.30] $heap<sub>1032,1;1054,8</sub> == $heap<sub>funcstart_1032,1</sub>._replace(this.$r \rightarrow
this.$r.value(heapIs heapIs_{tuncstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart=1032,1}, this.r.value(heapIs \rho_{funcstart=1032,1}).p1,
177).quot) + (171 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
\theta_{tuncstart\_1032.1}.p1, 177).rem)))).\_replace(this.\$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.\r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs $heap_{funcstart\_1032,1}, this.$r.value(heapIs
\frac{\text{sheap}_{funcstart\_1032.1}, p_1, 177, rem)}{\text{constart}\_1032.1}, p_1, 177, rem)}._replace(p2 \rightarrow asType<P2Type>(0 +
((-35 * div(heapIs \$heap_{funcstart\_1032,1}, this.\$r.value(heapIs
\text{Sheap}_{funcstart\_1032,1}.p2, 176).quot) + (172 * div(heapIs \text{Sheap}_{funcstart\_1032,1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p2, 176).rem)))))
\rightarrow [simplify]
[57.33] $heap<sub>1032,1;1054,8</sub> == $heap<sub>funcstart_1032,1</sub>._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.\r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs $heap_{funcstart\_1032,1}, this.$r.value(heapIs
\theta_{tuncstart_1032.1}.p1, 177.rem)))._replace(this.$r \rightarrow
\textbf{this.}\$r.\textbf{value}(\textbf{heapIs}~\$\text{heap}_{funcstart\_1032,1}).\_\textbf{replace}(\text{p1} \rightarrow ((\text{-}2~*\text{div}(\textbf{heapIs}
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
\rho_{funcstart\_1032,1}.p1, 177).rem))._replace(p2 \rightarrow ((-35 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p2,
176).quot) + (172 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032.1}, \text{this.} \text{\$r.value}(\text{heapIs}))
heap_{funcstart\_1032,1}.p2, 176).rem)))
```

```
[Take given term]
[58.0] (($heap<sub>1032.1:1054.8</sub>.r3 * static_cast<signed int>(div3.rem)) -
(\text{sheap}_{1032,1;1054,8}.\text{b3} * \text{static\_cast} < \text{signed int} > (\text{div3.quot}))) == \text{temp3}
\rightarrow [from term 57.33, $heap<sub>1032,1;1054,8</sub> is equal to
$heap_{funcstart\_1032,1}.$_replace(this.$r \rightarrow this.$r.value(heapIs)
heap_{funcstart\_1032,1}._replace(p1 \rightarrow ((-2 * div(heapIs $heap_{funcstart\_1032,1},
this.$r.value(heapIs $heap_{funcstart\_1032.1}).p1, 177).quot) + (171
div(\mathbf{heapIs}\ \$heap_{funcstart\_1032,1},\ \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}
\theta_{funcstart\_1032,1}.p1, 177).rem))))._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs)))
heap_{funcstart\_1032,1}, this.r.value(heapIs heap_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(\mathbf{heapIs} \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}))
\$heap_{funcstart\_1032,1}).p1,\ 177).rem))).\_\mathbf{replace}(p2 \rightarrow (-35\ *div(\mathbf{heapIs}
heap_{funcstart\_1032,1}, this.r.value(heapIs heap_{funcstart\_1032,1}).p2,
176).quot) + (172 * div(heapIs $heap_{funcstart\_1032,1}, this.$r.value(heapIs)
heap_{funcstart_{1032,1}}.p2, 176).rem)))
[58.1] \; ((\$ heap_{funcstart\_1032,1}.\_\textbf{replace}(\textbf{this}.\$r \to \textbf{this}.\$r.\textbf{value}(\textbf{heapIs}))) \\
\rho_{tuncstart_1032.1}._replace(p1 \rightarrow ((-2 * div(heapIs \rho_{tuncstart_1032.1})
this.$r.value(heapIs heap_{funcstart\_1032,1}).p1, 177).quot) + (171 *
\operatorname{div}(\mathbf{heapIs}\ \$ \mathrm{heap}_{funcstart\_1032,1},\ \mathbf{this}.\$ \mathrm{r.value}(\mathbf{heapIs}
\theta_{funcstart\_1032,1}.p1, 177).rem)))).\_replace(this.\$r \rightarrow 0
this.$r.value(heapIs \rho_{uncstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs)
\$heap_{funcstart\_1032,1},\, \textbf{this}.\$r.\textbf{value}(\textbf{heapIs}\,\,\$heap_{funcstart\_1032,1}).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.} \text{\$r.value}(\text{heapIs}))
\rho_{uncstart\_1032,1}.p1, 177).rem))._replace(p2 \rightarrow ((-35 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p2,
176).quot) + (172 * div(heapIs \rho_{funcstart\_1032,1}, this.r.value(heapIs)
\theta_{funcstart\_1032,1}.p2, 176).rem))).r3 * static\_cast < signed
\mathbf{int}{>}(\mathbf{div3.rem})) - (\$\mathbf{heap}_{1032,1;1054,8}.\mathbf{b3} * \mathbf{static\_cast}{<} \mathbf{signed}
int>(div3.quot)) = temp3
→ [const member of object with modified fields]
[58.3] (({\rm sheap}_{funcstart\_1032,1}.r3 * static\_cast < signed int > (div3.rem)) -
(\text{sheap}_{1032,1;1054,8}.\text{b3} * \text{static\_cast} < \text{signed int} > (\text{div}3.\text{quot}))) == \text{temp}_3
\rightarrow [const static or extern object]
[58.4] (($heap<sub>init</sub>.r3 * static_cast<signed int>(div3.rem)) -
(\text{sheap}_{1032,1:1054,8}.\text{b3 * static\_cast} < \text{signed int} > (\text{div3.quot}))) == \text{temp3}
\rightarrow [expand definition of constant 'r3' at prang.cpp (39,26)]
[58.5] (((int)170 * static_cast<signed int>(div3.rem)) -
(\text{sheap}_{1032.1:1054.8}.\text{b3} * \text{static\_cast} < \text{signed int} > (\text{div3.quot}))) = = \text{temp3}
\rightarrow [simplify]
[58.6] ((170 * static_cast<signed int>(div3.rem)) - ($heap_1032.1:1054.8.b3 *
```

```
static_cast<signed int>(div3.quot))) == temp3
\rightarrow [from term 34.6, div3 is equal to div(heapIs $heap_{funcstart\_1032,1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p3, 178)]
[58.7] ((170 * static_cast < signed int > (div(heapIs heapIs funcstart_{1032,1}),
\mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}\ \$heap_{funcstart\_1032,1}).p3,\ 178).rem)) \ \text{-}
(\text{sheap}_{1032,1:1054.8}.\text{b3} * \text{static\_cast} < \text{signed int} > (\text{div3.quot}))) == \text{temp3}
\rightarrow [simplify]
[58.8] ((170 * div(heapIs heap_{funcstart\_1032.1}, this.r.value(heapIs)
\rho_{funcstart\_1032,1}.p3, 178.em) - (\rho_{1032,1;1054,8}.b3 *
static_cast<signed int>(div3.quot))) == temp3
\rightarrow [from term 57.33, $heap<sub>1032,1:1054,8</sub> is equal to
heap_{funcstart\_1032,1}._replace(this.r \rightarrow this.r.value(heapIs)
heap_{funcstart\_1032,1}._replace(p1 \rightarrow ((-2 * div(heapIs \$heap_{funcstart\_1032,1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177).quot) + (171 * leap_{funcstart\_1032,1}).p1, 177).quot) + (171 * leap_{funcstart\_1032,1}).quot) + (171 * leap_{funcstart\_
div(\mathbf{heapIs} \ \$heap_{funcstart\_1032,1}, \ \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
\theta_{tuncstart\_1032.1}.p1, 177).rem))))\_replace(this.\$r \rightarrow 0
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
heap_{funcstart\_1032,1}, this.r.value(heapIs heap_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(\mathbf{heapIs} \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}))
heap_{funcstart\_1032,1}.p1, 177).rem)))._replace(p2 \rightarrow (-35 * div(heapIs)))
heap_{funcstart\_1032,1}, this.r.value(heapIs heap_{funcstart\_1032,1}).p2,
(176).quot) + (172*div(\textbf{heapIs} \$heap_{funcstart\_1032,1}, \textbf{this}.\$r.\textbf{value}(\textbf{heapIs}))
heap_{funcstart_1032,1}.p2, 176).rem)))]
[58.9] ((170 * div(heap
Is \rho_{funcstart\_1032,1}, this.\r.value(heap
Is
\rho_{funcstart\_1032,1}.p3, 178).rem – (\rho_{funcstart\_1032,1}.\_replace)
\rightarrow this.$r.value(heapIs $heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 *
div(\mathbf{heapIs} \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
\text{Sheap}_{funcstart\_1032,1}.p1, 177).quot) + (171 * div(heapIs \text{Sheap}_{funcstart\_1032,1},
this.r.value(heapIs \theta_{funcstart\_1032,1}).p1, 177).rem)))).replace(this. replace(this. replace(thi
\rightarrow this.$r.value(heap
Is $heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 *
div(\mathbf{heapIs} \$ heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
\text{Sheap}_{funcstart\_1032.1}.p1, 177).quot) + (171 * div(heapIs \text{Sheap}_{funcstart\_1032.1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177).rem))).\_replace(p2 \rightarrow
((-35 * div(\mathbf{heapIs} \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}))
\text{Sheap}_{funcstart\_1032,1}.p2, 176).quot) + (172 * div(heapIs \text{Sheap}_{funcstart\_1032,1},
this.r.value(heapIs \ensuremath{\$}heap_{funcstart\_1032,1}).p2, 176).rem)))).b3**
static_cast<signed int>(div3.quot))) == temp3
\rightarrow [const member of object with modified fields]
[58.11] ((170 * div(heapIs heap_{funcstart\_1032,1}, this.r.value(heapIs)
\text{Sheap}_{funcstart\_1032,1}.p3, 178).rem) - (\text{Sheap}_{funcstart\_1032,1}.b3 *
static_cast<signed int>(div3.quot))) == temp3
\rightarrow [const static or extern object]
```

```
[58.12] ((170 * div(heapIs heap_{funcstart\_1032,1}, this.r.value(heapIs)
\rho_{funcstart\_1032,1}.p3, 178).rem – (\rho_{init}.b3 * static\_cast < signed
int>(div3.quot))) == temp3
\rightarrow [expand definition of constant 'b3' at prang.cpp (41,26)]
[58.13] ((170 * div(heapIs \$heap_{funcstart\_1032,1}, this.\$r.value(heapIs
\theta_{funcstart=1032.1}.p3, 178).rem) - ((int)63 * static_cast<signed)
int>(div3.quot))) == temp3
\rightarrow [simplify]
[58.14] ((170 * div(heapIs heap_{funcstart\_1032,1}, this.r.value(heapIs)
\rho_{tuncstart=1032.1}, p3, 178).rem) - (63 * static_cast<signed)
int>(div3.quot)) = temp3
\rightarrow [from term 34.6, div3 is equal to div(heapIs $heap_{funcstart\_1032,1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p3, 178)]
[58.15] ((170 * div(heapIs heap_{funcstart\_1032,1}, this.r.value(heapIs)
\theta_{funcstart\_1032,1}.p3, 178).rem – (63 * static_cast<signed
int>(div(heapIs \$heap_{funcstart\_1032,1}, this.\$r.value(heapIs
heap_{funcstart_1032,1}.p3, 178.quot)) = temp3
\rightarrow [simplify]
[58.20] 0 == (-\text{temp3} + (-63 * \text{div}(\text{heapIs } \text{$heap}_{funcstart\_1032,1},
this.r.value(heapIs \ensuremath{\$}heap_{funcstart\_1032,1}).p3, 178).quot) + (170 *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_1032,1}, \ \mathbf{this}.\$ r. \mathbf{value}(\mathbf{heapIs}
heap_{funcstart_{-1032.1}}.p3, 178).rem
[Take given term]
[59.0] minof(signed int) \leq temp3
\rightarrow [simplify]
[59.3] - 32769 < \text{temp3}
\rightarrow [from term 58.20, temp3 is equal to (-63 * div(heapIs $heap_{funcstart\_1032,1},
this.r.value(heapIs \ \ heap_{funcstart\_1032,1}).p3, \ 178).quot) + (170 \ \ *
div(heapIs $heap_{funcstart\_1032.1}, this.$r.value(heapIs
heap_{funcstart\_1032,1}.p3, 178).rem
[59.4] -32769 < ((-63 * div(heapIs $heap_{funcstart\_1032,1}, this.$r.value(heapIs)]
\text{Sheap}_{funcstart\_1032,1}.p3, 178).quot) + (170 * div(heapIs \text{Sheap}_{funcstart\_1032,1},
this.r.value(heapIs $heap_{funcstart\_1032,1}).p3, 178).rem))
[Take goal term]
[1.0] minof(signed int) \leq (($heap_{1032,1;1054,8}.M3 *
asType < int > (static\_cast < integer > (static\_cast < signed)
int > (operator^*(heapIs \$heap_{1032,1;1054,8}, this).p3) < (int)0))) + temp3)
\rightarrow [simplify]
```

```
[1.1] -32768 \leq (($heap_{1032.1:1054.8}.M3 *
asType<int>(static_cast<integer>(static_cast<signed
int>(operator*(heapIs $heap_{1032,1:1054.8}, this).p3) < (int)0))) + temp3)
\rightarrow [from term 57.33, $heap<sub>1032.1:1054.8</sub> is equal to
heap_{funcstart\_1032.1}._replace(this.r \rightarrow this.r.value(heapIs)
heap_{funcstart\_1032,1}._replace(p1 \rightarrow ((-2 * div(heapIs heap_{funcstart\_1032,1}),
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177).quot) + (171 \ *
div(\mathbf{heapIs} \ \$heap_{funcstart\_1032,1}, \ \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
\theta_{tuncstart\_1032.1}.p1, 177).rem)))._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs)))
heap_{funcstart\_1032,1}, this.r.value(heapIs heap_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs $heap_{tuncstart\_1032.1}, this.$r.value(heapIs
heap_{funcstart\_1032,1}.p1, 177).rem))).\_replace(p2 \rightarrow (-35 * div(heapIs))).
heap_{funcstart\_1032,1}, this.r.value(heapIs heap_{funcstart\_1032,1}).p2,
176).quot) + (172 * div(heapIs $heap_{funcstart\_1032,1}, this.$r.value(heapIs
heap_{funcstart\_1032,1}.p2, 176).rem)))]
[1.2] -32768 \le ((\$heap_{funcstart\_1032,1}.\_replace(this.\$r \rightarrow
\textbf{this.}\$r.\textbf{value}(\textbf{heapIs}~\$heap_{funcstart\_1032,1}).\_\textbf{replace}(p1 \rightarrow ((\text{-}2~*\text{div}(\textbf{heapIs}
\rho_{funcstart\_1032,1}, this.\r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs \rho_{funcstart\_1032,1}, this.r.value(heapIs)
\theta_{funcstart\_1032,1}.p1, 177).rem))))._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(\mathbf{heapIs} \ \$heap_{funcstart\_1032,1}, \ \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
\rho_{uncstart_1032,1}.p1, 177).rem))._replace(p2 \rightarrow ((-35 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p2,
176).quot) + (172 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
\rho_{funcstart_{1032,1}}.p2, 176).rem))).M3 *
asType<int>(static_cast<integer>(static_cast<signed
int>(operator*(heapIs $heap_{1032,1:1054.8}, this).p3) < (int)0))) + temp3)
→ [const member of object with modified fields]
[1.4] -32768 \leq (($heap_funcstart_1032,1.M3 *
asType<int>(static_cast<integer>(static_cast<signed
int>(operator*(heapIs $heap_{1032,1:1054.8}, this).p3) < (int)0))) + temp3)
\rightarrow [const static or extern object]
[1.5] -32768 \le ((\$heap_{init}.M3 *
asType<int>(static_cast<integer>(static_cast<signed
int>(operator^*(heapIs $heap_{1032,1;1054,8}, this).p3) < (int)0))) + temp3)
\rightarrow [expand definition of constant 'M3' at prang.cpp (38,26)]
[1.6] -32768 < (((int)30323 *
asType < int > (static\_cast < integer > (static\_cast < signed)
int>(operator*(heapIs $heap_{1032,1:1054.8}, this).p3) < (int)0))) + temp3)
```

```
\rightarrow [simplify]
[1.7] -32768 \le ((30323 *
asType<int>(static_cast<integer>(static_cast<signed
int>(operator^*(heapIs $heap_{1032.1:1054.8}, this).p3) < (int)0))) + temp3)
\rightarrow [from term 57.33, heap_{1032,1;1054,8} is equal to
heap_{funcstart\_1032.1}._replace(this.r \rightarrow this.r.value(heapIs)
heap_{funcstart\_1032,1}._replace(p1 \rightarrow ((-2 * div(heapIs $heap_{funcstart\_1032,1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, \ 177).quot) + (171 * leap_{funcstart\_1032,1}).p1 + (171 * leap_{func
div(\mathbf{heapIs} \ \$heap_{funcstart\_1032.1}, \ \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
\theta_{tuncstart, 1032.1}.p1, 177).rem)))._replace(this.r \rightarrow 0
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
$heap_{funcstart\_1032,1}$, this.$r.value(heapIs $heap_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs \$heap_{funcstart\_1032,1}, this.\$r.value(heapIs))
heap_{funcstart\_1032,1}.p1, 177).rem))).\_replace(p2 \rightarrow (-35 * div(heapIs)))
heap_{funcstart\_1032,1}, this.r.value(heapIs heap_{funcstart\_1032,1}).p2,
176).quot) + (172 * div(\textbf{heapIs} \$heap_{funcstart\_1032,1}, \textbf{this}.\$r.\textbf{value}(\textbf{heapIs}))
heap_{funcstart\_1032,1}.p2, 176).rem)))]
[1.8] -32768 < ((30323 *
asType<int>(static_cast<integer>(static_cast<signed
\mathbf{int}{>}(\mathbf{operator}^*(\mathbf{heapIs}\ \$\mathbf{heap}_{funcstart\_1032,1}.\_\mathbf{replace}(\mathbf{this}.\$\mathbf{r}\rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
\theta_{funcstart\_1032,1}.p1, 177).rem)))).\_replace(this.$r \rightarrow
this.$r.value(heapIs \rho_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs \rho_{funcstart\_1032,1}, this.r.value(heapIs)
\rho_{funcstart\_1032.1}.p1, 177).rem))._replace(p2 \rightarrow (-35 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p2,
176).quot) + (172 * div(heapIs $heap<sub>funcstart_1032.1</sub>, this.$r.value(heapIs
\theta_{uncstart_{1032,1},2}, 176).rem)), this).p3) < (int)0))) + temp3)
→ [expand definition of operator '*' in class 'pointer' at built in declaration]
[1.9] -32768 \le ((30323 *
asType<int>(static_cast<integer>(static_cast<signed
\mathbf{int}{>}(\mathbf{this.\$r.value}(\mathbf{heapIs}\ \$\mathbf{heap}_{funcstart\_1032,1}.\_\mathbf{replace}(\mathbf{this.\$r}\ \rightarrow\ 
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
$heap_tuncstart_1032.1, this.$r.value(heapIs $heap_tuncstart_1032.1).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.\$r.value}(\text{heapIs}))
\theta_{tuncstart\_1032.1}.p1, 177).rem)))._replace(this.$r \rightarrow
this.$r.value(heapIs heapIs_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\$heap_{funcstart\_1032,1},\, \textbf{this.}\$r.\textbf{value}(\textbf{heapIs}\,\,\$heap_{funcstart\_1032,1}).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.} \text{\$r.value}(\text{heapIs}))
\rho_{tuncstart=1032.1}.p1, 177.rem).-replace\rho_{tuncstart=1032.1}.p1, 177.rem).-replace
```

```
\rho_{funcstart=1032,1}, this.r.value(heapIs \rho_{funcstart=1032,1}).p2,
176).quot) + (172 * div(heapIs \theta_{funcstart\_1032,1}, this.r.value(heapIs)
\text{Sheap}_{funcstart\_1032,1}.\text{p2}, 176).\text{rem})))).\text{p3}) < (int)0))) + temp3)
\rightarrow [evaluate dereferenced pointer into modified heap]
[1.10] -32768 \le ((30323 *
asType < int > (static\_cast < integer > (static\_cast < signed\ int > (([this.\$r
== this.$r]: this.$r.value(heapIs \theta_{funcstart\_1032.1})._replace(p1 \theta ((-2)
* div(\mathbf{heapIs} \ \mathbf{sheap}_{funcstart\_1032,1}, \ \mathbf{this.sr.value}(\mathbf{heapIs})
\text{Sheap}_{funcstart\_1032.1}, p1, 177).quot) + (171 * div(heapIs \text{Sheap}_{funcstart\_1032.1},
this.$r.value(heapIs \rho_{tuncstart\_1032,1}).p1, 177).rem)))._replace(p2 \rightarrow
(-35 * div(heapIs \$heap_{funcstart\_1032.1}, this.\$r.value(heapIs
\text{Sheap}_{funcstart\_1032,1}.p2, 176).quot) + (172 * div(heapIs \text{Sheap}_{funcstart\_1032,1},
this.$r.value(heapIs heap_{funcstart\_1032,1}).p2, 176).rem)), []:
this.$r.value(heapIs \rho_{tuncstart\_1032,1}._replace(this.$r \rightarrow
this.$r.value(heapIs heapIs $heapfuncstart_1032,1)._replace(p1 \rightarrow (-2 * div(heapIs
\rho_{funcstart_1032,1}, this.r.value(heapIs \rho_{funcstart_1032,1}).p1,
177).quot) + (171 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
\text{Sheap}_{funcstart\_1032.1}.\text{p1}, 177).\text{rem})))).\text{p3} < (\text{int})0)) + \text{temp3}
→ [explicitly assert falsehood of skipped guards in subsequent guards]
[1.11] -32768 < ((30323 *
asType < int > (static\_cast < integer > (static\_cast < signed\ int > (([this.\$r])))) \\
== this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2
* div(\mathbf{heapIs} \ \$\mathbf{heap}_{funcstart\_1032,1}, \ \mathbf{this}.\$\mathbf{r.value}(\mathbf{heapIs})
\label{eq:heap_funcstart_1032,1} \$ \operatorname{heap}_{funcstart\_1032,1} . \operatorname{pl}, \ 177).\operatorname{quot}) + (171 * \operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_1032,1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177).rem))).\_replace(p2 \rightarrow
(-35 * div(heapIs $heap_{funcstart\_1032,1}, this.$r.value(heapIs)]
\text{Sheap}_{funcstart\_1032,1}.p2, 176).quot) + (172 * div(heapIs \text{Sheap}_{funcstart\_1032,1},
this.r.value(heapIs \ensuremath{\$}heap_{funcstart\_1032,1}).p2, 176).rem)), [!(this.\ensuremath{\$}r ==
this.r.value(heapIs \ensuremath{\$}heap_{funcstart\_1032,1}.\_replace(this.\ensuremath{\$}r \to this.\ensuremath{\$}r.
this.$r.value(heapIs $heap_{funcstart\_1032,1})._replace(p1 \rightarrow (-2 * div(heapIs
\rho_{tuncstart\_1032,1}, this.r.value(heapIs \rho_{tuncstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs \theta_{funcstart\_1032,1}, this.r.value(heapIs)
\text{Sheap}_{funcstart\_1032,1}.\text{p1}, 177).\text{rem}))))).\text{p3}) < (int)0))) + \text{temp3})
\rightarrow [simplify]
[1.19] -32768 \le ((30323 * asType < int > (static_cast < integer > (0 < integer 
-this.r.value(heapIs heap_{funcstart\_1032,1}.p3))) + temp3)
\rightarrow [from term 40.0, literala < -this.$r.value(heapIs $heap_{funcstart\_1032.1}).p3
is false whenever -2 < (0 + literala)
      Proof of rule precondition:
      [1.19.0] - 2 < (0 + 0)
      \rightarrow [simplify]
```

```
[1.19.2] true
[1.20] -32768 \leq ((30323 * asType<int>(static_cast<integer>(false))) +
temp3)
\rightarrow [simplify]
[1.21] -32768 \leq ((30323 * asType<int>(([false]: 1, []: 0))) + temp3)
→ [explicitly assert falsehood of skipped guards in subsequent guards]
[1.22] -32768 \leq ((30323 * asType<int>(([false]: 1, [true]: 0))) + temp3)
\rightarrow [simplify]
[1.25] -32768 \le (0 + \text{temp3})
\rightarrow [from term 58.20, temp3 is equal to (-63 * div(heapIs $heap_{funcstart\_1032,1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p3, 178).quot) + (170 \ heapIs \ heap_{funcstart\_1032,1}).p3, 178).quot)
div(heapIs $heap_{tuncstart\_1032.1}, this.$r.value(heapIs
heap_{funcstart_{1032,1}}.p3, 178).rem
[1.26] -32768 \leq (0 + ((-63 * div(heapIs $heap_{funcstart\_1032,1},
this.r.value(heapIs \ensuremath{\$}heap_{funcstart\_1032,1}).p3, 178).quot) + (170 *
div(\mathbf{heapIs} \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
heap_{funcstart_1032,1}.p3, 178.rem)
\rightarrow [simplify]
 [1.30] \ -32769 < ((-63 \ ^* \ \mathrm{div}(\mathbf{heapIs} \ \$ \mathrm{heap}_{funcstart\_1032,1}, \ \mathbf{this}.\$ \mathbf{r.value}(\mathbf{heapIs} \ \$ \mathbf{heap}_{funcstart\_1032,1}, \ \mathbf{this}.\$ \mathbf{r.value}(\mathbf{heapIs} \ \mathsf{heap}_{funcstart\_1032,1}, \ \mathbf{this}.\$ \mathbf{r.value}(\mathbf{heapIs} \ \mathsf{heap}_{funcstart\_1032,1}, \ \mathbf{this}.\$ \mathbf{r.value}(\mathbf{heap}_{funcstart\_1032,1}, \ \mathbf{this}.\$ \mathbf{r.value}(\mathbf{heap}_{funcst
\rho_{funcstart_{1032,1}}, p3, 178).quot) + (170 * div(heapIs \rho_{funcstart_{1032,1}},
this.r.value(heapIs \ heap_{funcstart\_1032.1}).p3, 178).rem))
\rightarrow [from term 59.4, literala < ((-63 * div(heapIs $heap_{funcstart\_1032,1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p3, 178).quot) + (170 \ *
div(\mathbf{heapIs} \ \$heap_{funcstart\_1032,1}, \ \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
heap_{funcstart\_1032,1}.p3, 178).rem) is true whenever (-1 + literala) < -32769
        Proof of rule precondition:
        [1.30.0](-32769 + -1) < -32769
        \rightarrow [simplify]
        [1.30.2] true
[1.31] true
Proof of verification condition: Type constraint satisfied in implicit
conversion from 'signed int' to 'P3Type'
In the context of class: WHPrang, declared at:
C:\Escher\Customers\prang-cpp\prang.cpp (18,1)
Condition generated at: C:\Escher\Customers\prang-cpp\prang.cpp
```

(81,16)

Condition defined at:

```
To prove: (($heap<sub>1032.1:1054.8</sub>.M3 *
asType<int>(static_cast<integer>(static_cast<signed
\mathbf{int} > (\mathbf{operator}^*(\mathbf{heapIs} \ \$ \mathrm{heap}_{1032,1;1054,8}, \ \mathbf{this}).\mathrm{p3}) < (\mathbf{int})0))) + \mathrm{temp3}) \leq
maxof(signed int)
Given:
heap_{init}.LIMIT == (int)80
heap_{init}.class WHPrang \in M1 == (int)30269
heap_{init}.class WHPrang \in r1 == (int)171
heap_{init}.class WHPrang \in a1 == (int)177
heap_{init}.class WHPrang \in b1 == (int)2
heap_{init}.class WHPrang \in M2 == (int)30307
heap_{init}.class WHPrang \in r2 == (int)172
heap_{init}.class WHPrang \in a2 == (int)176
heap_{init}.class WHPrang \in b2 == (int)35
heap_{init}.class WHPrang \in M3 == (int)30323
heap_{init}.class WHPrang \in r3 == (int)170
heap_{init}.class WHPrang \in a3 == (int)178
heap_{init}.class WHPrang \in b3 == (int)63
\operatorname{div1} == \operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_1032,1},
\mathbf{static\_cast} {<} \mathbf{int} {>} (\mathbf{operator^*(heapIs}\ \$heap_{funcstart\_1032,1},\ \mathbf{this}).p1),
static\_cast < int > (\$heap_{funcstart\_1032,1}.a1))
(asType<integer>(static_cast<int>(operator*(heapIs
heap_{funcstart\_1032,1}, this).p1) /
asType < integer > (static\_cast < int > (\$heap_{funcstart\_1032.1}.a1))) = =
asType < integer > (div1.quot)
(asType<integer>(static_cast<int>(operator*(heapIs
heap_{funcstart\_1032.1}, this).p1)
asType < integer > (static\_cast < int > (\$heap_{funcstart\_1032.1}.a1))) = =
asType<integer>(div1.rem)
(\mathbf{asType}{<}\mathbf{integer}{>}(\mathbf{operator}^*(\mathbf{heapIs}\ \$\mathbf{heap}_{funcstart\_1032,1},\ \mathbf{this}).\mathtt{p1}) <
asType < integer > (\$heap_{funcstart\_1032,1}.a1)) = >
(asType<integer>(div1.rem) == asType<integer>(operator*(heapIs
heap_{funcstart_{-1032,1}}, this).p1)
(\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathbf{heap}_{funcstart\_1032,1}.\mathbf{a1}) \leq
\mathbf{asType} < \mathbf{integer} > (\mathbf{operator}^*(\mathbf{heapIs} \ \$ \mathbf{heap}_{funcstart\_1032,1}, \ \mathbf{this}).\mathtt{p1})) = >
!(0 == asType < integer > (div1.quot))
```

```
!(0 == asType < integer > (div1.rem)) || !(0 ==
asType<integer>(div1.quot))
div2 == div(\mathbf{heapIs} \$heap_{funcstart\_1032,1},
static_cast<int>(operator*(heapIs $heap_{tuncstart\_1032.1}, this).p2),
static\_cast < int > (\$heap_{funcstart\_1032,1}.a2))
(asType < integer > (static\_cast < int > (operator*(heapIs)))
heap_{funcstart\_1032,1}, this).p2) /
\mathbf{asType} < \mathbf{integer} > (\mathbf{static\_cast} < \mathbf{int} > (\$ \mathbf{heap}_{funcstart\_1032,1}.\mathbf{a2}))) = =
asType<integer>(div2.quot)
(\mathbf{asType} {<} \mathbf{integer} {>} (\mathbf{static\_cast} {<} \mathbf{int} {>} (\mathbf{operator}^* (\mathbf{heapIs}
heap_{funcstart\_1032.1}, this).p2)
asType < integer > (static\_cast < int > (\$heap_{funcstart\_1032.1}.a2))) = =
asType<integer>(div2.rem)
(\mathbf{asType}{<}\mathbf{integer}{>}(\mathbf{operator}^*(\mathbf{heapIs}\ \$\mathbf{heap}_{funcstart\_1032,1},\ \mathbf{this}).\mathtt{p2}) <
asType < integer > (\$heap_{funcstart\_1032,1}.a2)) = >
(asType<integer>(div2.rem) == asType<integer>(operator*(heapIs
heap_{funcstart\_1032,1}, this).p2)
(\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathrm{heap}_{funcstart\_1032,1}.\mathrm{a2}) \leq
\mathbf{asType} < \mathbf{integer} > (\mathbf{operator}^*(\mathbf{heapIs} \ \$ \mathbf{heap}_{funcstart\_1032,1}, \ \mathbf{this}).\mathtt{p2})) = >
!(0 == asType < integer > (div2.quot))
!(0 == asType < integer > (div2.rem)) || !(0 ==
asType<integer>(div2.quot))
div3 == div(\mathbf{heapIs} \$ heap_{funcstart\_1032,1},
\mathbf{static\_cast} < \mathbf{int} > (\mathbf{operator}^*(\mathbf{heapIs}\ \$ \mathbf{heap}_{funcstart\_1032,1},\ \mathbf{this}).\mathbf{p3}),
\mathbf{static\_cast}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_1032,1}.\mathrm{a3}))
(asType<integer>(static_cast<int>(operator*(heapIs
heap_{funcstart\_1032,1}, this).p3)
asType < integer > (static\_cast < int > (\$heap_{funcstart\_1032.1}.a3))) = =
asType<integer>(div3.quot)
(asType < integer > (static\_cast < int > (operator*(heapIs)))
heap_{funcstart\_1032.1}, this).p3)
asType < integer > (static\_cast < int > (\$heap_{funcstart\_1032.1}.a3))) = =
asType<integer>(div3.rem)
(asType<integer>(operator*(heapIs $heap_{funcstart\_1032,1}, this).p3) <
asType < integer > ($heap_{funcstart\_1032,1}.a3)) = >
(asType<integer>(div3.rem) == asType<integer>(operator*(heapIs
heap_{funcstart\_1032,1}, this).p3)
(\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathsf{heap}_{funcstart\_1032,1}.\mathbf{a3}) \leq
asType<integer>(operator*(heapIs $heap_{tuncstart\_1032.1}, this).p3)) =>
!(0 == asType < integer > (div3.quot))
!(0 == asType < integer > (div3.rem)) || !(0 ==
```

```
asType<integer>(div3.quot))
temp1 == (\$heap_{funcstart\_1032,1}.r1 * static\_cast < signed int > (div1.rem)) -
($heap_funcstart_1032,1.b1 * static_cast<signed int>(div1.quot))
minof(signed\ int) \le temp1
temp1 \le maxof(signed int)
heap_{1032,1;1051,8} == heap_{funcstart\_1032,1}._replace(this.$r \rightarrow
operator*(heapIs heap_{funcstart\_1032,1}, this)._replace(p1 \rightarrow
asType<P1Type>(($heap<sub>funcstart_1032.1</sub>.M1 *
asType < int > (static\_cast < integer > (static\_cast < signed
\mathbf{int} > (\mathbf{operator}^*(\mathbf{heapIs} \ \$ \mathbf{heap}_{funcstart\_1032,1}, \ \mathbf{this}).\mathbf{p1}) < (\mathbf{int})\mathbf{0}))) \ +
temp1)))
temp2 == (\$heap_{1032,1;1051,8}.r2 * \textbf{static\_cast} < \textbf{signed int} > (div2.rem)) -
(\text{sheap}_{1032,1:1051,8}.\text{b2} * \text{static\_cast} < \text{signed int} > (\text{div}2.\text{quot}))
minof(signed int) < temp2
temp2 \le maxof(signed int)
\text{heap}_{1032,1;1054,8} == \text{heap}_{1032,1;1051,8}.\_\text{replace}(\text{this}.\text{r} \to \text{this})
operator*(heapIs heap_{1032,1;1051,8}, this)._replace(p2 \rightarrow
asType<P2Type>(($heap<sub>1032,1;1051,8</sub>.M2 *
asType<int>(static_cast<integer>(static_cast<signed
int > (operator^*(heapIs \$heap_{1032,1;1051,8}, this).p2) < (int)0))) + temp2)))
temp3 == (\$heap_{1032,1;1054,8}.r3 * \textbf{static\_cast} < \textbf{signed int} > (div3.rem)) -
(\text{sheap}_{1032,1:1054,8}.\text{b3} * \text{static\_cast} < \text{signed int} > (\text{div}3.\text{quot}))
minof(signed\ int) \le temp3
temp3 \le maxof(signed int)
Proof:
[Take given term]
[2.0] div1 == div(heapIs $heap<sub>funcstart_1032,1</sub>,
static\_cast < int > (operator^*(heapIs \$heap_{funcstart\_1032,1}, this).p1),
\mathbf{static\_cast}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_1032,1}.\mathrm{a1}))
→ [expand definition of operator '*' in class 'pointer' at built in declaration]
[2.1] \operatorname{div1} == \operatorname{div}(\mathbf{heapIs} \ \text{$heap}_{funcstart\_1032,1},
static\_cast < int > (this. r.value(heapIs  heap_{funcstart\_1032,1}).p1),
static\_cast < int > (\$heap_{funcstart\_1032,1}.a1))
\rightarrow [simplify]
[2.2] \text{ div1} == \text{div}(\text{heapIs } \text{heap}_{funcstart\_1032,1}, \text{this.}\text{\$r.value}(\text{heapIs})
\rho_{tuncstart\_1032,1}, p1, static_cast<int>(\rho_{tuncstart\_1032,1})
\rightarrow [const static or extern object]
```

```
[2.3] \operatorname{div1} == \operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_1032,1}, \mathbf{this}.\$ \mathbf{r.value}(\mathbf{heapIs})
\theta_{nit}.a1).p1, \theta_{nit}.a1
\rightarrow [expand definition of constant 'a1' at prang.cpp (30,26)]
[2.4] \text{ div1} == \text{div(heapIs } \text{$heap}_{funcstart\_1032,1}, \text{ this.} \text{$r.value(heapIs)}
\theta_{funcstart\_1032,1}.p1, \theta_{funcstart\_1032,1}.p1, \theta_{funcstart\_1032,1}.p1
\rightarrow [simplify]
[2.6] div1 == div(heapIs heap_{funcstart\_1032,1}, this.r.value(heapIs)
heap_{funcstart_{1032,1}}.p1, 177
[Assume known post-assertion, class invariant or type constraint for term 2.6]
[7.0] (0 < asType<integer>(this.$r.value(heapIs
\theta_{funcstart\_1032.1}.p1) && (asType<integer>(this.$r.value(heapIs)
\rho_{funcstart\_1032.1}.p1 < asType<integer>(\rho_{funcstart\_1032.1}.p1) < asType<integer>(\rho_{funcstart\_1032.1}.p1)
M1))
\rightarrow [simplify]
[7.2] (0 < this.\$r.value(heapIs \$heap_{funcstart_1032.1}).p1) &&
(this.r.value(heapIs $heap_{funcstart\_1032.1}).p1 <
asType<integer>($heap.class WHPrang ∈ M1))
\rightarrow [const static or extern object]
[7.3] (0 < this.$r.value(heap
Is \rho_{uncstart\_1032,1}.p1) \
(this.$r.value(heapIs heap_{funcstart\_1032,1}).p1 <
asType < integer > (\$heap_{init}.class WHPrang \in M1))
\rightarrow [expand definition of constant 'M1' at prang.cpp (28,26)]
[7.4] (0 < this.$r.value(heapIs \rho_{funcstart\_1032,1}).p1) &&
(this.r.value(heapIs $heap_{funcstart\_1032,1}).p1 <
asType < integer > ((int)30269))
\rightarrow [simplify]
[7.10] (-30269 < -this.$r.value(heapIs heap_{funcstart\_1032,1}).p1) \land (0 <
this.r.value(heapIs $heap_{funcstart\_1032,1}).p1)
[Work on sub-term 2 of conjunction in term 7.10]
[8.0] 0 < this.$r.value(heapIs \theta_{funcstart\_1032,1}).p1
[Take given term]
[18.0] div2 == div(heapIs heap_{funcstart\_1032,1},
\mathbf{static\_cast} < \mathbf{int} > (\mathbf{operator}^*(\mathbf{heapIs} \ \$ \mathbf{heap}_{funcstart\_1032,1}, \ \mathbf{this}).\mathtt{p2}),
static\_cast < int > (\$heap_{funcstart\_1032,1}.a2))
→ [expand definition of operator '*' in class 'pointer' at built in declaration]
[18.1] \operatorname{div2} == \operatorname{div}(\mathbf{heapIs} \ \text{$heap}_{funcstart\_1032,1},
static\_cast < int > (this.\$r.value(heapIs \$heap_{funcstart\_1032,1}).p2),
```

```
\mathbf{static\_cast} {<} \mathbf{int} {>} (\$ \mathbf{heap}_{funcstart\_1032,1}.\mathbf{a2}))
\rightarrow [simplify]
[18.2] \operatorname{div2} == \operatorname{div}(\mathbf{heapIs} \ \mathbf{\$heap}_{funcstart\_1032,1}, \ \mathbf{this}.\mathbf{\$r.value}(\mathbf{heapIs})
\theta_{funcstart\_1032,1}.p2, \theta_{funcstart\_1032,1}.p2, \theta_{funcstart\_1032,1}.a2))
\rightarrow [const static or extern object]
[18.3] \operatorname{div2} == \operatorname{div}(\mathbf{heapIs} \ \text{$heap}_{funcstart\_1032,1}, \ \mathbf{this}.\text{$r.value}(\mathbf{heapIs})
\theta_{funcstart\_1032,1}.p2, \theta_{funcstart\_1032,1
\rightarrow [expand definition of constant 'a2' at prang.cpp (35,26)]
[18.4] \text{ div2} == \text{div}(\text{heapIs } \text{$heap}_{funcstart\_1032,1}, \text{this.}\text{$r.value}(\text{heapIs})
\theta_{tuncstart\_1032.1}.p2, \theta_{tuncstart\_1032.1}.p3, \theta_{tuncstart\_1032.1}.p2, \theta_{tuncstart\_1032.1}.p2, \theta_{tuncstart\_1032.1}.p3, \theta_{tuncstart\_1032.1}.p2, \theta_{tuncstart\_1032.1}.p3, \theta_{tuncstart\_1032.1}.p4, \theta_{tuncstart\_1032.1}.p4, \theta_{tuncstart\_1032.1
\rightarrow [simplify]
 [18.6] div2 == div(heapIs $heap_{funcstart\_1032,1}, this.$r.value(heapIs)
heap_{funcstart_{-1032,1}}.p2, 176
[Assume known post-assertion, class invariant or type constraint for term 18.6]
[23.0] (0 < asType<integer>(this.$r.value(heapIs
\label{eq:continuous} $\operatorname{heap}_{funcstart\_1032,1}).p2)) \&\& (\mathbf{asType}{<}\mathbf{integer}{>} (\mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})) \&\& (\mathbf{asType}{<}\mathbf{integer}{>} (\mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}))) \&\& (\mathbf{asType}{<}\mathbf{integer}{>} (\mathbf{heapIs})) \&\& (\mathbf{asType}{<}\mathbf{
\rho_{funcstart\_1032,1}.p2 < asType<integer>(\rho_{funcstart\_1032,1}.p2) < asType<integer>(\rho_{funcstart\_1032,1}.p2)
M2))
\rightarrow [simplify]
[23.2] (0 < this.$r.value(heap
Is \rho_{funcstart\_1032,1}).p2) &&
(this.$r.value(heapIs heap_{funcstart\_1032,1}).p2 <
asType < integer > (\$heap.class WHPrang \in M2))
\rightarrow [const static or extern object]
[23.3] (0 < this.$r.value(heapIs heap_{funcstart\_1032,1}).p2) &&
(this.$r.value(heapIs \rho_{funcstart\_1032,1}).p2 <
asType < integer > (\$heap_{init}.class WHPrang \in M2))
\rightarrow [expand definition of constant 'M2' at prang.cpp (33,26)]
[23.4] (0 < this.$r.value(heapIs $heap_{funcstart\_1032,1}).p2) &&
(this.$r.value(heapIs \theta_{funcstart\_1032,1}).p2 <
asType < integer > ((int)30307))
\rightarrow [simplify]
[23.10] (-30307 < -this.$r.value(heapIs $heap_{funcstart\_1032,1}).p2) \land (0 <
this.r.value(heapIs $heap_{funcstart\_1032,1}).p2)
[Work on sub-term 2 of conjunction in term 23.10]
[24.0] 0 < this.$r.value(heapIs $heap_{funcstart\_1032,1}).p2
[Take given term]
```

```
[34.0] div3 == div(heapIs $heap_{funcstart\_1032,1},
\mathbf{static\_cast} < \mathbf{int} > (\mathbf{operator}^*(\mathbf{heapIs} \ \$ \mathbf{heap}_{funcstart\_1032,1}, \ \mathbf{this}).\mathbf{p3}),
\mathbf{static\_cast}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_1032,1}.\mathrm{a3}))
→ [expand definition of operator '*' in class 'pointer' at built in declaration]
[34.1] \operatorname{div3} == \operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_1032,1},
static\_cast < int > (this. r.value(heapIs  heap_{funcstart\_1032,1}).p3),
\mathbf{static\_cast}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_1032,1}.\mathrm{a3}))
\rightarrow [simplify]
[34.2] \text{ div3} == \text{div(heapIs $heap}_{funcstart\_1032,1}, \text{ this.} \text{$r.value(heapIs)}
\label{eq:cast_int} $$ \theta_{funcstart\_1032,1}.p3, \ \mathbf{static\_cast} < \mathbf{int} > (\$ \theta_{funcstart\_1032,1}.a3)) $$
\rightarrow [const static or extern object]
[34.3] div3 == div(heapIs $heap<sub>funcstart_1032,1</sub>, this.$r.value(heapIs)
\label{eq:cast} $$ \theta_{funcstart\_1032,1}.p3, \ \mathbf{static\_cast} < \mathbf{int} > (\theta_{init}.a3))$ 
\rightarrow [expand definition of constant 'a3' at prang.cpp (40,26)]
[34.4] div3 == div(heapIs $heap_{tuncstart\_1032.1}, this.$r.value(heapIs)
\theta_{funcstart\_1032,1}.p3, \theta_{funcstart\_1032,1}.p4, \theta_{funcstart\_1032,1}.p4, \theta_{funcstart\_1032,1}.p4, \theta_{funcstart\_1032,1}.p5, \theta_{funcstart\_1032,1}.p5, \theta_{funcstart\_1032,1}.p5, \theta_{funcstart\_1032,1}.p5, \theta_{funcstart\_1032,1}.p5, \theta_{funcstart\_1032,1}.p5, \theta_{funcstart\_1032,1}.p5, \theta_{funcstart\_1032,1}.p5, \theta_{funcstart\_1032,1
\rightarrow [simplify]
[34.6] div3 == div(heapIs heapIs  heap_{funcstart\_1032,1}, this.r.value(heapIs)
heap_{funcstart_{1032,1}}.p3, 178
[Assume known post-assertion, class invariant or type constraint for term 34.6]
[39.0] (0 < asType<integer>(this.$r.value(heapIs
$heap_funcstart_1032.1).p3)) && (asType<integer>(this.$r.value(heapIs
\$heap_{funcstart\_1032,1}).p3) < \mathbf{asType} < \mathbf{integer} > (\$heap.\mathbf{class} \ WHPrang \in \texttt{Constart} = \texttt{Constart} =
M3))
\rightarrow [simplify]
[39.2] (0 < this.$r.value(heap
Is $heap_{funcstart\_1032,1}).p3) &&
(this.$r.value(heapIs \theta_{funcstart\_1032,1}).p3 <
asType < integer > (\text{$heap.class WHPrang} \in M3))
\rightarrow [const static or extern object]
[39.3] (0 < this.$r.value(heap
Is \rho_{uncstart\_1032,1}).p3) &&
(this.$r.value(heapIs heap_{funcstart\_1032,1}).p3 <
asType < integer > (\$heap_{init}.class WHPrang \in M3))
\rightarrow [expand definition of constant 'M3' at prang.cpp (38,26)]
[39.4] (0 < this.$r.value(heap
Is \rho_{uncstart\_1032,1}).p3) &&
(this.$r.value(heapIs \theta_{funcstart\_1032,1}).p3 <
asType < integer > ((int)30323))
\rightarrow [simplify]
```

```
[39.10] (-30323 < -this.$r.value(heapIs $heap_{funcstart_1032.1}).p3) \land (0 <
this.r.value(heapIs $heap_{funcstart\_1032,1}).p3)
[Work on sub-term 2 of conjunction in term 39.10]
[40.0] 0 < this.$r.value(heapIs $heap_{funcstart\_1032,1}).p3
[Take given term]
[50.0]\;((\$heap_{funcstart\_1032,1}.r1\;*\;\textbf{static\_cast}{<}\textbf{signed int}{>}(\text{div}1.rem))\;-
(\text{sheap}_{funcstart\_1032,1}.\text{b1 * static\_cast} < \text{signed int} > (\text{div1.quot}))) == \text{temp1}
\rightarrow [const static or extern object]
[50.1] (($heap<sub>init</sub>.r1 * static_cast<signed int>(div1.rem)) -
(\$heap_{funcstart\_1032,1}.b1 * \textbf{static\_cast} < \textbf{signed int} > (\text{div1.quot}))) == \text{temp1}
→ [expand definition of constant 'r1' at prang.cpp (29,26)]
[50.2] (((int)171 * static_cast<signed int>(div1.rem)) -
(\text{sheap}_{funcstart\_1032,1}.\text{b1} * \text{static\_cast} < \text{signed int} > (\text{div1.quot}))) == \text{temp1}
\rightarrow [simplify]
[50.3] ((171 * static_cast < signed int > (div1.rem)) - ($heap_{funcstart\_1032,1}.b1]
* static_cast<signed int>(div1.quot))) == temp1
\rightarrow [from term 2.6, div1 is equal to div(heapIs $heap_{funcstart\_1032,1},
this.r.value(heapIs \ heap_{funcstart\_1032.1}).p1, 177)
[50.4] ((171 * static_cast<signed int>(div(heapIs $heap_{funcstart\_1032,1},
this.r.value(heapIs $heap_{funcstart\_1032,1}).p1, 177).rem)) -
(\text{sheap}_{funcstart\_1032,1}.\text{b1} * \text{static\_cast} < \text{signed int} > (\text{div1.quot}))) == \text{temp1}
\rightarrow [simplify]
[50.5] ((171 * div(heapIs $heap_{funcstart\_1032,1}, this.$r.value(heapIs
$\text{heap}_{funcstart=1032.1}.\text{p1}, 177).\text{rem} - (\text{$heap}_{funcstart=1032.1}.\text{b1} *
static_cast<signed int>(div1.quot))) == temp1
\rightarrow [const static or extern object]
[50.6] \ ((171 \ ^* \ \mathrm{div}(\mathbf{heapIs} \ \$ \mathrm{heap}_{funcstart\_1032,1}, \ \mathbf{this}.\$ r. \mathbf{value}(\mathbf{heapIs} \ \$))
\rho_{uncstart\_1032,1}.p1, 177).rem - (\rho_{unit}.b1 * static_cast < signed)
int>(div1.quot)) == temp1
\rightarrow [expand definition of constant 'b1' at prang.cpp (31,26)]
[50.7] ((171 * div(heapIs $heap_{funcstart\_1032.1}, this.$r.value(heapIs)]
\theta_{funcstart\_1032,1}.p1, 177).rem - ((int)2 * static\_cast < signed)
int>(div1.quot)) == temp1
\rightarrow [simplify]
[50.8] ((171 * div(heapIs \$heap_{funcstart\_1032,1}, this.\$r.value(heapIs)
\theta_{funcstart\_1032,1}.p1, 177).rem - (2 * static\_cast < signed)
int>(div1.quot))) == temp1
```

```
\rightarrow [from term 2.6, div1 is equal to div(heapIs $heap_{funcstart\_1032,1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177)]
[50.9] ((171 * div(heapIs $heap<sub>funcstart_1032,1</sub>, this.$r.value(heapIs)
\theta_{tuncstart\_1032.1}.p1, 177).rem) - (2 * static_cast<signed)
int>(div(heapIs $heap_{tuncstart\_1032.1}, this.$r.value(heapIs
\$ \operatorname{heap}_{funcstart\_1032,1}).\operatorname{p1},\ 177).\operatorname{quot}))) == \operatorname{temp1}
\rightarrow [simplify]
[50.14] 0 == (-\text{temp1} + (-2 * \text{div}(\text{heapIs } \text{$heap}_{funcstart\_1032,1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177).quot) + (171 *
\label{eq:div_heapIs} $ \text{heap}_{funcstart\_1032,1}, \ \textbf{this}.\$r. \textbf{value} (\textbf{heapIs} \\
heap_{funcstart\_1032,1}.p1, 177).rem
[Take given term]
[53.0] heap_{1032,1;1051,8} == heap_{funcstart\_1032,1}._replace(this.$r \rightarrow
operator*(heapIs heap_{funcstart\_1032,1}, this)._replace(p1 \rightarrow
asType < P1Type > ((\$heap_{funcstart\_1032,1}.M1 *
asType<int>(static_cast<integer>(static_cast<signed
int>(operator^*(heapIs \$heap_{funcstart\_1032,1}, this).p1) < (int)0))) +
temp1)))
→ [expand definition of operator '*' in class 'pointer' at built in declaration]
[53.1] \theta_{1032,1;1051,8} == \theta_{1032,1;1051,8} = \theta_{1032,1;1051,8} == \theta
this.$r.value(heapIs \theta_{funcstart\_1032,1})._replace(p1 \rightarrow
asType<P1Type>(($heap_tuncstart_1032.1.M1 *
asType<int>(static_cast<integer>(static_cast<signed
int>(operator^*(heapIs \$heap_{funcstart\_1032,1}, this).p1) < (int)0))) +
temp1)))
\rightarrow [const static or extern object]
[53.2] $\text{heap}_{1032,1:1051.8} == \text{$heap}_{funcstart\_1032,1}._\text{replace}(\text{this}.\text{$r} \to \text{$}
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow
asType<P1Type>(($heap<sub>init</sub>.M1 *
as Type < int > (static\_cast < integer > (static\_cast < signed
int>(operator^*(heapIs $heap_{funcstart\_1032.1}, this).p1) < (int)0))) +
temp1)))
\rightarrow [expand definition of constant 'M1' at prang.cpp (28,26)]
[53.3] heap_{1032,1;1051,8} == heap_{funcstart\_1032,1}._replace(this.r \rightarrow
\mathbf{this.\$r.value}(\mathbf{heapIs}~\$ \mathrm{heap}_{funcstart\_1032,1}).\_\mathbf{replace}(\mathrm{p1} \rightarrow
asType<P1Type>(((int)30269 *
asType < int > (static\_cast < integer > (static\_cast < signed
int>(operator*(heapIs $heap_{funcstart\_1032,1}, this).p1) < (int)0))) +
temp1)))
\rightarrow [simplify]
```

```
[53.4] heap_{1032,1;1051,8} == heap_{funcstart\_1032,1}._replace(this.r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow
asType<P1Type>((30269 *
asType{<}int{>}(static\_cast{<}integer{>}(static\_cast{<}signed
int>(operator^*(heapIs \$heap_{funcstart\_1032,1}, this).p1) < (int)0))) +
temp1)))
→ [expand definition of operator '*' in class 'pointer' at built in declaration]
[53.5] $heap<sub>1032,1;1051,8</sub> == $heap<sub>funcstart_1032,1</sub>._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow
asType<P1Type>((30269 *
asType<int>(static_cast<integer>(static_cast<signed
int>(this.\$r.value(heapIs \$heap_{funcstart\_1032,1}).p1) < (int)0))) + temp1)))
\rightarrow [simplify]
[53.9] heap_{1032,1;1051,8} == heap_{funcstart\_1032,1}.\_replace(this.\$r \rightarrow this)
\mathbf{this.\$r.value}(\mathbf{heapIs}~\$ \mathrm{heap}_{funcstart\_1032,1}).\_\mathbf{replace}(\mathrm{p1} \rightarrow
asType<P1Type>((30269 * asType<int>(static_cast<integer>(0 <
-\mathbf{this.}\$r.\mathbf{value}(\mathbf{heapIs}\ \$heap_{funcstart\_1032,1}).p1))) + temp1)))
\rightarrow [from term 8.0, literala < -this.$r.value(heapIs $heap_{funcstart\_1032.1}).p1
is false whenever -2 < (0 + literala)
   Proof of rule precondition:
   [53.9.0] - 2 < (0 + 0)
   \rightarrow [simplify]
   [53.9.2] true
[53.10] $heap<sub>1032,1;1051,8</sub> == $heap<sub>funcstart_1032,1</sub>._replace(this.$r \rightarrow
this.r.value(heapIs \ heap_{funcstart\_1032,1}).\_replace(p1 \rightarrow
asType<P1Type>((30269 * asType<int>(static_cast<integer>(false)))
+ \text{ temp1})))
\rightarrow [simplify]
[53.11] $\text{heap}_{1032,1;1051,8} == $\text{heap}_{funcstart\_1032,1}._\text{replace}(\text{this}.\text{$\frac{1}{2}r$})
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow
asType < P1Type > ((30269 * asType < int > (([false]: 1, []: 0))) + temp1)))
\rightarrow [explicitly assert falsehood of skipped guards in subsequent guards]
[53.12] \theta_{1032,1;1051,8} == \theta_{1032,1;1051,8} == \theta_{1032,1}.replace(this.$r \to
this.$r.value(heapIs \rho_{funcstart\_1032,1})._replace(p1 \rightarrow
asType<P1Type>((30269 * asType<int>(([false]: 1, [true]: 0))) +
temp1)))
\rightarrow [simplify]
[53.15] $\text{heap}_{1032,1:1051.8} == $\text{heap}_{funcstart\_1032,1}.$\text{-replace}(\text{this}.$\text{$r} \to \text{
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow
```

```
asType < P1Type > (0 + temp1))
\rightarrow [from term 50.14, temp1 is equal to (-2 * div(heapIs $heap_{tuncstart\_1032.1},
div(\mathbf{heapIs} \ \$heap_{funcstart\_1032,1}, \ \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
heap_{funcstart_{1032,1}}.p1, 177).rem
[53.16] $heap<sub>1032,1;1051,8</sub> == $heap<sub>funcstart_1032,1</sub>._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow
asType < P1Type > (0 + ((-2 * div(heapIs $heap_{funcstart\_1032,1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177).quot) + (171 *
div(heapIs $heap<sub>funcstart 1032.1</sub>, this.$r.value(heapIs
heap_{funcstart_{1032,1}}.p1, 177).rem))))
\rightarrow [simplify]
[53.19] $heap<sub>1032,1;1051,8</sub> == $heap<sub>funcstart_1032,1</sub>._replace(this.$r \rightarrow
\textbf{this.\$r.value}(\textbf{heapIs}~\$ heap_{funcstart\_1032,1}).\_\textbf{replace}(p1 \rightarrow ((-2~*div(\textbf{heapIs})))))
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs $heap<sub>funcstart_1032,1</sub>, this.$r.value(heapIs
heap_{funcstart\_1032,1}.p1, 177.rem)))
[Take given term]
[54.0] \; ((\$ heap_{1032,1;1051,8}.r2 * \textbf{static\_cast} < \textbf{signed int} > (div2.rem)) \; - \;
(\text{sheap}_{1032,1;1051,8}.\text{b2} * \text{static\_cast} < \text{signed int} > (\text{div2.quot}))) == \text{temp2}
\rightarrow [from term 53.19, $heap_{1032,1;1051,8}$ is equal to
\$heap_{funcstart\_1032,1}.\_\textbf{replace}(\textbf{this.}\$r \rightarrow \textbf{this.}\$r.\textbf{value}(\textbf{heapIs}
heap_{funcstart\_1032,1}._replace(p1 \rightarrow (-2 * div(heapIs p_{funcstart\_1032,1}).
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177).quot) + (171 *
div(\mathbf{heapIs} \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
heap_{funcstart\_1032,1}.p1, 177).rem)))]
[54.1] ((\text{$heap}_{funcstart\_1032,1}._replace(this.$r \rightarrow this.$r.value(heapIs
\text{Sheap}_{funcstart\_1032,1}._replace(p1 \rightarrow ((-2 * div(heapIs \text{Sheap}_{funcstart\_1032,1},
this.r.value(heapIs $heap_{funcstart\_1032,1}).p1, 177).quot) + (171)^2
div(\mathbf{heapIs} \$ heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
\theta_{funcstart\_1032,1}.p1, 177).rem))).r2 * static\_cast < signed
\mathbf{int}{>}(\mathbf{div2.rem})) - (\$\mathbf{heap}_{1032,1;1051,8}.\mathbf{b2} * \mathbf{static\_cast}{<} \mathbf{signed}
int>(div2.quot)) == temp2
\rightarrow [const member of object with modified fields]
[54.2] \; ((\$heap_{funcstart\_1032,1}.r2 * \textbf{static\_cast} < \textbf{signed int} > (\text{div2.rem})) \; - \\
(\text{sheap}_{1032,1;1051,8}.\text{b2} * \text{static\_cast} < \text{signed int} > (\text{div2.quot}))) == \text{temp2}
\rightarrow [const static or extern object]
[54.3] (($heap<sub>init</sub>.r2 * static_cast<signed int>(div2.rem)) -
(\$heap_{1032,1;1051,8}.b2 * \mathbf{static\_cast} < \mathbf{signed\ int} > (div2.quot))) == temp2
\rightarrow [expand definition of constant 'r2' at prang.cpp (34,26)]
```

```
[54.4] (((int)172 * static_cast<signed int>(div2.rem)) -
(\text{sheap}_{1032,1:1051,8}.\text{b2} * \text{static\_cast} < \text{signed int} > (\text{div2.quot}))) == \text{temp2}
\rightarrow [simplify]
[54.5] ((172 * static_cast<signed int>(div2.rem)) - ($heap_{1032.1:1051.8}.b2 *
static_cast<signed int>(div2.quot))) == temp2
\rightarrow [from term 18.6, div2 is equal to div(heapIs $heap_{funcstart\_1032,1},
this.r.value(heapIs $heap_{funcstart\_1032,1}).p2, 176)
[54.6] ((172 * static_cast<signed int>(div(heapIs $heap_{funcstart\_1032,1},
this.r.value(heapIs $heap_{funcstart\_1032,1}).p2, 176).rem)) -
(\text{\$heap}_{1032,1;1051,8}.\text{b2} * \textbf{static\_cast} < \textbf{signed int} > (\text{div}2.\text{quot}))) == \text{temp}2
\rightarrow [simplify]
[54.7] \; ((172 \; * \; \mathrm{div}(\mathbf{heapIs} \; \$ \mathrm{heap}_{funcstart\_1032,1}, \; \mathbf{this}.\$ r. \mathbf{value}(\mathbf{heapIs} \;
\text{heap}_{funcstart\_1032.1}.p2, 176).rem) - (\text{heap}_{1032.1:1051.8}.b2 *
static_cast<signed int>(div2.quot))) == temp2
\rightarrow [from term 53.19, p_{1032,1;1051,8} is equal to
\$heap_{funcstart\_1032,1}.\_\textbf{replace}(\textbf{this}.\$r \rightarrow \textbf{this}.\$r.\textbf{value}(\textbf{heapIs}
heap_{funcstart\_1032.1}._replace(p1 \rightarrow (-2 * div(heapIs p_{funcstart\_1032.1})
this.$r.value(heapIs heap_{funcstart_{-1032,1}}).p1, 177).quot) + (171
div(heapIs $heap_funcstart_1032.1, this.$r.value(heapIs
heap_{funcstart_1032,1}.p1, 177).rem)))
[54.8] ((172 * div(heapIs $heap<sub>funcstart_1032,1</sub>, this.$r.value(heapIs)
\rho_{tuncstart_1032,1}.p2, 176).rem – (\rho_{tuncstart_1032,1}.p2).replace(this.$r
\rightarrow this.$r.value(heapIs $heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 *
div(\mathbf{heapIs} \$ heap_{funcstart\_1032.1}, \mathbf{this.}\$r.\mathbf{value}(\mathbf{heapIs})
\text{Sheap}_{funcstart\_1032,1}.p1, 177).quot) + (171 * div(heapIs \text{Sheap}_{funcstart\_1032,1},
this.$r.value(heapIs $heap_{tuncstart_1032,1}).p1, 177).rem)))).b2 *
static_cast<signed int>(div2.quot))) == temp2
→ [const member of object with modified fields]
[54.9] ((172 * div(heapIs $heap<sub>funcstart_1032,1</sub>, this.$r.value(heapIs)
\text{Sheap}_{funcstart\_1032,1}.p2, 176).rem) - (\text{Sheap}_{funcstart\_1032,1}.b2 *
static_cast<signed int>(div2.quot))) == temp2
\rightarrow [const static or extern object]
[54.10] ((172 * div(heapIs heap_{funcstart\_1032,1}, this.r.value(heapIs)
$\text{heap}_{tuncstart=1032.1}\text{).p2}, 176\text{).rem}\text{ - ($\text{heap}_{init}\text{.b2} * static_cast<signed)}
int>(div2.quot)) == temp2
\rightarrow [expand definition of constant 'b2' at prang.cpp (36,26)]
[54.11] ((172 * div(heapIs $heap<sub>funcstart_1032,1</sub>, this.$r.value(heapIs
\rho_{tuncstart\_1032.1}.p2, 176).rem - ((int)35 * static\_cast < signed
int > (div2.quot))) == temp2
```

```
\rightarrow [simplify]
[54.12] ((172 * div(heapIs heap_{funcstart\_1032,1}, this.r.value(heapIs)
\theta_{funcstart\_1032,1}.p2, 176).rem) - (35 * static_cast<signed)
int>(div2.quot)) == temp2
\rightarrow [from term 18.6, div2 is equal to div(heapIs $heap_{funcstart\_1032,1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p2, 176)
[54.13] ((172 * div(heapIs $heap_{funcstart\_1032,1}, this.$r.value(heapIs
\theta_{funcstart\_1032,1}.p2,\,176).rem) – (35 * static_cast<signed
\mathbf{int}{>}(\mathrm{div}(\mathbf{heapIs}\ \$\mathrm{heap}_{funcstart\_1032,1},\ \mathbf{this}.\$\mathrm{r.value}(\mathbf{heapIs}
\theta_{funcstart\_1032,1}.p2, 176).quot))) == temp2
\rightarrow [simplify]
[54.18] 0 == (-\text{temp2} + (-35 * \text{div}(\text{heapIs } \text{$heap}_{funcstart\_1032.1})]
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p2, 176).quot) + (172 *
div(\mathbf{heapIs} \$ heap_{funcstart\_1032.1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
heap_{funcstart\_1032,1}.p2, 176).rem
[Take given term]
[57.0] $\text{heap}_{1032,1;1054,8} == $\text{heap}_{1032,1;1051,8}._\text{replace}(\text{this}.$\text{$r} \to \text{
operator*(heapIs heap_{1032,1:1051.8}, this)._replace(p2 \rightarrow
asType<P2Type>(($heap<sub>1032,1:1051,8</sub>.M2 *
asType < int > (static\_cast < integer > (static\_cast < signed
int>(operator^*(heapIs $heap_{1032.1:1051.8}, this).p2) < (int)(0))) + temp(2)))
\rightarrow [from term 53.19, $heap<sub>1032,1;1051,8</sub> is equal to
\theta_{tuncstart\_1032,1}._replace(this.r \to this.r.value(heapIs)
heap_{funcstart\_1032.1}._replace(p1 \rightarrow (-2 * div(heapIs $heap_{funcstart\_1032.1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177).quot) + (171 * leapIs \ heap_{funcstart\_1032,1}).p1, 177).quot)
div(\mathbf{heapIs}\ \$heap_{funcstart\_1032,1},\ \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}
heap_{funcstart\_1032,1}.p1, 177).rem)))
[57.2] \rho_{1032,1;1054,8} == \rho_{1032,1;1054,8} == \rho_{1032,1}.\_replace(this.\$r \rightarrow 0.000)
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs))
\rho_{funcstart\_1032,1}, this. r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.} \text{\$r.value}(\text{heapIs}))
\hat{p}_{funcstart\_1032,1}.p1, 177).rem)))).\_replace(this.\$r \rightarrow operator*(heapIs)
\$heap_{funcstart\_1032,1}.\_\textbf{replace}(\textbf{this}.\$r. \bm{\$this}.\$r. \bm{\$r.value}(\textbf{heapIs}
\text{Sheap}_{funcstart\_1032,1}._replace(p1 \rightarrow (-2 * div(heapIs \text{Sheap}_{funcstart\_1032,1}),
this.$r.value(heapIs heap_{funcstart_{-1032,1}}).p1, 177).quot) + (171 *
div(\mathbf{heapIs} \$ heap_{funcstart\_1032.1}, \mathbf{this.}\$r.\mathbf{value}(\mathbf{heapIs})
\$heap_{funcstart\_1032,1}).p1,\ 177).rem))),\ \textbf{this}).\_\textbf{replace}(p2\rightarrow
asType<P2Type>(($heap<sub>1032,1;1051,8</sub>.M2 *
asType<int>(static_cast<integer>(static_cast<signed
int > (operator^*(heapIs \$heap_{1032,1;1051,8}, this).p2) < (int)0))) + temp2)))
→ [expand definition of operator '*' in class 'pointer' at built in declaration]
```

```
[57.3] heap_{1032,1;1054,8} == heap_{funcstart\_1032,1}._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
\theta_{tuncstart\_1032,1}.p1, 177).rem)))).\_replace(this.\$r \rightarrow
this.$r.value(heapIs \rho_{funcstart\_1032,1}._replace(this.$r \rightarrow
this.$r.value(heapIs \rho_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{tuncstart_1032,1}, this.r.value(heapIs \rho_{tuncstart_1032,1}).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.}\text{\$r.value}(\text{heapIs}))
\theta_{funcstart\_1032,1}.p1, 177).rem)))).\_replace(p2 \rightarrow
asType < P2Type > ((\$heap_{1032,1;1051,8}.M2 *
asType<int>(static_cast<integer>(static_cast<signed
int>(operator^*(heapIs \$heap_{1032,1;1051,8}, this).p2) < (int)(0))) + temp(2)))
→ [evaluate dereferenced pointer into modified heap]
[57.4] heap_{1032,1;1054,8} == heap_{funcstart\_1032,1}._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart=1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{heap}_{funcstart\_1032,1}, \text{this.} \text{$r.value}(\text{heapIs}))
\theta_{funcstart\_1032,1}.p1, 177).rem))))._replace(this.$r \rightarrow ([this.$r ===
this.$r]: this.$r.value(heapIs \rho_{funcstart\_1032,1})._replace(p1 \rightarrow (-2 *
div(\mathbf{heapIs} \$ heap_{funcstart\_1032.1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
\text{Sheap}_{funcstart\_1032,1}.p1, 177).quot) + (171 * div(heapIs \text{Sheap}_{funcstart\_1032,1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177).rem)), []:
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p2 \rightarrow
asType<P2Type>(($heap<sub>1032.1:1051.8</sub>.M2 *
asType<int>(static_cast<integer>(static_cast<signed
int > (operator^*(heapIs \$heap_{1032,1;1051,8}, this).p2) < (int)0))) + temp2)))
→ [explicitly assert falsehood of skipped guards in subsequent guards]
[57.5] heap_{1032,1;1054,8} == heap_{funcstart\_1032,1}._replace(this.$r \rightarrow
this.$r.value(heapIs \rho_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{tuncstart\_1032,1}, this.r.value(heapIs \rho_{tuncstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs \theta_{funcstart\_1032,1}, this.r.value(heapIs)
\rho_{funcstart\_1032.1}.p1, 177).rem)))._replace(this.$r \rightarrow ([this.$r ==
this.$r]: this.$r.value(heapIs \rho_{tuncstart\_1032,1})._replace(p1 \rightarrow (-2 *
div(\mathbf{heapIs} \$ heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
\text{Sheap}_{funcstart\_1032,1}.p1, 177).quot) + (171 * div(heapIs \text{Sheap}_{funcstart\_1032,1},
\mathbf{this.\$r.value(heapIs}~\$ \mathrm{heap}_{funcstart\_1032,1}).\mathrm{p1},~177).\mathrm{rem})),~[!(\mathbf{this.\$r}==
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p2 \rightarrow
asType<P2Type>(($heap<sub>1032,1:1051,8</sub>.M2 *
asType < int > (static\_cast < integer > (static\_cast < signed
int>(operator^*(heapIs $heap_{1032.1:1051.8}, this).p2) < (int)(0))) + temp(2)))
\rightarrow [simplify]
[57.7] heap_{1032,1;1054,8} == heap_{funcstart\_1032,1}._replace(this.$r \rightarrow
```

```
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
\theta_{tuncstart\_1032,1}.p1, 177).rem)))).\_replace(this.\$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs $heap<sub>funcstart_1032,1</sub>, this.$r.value(heapIs
\theta_{tuncstart_{-1032.1}}.p1, 177).rem))._replace(p2 \rightarrow
asType<P2Type>(($heap<sub>1032,1:1051,8</sub>.M2 *
asType<int>(static_cast<integer>(static_cast<signed
int>(operator^*(heapIs $heap_{1032,1;1051,8}, this).p2) < (int)0))) + temp2)))
\rightarrow [from term 53.19, $heap<sub>1032.1:1051.8</sub> is equal to
$heap_{funcstart\_1032,1}.$_replace(this.$r \rightarrow this.$r.value(heapIs)
heap_{funcstart\_1032,1}._replace(p1 \rightarrow (-2 * div(heapIs $heap_{funcstart\_1032,1}).
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177).quot) + (171 \ respectively)
div(heapIs $heap_funcstart_1032.1, this.$r.value(heapIs
heap_{funcstart\_1032,1}.p1, 177).rem)))
[57.8] $heap<sub>1032.1:1054.8</sub> == $heap<sub>funcstart_1032.1</sub>._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.\r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs $heap<sub>funcstart_1032,1</sub>, this.$r.value(heapIs
\theta_{funcstart\_1032,1}.p1, 177).rem)))).\_replace(this.\$r \rightarrow 0
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.\r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{heap}_{funcstart\_1032.1}, \text{this.} \text{$r.value}(\text{heapIs}))
\theta_{funcstart\_1032,1}.p1, 177).rem)))._replace(p2 \rightarrow
asType < P2Type > ((\$heap_{funcstart\_1032,1}.\_replace(this.\$r \rightarrow funcstart\_1032,1))
\textbf{this.\$r.value}(\textbf{heapIs}~\$ heap_{funcstart\_1032,1}).\_\textbf{replace}(p1 \rightarrow ((\text{-}2~*\text{div}(\textbf{heapIs}
$\text{heap}_{funcstart=1032.1}$, this.$\text{r.value}(\text{heapIs} \text{$heap}_{funcstart=1032.1}).p1,
177).quot) + (171 * div(heapIs \theta_{funcstart\_1032,1}, this.r.value(heapIs)
heap_{funcstart_{1032,1}}.p1, 177).rem))).M2 *
asType<int>(static_cast<integer>(static_cast<signed
int>(operator*(heapIs $heap_{1032,1;1051,8}, this).p2) < (int)0))) + temp2)))
\rightarrow [const member of object with modified fields]
[57.9] $\text{heap}_{1032,1:1054,8} == $\text{heap}_{funcstart\_1032,1}._\text{replace}(\text{this}.\text{$\frac{1}{2}r$})
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
\theta_{funcstart\_1032,1}.p1, 177).rem)))).\_replace(this.$r \rightarrow
this.$r.value(heapIs \rho_{uncstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs)
\$heap_{funcstart\_1032,1},\, \textbf{this.}\$r.\textbf{value}(\textbf{heapIs}\,\,\$heap_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(\mathbf{heapIs} \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}))
\theta_{funcstart\_1032,1}.p1, 177).rem))).\_replace(p2 \rightarrow
asType<P2Type>(($heap_tuncstart_1032.1.M2 *
```

```
asType<int>(static_cast<integer>(static_cast<signed
int>(operator^*(heapIs $heap_{1032,1;1051,8}, this).p2) < (int)0))) + temp2)))
\rightarrow [const static or extern object]
[57.10] $heap<sub>1032,1;1054,8</sub> == $heap<sub>funcstart_1032,1</sub>._replace(this.$r \rightarrow
\textbf{this.}\$r.\textbf{value}(\textbf{heapIs}~\$heap_{funcstart\_1032,1}).\_\textbf{replace}(p1 \rightarrow ((\text{-}2~*\text{div}(\textbf{heapIs}
\rho_{funcstart_1032,1}, this.\r.value(heapIs \rho_{funcstart_1032,1}).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.} \text{\$r.value}(\text{heapIs}))
\theta_{funcstart\_1032,1}.p1, 177).rem))))._replace(this.$r \rightarrow
this.$r.value(heapIs \rho_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\$heap_{funcstart\_1032,1},\, \textbf{this}.\$r.\textbf{value}(\textbf{heapIs}\,\,\$heap_{funcstart\_1032.1}).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.} \text{\$r.value}(\text{heapIs}))
\theta_{funcstart\_1032,1}.p1, 177).rem))).\_replace(p2 \rightarrow
asType < P2Type > ((\$heap_{init}.M2 *
asType<int>(static_cast<integer>(static_cast<signed
int>(operator^*(heapIs $heap_{1032,1;1051,8}, this).p2) < (int)0))) + temp2)))
\rightarrow [expand definition of constant 'M2' at prang.cpp (33,26)]
[57.11] $\text{heap}_{1032,1;1054,8} == $\text{heap}_{funcstart\_1032,1}._\text{replace}(\text{this}.\text{$\frac{1}{2}r$})
this.$r.value(heapIs \rho_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs $heap<sub>funcstart_1032,1</sub>, this.$r.value(heapIs
\theta_{tuncstart_{1032,1}}.p1, 177).rem)))._replace(this.$r \rightarrow
\textbf{this.}\$r.\textbf{value}(\textbf{heapIs}~\$heap_{funcstart\_1032,1}).\_\textbf{replace}(p1 \rightarrow ((\text{-}2~*\text{div}(\textbf{heapIs}
\rho_{tuncstart\_1032.1}, this.r.value(heapIs \rho_{tuncstart\_1032.1}).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.} \text{\$r.value}(\text{heapIs}))
\theta_{funcstart\_1032,1}.p1, 177).rem))).\_replace(p2 \rightarrow
asType < P2Type > (((int)30307 *
asType<int>(static_cast<integer>(static_cast<signed
int>(operator^*(heapIs \$heap_{1032,1;1051,8}, this).p2) < (int)(0))) + temp(2)))
\rightarrow [simplify]
[57.12] \theta_{1032,1;1054,8} == \theta_{1032,1;1054,8} == \theta_{1032,1}.replace(this.$r \to
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{tuncstart\_1032.1}, this.r.value(heapIs \rho_{tuncstart\_1032.1}).p1,
177).quot) + (171 * div(heapIs $heap_{funcstart\_1032,1}, this.$r.value(heapIs
\label{eq:continuous_function} $ \text{heap}_{funcstart\_1032,1}.\text{p1},\ 177).\text{rem})))).$ \_\textbf{replace}(\textbf{this}.\$r \rightarrow
this.$r.value(heapIs $heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart_1032,1}, this.r.value(heapIs \rho_{funcstart_1032,1}).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{heap}_{funcstart\_1032,1}, \text{this.}\text{$r.value}(\text{heapIs}))
\theta_{funcstart\_1032,1}.p1, 177).rem))).\_replace(p2 \rightarrow
\mathbf{asType}{<}\mathrm{P2Type}{>}((30307~*
asType < int > (static\_cast < integer > (static\_cast < signed
int>(operator^*(heapIs $heap_{1032,1;1051,8}, this).p2) < (int)(0))) + temp(2)))
\rightarrow [from term 53.19, $heap<sub>1032.1:1051.8</sub> is equal to
\$heap_{funcstart\_1032,1}.\_\textbf{replace}(\textbf{this.}\$r \rightarrow \textbf{this.}\$r.\textbf{value}(\textbf{heapIs}
```

```
heap_{funcstart\_1032.1}._replace(p1 \rightarrow (-2 * div(heapIs $heap_{funcstart\_1032.1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, \ 177).quot) + (171 \ funcstart\_1032,1).p1
div(\mathbf{heapIs} \ \$heap_{funcstart\_1032,1}, \ \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
heap_{funcstart\_1032,1}.p1, 177).rem)))
[57.13] $heap<sub>1032.1:1054.8</sub> == $heap<sub>funcstart_1032.1</sub>._replace(this.$r \rightarrow
\textbf{this.}\$r.\textbf{value}(\textbf{heapIs}~\$heap_{funcstart\_1032,1}).\_\textbf{replace}(p1 \rightarrow ((-2~*div(\textbf{heapIs})))))
\$heap_{funcstart\_1032,1},\, \textbf{this.}\$r.\textbf{value}(\textbf{heapIs}\,\,\$heap_{funcstart\_1032,1}).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.} \text{\$r.value}(\text{heapIs}))
\theta_{tuncstart\_1032.1}.p1, 177.rem)))._replace(this.$r \rightarrow
this.$r.value(heapIs \rho_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.\r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs $heap<sub>funcstart_1032.1</sub>, this.$r.value(heapIs
\theta_{tuncstart = 1032.1}, p1, 177).rem)))._replace(p2 \rightarrow
asType<P2Type>((30307 *
asType<int>(static_cast<integer>(static_cast<signed
int>(operator^*(heapIs \ heap_{funcstart\_1032,1}.\_replace(this.\$r \rightarrow
this.$r.value(heapIs heapIs $heapfuncstart_1032,1)._replace(p1 \rightarrow (-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * \operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_1032,1}, \ \mathbf{this}.\$ \mathbf{r.value}(\mathbf{heapIs})
\text{Sheap}_{funcstart\_1032.1}.\text{p1}, 177).\text{rem})), \text{this}.\text{p2}) < (\text{int})0))) + \text{temp2}))
→ [expand definition of operator '*' in class 'pointer' at built in declaration]
[57.14] $heap<sub>1032,1;1054,8</sub> == $heap<sub>funcstart_1032,1</sub>._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
\theta_{tuncstart_{1032,1}}.p1, 177.rem)))._replace(this.r \rightarrow
this.$r.value(heapIs \rho_{uncstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs)
\rho_{funcstart=1032,1}, this.r.value(heapIs \rho_{funcstart=1032,1}).p1,
177).quot) + (171 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
\theta_{funcstart\_1032.1}.p1, 177).rem)))._replace(p2 \rightarrow
asType<P2Type>((30307 *
as Type < int > (static\_cast < integer > (static\_cast < signed
int>(this.\$r.value(heapIs \$heap_{funcstart\_1032,1}.\_replace(this.\$r \rightarrow
this.$r.value(heapIs $heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\theta_{funcstart\_1032.1}, this.r.value(heapIs \theta_{funcstart\_1032.1}).p1,
177).quot) + (171 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
\text{Sheap}_{funcstart=1032.1}.\text{p1}, 177).\text{rem})))).\text{p2}) < (int)0))) + \text{temp2}))
→ [evaluate dereferenced pointer into modified heap]
[57.15] $heap<sub>1032.1:1054.8</sub> == $heap<sub>funcstart_1032.1</sub>._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs)
\rho_{uncstart\_1032,1}, this.r.value(heapIs \rho_{uncstart\_1032,1}).p1,
177).quot) + (171 * div(\mathbf{heapIs} \ \$heap_{funcstart\_1032,1}, \ \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
\theta_{tuncstart_1032.1}.p1, 177).rem)))._replace(this.$r \rightarrow
```

```
this.$r.value(heapIs heap_{tuncstart=1032.1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
\theta_{funcstart\_1032,1}.p1, 177).rem)))._replace(p2 \rightarrow
asType<P2Type>((30307 *
asType < int > (static\_cast < integer > (static\_cast < signed\ int > (([this.\$r
== this.$r]: this.$r.value(heapIs \rho_{tuncstart\_1032,1})._replace(p1 \rightarrow (-2 *
div(heapIs $heap_tuncstart_1032.1, this.$r.value(heapIs
\text{Sheap}_{funcstart\_1032.1}, p1, 177).quot) + (171 * div(heapIs \text{Sheap}_{funcstart\_1032.1},
this.r.value(heapIs \ heap_{funcstart\_1032.1}).p1, 177).rem)), []:
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p2) < (int)0))) + temp2)))
→ [explicitly assert falsehood of skipped guards in subsequent guards]
[57.16] $heap<sub>1032,1;1054,8</sub> == $heap<sub>funcstart_1032,1</sub>._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
\theta_{funcstart\_1032,1}.p1, 177).rem))))._replace(this.$r \rightarrow
\textbf{this.}\$r.\textbf{value}(\textbf{heapIs}~\$heap_{funcstart\_1032,1}).\_\textbf{replace}(p1 \rightarrow ((\text{-}2~*\text{div}(\textbf{heapIs}
$\text{heap}_{funcstart_1032.1}$, this.$\text{r.value}(\text{heapIs} \text{$heap}_{funcstart_1032.1}).p1,
177).quot) + (171 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
\theta_{funcstart\_1032,1}.p1, 177).rem))).\_replace(p2 \rightarrow
asType<P2Type>((30307 *
asType < int > (static\_cast < integer > (static\_cast < signed\ int > (([this.\$r
== this.$r]: this.$r.value(heapIs \rho_{tangle} = 1032,1)._replace(p1 \rho (-2 *
div(heapIs $heap<sub>funcstart_1032.1</sub>, this.$r.value(heapIs
\text{Sheap}_{funcstart\_1032,1}.p1, 177).quot) + (171 * div(heapIs \text{Sheap}_{funcstart\_1032,1},
this.r.value(heapIs \ensuremath{\$}heap_{funcstart\_1032,1}).p1, 177).rem)), [!(this.\ensuremath{\$}r ==
\mathbf{this.\$r.}\mathbf{value}(\mathbf{heapIs}\ \$\mathbf{heap}_{funcstart\_1032,1})).\mathbf{p2}) < (\mathbf{int})\mathbf{0}))) \ +
temp2)))
\rightarrow [simplify]
[57.23] $heap<sub>1032,1;1054,8</sub> == $heap<sub>funcstart_1032,1</sub>._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
\theta_{funcstart\_1032,1}.p1, 177).rem)))).\_replace(this.\$r \rightarrow 0
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
\theta_{funcstart\_1032,1}.p1, 177).rem)))._replace(p2 \rightarrow
{\bf asType} < P2Type > ((30307 * {\bf asType} < {\bf int} > ({\bf static\_cast} < {\bf integer} > (0 < {\bf output})) < {\bf output} > ({\bf output}) < {\bf o
-\mathbf{this.\$r.value}(\mathbf{heapIs}\ \$\mathrm{heap}_{funcstart\_1032,1}).\mathrm{p2}))) + \mathrm{temp2})))
\rightarrow [from term 24.0, literala < -this.$r.value(heapIs $heap_{funcstart\_1032.1}).p2
is false whenever -2 < (0 + literala)
```

```
Proof of rule precondition:
```

```
[57.23.0] - 2 < (0 + 0)
    \rightarrow [simplify]
    [57.23.2] true
[57.24] $\text{heap}_{1032,1;1054,8} == $\text{heap}_{funcstart\_1032,1}._\text{replace}(\text{this}.\text{$\frac{1}{2}r$})
\textbf{this.}\$r.\textbf{value}(\textbf{heapIs}~\$heap_{funcstart\_1032,1}).\_\textbf{replace}(p1 \rightarrow ((\text{-}2~*\text{div}(\textbf{heapIs}
\rho_{funcstart\_1032,1}, this. r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.} \text{\$r.value}(\text{heapIs}))
\theta_{tuncstart\_1032.1}.p1, 177).rem)))).\_replace(this.\$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{tuncstart_{-1032.1}}, this.r.value(heapIs \rho_{tuncstart_{-1032.1}}).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{heap}_{funcstart\_1032.1}, \text{this.} \text{$r.value}(\text{heapIs}))
\theta_{funcstart\_1032,1}.p1, 177).rem))).\_replace(p2 \rightarrow
asType<P2Type>((30307 * asType<int>(static_cast<integer>(false)))
+ \text{ temp2})))
\rightarrow [simplify]
[57.25] $heap<sub>1032,1;1054,8</sub> == $heap<sub>funcstart_1032,1</sub>._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
\theta_{funcstart, 1032.1}.p1, 177).rem)))._replace(this.$r \rightarrow
\textbf{this.\$r.value}(\textbf{heapIs}~\$ heap_{funcstart\_1032,1}).\_\textbf{replace}(p1 \rightarrow ((-2~*div(\textbf{heapIs})))))
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
\theta_{funcstart\_1032,1}.p1, 177).rem))).\_replace(p2 \rightarrow
asType < P2Type > ((30307 * asType < int > (([false]: 1, []: 0))) + temp2)))
→ [explicitly assert falsehood of skipped guards in subsequent guards]
[57.26] $heap<sub>1032,1;1054,8</sub> == $heap<sub>funcstart_1032,1</sub>._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.} \text{\$r.value}(\text{heapIs}))
\theta_{funcstart\_1032,1}.p1, 177).rem)))).replace(this.r \rightarrow 0
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\label{eq:heapIs} $ \text{heap}_{funcstart\_1032,1}, \, \textbf{this}. \\ \$r. \textbf{value}(\textbf{heapIs} \,\, \$ \text{heap}_{funcstart\_1032,1}). \\ \text{p1},
177).quot) + (171 * div(heapIs \rho_{funcstart\_1032,1}, this.r.value(heapIs)
\theta_{funcstart\_1032,1}.p1, 177).rem))).\_replace(p2 \rightarrow
asType<P2Type>((30307 * asType<int>(([false]: 1, [true]: 0))) +
temp2)))
\rightarrow [simplify]
[57.29] $\text{heap}_{1032,1;1054,8} == $\text{heap}_{funcstart\_1032,1}._\text{replace}(\text{this}.\text{$\frac{1}{2}r$})
this.$r.value(heapIs heapIs = funcstart_{1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
```

```
\rho_{funcstart=1032,1}, this.r.value(heapIs \rho_{funcstart=1032,1}).p1,
177).quot) + (171 * div(heapIs \theta), this.$r.value(heapIs
\theta_{funcstart\_1032,1}.p1, 177).rem)))._replace(this.$r \rightarrow
this.$r.value(heapIs \frac{1}{2} heap\frac{1}{2} line \frac{1}{2} heap\frac{1}{2} heap\frac{1}{2
\$heap_{funcstart\_1032,1},\, \textbf{this}.\$r.\textbf{value}(\textbf{heapIs}\,\,\$heap_{funcstart\_1032.1}).p1,
177).quot) + (171 * div(heapIs $heap_{funcstart\_1032,1}, this.$r.value(heapIs
\rho_{uncstart\_1032,1}.p1, 177).rem)))._replace(p2 \rightarrow asType<P2Type>(0 +
\rightarrow [from term 54.18, temp2 is equal to (-35 * div(heapIs $heap_{funcstart\_1032.1},
this.r.value(heapIs \ \ heap_{funcstart\_1032,1}).p2, \ 176).quot) + (172 \ \ *
div(\mathbf{heapIs} \ \$heap_{funcstart\_1032,1}, \ \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
heap_{funcstart_{1032.1}}.p2, 176).rem
[57.30] heap_{1032,1;1054,8} == heap_{funcstart\_1032,1}.\_replace(this.$r \rightarrow funcstart\_1032,1]
this.$r.value(heapIs p_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\$heap_{funcstart\_1032,1},\, \textbf{this}.\$r.\textbf{value}(\textbf{heapIs}\,\,\$heap_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
\theta_{funcstart\_1032,1}.p1, 177).rem))))._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this. r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs \theta_{funcstart\_1032,1}, this.r.value(heapIs)
\rho_{uncstart\_1032.1}, p1, 177).rem)))._replace(p2 \rightarrow asType<P2Type>(0 +
((-35 * div(heapIs $heap_{tuncstart\_1032.1}, this.$r.value(heapIs
\text{Sheap}_{funcstart\_1032,1}.p2, 176).quot) + (172 * div(heapIs \text{Sheap}_{funcstart\_1032,1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p2, 176).rem)))))
\rightarrow [simplify]
[57.33] \theta_{1032,1;1054,8} == \theta_{funcstart\_1032,1}._replace(this.$r \to
this.$r.value(heapIs $heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(\mathbf{heapIs} \ \$heap_{funcstart\_1032,1}, \ \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
\theta_{funcstart\_1032,1}.p1, 177).rem)))).\_replace(this.\$r \rightarrow 0
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs \theta_{funcstart\_1032,1}, this.r.value(heapIs)
\rho_{funcstart\_1032,1}.p1, 177).rem))._replace(p2 \rightarrow ((-35 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p2,
176).quot) + (172 * div(heapIs \rho_{funcstart\_1032,1}, this.r.value(heapIs)
heap_{funcstart\_1032,1}.p2, 176).rem)))
[Take given term]
[58.0] (($heap_{1032,1;1054,8}.r3 * static_cast < signed int > (div3.rem)) -
(\text{sheap}_{1032,1:1054,8}.\text{b3} * \text{static\_cast} < \text{signed int} > (\text{div3.quot}))) == \text{temp3}
\rightarrow [from term 57.33, $heap<sub>1032,1;1054,8</sub> is equal to
\$heap_{funcstart\_1032,1}.\_\textbf{replace}(\textbf{this.}\$r \rightarrow \textbf{this.}\$r.\textbf{value}(\textbf{heapIs}
heap_{funcstart\_1032,1}._replace(p1 \rightarrow ((-2 * div(heapIs heap_{funcstart\_1032,1}),
```

```
this.r.value(heapIs \ \ heap_{funcstart\_1032,1}).p1, \ 177).quot) + (171 *
div(\textbf{heapIs}~\$heap_{funcstart\_1032,1},~\textbf{this.}\$r.\textbf{value}(\textbf{heapIs}
\theta_{tuncstart\_1032.1}.p1, 177).rem)))).\_replace(this.\$r \rightarrow 0
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs) + (-2 * div(heapIs) + (
heap_{funcstart\_1032,1}, this.r.value(heapIs heap_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs $heap_{funcstart\_1032.1}, this.$r.value(heapIs
\rho_{uncstart\_1032,1}.p1, 177).rem))).\_replace(p2 \rightarrow (-35 * div(heapIs))).
$heap_{funcstart\_1032,1}$, this. $r.value(heapIs $heap_{funcstart\_1032,1}).p2$,
176).quot) + (172 * div(\textbf{heapIs} \$heap_{funcstart\_1032,1}, \textbf{this}.\$r.\textbf{value}(\textbf{heapIs}))
heap_{funcstart_1032,1}.p2, 176).rem)))]
[58.1] \; ((\$ heap_{funcstart\_1032,1}.\_\textbf{replace}(\textbf{this}.\$r \to \textbf{this}.\$r.\textbf{value}(\textbf{heapIs}))) \\
\rho_{tuncstart_1032.1}._replace(p1 \rightarrow ((-2 * div(heapIs \rho_{tuncstart_1032.1})
this.$r.value(heapIs $heap_{tuncstart_1032_1}).p1, 177).quot) + (171 *
div(\mathbf{heapIs} \$ heap_{funcstart\_1032.1}, \mathbf{this.}\$r.\mathbf{value}(\mathbf{heapIs})
\theta_{tuncstart\_1032,1}.p1, 177).rem)))).\_replace(this.\$r \rightarrow
this.$r.value(heapIs $heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032.1}, this.r.value(heapIs \rho_{funcstart\_1032.1}).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.}\text{\$r.value}(\text{heapIs}))
\rho_{uncstart\_1032,1}.p1, 177).rem))).\_replace(p2 \rightarrow ((-35 * div(heapIs)))._replace(p2 \rightarrow ((-35 * div(heapIs))))._replace(p3 + div(heapIs)))
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p2,
176).quot) + (172 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
\rho_{funcstart\_1032,1}.p2, 176).rem))).r3 * static\_cast < signed
int>(div3.rem)) - (\$heap_{1032.1:1054.8}.b3 * static\_cast < signed
int>(div3.quot)) = temp3
\rightarrow [const member of object with modified fields]
[58.3] \; ((\$heap_{funcstart\_1032,1}.r3 * \textbf{static\_cast} < \textbf{signed int} > (\text{div3.rem})) \; - \\
(\text{sheap}_{1032.1;1054.8}.\text{b3 * static\_cast} < \text{signed int} > (\text{div3.quot}))) == \text{temp3}
\rightarrow [const static or extern object]
[58.4] ((\theta) + \theta) * static_cast < signed int > (\theta) -
(\text{sheap}_{1032,1;1054,8}.\text{b3 * static\_cast} < \text{signed int} > (\text{div3.quot}))) == \text{temp3}
→ [expand definition of constant 'r3' at prang.cpp (39.26)]
[58.5] (((int)170 * static_cast<signed int>(div3.rem)) -
(\text{sheap}_{1032,1;1054,8}.\text{b3} * \text{static\_cast} < \text{signed int} > (\text{div3.quot}))) == \text{temp3}
\rightarrow [simplify]
[58.6] ((170 * static_cast < signed int > (div3.rem)) - ($heap_{1032.1:1054.8}.b3 *
static_cast<signed int>(div3.quot))) == temp3
\rightarrow [from term 34.6, div3 is equal to div(heapIs $heap_{funcstart\_1032,1},
this.r.value(heapIs $heap_{funcstart\_1032,1}).p3, 178)]
[58.7] ((170 * static_cast < signed int > (div(heapIs heapIs funcstart_{1032,1}),
this.r.value(heapIs \ heap_{funcstart\_1032.1}).p3, 178).rem)) -
(\text{sheap}_{1032,1;1054,8}.\text{b3 * static\_cast} < \text{signed int} > (\text{div3.quot}))) == \text{temp3}
```

```
\rightarrow [simplify]
[58.8] ((170 * div(heapIs \$heap_{funcstart\_1032,1}, this.\$r.value(heapIs
\text{heap}_{funcstart\_1032,1}.p3, 178).rem) - (\text{heap}_{1032,1;1054,8}.b3 *
static_cast<signed int>(div3.quot))) == temp3
\rightarrow [from term 57.33, $heap_{1032,1;1054,8}$ is equal to
heap_{funcstart\_1032.1}._replace(this.r \rightarrow this.r.value(heapIs)
heap_{funcstart\_1032,1}._replace(p1 \rightarrow ((-2 * div(heapIs $heap_{funcstart\_1032,1},
div(\mathbf{heapIs}\ \$heap_{funcstart\_1032,1},\ \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}
\theta_{tuncstart\ 1032.1}.p1,\ 177).rem)))._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs) + (-2 * div(heapIs) + (
$heap_{funcstart\_1032,1}$, this.$r.value(heapIs $heap_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs $heap_{funcstart\_1032,1}, this.$r.value(heapIs
heap_{funcstart\_1032,1}.p1, 177).rem))).\_replace(p2 \rightarrow (-35 * div(heapIs))).
heap_{funcstart\_1032,1}, this.r.value(heapIs heap_{funcstart\_1032,1}).p2,
(176).quot) + (172*div(\textbf{heapIs} \$heap_{funcstart\_1032,1}, \textbf{this}.\$r.\textbf{value}(\textbf{heapIs}))
heap_{funcstart\_1032,1}.p2, 176).rem)))]
[58.9] ((170 * div(heapIs $heap_{funcstart\_1032,1}, this.$r.value(heapIs
\rho_{tuncstart\_1032,1}.p3, 178.rem) - (\rho_{tuncstart\_1032,1}.p_{tuncstart\_1032,1}.p_{tuncstart\_1032,1}
\rightarrow this.$r.value(heap
Is \rho_{1032,1}).\_replace(p1 \rightarrow ((-2 * -2.5)))
{\rm div}(\mathbf{heapIs}~\$\mathrm{heap}_{funcstart\_1032,1},~\mathbf{this.\$r.value}(\mathbf{heapIs}
\text{Sheap}_{funcstart\_1032,1}.p1, 177).quot) + (171 * div(heapIs \text{Sheap}_{funcstart\_1032,1},
\mathbf{this.\$r.value(heapIs\ \$heap}_{funcstart\_1032,1}).p1,\ 177).rem)))).\_\mathbf{replace(this.\$r}
\rightarrow this.$r.value(heapIs $heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 *
div(\mathbf{heapIs} \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
\text{Sheap}_{funcstart\_1032.1}).p1, 177).quot) + (171 * div(heapIs \text{Sheap}_{funcstart\_1032.1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177).rem))).\_replace(p2 \rightarrow
((-35 * div(\mathbf{heapIs} \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}))
\rho_{tuncstart\_1032,1}.p2, 176.quot) + \rho_{tuncstart\_1032,1} $heap_\rho_{tuncstart\_1032,1}
this.$r.value(heapIs $heap_{tuncstart_1032.1}).p2, 176).rem)))).b3 *
static_cast<signed int>(div3.quot))) == temp3
\rightarrow [const member of object with modified fields]
[58.11] ((170 * div(heapIs $heap_{funcstart\_1032,1}, this.$r.value(heapIs
\text{Sheap}_{funcstart\_1032,1}.p3, 178).rem) - (\text{Sheap}_{funcstart\_1032,1}.b3 *
static_cast<signed int>(div3.quot))) == temp3
\rightarrow [const static or extern object]
[58.12] ((170 * div(heapIs $heap<sub>funcstart_1032,1</sub>, this.$r.value(heapIs)
\rho_{tuncstart=1032.1}, p3, 178).rem) - (\rho_{tuncstart=1032.1}).p3, 178).rem) - (\rho_{tuncstart=1032.1}).p3, 178).rem)
int>(div3.quot)) == temp3
\rightarrow [expand definition of constant 'b3' at prang.cpp (41,26)]
[58.13] ((170 * div(heapIs $heap_{funcstart\_1032,1}, this.$r.value(heapIs
\theta_{100} = \theta_{1000} - ((int)63 * static_cast < signed
```

```
int>(div3.quot)) = temp3
\rightarrow [simplify]
[58.14] ((170 * div(heapIs heap_{funcstart\_1032,1}, this.r.value(heapIs)
\theta_{funcstart\_1032,1}.p3, 178).rem - (63 * static\_cast < signed)
int>(div3.quot)) == temp3
\rightarrow [from term 34.6, div3 is equal to div(heapIs $heap_{funcstart\_1032,1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p3, 178)
[58.15] ((170 * div(heapIs \$heap_{funcstart\_1032,1}, this.\$r.value(heapIs
\theta_{funcstart\_1032,1}.p3, 178).rem) - (63 * static_cast<signed
\mathbf{int}{>}(\mathrm{div}(\mathbf{heapIs}\ \$\mathrm{heap}_{funcstart\_1032,1},\ \mathbf{this}.\$\mathrm{r.value}(\mathbf{heapIs}
heap_{funcstart_1032.1}.p3, 178).quot))) == temp3
\rightarrow [simplify]
[58.20] 0 == (-\text{temp3} + (-63 * \text{div}(\text{heapIs} \$\text{heap}_{funcstart\_1032.1}),
this.r.value(heapIs \ heap_{funcstart\_1032.1}).p3, 178).quot) + (170 *
div(\mathbf{heapIs} \$ heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
heap_{funcstart\_1032,1}.p3, 178).rem))
[Take given term]
[60.0] temp3 \leq maxof(signed int)
\rightarrow [simplify]
[60.9] - 32768 < -\text{temp3}
\rightarrow [from term 58.20, temp3 is equal to (-63 * div(heapIs $heap_{tuncstart\_1032.1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p3, 178).quot) + (170)
div(\textbf{heapIs}~\$heap_{funcstart\_1032,1},~\textbf{this.}\$r.\textbf{value}(\textbf{heapIs}
heap_{funcstart\_1032,1}.p3, 178.rem
[60.10] -32768 < -((-63 * div(\mathbf{heapIs} \$heap_{funcstart\_1032,1},
this.$r.value(heapIs heap_{funcstart\_1032.1}).p3, 178).quot) + (170 *
div(\mathbf{heapIs} \$ heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
heap_{funcstart_{1032,1}}.p3, 178).rem
\rightarrow [simplify]
[60.13] -32768 < ((63 * div(heapIs $heap_{funcstart\_1032,1}),
this.r.value(heapIs $heap_{funcstart\_1032,1}).p3, 178).quot) + (-170 *
div(\mathbf{heapIs} \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
heap_{funcstart\_1032,1}.p3, 178).rem)
[Take goal term]
[1.0] (($heap<sub>1032,1;1054,8</sub>.M3 *
asType < int > (static\_cast < integer > (static\_cast < signed)
int>(operator^*(heapIs \$heap_{1032,1;1054,8}, this).p3) < (int)0))) + temp3) \le 1
maxof(signed int)
```

```
\rightarrow [from term 57.33, $heap<sub>1032.1:1054.8</sub> is equal to
\$heap_{funcstart\_1032,1}.\_\textbf{replace}(\textbf{this}.\$r \rightarrow \textbf{this}.\$r.\textbf{value}(\textbf{heapIs}
heap_{funcstart\_1032,1}._replace(p1 \rightarrow ((-2 * div(heapIs $heap_{funcstart\_1032,1},
this.r.value(heapIs \ \ heap_{funcstart\_1032.1}).p1, \ 177).quot) + (171)
div(heapIs $heap_funcstart_1032.1, this.$r.value(heapIs
\theta_{funcstart\_1032,1}.p1, 177).rem)))).\_replace(this.\$r \rightarrow 0
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
heap_{funcstart\_1032,1}, this.r.value(heapIs heap_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs \$heap_{funcstart\_1032,1}, this.\$r.value(heapIs))
\$heap_{funcstart\_1032,1}).p1,\ 177).rem))).\_\mathbf{replace}(p2 \rightarrow (-35\ *div(\mathbf{heapIs}
heap_{funcstart\_1032,1}, this.r.value(heapIs heap_{funcstart\_1032,1}).p2,
(176).quot) + (172*div(\textbf{heapIs} \$heap_{funcstart\_1032,1}, \textbf{this}.\$r.\textbf{value}(\textbf{heapIs}))
heap_{funcstart\_1032,1}.p2, 176).rem)))]
\textit{[1.1]} \ ((\$ heap_{funcstart\_1032,1}.\_\textbf{replace}(\textbf{this}.\$r \rightarrow \textbf{this}.\$r. \textbf{value}(\textbf{heapIs}))
\rho_{tuncstart\_1032.1}._replace(p1 \rightarrow ((-2 * div(heapIs \rho_{tuncstart\_1032.1})
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177).quot) + (171 *
div(\mathbf{heapIs} \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
\theta_{funcstart\_1032,1}.p1, 177).rem)))).\_replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs \theta), this.$r.value(heapIs
\rho_{uncstart_1032,1}.p1, 177).rem))._replace(p2 \rightarrow ((-35 * div(heapIs
\rho_{funcstart\_1032,1}, this. r.value(heapIs \rho_{funcstart\_1032,1}).p2,
176).quot) + (172 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
heap_{funcstart_{1032,1}}.p2, 176).rem))).M3 *
asType<int>(static_cast<integer>(static_cast<signed
int>(operator^*(heapIs $heap_{1032,1;1054,8}, this).p3) < (int)0))) + temp3) \le
maxof(signed int)
→ [const member of object with modified fields]
[1.3] (($heap<sub>funcstart_1032.1</sub>.M3 *
asType<int>(static_cast<integer>(static_cast<signed
int>(operator^*(heapIs $heap_{1032,1:1054.8}, this).p3) < (int)0))) + temp3) \le
maxof(signed int)
\rightarrow [const static or extern object]
[1.4] (($heap<sub>init</sub>.M3 *
asType<int>(static_cast<integer>(static_cast<signed
int>(operator^*(heapIs $heap_{1032.1:1054.8}, this).p3) < (int)0))) + temp3) \le
maxof(signed int)
\rightarrow [expand definition of constant 'M3' at prang.cpp (38,26)]
[1.5] (((int)30323 *
asType<int>(static_cast<integer>(static_cast<signed
int>(operator^*(heapIs $heap_{1032.1:1054.8}, this).p3) < (int)0))) + temp3) \le
maxof(signed int)
```

```
[1.6] ((30323 * asType<int>(static_cast<integer>(static_cast<signed)
int>(operator^*(heapIs $heap_{1032.1:1054.8}, this).p3) < (int)0))) + temp3) \le
maxof(signed int)
\rightarrow [from term 57.33, $heap<sub>1032,1;1054,8</sub> is equal to
heap_{funcstart\_1032.1}._replace(this.r \rightarrow this.r.value(heapIs)
heap_{funcstart\_1032,1}._replace(p1 \rightarrow ((-2 * div(heapIs $heap_{funcstart\_1032,1},
div(\mathbf{heapIs}\ \$heap_{funcstart\_1032,1},\ \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}
\theta_{tuncstart, 1032.1}.p1, 177).rem)))._replace(this.r \rightarrow 0
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
$heap_{funcstart\_1032,1}$, this.$r.value(heapIs $heap_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs \$heap_{funcstart\_1032,1}, this.\$r.value(heapIs))
\rho_{funcstart\_1032,1}.p1, 177).rem))).\_replace(p2 \rightarrow (-35 * div(heapIs))).
heap_{funcstart\_1032,1}, this.r.value(heapIs heap_{funcstart\_1032,1}).p2,
176).quot) + (172 * div(\mathbf{heapIs} \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}))
heap_{funcstart\_1032,1}.p2, 176).rem)))
{\it [1.7]}~((30323~*~asType< int> (static\_cast< integer> (static\_cast< signed)
int>(operator*(heapIs \theta_{funcstart\ 1032.1}-replace(this.\theta_{funcstart\ 1032.1}-replace)
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs $heap<sub>funcstart_1032,1</sub>, this.$r.value(heapIs
\theta_{funcstart\_1032,1}.p1, 177).rem))))._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs $heap<sub>funcstart_1032,1</sub>, this.$r.value(heapIs
\rho_{funcstart\_1032,1}.p1, 177).rem))._replace(p2 \rightarrow (-35 * div(heapIs
$heap_funcstart_1032,1, this.$r.value(heapIs $heap_funcstart_1032,1).p2,
176).quot) + (172 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.} \text{\$r.value}(\text{heapIs}))
\text{Sheap}_{funcstart\_1032.1}.p2, 176).rem))), this).p3) < (int)0))) + temp3) \leq
maxof(signed int)
→ [expand definition of operator '*' in class 'pointer' at built in declaration]
[1.8] ((30323 * asType<int>(static_cast<integer>(static_cast<signed)
\textbf{int}{>}(\textbf{this}.\$r.\textbf{value}(\textbf{heapIs}~\$\text{heap}_{funcstart\_1032,1}.\_\textbf{replace}(\textbf{this}.\$r\rightarrow
this.$r.value(heapIs $heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032.1}, this.r.value(heapIs \rho_{funcstart\_1032.1}).p1,
177).quot) + (171 * div(heapIs \rho_{funcstart\_1032,1}, this.r.value(heapIs)
\theta_{tuncstart\_1032.1}.p1, 177.rem)))._replace(this.$r \rightarrow
this.$r.value(heapIs \rho_{uncstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs \theta), this.$r.value(heapIs
\rho_{uncstart\_1032,1}.p1, 177).rem))._replace(p2 \rightarrow ((-35 * div(heapIs
\rho_{tuncstart=1032.1}, this.r.value(heapIs \rho_{tuncstart=1032.1}).p2,
```

 \rightarrow [simplify]

```
176).quot) + (172 * \text{div}(\text{heapIs } \text{heap}_{funcstart\_1032.1}, \text{this.}\text{$\text{r.value}(\text{heapIs})$})
\text{Sheap}_{funcstart\_1032,1}.\text{p2}, 176).\text{rem})))).\text{p3}) < (int)0))) + \text{temp3}) \le
maxof(signed int)
→ [evaluate dereferenced pointer into modified heap]
[1.9] ((30323 * asType<int>(static_cast<integer>(static_cast<signed
int>(([this.\$r == this.\$r]: this.\$r.value(heapIs
heap_{funcstart\_1032,1}._replace(p1 \rightarrow ((-2 * div(heapIs p_{funcstart\_1032,1}),
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177).quot) + (171 *
\operatorname{div}(\mathbf{heapIs}\ \$ \mathrm{heap}_{funcstart\_1032,1},\ \mathbf{this}.\$ r. \mathbf{value}(\mathbf{heapIs}
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p2,
176).quot) + (172 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.}\text{\$r.value}(\text{heapIs}))
\theta_{funcstart\_1032.1}, p2, 176).rem)), []: this.$r.value(heapIs)
\theta_{funcstart\_1032,1}._replace(this.r \to this.r.value(heapIs)
\text{Sheap}_{funcstart\_1032,1}._replace(p1 \rightarrow (-2 * div(heapIs \text{Sheap}_{funcstart\_1032,1}),
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177).quot) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_1032,1}, \ \mathbf{this}.\$ r. \mathbf{value}(\mathbf{heapIs}
\text{Sheap}_{funcstart_1032.1}.p1, 177).rem))))).p3) < (int)0))) + temp3) \leq
maxof(signed int)
→ [explicitly assert falsehood of skipped guards in subsequent guards]
[1.10] ((30323 * asType<int>(static_cast<integer>(static_cast<signed)
int>(([this.\$r == this.\$r]: this.\$r.value(heapIs
\rho_{tuncstart\_1032.1}._replace(p1 \rightarrow ((-2 * div(heapIs \rho_{tuncstart\_1032.1})
this.$r.value(heapIs heap_{funcstart_{-1032,1}}).p1, 177).quot) + (171 *
div(\mathbf{heapIs} \$ heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
\$heap_{funcstart\_1032,1}).p1,\ 177).rem))).\_\mathbf{replace}(p2 \rightarrow (-35\ *\ div(\mathbf{heapIs}
\rho_{tuncstart\_1032.1}, this.r.value(heapIs \rho_{tuncstart\_1032.1}).p2,
176).quot) + (172 * \text{div}(\text{heapIs } \text{heap}_{funcstart\_1032,1}, \text{this.} \text{$r.value}(\text{heapIs}))
heap_{funcstart\_1032,1}.p2, 176).rem), [!(this.$r == this.$r)]:
this.$r.value(heapIs \rho_{tuncstart\_1032.1}._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow (-2 * div(heapIs
\$heap_{funcstart\_1032,1},\, \textbf{this.}\$r.\textbf{value}(\textbf{heapIs}\,\,\$heap_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(\mathbf{heapIs} \$ heap_{funcstart\_1032,1}, \mathbf{this}.\$ r. \mathbf{value}(\mathbf{heapIs})
\theta_{funcstart\_1032,1}.p1, 177).rem)))).p3) < (int)0))) + temp3) \le 1.00
maxof(signed int)
\rightarrow [simplify]
[1.18] ((30323 * asType<int>(static_cast<integer>(0 <
-this.$r.value(heapIs heap_{funcstart\_1032,1}.p3)) + temp3) \leq
maxof(signed int)
\rightarrow [from term 40.0, literala < -this.$r.value(heapIs $heap_{funcstart\_1032,1}).p3
is false whenever -2 < (0 + literala)
```

Proof of rule precondition:

```
[1.18.0] - 2 < (0 + 0)
       \rightarrow [simplify]
       [1.18.2] true
[1.19] ((30323 * asType<int>(static_cast<integer>(false))) + temp3) \leq
maxof(signed int)
\rightarrow [simplify]
[1.20] ((30323 * asType<int>(([false]: 1, []: 0))) + temp3) \leq maxof(signed)
→ [explicitly assert falsehood of skipped guards in subsequent guards]
[1.21] ((30323 * asType<int>(([false]: 1, [true]: 0))) + temp3) \leq
maxof(signed int)
\rightarrow [simplify]
[1.24] (0 + \text{temp3}) \le \text{maxof(signed int)}
\rightarrow [from term 58.20, temp3 is equal to (-63 * div(heapIs $heap_{funcstart\_1032,1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p3, 178).quot) + (170)
div(heapIs $heap_{funcstart\_1032.1}, this.$r.value(heapIs
heap_{funcstart\_1032,1}.p3, 178).rem
[1.25] (0 + ((-63 * div(heap
Is $heap_{funcstart\_1032,1}, this.$r.value(heap
Is
\text{Sheap}_{funcstart\_1032,1}.\text{p3}, 178).\text{quot} + (170 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_1032,1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p3, 178).rem))) \le maxof(signed)
int)
\rightarrow [simplify]
[1.41] -32768 < ((-170 * div(heapIs $heap<sub>funcstart_1032,1</sub>,
this.r.value(heapIs \heap_{funcstart\_1032,1}).p3, 178).rem) + (63 * div(heapIs)
\rho_{funcstart\_1032,1}, this.\r.value(heapIs \rho_{funcstart\_1032,1}).p3,
178).quot))
\rightarrow [from term 60.13, literala < ((-170 * div(heapIs $heap_{funcstart\_1032.1},
this.r.value(heapIs $heap_{funcstart\_1032,1}).p3, 178).rem) + (63 * div(heapIs + div(heapIs)) + (63 * div(heapIs
heap_{funcstart\_1032,1}, this.r.value(heapIs heap_{funcstart\_1032,1}).p3,
(-178).quot)) is true whenever (-1 + literala) < -32768
       Proof of rule precondition:
       [1.41.0](-32768 + -1) < -32768
       \rightarrow [simplify]
       [1.41.2] true
[1.42] true
```

Proof of verification condition: Precondition of 'operator /' satisfied

```
In the context of class: WHPrang, declared at:
C:\Escher\Customers\prang-cpp\prang.cpp (18,1)
Condition generated at: C:\Escher\Customers\prang-cpp\prang.cpp
(88,30)
Condition defined at: built in declaration
To prove: !(0.0 ==
asType < double > (static\_cast < real > (\$heap_{funcend\_1032,1}.M1)))
Given:
heap_{init}.LIMIT == (int)80
heap_{init}.class WHPrang \in M1 == (int)30269
heap_{init}.class WHPrang \in r1 == (int)171
heap_{init}.class WHPrang \in a1 == (int)177
\text{Sheap}_{init}.\mathbf{class} \text{ WHPrang} \in b1 == (\mathbf{int})2
heap_{init}.class WHPrang \in M2 == (int)30307
heap_{init}.class WHPrang \in r2 == (int)172
heap_{init}.class WHPrang \in a2 == (int)176
heap_{init}.class WHPrang \in b2 == (int)35
heap_{init}.class WHPrang \in M3 == (int)30323
heap_{init}.class WHPrang \in r3 == (int)170
heap_{init}.class WHPrang \in a3 == (int)178
heap_{init}.class WHPrang \in b3 == (int)63
\operatorname{div1} == \operatorname{div}(\mathbf{heapIs} \ \operatorname{heap}_{funcstart\_1032,1},
static\_cast < int > (operator^*(heapIs \$heap_{funcstart\_1032,1}, this).p1),
static\_cast < int > (\$heap_{funcstart\_1032,1}.a1))
(asType<integer>(static_cast<int>(operator*(heapIs
heap_{funcstart\_1032,1}, this).p1) /
\mathbf{asType} {<} \mathbf{integer} {>} (\mathbf{static\_cast} {<} \mathbf{int} {>} (\$ \mathbf{heap}_{funcstart\_1032,1}.\mathbf{a1}))) = =
asType<integer>(div1.quot)
(asType<integer>(static_cast<int>(operator*(heapIs
\theta_{funcstart\_1032,1}, this).p1)
asType < integer > (static\_cast < int > (\$heap_{funcstart\_1032.1}.a1))) = =
asType<integer>(div1.rem)
(\mathbf{asType}{<}\mathbf{integer}{>}(\mathbf{operator}^*(\mathbf{heapIs}\ \$\mathbf{heap}_{funcstart\_1032,1},\ \mathbf{this}).\mathtt{p1}) <
asType < integer > (\$heap_{tuncstart=1032.1}.a1)) = >
(asType<integer>(div1.rem) == asType<integer>(operator*(heapIs
heap_{funcstart\_1032,1}, this).p1)
```

```
(\mathbf{asType} < \mathbf{integer} > (\$ \mathbf{heap}_{funcstart\_1032,1}.\mathbf{a1}) \le
asType < integer > (operator*(heapIs $heap_{funcstart\_1032,1}, this).p1)) = >
!(0 == asType < integer > (div1.quot))
!(0 == asType < integer > (div1.rem)) || !(0 ==
asType<integer>(div1.quot))
div2 == div(\mathbf{heapIs} \$ heap_{funcstart\_1032,1},
static\_cast < int > (operator*(heapIs $heap_{funcstart\_1032,1}, this).p2),
\mathbf{static\_cast}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_1032,1}.\mathrm{a2}))
(asType < integer > (static\_cast < int > (operator*(heapIs)))
heap_{funcstart\_1032,1}, this).p2)
asType < integer > (static\_cast < int > (\$heap_{funcstart\_1032.1}.a2))) = =
asType < integer > (div2.quot)
(asType<integer>(static_cast<int>(operator*(heapIs
heap_{funcstart\_1032,1}, this).p2)
asType < integer > (static\_cast < int > (\$heap_{funcstart\_1032,1}.a2))) = =
asType<integer>(div2.rem)
(asType<integer>(operator*(heapIs $heap_{tuncstart\_1032.1}, this).p2) <
asType < integer > (\$heap_{funcstart\_1032,1}.a2)) = >
(asType<integer>(div2.rem) == asType<integer>(operator*(heapIs
heap_{funcstart\_1032.1}, this).p2)
(asType < integer > (\$heap_{funcstart\_1032,1}.a2) \le
\mathbf{asType} < \mathbf{integer} > (\mathbf{operator}^*(\mathbf{heapIs} \ \$ \mathbf{heap}_{funcstart\_1032,1}, \ \mathbf{this}).\mathbf{p2})) = >
!(0 == asType < integer > (div2.quot))
!(0 == asType < integer > (div2.rem)) || !(0 ==
asType<integer>(div2.quot))
div3 == div(\mathbf{heapIs} \$ heap_{funcstart\_1032,1},
\mathbf{static\_cast} {<} \mathbf{int} {>} (\mathbf{operator}^*(\mathbf{heapIs}\ \$ \mathbf{heap}_{funcstart\_1032,1},\ \mathbf{this}).\mathbf{p3}),
\mathbf{static\_cast} < \mathbf{int} > (\$ \mathbf{heap}_{funcstart\_1032,1}.\mathbf{a3}))
(asType<integer>(static_cast<int>(operator*(heapIs
heap_{funcstart\_1032,1}, this).p3)
asType < integer > (static\_cast < int > (\$heap_{funcstart\_1032.1}.a3))) = =
asType<integer>(div3.quot)
(asType<integer>(static_cast<int>(operator*(heapIs
heap_{funcstart\_1032,1}, this).p3)
\mathbf{asType} < \mathbf{integer} > (\mathbf{static\_cast} < \mathbf{int} > (\$ \mathbf{heap}_{funcstart\_1032,1}.\mathbf{a3}))) = =
asType<integer>(div3.rem)
(asType < integer > (operator*(heapIs $heap_{funcstart\_1032,1}, this).p3) < footnote{the content of the conte
asType < integer > (\$heap_{funcstart\_1032,1}.a3)) = >
(asType<integer>(div3.rem) == asType<integer>(operator*(heapIs
heap_{funcstart=1032.1}, this).p3)
(asType < integer > (\$heap_{funcstart\_1032,1}.a3) \le
```

```
asType<integer>(operator*(heapIs $heap_{tuncstart\_1032,1}, this).p3)) =>
!(0 == asType < integer > (div3.quot))
!(0 == asType < integer > (div3.rem)) || !(0 ==
asType<integer>(div3.quot))
temp1 == (\text{sheap}_{funcstart\_1032,1}.r1 * static\_cast < signed int > (div1.rem)) -
(\text{sheap}_{funcstart\_1032,1}.\text{b1} * \text{static\_cast} < \text{signed int} > (\text{div1.quot}))
minof(signed\ int) \le temp1
temp1 \le maxof(signed int)
heap_{1032,1;1051,8} == heap_{funcstart\_1032,1}._replace(this.$r \rightarrow
operator*(heapIs heap_{funcstart\_1032,1}, this)._replace(p1 \rightarrow
\mathbf{asType}{<}\text{P1Type}{>}((\$\text{heap}_{funcstart\_1032,1}.\text{M1} *
asType < int > (static\_cast < integer > (static\_cast < signed)
int>(operator^*(heapIs \$heap_{funcstart\_1032,1}, this).p1) < (int)0))) +
temp1)))
temp2 == (\$heap_{1032,1;1051,8}.r2 * static\_cast < signed int > (div2.rem)) -
(\text{sheap}_{1032,1:1051.8}.\text{b2} * \text{static\_cast} < \text{signed int} > (\text{div}2.\text{quot}))
minof(signed int) \le temp2
temp2 \le maxof(signed int)
heap_{1032,1;1054,8} == heap_{1032,1;1051,8}.replace(this.$r \rightarrow
operator*(heapIs heap_{1032,1:1051.8}, this)._replace(p2 \rightarrow
asType<P2Type>(($heap<sub>1032,1;1051,8</sub>.M2 *
as Type < int > (static\_cast < integer > (static\_cast < signed))
int > (operator^*(heapIs \$heap_{1032,1;1051,8}, this).p2) < (int)0))) + temp2)))
temp3 == (\$heap_{1032.1:1054.8}.r3 * static\_cast < signed int > (div3.rem)) -
(\text{sheap}_{1032.1:1054.8}.\text{b3} * \text{static\_cast} < \text{signed int} > (\text{div3.quot}))
minof(signed\ int) \le temp3
temp3 < maxof(signed int)
\theta_{1032,1;1054,8} = \theta_{1032,1;1054,8}
operator*(heapIs \theta_{1032,1;1054,8}, this)._replace(p3 \rightarrow
asType < P3Type > ((\$heap_{1032,1;1054,8}.M3 *
asType<int>(static_cast<integer>(static_cast<signed
int>(operator^*(heapIs $heap_{1032,1;1054,8}, this).p3) < (int)(0))) + temp3)))
Proof:
[Take given term]
[2.0] \operatorname{div1} == \operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_1032,1},
static_cast<int>(operator*(heapIs $heap_{tuncstart\_1032.1}, this).p1),
static\_cast < int > (\$heap_{funcstart\_1032,1}.a1))
→ [expand definition of operator '*' in class 'pointer' at built in declaration]
```

```
[2.1] \operatorname{div1} == \operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_1032,1},
\mathbf{static\_cast} < \mathbf{int} > (\mathbf{this.\$r.value}(\mathbf{heapIs} \ \$ \mathbf{heap}_{funcstart\_1032,1}).\mathbf{p1}),
\mathbf{static\_cast}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_1032,1}.\mathrm{a1}))
\rightarrow [simplify]
[2.2] \operatorname{div1} == \operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_1032,1}, \mathbf{this.}\$ r.\mathbf{value}(\mathbf{heapIs})
\theta_{funcstart=1032,1}, p1, static_cast<int>(\theta_{funcstart=1032,1})
\rightarrow [const static or extern object]
[2.3] \text{ div1} == \text{div(heapIs } \text{$heap}_{funcstart\_1032.1}, \text{this.} \text{$r.value(heapIs)}
\theta_{tuncstart\_1032.1}.p1, \theta_{tuncstart\_1032.1}.p2, \theta_{tuncstart\_1032.1}.p2, \theta_{tuncstart\_1032.1}.p2, \theta_{tuncstart\_1032.1}.p2, \theta_{tuncstart\_1032.1}.p2, \theta_{tuncstart\_1032.1}.p2, \theta_{tuncstart\_1032.1}.p2, \theta_{tuncstart\_1032.1}.p3, \theta_{tuncstart\_1032.1}.p2, \theta_{tuncstart\_1032.1}.p2, \theta_{tuncstart\_1032.1}.p3, \theta_{tuncstart\_1032.1}.p4, \theta_{tuncstart\_1032.1}.p4, \theta_{tuncstart\_1032.1}.p4, \theta_{tuncstart\_1032.1}.p5, \theta_{tuncstart\_1032.1
\rightarrow [expand definition of constant 'a1' at prang.cpp (30,26)]
[2.4] \text{ div1} == \text{div}(\text{heapIs } \text{heap}_{funcstart\_1032,1}, \text{this.}\text{\$r.value}(\text{heapIs})
\theta_{tuncstart\_1032.1}.p1, \theta_{tuncstart\_1032.1}.p1, \theta_{tuncstart\_1032.1}.p1, \theta_{tuncstart\_1032.1}.p1, \theta_{tuncstart\_1032.1}.p1, \theta_{tuncstart\_1032.1}.p1, \theta_{tuncstart\_1032.1}.p2, \theta_{tuncstart\_1032.1}.p1, \theta_{tuncstart\_1032.1}.p2, \theta_{tuncstart\_1032.1}.p2, \theta_{tuncstart\_1032.1}.p2, \theta_{tuncstart\_1032.1}.p2, \theta_{tuncstart\_1032.1}.p2, \theta_{tuncstart\_1032.1}.p3, \theta_{tuncstart\_1032.1}.p2, \theta_{tuncstart\_1032.1}.p3, \theta_{tuncstart\_1032.1}.p4, \theta_{tuncstart\_1032.1}.p4, \theta_{tuncstart\_1032.1}.p4, \theta_{tuncstart\_1032.1}.p4, \theta_{tuncstart\_1032.1}.p5, \theta_{tuncstart\_1032.1}.p5, \theta_{tuncstart\_1032.1}.p5, \theta_{tuncstart\_1032.1}.p5, \theta_{tuncstart\_1032.1}.p5, \theta_{tuncstart\_1032.1}.p5, \theta_{tuncstart\_1032.1}.p5, \theta_{tuncstart\_1032.1}.p5, \theta_{tuncstart\_1032.1}.p5, \theta_{tuncstart\_1032.1
\rightarrow [simplify]
[2.6] \text{ div1} == \text{div(heapIs } \text{$heap}_{funcstart\_1032,1}, \text{this.} \text{$r.value(heapIs)}
heap_{funcstart_{-1032.1}}.p1, 177
[Assume known post-assertion, class invariant or type constraint for term 2.6]
[7.0] (0 < asType<integer>(this.$r.value(heapIs)
\label{eq:linear_funcstart} $$ $ [properties = 1032,1).p1) $$ \& (asType < properties = 1032,1).p1) $$ & (asType < properties = 1032,1).p2) $$ & (asType < properties
\theta_{uncstart\_1032,1}.p1 < asType<integer>(\theta_{uncstart\_1032,1}.p1) < asType<integer>(\theta_{uncstart\_1032,1}.p1)
M1))
\rightarrow [simplify]
[7.2] (0 < this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1) \&\&
(this.$r.value(heapIs heap_{funcstart\_1032,1}).p1 <
asType < integer > (\text{$heap.class WHPrang} \in M1))
\rightarrow [const static or extern object]
[7.3] (0 < this.$r.value(heapIs \rho_{funcstart\_1032,1}).p1) &&
(this.r.value(heapIs $heap_{funcstart\_1032,1}).p1 <
asType < integer > (\$heap_{init}.class WHPrang \in M1))
\rightarrow [expand definition of constant 'M1' at prang.cpp (28,26)]
[7.4] (0 < this.$r.value(heapIs \theta_{funcstart\_1032,1}).p1) &&
(this.$r.value(heapIs \rho_{funcstart\_1032,1}).p1 <
asType < integer > ((int)30269))
\rightarrow [simplify]
[7.10] (-30269 < -this.$r.value(heapIs heap_{funcstart\_1032,1}).p1) <math>\land (0 < 
this.$r.value(heapIs $heap_{funcstart\_1032,1}).p1)
[Work on sub-term 2 of conjunction in term 7.10]
[8.0] 0 < this.$r.value(heapIs $heap<sub>funcstart_1032,1</sub>).p1
```

```
[Take given term]
[18.0] \operatorname{div2} == \operatorname{div}(\mathbf{heapIs} \ \text{$heap}_{funcstart\_1032,1},
\mathbf{static\_cast} < \mathbf{int} > (\mathbf{operator}^*(\mathbf{heapIs} \ \$ \mathbf{heap}_{funcstart\_1032,1}, \ \mathbf{this}).\mathtt{p2}),
\mathbf{static\_cast}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_1032,1}.\mathrm{a2}))
→ [expand definition of operator '*' in class 'pointer' at built in declaration]
[18.1] \operatorname{div2} == \operatorname{div}(\mathbf{heapIs} \ \text{$heap}_{funcstart\_1032,1},
static\_cast < int > (this.\$r.value(heapIs \$heap_{funcstart\_1032,1}).p2),
static\_cast < int > (\$heap_{funcstart\_1032,1}.a2))
\rightarrow [simplify]
[18.2] div2 == div(heapIs \rho_{uncstart\_1032,1}, his.\r.value(heapIs
\theta_{funcstart\_1032,1}.p2, \theta_{funcstart\_1032,1}.a2))
\rightarrow [const static or extern object]
[18.3] div2 == div(heapIs \rho_{uncstart\_1032,1}, his.\r.value(heapIs
\theta_{funcstart\_1032,1}.p2, \theta_{funcstart\_1032,1
\rightarrow [expand definition of constant 'a2' at prang.cpp (35,26)]
[18.4] div2 == div(\mathbf{heapIs} \$ \mathbf{heap}_{funcstart\_1032,1}, \mathbf{this}.\$ \mathbf{r.value}(\mathbf{heapIs})
\theta_{funcstart\_1032,1}.p2, \theta_{funcstart\_1032,1}.p2, \theta_{funcstart\_1032,1}.p2, \theta_{funcstart\_1032,1}.p2
\rightarrow [simplify]
[18.6] div2 == div(\mathbf{heapIs} \ \hat{\mathbf{s}}_{funcstart\_1032,1}, \ \mathbf{this.\$r.value}(\mathbf{heapIs})
heap_{funcstart_{-1032,1}}.p2, 176
[Assume known post-assertion, class invariant or type constraint for term 18.6]
[23.0] (0 < asType<integer>(this.$r.value(heapIs
$\text{heap}_{funcstart_1032.1}\text{).p2})) && (asType<integer>(this.$r.value(heapIs)
\verb§heap$_{funcstart\_1032,1}).p2) < \mathbf{asType} < \mathbf{integer} > (\$ heap.\mathbf{class} \ WHPrang \in \texttt{Prang}) = \texttt{Prang} + \texttt{Prang}
M2))
\rightarrow [simplify]
[23.2] (0 < this.$r.value(heapIs $heap_{funcstart\_1032,1}).p2) &&
(this.$r.value(heapIs heap_{funcstart\_1032,1}).p2 <
asType < integer > (\text{$heap.class WHPrang} \in M2))
\rightarrow [const static or extern object]
[23.3] (0 < this.$r.value(heapIs \rho_{funcstart\_1032,1}).p2) &&
(this.$r.value(heapIs \theta_{funcstart\_1032,1}).p2 <
asType < integer > (\$heap_{init}.class WHPrang \in M2))
\rightarrow [expand definition of constant 'M2' at prang.cpp (33,26)]
[23.4] (0 < this.$r.value(heap
Is \rho_{uncstart\_1032,1}).p2) &&
(this.r.value(heapIs $heap_{funcstart\_1032.1}).p2 <
asType < integer > ((int)30307))
```

```
\rightarrow [simplify]
[23.10] (-30307 < -this.$r.value(heapIs $heap_{tuncstart\_1032.1}).p2) \land (0 <
this.r.value(heapIs $heap_{funcstart\_1032,1}).p2)
[Work on sub-term 2 of conjunction in term 23.10]
[24.0] 0 < this.$r.value(heapIs $heap_{funcstart\_1032.1}).p2
[Take given term]
[34.0] div3 == div(heapIs $heap_{funcstart\_1032,1},
static_cast<int>(operator*(heapIs $heap_{funcstart\_1032,1}, this).p3),
\mathbf{static\_cast} < \mathbf{int} > (\$ \mathbf{heap}_{funcstart\_1032,1}.\mathbf{a3}))
\rightarrow [expand definition of operator '*' in class 'pointer' at built in declaration]
[34.1] \operatorname{div3} == \operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_1032,1},
static\_cast < int > (this. r.value(heapIs $heap_{funcstart\_1032,1}).p3),
static\_cast < int > (\$heap_{funcstart\_1032,1}.a3))
\rightarrow [simplify]
[34.2] div3 == div(heapIs $heap<sub>funcstart_1032,1</sub>, this.$r.value(heapIs)
\rho_{tuncstart_1032.1}, p3, static_cast<int>(\rho_{tuncstart_1032.1})
\rightarrow [const static or extern object]
[34.3] div3 == div(heapIs $heap_{funcstart\_1032.1}, this.$r.value(heapIs)
\$heap_{funcstart\_1032,1}).p3,\, \textbf{static\_cast} < \textbf{int} > (\$heap_{init}.a3))
\rightarrow [expand definition of constant 'a3' at prang.cpp (40,26)]
[34.4] \text{ div3} == \text{div}(\text{heapIs } \text{$heap}_{funcstart\_1032,1}, \text{this.}\text{$r.value}(\text{heapIs})
\theta_{funcstart\_1032,1}.p3, \theta_{funcstart\_1032,1}.p4, \theta_{funcstart\_1032,1}.p4, \theta_{funcstart\_1032,1}.p4, \theta_{funcstart\_1032,1}.p4, \theta_{funcstart\_1032,1}.p5, \theta_{funcstart\_1032,1}.p5, \theta_{funcstart\_1032,1}.p5, \theta_{funcstart\_1032,1}.p5, \theta_{funcstart\_1032,1}.p5, \theta_{funcstart\_1032,1
\rightarrow [simplify]
[34.6] div3 == div(heapIs $heap_{funcstart\_1032,1}, this.$r.value(heapIs)
heap_{funcstart\_1032,1}.p3, 178)
[Assume known post-assertion, class invariant or type constraint for term 34.6]
[39.0] (0 < asType<integer>(this.$r.value(heapIs
$heap_funcstart_1032.1).p3)) && (asType<integer>(this.$r.value(heapIs
\theta_{funcstart\_1032,1}.p3 < asType<integer>(\theta_{funcstart\_1032,1}.p3) < asType<integer>(\theta_{funcstart\_1032,1}.p3)
M3))
\rightarrow [simplify]
[39.2] (0 < this.$r.value(heapIs heap_{funcstart\_1032,1}).p3) &&
(this.$r.value(heapIs \theta_{funcstart\_1032,1}).p3 <
asType < integer > (\$heap.class WHPrang \in M3))
\rightarrow [const static or extern object]
[39.3] (0 < this.$r.value(heapIs heap_{funcstart\_1032,1}).p3) &&
(this.r.value(heapIs \ heap_{funcstart\_1032,1}).p3 <
```

```
asType < integer > (\$heap_{init}.class WHPrang \in M3))
\rightarrow [expand definition of constant 'M3' at prang.cpp (38,26)]
[39.4] (0 < this.$r.value(heapIs heap_{funcstart\_1032,1}).p3) &&
(this.r.value(heapIs $heap_{funcstart\_1032,1}).p3 <
asType<integer>((int)30323))
\rightarrow [simplify]
[39.10] (-30323 < -this.$r.value(heapIs \rho_{funcstart\_1032,1}).p3) \wedge (0 <
this.r.value(heapIs $heap_{funcstart\_1032.1}).p3)
[Work on sub-term 2 of conjunction in term 39.10]
[40.0] 0 < this.$r.value(heapIs $heap_{funcstart\_1032,1}).p3
[Take given term]
[50.0]\;((\$heap_{funcstart\_1032,1}.r1\;*\;\textbf{static\_cast}{<}\textbf{signed int}{>}(\text{div}1.rem))\;-
(\text{sheap}_{funcstart\_1032,1}.\text{b1 * static\_cast} < \text{signed int} > (\text{div1.quot}))) == \text{temp1}
\rightarrow [const static or extern object]
[50.1] \; ((\$ heap_{init}.r1 * \mathbf{static\_cast} < \mathbf{signed int} > (div1.rem)) \; - \\
(\text{sheap}_{funcstart\_1032,1}.\text{b1} * \text{static\_cast} < \text{signed int} > (\text{div1.quot}))) == \text{temp1}
\rightarrow [expand definition of constant 'r1' at prang.cpp (29,26)]
[50.2] (((int)171 * static_cast<signed int>(div1.rem)) -
(\text{sheap}_{funcstart\_1032,1}.\text{b1 * static\_cast} < \text{signed int} > (\text{div1.quot}))) == \text{temp1}
\rightarrow [simplify]
[50.3] ((171 * static_cast < signed int > (div1.rem)) - ($heap_{funcstart\_1032,1}.b1
* static_cast<signed int>(div1.quot))) == temp1
\rightarrow [from term 2.6, div1 is equal to div(heapIs $heap_{funcstart\_1032,1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177)]
[50.4] ((171 * static_cast < signed int > (div(heapIs heapIs funcstart_{1032,1},
this.r.value(heapIs $heap_{funcstart\_1032,1}).p1, 177).rem)) -
(\text{sheap}_{funcstart\_1032,1}.\text{b1 * static\_cast} < \text{signed int} > (\text{div1.quot}))) == \text{temp1}
\rightarrow [simplify]
[50.5] ((171 * \mathrm{div}(\mathbf{heapIs}\ \$\mathrm{heap}_{funcstart\_1032,1},\ \mathbf{this}.\$\mathrm{r.value}(\mathbf{heapIs}
\text{Sheap}_{funcstart\_1032,1}.\text{p1}, 177).\text{rem} - (\text{Sheap}_{funcstart\_1032,1}.\text{b1} *
static_cast<signed int>(div1.quot))) == temp1
\rightarrow [const static or extern object]
[50.6] ((171 * div(heapIs $heap_{funcstart\_1032,1}, this.$r.value(heapIs)
\theta_{uncstart\_1032,1}.p1, 177).rem - (\theta_{unit}.b1 * static_cast < signed)
int>(div1.quot)) == temp1
\rightarrow [expand definition of constant 'b1' at prang.cpp (31,26)]
```

```
[50.7] ((171 * \operatorname{div}(\mathbf{heapIs} \ \mathbf{sheap}_{funcstart\_1032,1}, \ \mathbf{this}.\mathbf{sr.value}(\mathbf{heapIs})
\theta_{funcstart\_1032,1}.p1, 177).rem) - ((int)2 * static_cast<signed)
int>(div1.quot))) == temp1
\rightarrow [simplify]
[50.8] ((171 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs = f_{uncstart\_1032,1})
\rho_{tuncstart_1032.1}, p1, 177).rem) - (2 * static_cast<signed
int>(div1.quot))) == temp1
\rightarrow [from term 2.6, div1 is equal to div(heapIs $heap_{funcstart\_1032,1},
this.r.value(heapIs $heap_{funcstart\_1032,1}).p1, 177)]
[50.9] ((171 * div(heapIs $heap_{funcstart\_1032,1}, this.$r.value(heapIs
\rho_{tuncstart\_1032.1}, p1, 177).rem) - (2 * static_cast<signed
int>(div(heapIs \$heap_{funcstart\_1032,1}, this.\$r.value(heapIs
\text{Sheap}_{funcstart\_1032,1}).p1, 177).quot))) == temp1
\rightarrow [simplify]
[50.14] 0 == (-\text{temp1} + (-2 * \text{div}(\text{heapIs } \$\text{heap}_{funcstart\_1032,1},
this.$r.value(heapIs heap_{funcstart_{-1032,1}}).p1, 177).quot) + (171 *
div(\mathbf{heapIs} \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
heap_{funcstart\_1032,1}.p1, 177.rem)
[Take given term]
[53.0] heap_{1032,1;1051,8} == heap_{funcstart\_1032,1}._replace(this.$r \rightarrow
operator*(heapIs heap_{funcstart\_1032,1}, this)._replace(p1 \rightarrow
asType<P1Type>(($heap<sub>funcstart_1032.1</sub>.M1 *
asType<int>(static_cast<integer>(static_cast<signed
int>(operator^*(heapIs \$heap_{funcstart\_1032,1}, this).p1) < (int)0))) +
temp1)))
→ [expand definition of operator '*' in class 'pointer' at built in declaration]
[53.1] heap_{1032,1;1051,8} == heap_{funcstart\_1032,1}._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow
asType<P1Type>(($heap_funcstart_1032,1.M1 *
asType<int>(static_cast<integer>(static_cast<signed
int>(operator^*(heapIs \$heap_{funcstart\_1032,1}, this).p1) < (int)0))) +
temp1)))
\rightarrow [const static or extern object]
[53.2] $\text{heap}_{1032,1:1051,8} == \text{$heap}_{funcstart\_1032,1}._\text{replace}(\text{this}.\text{$r} \to \text{$}
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow
asType < P1Type > ((\$heap_{init}.M1 *
asType<int>(static_cast<integer>(static_cast<signed
int>(operator^*(heapIs $heap_{funcstart\_1032,1}, this).p1) < (int)0))) +
temp1)))
→ [expand definition of constant 'M1' at prang.cpp (28,26)]
```

```
[53.3] heap_{1032,1;1051,8} == heap_{funcstart\_1032,1}._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow
asType<P1Type>(((int)30269 *
asType < int > (static\_cast < integer > (static\_cast < signed)
int>(operator^*(heapIs \$heap_{funcstart\_1032,1}, this).p1) < (int)0))) +
temp1)))
\rightarrow [simplify]
[53.4] heap_{1032,1;1051,8} == heap_{funcstart\_1032,1}._replace(this.r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow
asType<P1Type>((30269 *
asType<int>(static_cast<integer>(static_cast<signed
int>(operator^*(heapIs \$heap_{funcstart\_1032,1}, this).p1) < (int)0))) +
temp1)))
→ [expand definition of operator '*' in class 'pointer' at built in declaration]
[53.5] $heap<sub>1032,1;1051,8</sub> == $heap<sub>funcstart_1032,1</sub>._replace(this.$r \rightarrow
\mathbf{this.\$r.value}(\mathbf{heapIs}~\$ \mathrm{heap}_{funcstart\_1032,1}).\_\mathbf{replace}(\mathrm{p1} \rightarrow
asType<P1Type>((30269 *
asType{<}int{>}(static\_cast{<}integer{>}(static\_cast{<}signed
int>(this.\$r.value(heapIs \$heap_{funcstart\_1032,1}).p1) < (int)0))) + temp1)))
\rightarrow [simplify]
[53.9] heap_{1032,1;1051,8} == heap_{funcstart\_1032,1}._replace(this.$r \rightarrow
\textbf{this.}\$r.\textbf{value}(\textbf{heapIs}~\$heap_{funcstart\_1032,1}).\_\textbf{replace}(p1 \rightarrow
asType<P1Type>((30269 * asType<int>(static_cast<integer>(0 <
-\mathbf{this.\$r.value}(\mathbf{heapIs}\ \$\mathbf{heap}_{funcstart\_1032,1}).\mathbf{p1}))) + \mathbf{temp1})))
\rightarrow [from term 8.0, literala < -this.$r.value(heapIs $heap_{funcstart\_1032,1}).p1
is false whenever -2 < (0 + literala)
   Proof of rule precondition:
   [53.9.0] - 2 < (0 + 0)
   \rightarrow [simplify]
   [53.9.2] true
[53.10] $heap<sub>1032,1;1051,8</sub> == $heap<sub>funcstart_1032,1</sub>._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow
asType<P1Type>((30269 * asType<int>(static_cast<integer>(false)))
+ \text{temp1})))
\rightarrow [simplify]
[53.11] $\text{heap}_{1032,1;1051,8} == $\text{heap}_{funcstart\_1032,1}._\text{replace}(\text{this}.\text{$\frac{1}{2}r$})
\textbf{this}.\$r.\textbf{value}(\textbf{heapIs}~\$heap_{funcstart\_1032,1}).\_\textbf{replace}(p1 \rightarrow
asType<P1Type>((30269 * asType<int>(([false]: 1, []: 0))) + temp1)))
→ [explicitly assert falsehood of skipped guards in subsequent guards]
```

```
[53.12] $\text{heap}_{1032,1;1051,8} == $\text{heap}_{funcstart\_1032,1}._\text{replace}(\text{this}.\text{$\frac{1}{2}r$})
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow
asType<P1Type>((30269 * asType<int>(([false]: 1, [true]: 0))) +
temp1)))
\rightarrow [simplify]
[53.15] $heap<sub>1032,1;1051,8</sub> == $heap<sub>funcstart_1032,1</sub>._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow
asType < P1Type > (0 + temp1))
\rightarrow [from term 50.14, temp1 is equal to (-2 * div(heapIs $heap_{funcstart\_1032,1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177).quot) + (171)
div(\mathbf{heapIs} \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
heap_{funcstart\_1032.1}.p1, 177).rem)
[53.16] $heap<sub>1032,1;1051,8</sub> == $heap<sub>funcstart_1032,1</sub>._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow
asType<P1Type>(0 + ((-2 * div(heapIs $heap_{funcstart\_1032.1},
\mathbf{this.\$r.value(heapIs}\ \$heap_{funcstart\_1032,1}).p1,\ 177).quot) + (171\ *
div(\mathbf{heapIs} \$ heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
heap_{funcstart\_1032,1}.p1, 177).rem))))
\rightarrow [simplify]
[53.19] $heap<sub>1032,1;1051,8</sub> == $heap<sub>funcstart_1032,1</sub>._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{tuncstart = 1032.1})._replace(p1 \rightarrow ((-2 * div(heapIs
\$heap_{funcstart\_1032,1},\, \textbf{this}.\$r.\textbf{value}(\textbf{heapIs}\,\,\$heap_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs \theta_{funcstart\_1032,1}, this.r.value(heapIs)
heap_{funcstart\_1032,1}.p1, 177).rem)))
[Take given term]
[54.0] (($heap<sub>1032,1:1051,8</sub>.r2 * static_cast<signed int>(div2.rem)) -
(\text{sheap}_{1032,1;1051,8}.\text{b2} * \text{static\_cast} < \text{signed int} > (\text{div2.quot}))) == \text{temp2}
\rightarrow [from term 53.19, $heap<sub>1032,1;1051,8</sub> is equal to
heap_{funcstart\_1032.1}._replace(this.r \rightarrow this.r.value(heapIs)
heap_{funcstart\_1032,1}._replace(p1 \rightarrow (-2 * div(heapIs heap_{funcstart\_1032,1}),
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177).quot) + (171 *
div(\mathbf{heapIs} \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
heap_{funcstart\_1032,1}.p1, 177).rem)))]
[54.1] \; ((\$ heap_{funcstart\_1032,1}.\_\textbf{replace}(\textbf{this}.\$r \rightarrow \textbf{this}.\$r.\textbf{value}(\textbf{heapIs}))) \\
\rho_{tuncstart\_1032,1}._replace(p1 \rightarrow ((-2 * div(heapIs \rho_{tuncstart\_1032,1})
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177).quot) + (171 *
\operatorname{div}(\mathbf{heapIs}\ \$ \mathbf{heap}_{funcstart\_1032,1},\ \mathbf{this}.\$ \mathbf{r.value}(\mathbf{heapIs}
\rho_{funcstart\_1032,1}.p1, 177).rem))).r2 * static_cast < signed
int>(div2.rem)) - (\$heap_{1032,1;1051,8}.b2 * static\_cast < signed
int>(div2.quot)) == temp2
\rightarrow [const member of object with modified fields]
```

```
[54.2]\;((\$heap_{funcstart\_1032,1}.r2\;*\;\textbf{static\_cast} < \textbf{signed int} > (\text{div}2.rem))\;-
(\text{sheap}_{1032,1;1051,8}.\text{b2} * \text{static\_cast} < \text{signed int} > (\text{div2.quot}))) == \text{temp2}
\rightarrow [const static or extern object]
[54.3] (($heap<sub>init</sub>.r2 * static_cast<signed int>(div2.rem)) -
(\text{sheap}_{1032,1;1051,8}.\text{b2} * \text{static\_cast} < \text{signed int} > (\text{div2.quot}))) == \text{temp2}
\rightarrow [expand definition of constant 'r2' at prang.cpp (34,26)]
[54.4] (((int)172 * static_cast<signed int>(div2.rem)) -
(\text{sheap}_{1032.1:1051.8}.\text{b2} * \text{static\_cast} < \text{signed int} > (\text{div2.quot}))) == \text{temp2}
\rightarrow [simplify]
[54.5] ((172 * static_cast < signed int > (div2.rem)) - ($heap_{1032,1:1051,8}.b2 *
static_cast<signed int>(div2.quot))) == temp2
\rightarrow [from term 18.6, div2 is equal to div(heapIs $heap_{funcstart\_1032,1},
this.r.value(heapIs $heap_{funcstart\_1032,1}).p2, 176)]
[54.6] ((172 * static_cast<signed int>(div(heapIs $heap_{tuncstart\_1032.1})
this.r.value(heapIs \ heap_{funcstart\_1032.1}).p2, 176).rem)) -
(\text{sheap}_{1032,1;1051,8}.\text{b2} * \text{static\_cast} < \text{signed int} > (\text{div2.quot}))) == \text{temp2}
\rightarrow [simplify]
[54.7] ((172 * div(heapIs $heap<sub>funcstart_1032,1</sub>, this.$r.value(heapIs)
\text{Sheap}_{funcstart\_1032,1}.p2, 176).rem) - (\text{Sheap}_{1032,1;1051,8}.b2 *
static_cast<signed int>(div2.quot))) == temp2
\rightarrow [from term 53.19, $heap_{1032,1;1051,8}$ is equal to
heap_{funcstart\_1032,1}._replace(this.r \rightarrow this.r.value(heapIs)
heap_{funcstart\_1032,1}._replace(p1 \rightarrow (-2 * div(heapIs $heap_{funcstart\_1032,1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, \ 177).quot) + (171)
div(heapIs $heap_funcstart_1032.1, this.$r.value(heapIs
heap_{funcstart\_1032,1}.p1, 177).rem)))]
[54.8] ((172 * div(heapIs \rho_{funcstart\_1032,1}, this.\r.value(heapIs
\rho_{uncstart\_1032,1}.p2, 176).rem – (\rho_{uncstart\_1032,1}.p2).rem
\rightarrow this.$r.value(heapIs $heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 *
div(heapIs $heap<sub>funcstart_1032.1</sub>, this.$r.value(heapIs
\text{Sheap}_{funcstart\_1032,1}.p1, 177).quot) + (171 * div(heapIs \text{Sheap}_{funcstart\_1032,1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177).rem)))).b2 *
static_cast<signed int>(div2.quot))) == temp2
\rightarrow [const member of object with modified fields]
[54.9] ((172 * div(heapIs $heap<sub>funcstart_1032.1</sub>, this.$r.value(heapIs
\text{Sheap}_{funcstart\_1032.1}.p2, 176).rem) - (\text{Sheap}_{funcstart\_1032.1}.b2 *
static_cast<signed int>(div2.quot))) == temp2
\rightarrow [const static or extern object]
[54.10] ((172 * div(heapIs $heap<sub>funcstart_1032,1</sub>, this.$r.value(heapIs
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\rho_{uncstart_{1032,1}}.p2, 176).rem – (\rho_{uncstart_{1032,1}}.p2, 176).rem
int>(div2.quot)) == temp2
\rightarrow [expand definition of constant 'b2' at prang.cpp (36,26)]
[54.11] ((172 * div(heapIs $heap_{funcstart\_1032,1}, this.$r.value(heapIs
\rho_{funcstart\_1032,1}.p2, 176).rem - ((int)35 * static\_cast < signed)
int>(div2.quot)) == temp2
\rightarrow [simplify]
[54.12] ((172 * div(heapIs heap_{funcstart\_1032,1}, this.r.value(heapIs)
\rho_{funcstart\_1032.1}.p2, 176).rem) - (35 * static_cast<signed)
int>(div2.quot)) == temp2
\rightarrow [from term 18.6, div2 is equal to div(heapIs $heap_{funcstart\_1032,1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p2, 176)
[54.13] ((172 * div(heapIs heap_{funcstart\_1032,1}, this.r.value(heapIs)
\theta_{tuncstart\_1032.1}.p2, 176).rem) - (35 * static_cast<signed)
int>(div(heapIs \$heap_{funcstart\_1032,1}, this.\$r.value(heapIs
\theta_{funcstart\_1032,1}.p2, 176).quot))) == temp2
\rightarrow [simplify]
[54.18] 0 == (-\text{temp2} + (-35 * \text{div}(\text{heapIs } \text{$heap}_{funcstart\_1032,1},
this.$r.value(heapIs heap_{funcstart\_1032,1}).p2, 176).quot) + (172 *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_1032,1}, \ \mathbf{this}.\$ r. \mathbf{value}(\mathbf{heapIs}
heap_{funcstart\_1032,1}.p2, 176).rem
[Take given term]
[57.0] $\text{heap}_{1032,1;1054,8} == $\text{heap}_{1032,1;1051,8}._\text{replace}(\text{this}.$\text{$r} \to \text{
operator*(heapIs heap_{1032,1:1051.8}, this)._replace(p2 \rightarrow
asType<P2Type>(($heap<sub>1032,1:1051,8</sub>.M2 *
asType<int>(static_cast<integer>(static_cast<signed
int>(operator^*(heapIs $heap_{1032.1:1051.8}, this).p2) < (int)(0))) + temp(2)))
\rightarrow [from term 53.19, $heap<sub>1032,1:1051,8</sub> is equal to
$heap_{funcstart\_1032,1}.$_replace(this.$r \rightarrow this.$r.value(heapIs)
heap_{funcstart\_1032,1}._replace(p1 \rightarrow (-2 * div(heapIs p_{funcstart\_1032,1}).
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177).quot) + (171 *
div(\mathbf{heapIs}\ \$heap_{funcstart\_1032,1},\ \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}
heap_{funcstart_{1032,1}}.p1, 177).rem)))
[57.2] \theta_{1032,1;1054,8} = \theta_{1032,1;1054,8}
this.$r.value(heapIs \frac{1}{2} heap\frac{1}{2} heap\frac{1}{2}
\$heap_{funcstart\_1032,1},\, \textbf{this}.\$r.\textbf{value}(\textbf{heapIs}\,\,\$heap_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(\mathbf{heapIs} \$heap_{funcstart\_1032.1}, \mathbf{this.\$r.value}(\mathbf{heapIs}))
\rho_{funcstart\_1032,1}.p1, 177).rem)))).\_replace(this.\$r \rightarrow operator*(heapIs)
\theta_{funcstart\_1032,1}.\_replace(this.\$r \rightarrow this.\$r.value(heapIs)
heap_{funcstart\_1032,1}._replace(p1 \rightarrow (-2 * div(heapIs p_{funcstart\_1032,1}).
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177).quot) + (171 *
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div(\mathbf{heapIs} \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
heap_{funcstart\_1032,1}.p1, 177).rem)), this)._replace(p2 \rightarrow
asType<P2Type>(($heap<sub>1032,1;1051,8</sub>.M2 *
asType<int>(static_cast<integer>(static_cast<signed
int>(operator^*(heapIs $heap_{1032,1:1051,8}, this).p2) < (int)0))) + temp2)))
→ [expand definition of operator '*' in class 'pointer' at built in declaration]
[57.3] heap_{1032,1;1054,8} == heap_{funcstart\_1032,1}._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.} \text{\$r.value}(\text{heapIs}))
\theta_{funcstart\_1032,1}.p1, 177).rem)))).\_replace(this.$r \rightarrow
this.$r.value(heapIs \rho_{tuncstart\_1032,1}._replace(this.$r \rightarrow
this.$r.value(heapIs \frac{1}{2} heap\frac{1}{2} heap\frac{1}{2}
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
heap_{funcstart\_1032,1}.p1, 177).rem))))).\_replace(p2 \rightarrow
asType<P2Type>(($heap<sub>1032,1;1051,8</sub>.M2 *
asType < int > (static\_cast < integer > (static\_cast < signed)
int>(operator^*(heapIs $heap_{1032.1:1051.8}, this).p2) < (int)(0))) + temp(2)))
→ [evaluate dereferenced pointer into modified heap]
[57.4] heap_{1032,1;1054,8} == heap_{funcstart\_1032,1}._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{tuncstart_{1032.1}}, this.$r.value(heapIs \rho_{tuncstart_{1032.1}}).p1,
177).quot) + (171 * div(heapIs $heap_{funcstart\_1032,1}, this.$r.value(heapIs)
\theta_{funcstart\_1032,1}.p1, 177).rem))))._replace(this.$r \rightarrow ([this.$r ===
this.$r]: this.$r.value(heapIs \rho_{funcstart\_1032,1})._replace(p1 \rightarrow (-2 *
div(\mathbf{heapIs} \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
\text{Sheap}_{funcstart\_1032,1}.p1, 177).quot) + (171 * div(heapIs \text{Sheap}_{funcstart\_1032,1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177).rem)), []:
\textbf{this.}\$r.\textbf{value}(\textbf{heapIs}~\$heap_{funcstart\_1032,1})).\_\textbf{replace}(p2 \rightarrow
asType<P2Type>(($heap<sub>1032,1:1051,8</sub>.M2 *
asType<int>(static_cast<integer>(static_cast<signed
int>(operator^*(heapIs $heap_{1032,1;1051,8}, this).p2) < (int)(0))) + temp(2)))
→ [explicitly assert falsehood of skipped guards in subsequent guards]
[57.5] $heap<sub>1032,1;1054,8</sub> == $heap<sub>funcstart_1032,1</sub>._replace(this.$r \rightarrow
this.$r.value(heapIs \theta_{funcstart\_1032,1})._replace(p1 \theta ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs \rho_{funcstart\_1032,1}, this.r.value(heapIs)
\label{eq:continuous_funcstart_1032,1} $$ \operatorname{heap}_{funcstart_1032,1}.p1,\ 177).rem)))).$$ $$ $$ replace(this.$r \to ([this.$r == ]]) $$
this.$r]: this.$r.value(heapIs \rho_{tuncstart\_1032.1})._replace(p1 \rightarrow (-2 *
div(\mathbf{heapIs} \$ heap_{funcstart\_1032.1}, \mathbf{this.}\$r.\mathbf{value}(\mathbf{heapIs})
\text{Sheap}_{funcstart\_1032.1}.p1, 177).quot) + (171 * div(heapIs \text{Sheap}_{funcstart\_1032.1},
this.r.value(heapIs \theta_{funcstart\_1032.1}).p1, 177).rem)), [!(this. r ==
```

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this.$r)]: this.$r.value(heapIs \rho_{funcstart=1032,1})._replace(p2 \rightarrow
asType<P2Type>(($heap<sub>1032,1;1051,8</sub>.M2 '
as Type < int > (static\_cast < integer > (static\_cast < signed))
int>(operator^*(heapIs $heap_{1032,1;1051,8}, this).p2) < (int)(0))) + temp(2)))
\rightarrow [simplify]
[57.7] heap_{1032,1;1054,8} == heap_{funcstart\_1032,1}._replace(this.$r \rightarrow
this.$r.value(heapIs \rho_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.} \text{\$r.value}(\text{heapIs}))
\theta_{tuncstart\ 1032.1}.p1,\ 177.rem)))._replace(this.r \rightarrow
this.$r.value(heapIs p_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs $heap<sub>funcstart_1032,1</sub>, this.$r.value(heapIs
\theta_{funcstart\_1032,1}.p1, 177).rem))).\_replace(p2 \rightarrow
asType<P2Type>(($heap<sub>1032,1:1051,8</sub>.M2 *
as Type < int > (static\_cast < integer > (static\_cast < signed))
int>(operator^*(heapIs $heap_{1032,1;1051,8}, this).p2) < (int)0))) + temp2)))
\rightarrow [from term 53.19, $heap<sub>1032.1:1051.8</sub> is equal to
heap_{funcstart\ 1032,1}-replace(this.r \rightarrow this.r.value(heapIs)
heap_{funcstart\_1032,1}._replace(p1 \rightarrow (-2 * div(heapIs $heap_{funcstart\_1032,1}).
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177).quot) + (171 *
div(\mathbf{heapIs} \$heap_{funcstart\_1032.1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
heap_{funcstart_{1032,1}}.p1, 177).rem)))
[57.8] \rho_{1032,1;1054,8} == 
\textbf{this.}\$r.\textbf{value}(\textbf{heapIs}~\$heap_{funcstart\_1032,1}).\_\textbf{replace}(p1 \rightarrow ((-2~*div(\textbf{heapIs})))))
\rho_{funcstart\_1032,1}, this.\r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{heap}_{funcstart\_1032.1}, \text{this.} \text{$r.value}(\text{heapIs}))
\theta_{funcstart\_1032.1}.p1, 177).rem)))._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
$heap_funcstart_1032.1, this.$r.value(heapIs $heap_funcstart_1032.1).p1,
177).quot) + (171 * div(\mathbf{heapIs} \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}))
\label{eq:continuous_function} $\operatorname{heap}_{funcstart\_1032,1}).p1,\ 177).rem))).\_\mathbf{replace}(p2 \to
asType < P2Type > ((\$heap_{funcstart\_1032,1}.\_replace(this.\$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
\theta_{funcstart_{1032,1}}.p1, 177).rem))).M2 *
asType < int > (static\_cast < integer > (static\_cast < signed)
int>(operator^*(heapIs $heap_{1032,1;1051,8}, this).p2) < (int)(0))) + temp(2)))
→ [const member of object with modified fields]
[57.9] $heap<sub>1032,1:1054,8</sub> == $heap<sub>funcstart_1032,1</sub>._replace(this.$r \rightarrow
this.$r.value(heapIs \rho_{uncstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs)
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
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177).quot) + (171 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.} \text{\$r.value}(\text{heapIs}))
\theta_{funcstart\_1032,1}.p1, 177).rem))))._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.}\text{\$r.value}(\text{heapIs}))
heap_{funcstart\_1032,1}.p1, 177).rem)))._replace(p2 \rightarrow
asType < P2Type > ((\$heap_{funcstart\_1032,1}.M2 *
asType<int>(static_cast<integer>(static_cast<signed
int>(operator^*(heapIs $heap_{1032,1:1051.8}, this).p2) < (int)(0))) + temp(2)))
\rightarrow [const static or extern object]
[57.10] $heap<sub>1032,1;1054,8</sub> == $heap<sub>funcstart_1032,1</sub>._replace(this.$r \rightarrow
this.$r.value(heapIs \theta_{funcstart\_1032,1})._replace(p1 \theta ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
\label{eq:continuous_function} $ \text{heap}_{funcstart\_1032,1} . \text{p1}, 177).rem)))).$ \textbf{replace(this.} \$r \rightarrow $ \text{the properties of the prop
this.$r.value(heapIs heap_{funcstart=1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{heap}_{funcstart\_1032.1}, \text{this.} \text{$r.value}(\text{heapIs}))
\theta_{funcstart\_1032,1}.p1, 177).rem))).\_replace(p2 \rightarrow
asType<P2Type>(($heap<sub>init</sub>.M2 *
asType{<}int{>}(static\_cast{<}integer{>}(static\_cast{<}signed
int>(operator^*(heapIs \$heap_{1032,1;1051,8}, this).p2) < (int)(0))) + temp(2)))
\rightarrow [expand definition of constant 'M2' at prang.cpp (33,26)]
[57.11] $heap<sub>1032,1;1054,8</sub> == $heap<sub>funcstart_1032,1</sub>._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.\r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032.1}, \text{this.} \text{\$r.value}(\text{heapIs}))
\theta_{funcstart\_1032.1}.p1, 177).rem)))._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
$heap_funcstart_1032.1, this.$r.value(heapIs $heap_funcstart_1032.1).p1,
177).quot) + (171 * div(\mathbf{heapIs} \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}))
\label{eq:condition} $\operatorname{heap}_{funcstart\_1032,1}).p1,\ 177).rem))).$\_\mathbf{replace}(p2 \to
asType<P2Type>(((int)30307 *
asType<int>(static_cast<integer>(static_cast<signed
int>(operator^*(heapIs $heap_{1032,1:1051.8}, this).p2) < (int)0))) + temp2)))
\rightarrow [simplify]
[57.12] $\text{heap}_{1032,1;1054,8} == $\text{heap}_{funcstart\_1032,1}._\text{replace}(\text{this}.\text{$\frac{1}{2}r$})
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.}\text{\$r.value}(\text{heapIs}))
\theta_{tuncstart\_1032,1}.p1, 177).rem)))).\_replace(this.\$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\label{eq:heapIs} $ \text{heap}_{funcstart\_1032,1}, \, \textbf{this}. \\ \$r. \textbf{value}(\textbf{heapIs} \,\, \$ \text{heap}_{funcstart\_1032,1}). \\ \texttt{p1}, \\
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177).quot) + (171 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032.1}, \text{this.} \text{\$r.value}(\text{heapIs}))
\theta_{funcstart\_1032,1}.p1, 177).rem)))._replace(p2 \rightarrow
asType<P2Type>((30307 *
asType<int>(static_cast<integer>(static_cast<signed
int>(operator^*(heapIs $heap_{1032,1;1051,8}, this).p2) < (int)(0))) + temp(2)))
\rightarrow [from term 53.19, $heap<sub>1032,1;1051,8</sub> is equal to
$heap_{funcstart\_1032,1}.$_{replace}$ (this.$r \to this.$r.value(heapIs) $
heap_{funcstart\_1032,1}._replace(p1 \rightarrow (-2 * div(heapIs $heap_{funcstart\_1032,1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, \ 177).quot) + (171 \ *funcstart\_1032,1)
div(\mathbf{heapIs} \ \$heap_{funcstart\_1032,1}, \ \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
heap_{funcstart\_1032,1}.p1, 177).rem)))]
[57.13] heap_{1032,1;1054,8} == heap_{funcstart\_1032,1}._replace(this.r \rightarrow
this.$r.value(heapIs $heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
heap_{funcstart\_1032,1}, this.r.value(heapIs heap_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs \theta_{funcstart\_1032,1}, this.r.value(heapIs)
\theta_{funcstart\_1032,1}.p1, 177).rem)))).\_replace(this.\$r \rightarrow 0
this.$r.value(heapIs \rho_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
$heap_tuncstart_1032.1, this.$r.value(heapIs $heap_tuncstart_1032.1).p1,
177).quot) + (171 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
\theta_{funcstart\_1032,1}.p1, 177).rem))).\_replace(p2 \rightarrow
asType<P2Type>((30307 *
asType<int>(static_cast<integer>(static_cast<signed
int>(operator^*(heapIs \$heap_{funcstart\_1032,1}.\_replace(this.\$r \rightarrow
this.$r.value(heapIs heapIs_{funcstart\_1032,1})._replace(p1 \rightarrow (-2 * div(heapIs
\rho_{tuncstart=1032.1}, this.r.value(heapIs \rho_{tuncstart=1032.1}).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{heap}_{funcstart\_1032,1}, \text{this.}\text{$r.value}(\text{heapIs}))
\frac{\text{heap}_{funcstart_1032.1}.p1, 177).rem}{\text{his}.p2} < (int)0)) + temp2)))}
→ [expand definition of operator '*' in class 'pointer' at built in declaration]
[57.14] $heap<sub>1032,1;1054,8</sub> == $heap<sub>funcstart_1032,1</sub>._replace(this.$r \rightarrow
this.$r.value(heapIs \rho_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs \theta_{funcstart\_1032,1}, this.r.value(heapIs)
\theta_{tuncstart\_1032,1}.p1, 177).rem)))).\_replace(this.\$r \rightarrow
this.$r.value(heapIs $heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs \theta_{funcstart\_1032,1}, this.r.value(heapIs)
\theta_{funcstart\_1032,1}.p1, 177).rem))).\_replace(p2 \rightarrow
asType<P2Type>((30307 *
asType<int>(static_cast<integer>(static_cast<signed
\mathbf{int}{>}(\mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}~\$\mathbf{heap}_{funcstart\_1032,1}.\_\mathbf{replace}(\mathbf{this}.\$\mathbf{r}\rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
$\text{heap}_{funcstart_1032.1}$, this.$\text{r.value}(\text{heapIs} \text{$heap}_{funcstart_1032.1}).p1,
177).quot) + (171 * div(\mathbf{heapIs} \ \$heap_{funcstart\_1032,1}, \ \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
\text{Sheap}_{funcstart\_1032.1}.\text{p1}, 177).\text{rem})))).\text{p2}) < (int)0)) + \text{temp2}))
```

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\rightarrow [evaluate dereferenced pointer into modified heap]
[57.15] $heap<sub>1032,1;1054,8</sub> == $heap<sub>funcstart_1032,1</sub>._replace(this.$r \rightarrow
\textbf{this.\$r.value}(\textbf{heapIs}~\$ heap_{funcstart\_1032,1}).\_\textbf{replace}(p1 \rightarrow ((-2~*div(\textbf{heapIs})))))
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.} \text{\$r.value}(\text{heapIs}))
\theta_{funcstart\_1032,1}.p1, 177).rem)))).\_replace(this.\$r \rightarrow 0
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs)
\rho_{funcstart\_1032,1}, this.\r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs $heap_{funcstart\_1032,1}, this.$r.value(heapIs
\label{eq:place} $\operatorname{heap}_{funcstart\_1032,1}).p1,\ 177).rem))).\_\mathbf{replace}(p2 \to
asType<P2Type>((30307 *
asType < int > (static\_cast < integer > (static\_cast < signed\ int > (([this.\$r
== this.$r]: this.$r.value(heapIs \rho_{tuncstart = 1032.1})._replace(p1 \rightarrow (-2 *
div(\mathbf{heapIs} \$ heap_{funcstart\_1032.1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
\text{Sheap}_{funcstart\_1032.1}.p1, 177).quot) + (171 * div(heapIs \text{Sheap}_{funcstart\_1032.1},
this.r.value(heapIs \ heap_{funcstart\_1032.1}).p1, 177).rem)), []:
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p2) < (int)0)) + temp2)))
→ [explicitly assert falsehood of skipped guards in subsequent guards]
[57.16] heap_{1032,1;1054,8} == heap_{funcstart\_1032,1}._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
\label{eq:continuous_function} $ \text{heap}_{funcstart\_1032,1} . \text{p1, 177}.rem)))).\_\textbf{replace}(\textbf{this}.\$r \rightarrow
\textbf{this.\$r.value}(\textbf{heapIs}~\$ heap_{funcstart\_1032,1}).\_\textbf{replace}(p1 \rightarrow ((-2~*div(\textbf{heapIs})))))
\rho_{funcstart_1032,1}, this.\r.value(heapIs \rho_{funcstart_1032,1}).p1,
177).quot) + (171 * div(\mathbf{heapIs} \ \$heap_{funcstart\_1032,1}, \ \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
\label{eq:continuous_function} $\operatorname{heap}_{funcstart\_1032,1}).p1,\ 177).rem))).\_\mathbf{replace}(p2 \to
asType<P2Type>((30307 *
asType < int > (static\_cast < integer > (static\_cast < signed\ int > (([this.\$r
== this.$r]: this.$r.value(heapIs \rho_{tuncstart\_1032,1})._replace(p1 \rightarrow (-2 *
div(\mathbf{heapIs} \$ heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
\text{Sheap}_{funcstart\_1032,1}.p1, 177).quot) + (171 * div(heapIs \text{Sheap}_{funcstart\_1032,1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177).rem)), [!(this.<math>r = 
this.$r.value(heapIs \theta_{funcstart\_1032.1}).p2) < (int)0))) +
temp2)))
\rightarrow [simplify]
[57.23] $\text{heap}_{1032,1;1054,8} == \text{$heap}_{funcstart\_1032,1}._\text{replace}(\text{this.}\text{$r} \to \text{$}
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{tuncstart\_1032.1}, this.r.value(heapIs \rho_{tuncstart\_1032.1}).p1,
177).quot) + (171 * div(heapIs $heap_{funcstart\_1032,1}, this.$r.value(heapIs)
\label{eq:continuous_function} $ \text{heap}_{funcstart\_1032,1}.\text{p1},\ 177).\text{rem})))).$ \_\textbf{replace}(\textbf{this}.\$r \rightarrow
this.$r.value(heapIs \rho_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs)
\rho_{tuncstart_1032.1}, this.r.value(heapIs \rho_{tuncstart_1032.1}).p1,
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177).quot) + (171 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
\theta_{funcstart\_1032,1}.p1, 177).rem)))._replace(p2 \rightarrow
asType<P2Type>((30307 * asType<int>(static_cast<integer>(0 <
-this.$r.value(heapIs \theta_{funcstart\_1032,1}).p2))) + temp2)))
\rightarrow [from term 24.0, literala < -this.$r.value(heapIs $heap_{funcstart\_1032.1}).p2
is false whenever -2 < (0 + literala)
   Proof of rule precondition:
   [57.23.0] - 2 < (0 + 0)
   \rightarrow [simplify]
   [57.23.2] true
[57.24] $heap<sub>1032,1;1054,8</sub> == $heap<sub>funcstart_1032,1</sub>._replace(this.$r \rightarrow
this.$r.value(heapIs \theta_{funcstart\_1032,1})._replace(p1 \theta ((-2 * div(heapIs
\rho_{tuncstart\_1032.1}, this.r.value(heapIs \rho_{tuncstart\_1032.1}).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{heap}_{funcstart\_1032.1}, \text{this.} \text{$r.value}(\text{heapIs}))
\theta_{funcstart\_1032,1}.p1, 177).rem)))).\_replace(this.\$r \rightarrow 0
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
heap_{funcstart\_1032,1}.p1, 177).rem)))._replace(p2 \rightarrow
asType<P2Type>((30307 * asType<int>(static_cast<integer>(false)))
+ \text{ temp2})))
\rightarrow [simplify]
[57.25] $heap<sub>1032,1;1054,8</sub> == $heap<sub>funcstart_1032,1</sub>._replace(this.$r \rightarrow
this.$r.value(heapIs \frac{1}{2} heap\frac{1}{2} ._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs $heap<sub>funcstart_1032,1</sub>, this.$r.value(heapIs
\theta_{funcstart\_1032,1}.p1, 177).rem)))).\_replace(this.\$r \rightarrow 0
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs $heap<sub>funcstart_1032,1</sub>, this.$r.value(heapIs
\theta_{funcstart\_1032,1}.p1, 177).rem))).\_replace(p2 \rightarrow
asType<P2Type>((30307 * asType<int>(([false]: 1, []: 0))) + temp2)))
→ [explicitly assert falsehood of skipped guards in subsequent guards]
[57.26] heap_{1032,1;1054,8} == heap_{funcstart\_1032,1}._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs \theta_{funcstart\_1032,1}, this.r.value(heapIs)
\theta_{funcstart\_1032,1}.p1, 177).rem))))._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.} \text{\$r.value}(\text{heapIs}))
```

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\theta_{funcstart=1032.1}.p1, 177).rem)))._replace(p2 \rightarrow
asType<P2Type>((30307 * asType<int>(([false]: 1, [true]: 0))) +
temp2)))
\rightarrow [simplify]
[57.29] $\text{heap}_{1032,1;1054,8} == $\text{heap}_{funcstart\_1032,1}._\text{replace}(\text{this}.\text{$\frac{1}{2}r$})
this.$r.value(heapIs \rho_{tuncstart\_1032.1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{heap}_{funcstart\_1032,1}, \text{this.}\text{$r.value}(\text{heapIs}))
\theta_{funcstart\_1032,1}.p1, 177).rem))))._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\ 1032.1}).replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(\mathbf{heapIs} \$ heap_{funcstart\_1032,1}, \mathbf{this}.\$ r. \mathbf{value}(\mathbf{heapIs})
\rho_{tuncstart\_1032,1}.p1, 177).rem))._replace(p2 \rightarrow asType<P2Type>(0 +
temp2)))
\rightarrow [from term 54.18, temp2 is equal to (-35 * div(heapIs $heap_{funcstart\_1032,1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p2, 176).quot) + (172 \ function for the content of the conten
div(\mathbf{heapIs} \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
heap_{funcstart_{-1032.1}}.p2, 176).rem
[57.30] $heap<sub>1032,1;1054,8</sub> == $heap<sub>funcstart_1032,1</sub>._replace(this.$r \rightarrow
this.$r.value(heapIs heapIs_{tuncstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart=1032,1}, this.r.value(heapIs \rho_{funcstart=1032,1}).p1,
177).quot) + (171 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
\theta_{tuncstart\_1032.1}.p1, 177).rem)))).\_replace(this.\$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.\r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs $heap_{funcstart\_1032,1}, this.$r.value(heapIs
\frac{\text{sheap}_{funcstart\_1032.1}.p1, 177.rem)}{\text{ce}}._replace(p2 \rightarrow asType<P2Type>(0 +
((-35 * div(heapIs \$heap_{funcstart\_1032,1}, this.\$r.value(heapIs
\text{Sheap}_{funcstart\_1032,1}.p2, 176).quot) + (172 * div(heapIs \text{Sheap}_{funcstart\_1032,1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p2, 176).rem)))))
\rightarrow [simplify]
[57.33] $heap<sub>1032,1;1054,8</sub> == $heap<sub>funcstart_1032,1</sub>._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.\r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs $heap_{funcstart\_1032,1}, this.$r.value(heapIs
\theta_{tuncstart_1032.1}.p1, 177.rem)))._replace(this.$r \rightarrow
\textbf{this.}\$r.\textbf{value}(\textbf{heapIs}~\$\text{heap}_{funcstart\_1032,1}).\_\textbf{replace}(\text{p1} \rightarrow ((\text{-}2~*\text{div}(\textbf{heapIs}
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
\rho_{funcstart\_1032,1}.p1, 177).rem))._replace(p2 \rightarrow ((-35 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p2,
176).quot) + (172 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032.1}, \text{this.} \text{\$r.value}(\text{heapIs}))
heap_{funcstart\_1032,1}.p2, 176).rem)))
```

```
[Take given term]
[58.0] (($heap<sub>1032.1:1054.8</sub>.r3 * static_cast<signed int>(div3.rem)) -
(\text{sheap}_{1032,1;1054,8}.\text{b3} * \text{static\_cast} < \text{signed int} > (\text{div3.quot}))) == \text{temp3}
\rightarrow [from term 57.33, $heap<sub>1032,1;1054,8</sub> is equal to
$heap_{funcstart\_1032,1}.$_replace(this.$r \rightarrow this.$r.value(heapIs)
heap_{funcstart\_1032,1}._replace(p1 \rightarrow ((-2 * div(heapIs $heap_{funcstart\_1032,1},
this.$r.value(heapIs $heap_{funcstart\_1032.1}).p1, 177).quot) + (171
div(\mathbf{heapIs}\ \$heap_{funcstart\_1032,1},\ \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}
\theta_{funcstart\_1032,1}.p1, 177).rem)))).\_replace(this.\$r \rightarrow 0
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs)))
heap_{funcstart\_1032,1}, this.r.value(heapIs heap_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(\mathbf{heapIs} \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}))
\$heap_{funcstart\_1032,1}).p1,\ 177).rem))).\_\mathbf{replace}(p2 \rightarrow (-35\ *div(\mathbf{heapIs}
heap_{funcstart\_1032,1}, this.r.value(heapIs heap_{funcstart\_1032,1}).p2,
176).quot) + (172 * div(heapIs $heap_{funcstart\_1032,1}, this.$r.value(heapIs)
heap_{funcstart_{1032,1}}.p2, 176).rem)))
[58.1] \; ((\$ heap_{funcstart\_1032,1}.\_\textbf{replace}(\textbf{this}.\$r \to \textbf{this}.\$r.\textbf{value}(\textbf{heapIs}))) \\
\rho_{tuncstart_1032.1}._replace(p1 \rightarrow ((-2 * div(heapIs \rho_{tuncstart_1032.1})
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177).quot) + (171 *
{\rm div}(\mathbf{heapIs}~\$\mathrm{heap}_{funcstart\_1032,1},~\mathbf{this.\$r.value}(\mathbf{heapIs}
\theta_{funcstart\_1032,1}.p1, 177).rem)))).\_replace(this.\$r \rightarrow 0
this.$r.value(heapIs \rho_{uncstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs)
\$heap_{funcstart\_1032,1},\, \textbf{this}.\$r.\textbf{value}(\textbf{heapIs}\,\,\$heap_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(\mathbf{heapIs} \$ heap_{funcstart\_1032,1}, \mathbf{this}.\$ r. \mathbf{value}(\mathbf{heapIs})
\rho_{uncstart\_1032,1}.p1, 177).rem))._replace(p2 \rightarrow ((-35 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p2,
176).quot) + (172 * div(heapIs \rho_{funcstart\_1032,1}, this.r.value(heapIs)
\theta_{funcstart\_1032,1}.p2, 176).rem))).r3 * static\_cast < signed
\mathbf{int}{>}(\mathbf{div3.rem})) - (\$\mathbf{heap}_{1032,1;1054,8}.\mathbf{b3} * \mathbf{static\_cast}{<} \mathbf{signed}
int>(div3.quot)) == temp3
→ [const member of object with modified fields]
[58.3] (({\rm sheap}_{funcstart\_1032,1}.r3 * static\_cast < signed int > (div3.rem)) -
(\text{sheap}_{1032,1;1054,8}.\text{b3} * \text{static\_cast} < \text{signed int} > (\text{div}3.\text{quot}))) == \text{temp}_3
\rightarrow [const static or extern object]
[58.4] (($heap<sub>init</sub>.r3 * static_cast<signed int>(div3.rem)) -
(\text{sheap}_{1032,1:1054,8}.\text{b3 * static\_cast} < \text{signed int} > (\text{div3.quot}))) == \text{temp3}
\rightarrow [expand definition of constant 'r3' at prang.cpp (39,26)]
[58.5] (((int)170 * static_cast<signed int>(div3.rem)) -
(\text{sheap}_{1032.1:1054.8}.\text{b3} * \text{static\_cast} < \text{signed int} > (\text{div3.quot}))) = = \text{temp3}
\rightarrow [simplify]
[58.6] ((170 * static_cast<signed int>(div3.rem)) - ($heap_1032.1:1054.8.b3 *
```

```
static_cast<signed int>(div3.quot))) == temp3
\rightarrow [from term 34.6, div3 is equal to div(heapIs $heap_{funcstart\_1032,1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p3, 178)
[58.7] ((170 * static_cast < signed int > (div(heapIs heapIs funcstart_{1032,1}),
\mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}\ \$heap_{funcstart\_1032,1}).p3,\ 178).rem)) \ \text{-}
(\text{sheap}_{1032,1:1054.8}.\text{b3} * \text{static\_cast} < \text{signed int} > (\text{div3.quot}))) == \text{temp3}
\rightarrow [simplify]
[58.8] ((170 * div(heapIs heap_{funcstart\_1032.1}, this.r.value(heapIs)
\rho_{funcstart\_1032,1}.p3, 178.em) - (\rho_{1032,1;1054,8}.b3 *
static_cast<signed int>(div3.quot))) == temp3
\rightarrow [from term 57.33, $heap<sub>1032,1:1054,8</sub> is equal to
heap_{funcstart\_1032,1}._replace(this.r \rightarrow this.r.value(heapIs)
heap_{funcstart\_1032,1}._replace(p1 \rightarrow ((-2 * div(heapIs heap_{funcstart\_1032,1}),
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177).quot) + (171 * leap_{funcstart\_1032,1}).p1, 177).quot) + (171 * leap_{funcstart\_1032,1}).quot) + (171 * leap_{funcstart\_
div(\mathbf{heapIs} \ \$heap_{funcstart\_1032,1}, \ \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
\theta_{tuncstart\_1032.1}.p1, 177).rem))))\_replace(this.\$r \rightarrow 0
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs) + div(heapIs)))
heap_{funcstart\_1032,1}, this.r.value(heapIs heap_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(\mathbf{heapIs} \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}))
heap_{funcstart\_1032,1}.p1, 177).rem)))._replace(p2 \rightarrow (-35 * div(heapIs)))
heap_{funcstart\_1032,1}, this.r.value(heapIs heap_{funcstart\_1032,1}).p2,
176).quot) + (172 * div(heapIs $heap_{funcstart\_1032,1}, this.$r.value(heapIs)
heap_{funcstart_1032,1}.p2, 176).rem)))]
[58.9] ((170 * div(heap
Is \rho_{funcstart\_1032,1}, this.\r.value(heap
Is
\rho_{funcstart\_1032,1}.p3, 178).rem – (\rho_{funcstart\_1032,1}.\_replace)
\rightarrow this.$r.value(heapIs $heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 *
div(\mathbf{heapIs} \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
\text{Sheap}_{funcstart\_1032,1}.p1, 177).quot) + (171 * div(heapIs \text{Sheap}_{funcstart\_1032,1},
this.r.value(heapIs \theta_{funcstart\_1032,1}).p1, 177).rem)))).replace(this. replace(this. replace(thi
div(\mathbf{heapIs} \$ heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
\text{Sheap}_{funcstart\_1032.1}.p1, 177).quot) + (171 * div(heapIs \text{Sheap}_{funcstart\_1032.1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177).rem))).\_replace(p2 \rightarrow
((-35 * div(\mathbf{heapIs} \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}))
\text{Sheap}_{funcstart\_1032,1}.p2, 176).quot) + (172 * div(heapIs \text{Sheap}_{funcstart\_1032,1},
this.r.value(heapIs \ensuremath{\$}heap_{funcstart\_1032,1}).p2, 176).rem)))).b3**
static_cast<signed int>(div3.quot))) == temp3
\rightarrow [const member of object with modified fields]
[58.11] ((170 * div(heapIs heap_{funcstart\_1032,1}, this.r.value(heapIs)
\text{Sheap}_{funcstart\_1032,1}.p3, 178).rem) - (\text{Sheap}_{funcstart\_1032,1}.b3 *
static_cast<signed int>(div3.quot))) == temp3
\rightarrow [const static or extern object]
```

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[58.12] ((170 * div(heapIs heap_{funcstart\_1032,1}, this.r.value(heapIs)
\rho_{funcstart\_1032,1}.p3, 178).rem – (\rho_{init}.b3 * static\_cast < signed
int>(div3.quot)) == temp3
\rightarrow [expand definition of constant 'b3' at prang.cpp (41,26)]
[58.13] ((170 * div(heapIs $heap_{funcstart\_1032,1}, this.$r.value(heapIs
\rho_{tuncstart=1032.1}.p3, 178.rem) - ((int)63 * static_cast < signed)
int>(div3.quot))) == temp3
\rightarrow [simplify]
[58.14] ((170 * div(heapIs heap_{funcstart\_1032,1}, this.r.value(heapIs)
\rho_{tuncstart=1032.1}, p3, 178).rem) - (63 * static_cast<signed)
int>(div3.quot)) == temp3
\rightarrow [from term 34.6, div3 is equal to div(heapIs $heap_{funcstart\_1032,1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p3, 178)]
[58.15] ((170 * div(heapIs heap_{funcstart\_1032,1}, this.r.value(heapIs)
\theta_{funcstart\_1032,1}.p3, 178).rem) - (63 * static_cast<signed
int>(div(heapIs \$heap_{funcstart\_1032,1}, this.\$r.value(heapIs
heap_{funcstart_1032,1}.p3, 178.quot)) = temp3
\rightarrow [simplify]
[58.20] 0 == (-\text{temp3} + (-63 * \text{div}(\text{heapIs } \text{$heap}_{funcstart\_1032,1},
this.r.value(heapIs \ensuremath{\$}heap_{funcstart\_1032,1}).p3, 178).quot) + (170 *
div(\mathbf{heapIs} \$ heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
heap_{funcstart_{-1032.1}}.p3, 178).rem
[Take given term]
[61.0] $heap_{funcend_1032.1} == $heap_{1032.1:1054.8}._replace(this.$r \rightarrow
operator*(heapIs heap_{1032,1:1054.8}, this)._replace(p3 \rightarrow
asType<P3Type>(($heap<sub>1032.1:1054.8</sub>.M3 *
asType<int>(static_cast<integer>(static_cast<signed
int>(operator^*(heapIs \$heap_{1032,1:1054.8}, this).p3) < (int)0))) + temp3)))
\rightarrow [from term 57.33, $heap<sub>1032,1:1054.8</sub> is equal to
\$heap_{funcstart\_1032,1}.\_\textbf{replace}(\textbf{this}.\$r \rightarrow \textbf{this}.\$r.\textbf{value}(\textbf{heapIs}
heap_{funcstart\_1032,1}._replace(p1 \rightarrow ((-2 * div(heapIs $heap_{funcstart\_1032,1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177).quot) + (171)
div(\mathbf{heapIs} \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
\theta_{funcstart\_1032,1}.p1, 177).rem)))).\_replace(this.\$r \rightarrow 0
this.$r.value(heapIs $heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
heap_{funcstart\_1032,1}, this.r.value(heapIs heap_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(\textbf{heapIs} \$heap_{funcstart\_1032,1}, \textbf{this}.\$r.\textbf{value}(\textbf{heapIs}))
\rho_{funcstart\_1032.1}.p1, 177).rem))._replace\rho_{funcstart\_1032.1}.p1, 177).rem)
\$heap_{funcstart\_1032,1}, \ \textbf{this}.\$r. \textbf{value(heapIs} \ \$heap_{funcstart\_1032,1}).p2,
176).quot) + (172 * div(heapIs $heap_{funcstart=1032.1}, this.$r.value(heapIs
heap_{funcstart\_1032,1}.p2, 176).rem)))
```

```
[61.2] heap_{funcend\_1032,1} == heap_{funcstart\_1032,1}._replace(this.$r \rightarrow
this.$r.value(heapIs \theta_{funcstart\_1032,1})._replace(p1 \theta ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.} \text{\$r.value}(\text{heapIs}))
\theta_{tuncstart\_1032,1}.p1, 177).rem)))).\_replace(this.\$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs heap_{funcstart_1032,1}, this.r.value(heapIs)
\rho_{funcstart\_1032,1}.p1, 177).rem))._replace(p2 \rightarrow ((-35 * div(heapIs
\rho_{uncstart_{-1032,1}}, this. r.value(heapIs \rho_{uncstart_{-1032,1}}).p2,
176).quot) + (172 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.} \text{\$r.value}(\text{heapIs}))
\$heap_{funcstart\_1032,1}).p2,\,176).rem)))).\_replace(this.\$r \rightarrow operator*(heapIs))
\$heap_{funcstart\_1032,1}.\_\textbf{replace}(\textbf{this}.\$r \rightarrow \textbf{this}.\$r.\textbf{value}(\textbf{heapIs}
heap_{funcstart\_1032,1}._replace(p1 \rightarrow ((-2 * div(heapIs heap_{funcstart\_1032,1}),
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177).quot) + (171 *
div(\mathbf{heapIs} \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
\theta_{funcstart\_1032,1}.p1, 177).rem))))._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{tuncstart_{-1032.1}}, this.r.value(heapIs \rho_{tuncstart_{-1032.1}}).p1,
177).quot) + (171 * div(\mathbf{heapIs} \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}))
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p2,
176).quot) + (172 * div(heapIs $heap<sub>funcstart_1032,1</sub>, this.$r.value(heapIs
\theta_{funcstart\_1032,1}.p2, 176).rem)), this)._replace(p3 \rightarrow
asType<P3Type>(($heap<sub>1032,1;1054,8</sub>.M3 *
as Type < int > (static\_cast < integer > (static\_cast < signed))
int>(operator^*(heapIs $heap_{1032,1;1054,8}, this).p3) < (int)(0))) + temp3)))
→ [expand definition of operator '*' in class 'pointer' at built in declaration]
[61.3] heap_{funcend\_1032,1} == heap_{funcstart\_1032,1}._replace(this.r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs))
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(\mathbf{heapIs} \ \$heap_{funcstart\_1032,1}, \ \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
\theta_{funcstart\_1032,1}.p1, 177).rem)))).\_replace(this.\$r \rightarrow 0
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(\mathbf{heapIs} \ \$heap_{funcstart\_1032,1}, \ \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
\rho_{funcstart\_1032,1}.p1, 177).rem))._replace(p2 \rightarrow ((-35 * div(heapIs
\$heap_{funcstart\_1032,1},\, \textbf{this}.\$r.\textbf{value}(\textbf{heapIs}\,\,\$heap_{funcstart\_1032,1}).p2,
176).quot) + (172 * div(\mathbf{heapIs} \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}))
\theta_{funcstart\_1032,1}.p2, 176).rem)))).\_replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032.1}._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.\r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
\theta_{funcstart\_1032,1}.p1, 177).rem)))._replace(this.$r \rightarrow
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this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.}\text{\$r.value}(\text{heapIs}))
\text{Sheap}_{funcstart\_1032,1}.p1, 177).rem)))._replace(p2 \rightarrow ((-35 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p2,
176).quot) + (172 * div(heapIs $heap<sub>funcstart_1032,1</sub>, this.$r.value(heapIs
heap_{funcstart\_1032,1}.p2, 176).rem))))._replace(p3 \rightarrow
asType<P3Type>(($heap<sub>1032,1:1054,8</sub>.M3 *
asType<int>(static_cast<integer>(static_cast<signed
int>(operator^*(heapIs $heap_{1032,1;1054,8}, this).p3) < (int)(0))) + temp3)))
→ [evaluate dereferenced pointer into modified heap]
[61.4] heap_{funcend\_1032,1} == heap_{funcstart\_1032,1}._replace(this.$r \rightarrow
this.$r.value(heapIs \frac{1}{2} heap\frac{1}{2} heap\frac{1}{2}
heap_{funcstart\_1032,1}, this.r.value(heapIs heap_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
\theta_{funcstart\_1032,1}.p1, 177).rem)))).\_replace(this.\$r \rightarrow 0
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\$heap_{funcstart\_1032,1},\, \textbf{this}.\$r.\textbf{value}(\textbf{heapIs}\,\,\$heap_{funcstart\_1032,1}).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.} \text{\$r.value}(\text{heapIs}))
\verb§heap$_{funcstart\_1032,1}).p1,\ 177).rem))).\_\textbf{replace}(p2 \rightarrow ((-35 \ * \ div(\textbf{heapIs}
\rho_{tuncstart\_1032.1}, this.r.value(heapIs \rho_{tuncstart\_1032.1}).p2,
176).quot) + (172 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.} \text{\$r.value}(\text{heapIs}))
\theta_{uncstart\_1032,1}.p2, 176).rem)))._replace(this.$r \rightarrow ([this.$r ==
this.$r]: this.$r.value(heapIs \rho_{tuncstart\_1032,1})._replace(p1 \rightarrow ((-2 *
div(\mathbf{heapIs} \$ heap_{funcstart\_1032.1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
\text{Sheap}_{funcstart\_1032,1}.p1, 177).quot) + (171 * div(heapIs \text{Sheap}_{funcstart\_1032,1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177).rem))).\_replace(p2 \rightarrow
(-35 * div(heapIs \$heap_{funcstart\_1032,1}, this.\$r.value(heapIs
\text{Sheap}_{funcstart\_1032,1}.p2, 176).quot) + (172 * div(heapIs \text{Sheap}_{funcstart\_1032,1},
this.r.value(heapIs \ heap_{funcstart\_1032.1}).p2, 176).rem)), []:
this.r.value(heapIs \ heap_{funcstart\_1032,1}.\_replace(this.\rdotsr) \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow (-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs \rho_{funcstart\_1032,1}, this.r.value(heapIs)
\theta_{funcstart\_1032,1}.p1, 177).rem)))).\_replace(p3 \rightarrow
asType<P3Type>(($heap<sub>1032,1;1054,8</sub>.M3 *
asType<int>(static_cast<integer>(static_cast<signed
int>(operator^*(heapIs $heap_{1032,1;1054,8}, this).p3) < (int)0))) + temp3)))
→ [explicitly assert falsehood of skipped guards in subsequent guards]
[61.5] heap_{funcend\_1032,1} == heap_{funcstart\_1032,1}._replace(this.$r \rightarrow
this.$r.value(heapIs $heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
$\text{heap}_{funcstart_1032.1}$, this.$\text{r.value}(\text{heapIs} \text{$heap}_{funcstart_1032.1}).p1,
177).quot) + (171 * div(heapIs $heap<sub>funcstart_1032.1</sub>, this.$r.value(heapIs
\theta_{funcstart\_1032,1}.p1, 177).rem))))._replace(this.$r \rightarrow
```

```
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs \theta_{funcstart\_1032,1}, this.r.value(heapIs)
\rho_{funcstart\_1032,1}.p1, 177).rem))._replace(p2 \rightarrow ((-35 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p2,
176).quot) + (172 * div(heapIs $heap<sub>funcstart_1032,1</sub>, this.$r.value(heapIs
\rho_{funcstart\_1032,1}.p2, 176).rem)))).\_replace(this.$r \rightarrow ([this.$r ==
this.$r]: this.$r.value(heapIs \rho_{tart_1032,1})._replace(p1 \rightarrow ((-2 *
div(\mathbf{heapIs} \$ heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
\text{Sheap}_{funcstart\_1032,1}.p1, 177).quot) + (171 * div(heapIs \text{Sheap}_{funcstart\_1032,1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177).rem))).\_replace(p2 \rightarrow
(-35 * div(\mathbf{heapIs} \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}))
\text{Sheap}_{funcstart\_1032,1}.p2, 176).quot) + (172 * div(heapIs \text{Sheap}_{funcstart\_1032,1},
this.r.value(heapIs \ensuremath{\$heap}_{funcstart\_1032,1}).p2, 176).rem)), [!(this.\ensuremath{\$r} ==
this.$r.value(heapIs heapIs_{funcstart\_1032,1})._replace(p1 \rightarrow (-2 * div(heapIs
\rho_{tuncstart\_1032.1}, this.r.value(heapIs \rho_{tuncstart\_1032.1}).p1,
177).quot) + (171 * div(\mathbf{heapIs} \ \$heap_{funcstart\_1032,1}, \ \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
\theta_{funcstart_1032.1}.p1, 177).rem))))._replace(p3 \rightarrow
asType<P3Type>(($heap<sub>1032.1:1054.8</sub>.M3 *
asType<int>(static_cast<integer>(static_cast<signed
int>(operator^*(heapIs $heap_{1032,1;1054,8}, this).p3) < (int)(0))) + temp3)))
\rightarrow [simplify]
[61.7] heap_{funcend\_1032,1} == heap_{funcstart\_1032,1}._replace(this.$r \rightarrow
this.$r.value(heapIs \rho_{tuncstart\_1032.1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
\label{eq:continuous_function} $ \text{heap}_{funcstart\_1032,1} . \text{p1}, 177).rem)))).\_\textbf{replace}(\textbf{this}.\$r \rightarrow
this.$r.value(heapIs heap_{funcstart\ 1032.1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs \theta_{funcstart\_1032,1}, this.r.value(heapIs)
\rho_{uncstart\_1032,1}.p1, 177).rem))._replace(p2 \rightarrow ((-35 * div(heapIs
\rho_{funcstart_1032,1}, this.r.value(heapIs \rho_{funcstart_1032,1}).p2,
176).quot) + (172 * div(heapIs \rho_{funcstart\_1032,1}, this.r.value(heapIs)
\theta_{uncstart\_1032,1}.p2, 176).rem)))._replace(this.$r \rightarrow
\textbf{this.}\$r.\textbf{value}(\textbf{heapIs}~\$heap_{funcstart\_1032,1}).\_\textbf{replace}(p1 \rightarrow ((\text{-}2~*\text{div}(\textbf{heapIs}
\rho_{funcstart\_1032,1}, this. r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs \rho_{funcstart\_1032,1}, this.r.value(heapIs)
\rho_{funcstart\_1032,1}.p1, 177).rem))._replace(p2 \rightarrow ((-35 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p2,
176).quot) + (172 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.\$r.value}(\text{heapIs}))
\theta_{funcstart\_1032,1}.p2, 176).rem))._replace(p3 \rightarrow
asType<P3Type>(($heap<sub>1032,1:1054,8</sub>.M3 *
asType{<}int{>}(static\_cast{<}integer{>}(static\_cast{<}signed
int>(operator^*(heapIs $heap_{1032.1:1054.8}, this).p3) < (int)0))) + temp3)))
```

```
\rightarrow [from term 57.33, $heap<sub>1032.1:1054.8</sub> is equal to
\$heap_{funcstart\_1032,1}.\_\textbf{replace}(\textbf{this}.\$r \rightarrow \textbf{this}.\$r.\textbf{value}(\textbf{heapIs}
heap_{funcstart\_1032,1}._replace(p1 \rightarrow ((-2 * div(heapIs $heap_{funcstart\_1032,1},
this.r.value(heapIs \ \ heap_{funcstart\_1032.1}).p1, \ 177).quot) + (171)
div(\mathbf{heapIs} \ \$heap_{funcstart\_1032,1}, \ \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
heap_{funcstart\_1032,1}.p1, 177).rem))).\_replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
$heap_{funcstart\_1032,1}$, this. $r.value(heapIs $heap_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs \$heap_{funcstart\_1032,1}, this.\$r.value(heapIs))
\$heap_{funcstart\_1032,1}).p1,\ 177).rem))).\_\mathbf{replace}(p2 \rightarrow (\text{-}35\ *\ div(\mathbf{heapIs}
heap_{funcstart\_1032,1}, this.r.value(heapIs heap_{funcstart\_1032,1}).p2,
176).quot) + (172 * div(heapIs $heap_{tuncstart\_1032.1}, this.$r.value(heapIs
heap_{funcstart\_1032,1}.p2, 176).rem)))]
[61.8] heap_{funcend\_1032,1} == heap_{funcstart\_1032,1}._replace(this.r \rightarrow
\textbf{this.\$r.value}(\textbf{heapIs}~\$ heap_{funcstart\_1032,1}).\_\textbf{replace}(p1 \rightarrow ((-2~*div(\textbf{heapIs})))))
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.}\text{\$r.value}(\text{heapIs}))
\theta_{funcstart\_1032,1}.p1, 177).rem)))).\_replace(this.\$r \rightarrow 0
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\theta_{funcstart\_1032,1}, this.r.value(\theta_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs \theta), this.$r.value(heapIs
\rho_{uncstart_1032,1}.p1, 177).rem))._replace(p2 \rightarrow ((-35 * div(heapIs
\rho_{funcstart\_1032,1}, this.\r.value(heapIs \rho_{funcstart\_1032,1}).p2,
176).quot) + (172 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
\theta_{funcstart\_1032,1}.p2, 176).rem))))._replace(this.$r \rightarrow
\textbf{this.\$r.value}(\textbf{heapIs}~\$ heap_{funcstart\_1032,1}).\_\textbf{replace}(p1 \rightarrow ((-2 * div(\textbf{heapIs}) + (-2 * div(\textbf{heapI
\rho_{funcstart\_1032,1}, this. r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs $heap<sub>funcstart_1032.1</sub>, this.$r.value(heapIs
\rho_{funcstart\_1032,1}.p1, 177).rem)._replace\rho_{funcstart\_1032,1}.p1, 177).rem)._replace
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p2,
176).quot) + (172 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.} \text{\$r.value}(\text{heapIs}))
heap_{funcstart\_1032.1}, p2, 176).rem)))._replace(p3 \rightarrow
asType < P3Type > ((\$heap_{funcstart\_1032,1}.\_replace(this.\$r \rightarrow funcstart\_1032,1))
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(\mathbf{heapIs} \ \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
\label{eq:continuous_flux_start} $$  \parbox{$heap}_{funcstart\_1032,1}.p1,\ 177).rem)))).$$  \parbox{$\tt replace(this.\$r$} \to $$
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{heap}_{funcstart\_1032,1}, \text{this.} \text{$r.value}(\text{heapIs}))
\rho_{funcstart\_1032,1}.p1, 177).rem))._replace(p2 \rightarrow ((-35 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p2,
176).quot) + (172 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.} \text{\$r.value}(\text{heapIs}))
$heap<sub>funcstart_1032.1</sub>).p2, 176).rem)))).M3 *
asType<int>(static_cast<integer>(static_cast<signed
```

```
int>(operator^*(heapIs \$heap_{1032,1:1054.8}, this).p3) < (int)0))) + temp3)))
→ [const member of object with modified fields]
[61.10] $heap<sub>funcend_1032,1</sub> == $heap<sub>funcstart_1032,1</sub>.replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.} \text{\$r.value}(\text{heapIs}))
\theta_{funcstart\_1032,1}.p1, 177).rem)))).\_replace(this.\$r \rightarrow 0
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.} \text{\$r.value}(\text{heapIs}))
\$heap_{funcstart\_1032,1}).p1,\ 177).rem))).\_replace(p2 \rightarrow ((-35 * div(\textbf{heapIs}) + (-35 * div(\textbf{heapI
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p2,
176).quot) + (172 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.} \text{\$r.value}(\text{heapIs}))
\theta_{funcstart\_1032,1}.p2, 176).rem)))).\_replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart_1032,1}, this.r.value(heapIs \rho_{funcstart_1032,1}).p1,
177).quot) + (171 * div(\mathbf{heapIs} \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}))
\rho_{uncstart\_1032,1}.p1, 177).rem)._replace(\rho_{2} \rightarrow ((-35 * div(heapIs)))._replace
\label{eq:heapIs} $\operatorname{heap}_{funcstart\_1032,1}, \, \mathbf{this}. \\ $\operatorname{s.-value}(\mathbf{heapIs} \, \, \\ \\ \operatorname{heap}_{funcstart\_1032,1}).p2, \\
176).quot) + (172 * div(\mathbf{heapIs} \ \$heap_{funcstart\_1032,1}, \ \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
\theta_{funcstart\_1032.1}.p2, 176).rem)))._replace(p3 \rightarrow
asType<P3Type>(($heap_tuncstart_1032,1.M3 *
asType < int > (static\_cast < integer > (static\_cast < signed)
\mathbf{int}{>}(\mathbf{operator}^*(\mathbf{heapIs}\ \$\mathrm{heap}_{1032,1;1054,8},\ \mathbf{this}).\mathrm{p3})<(\mathbf{int})0)))+\mathrm{temp3})))
\rightarrow [const static or extern object]
[61.11] heap_{funcend\_1032,1} == heap_{funcstart\_1032,1}._replace(this.$r \rightarrow
\mathbf{this.\$r.value}(\mathbf{heapIs}\ \$ \mathrm{heap}_{funcstart\_1032,1}).\_\mathbf{replace}(\mathrm{p1} \to ((\text{-}2\ *\ \mathrm{div}(\mathbf{heapIs}\ 
\theta_{funcstart\_1032,1}, this.r.value(heapIs \theta_{funcstart\_1032,1}).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.} \text{\$r.value}(\text{heapIs}))
\theta_{funcstart\_1032,1}.p1, 177).rem)))).\_replace(this.\$r \rightarrow 0
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\$heap_{funcstart\_1032,1},\, \textbf{this}.\$r.\textbf{value}(\textbf{heapIs}\,\,\$heap_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(\mathbf{heapIs} \$ heap_{funcstart\_1032,1}, \mathbf{this}.\$ r. \mathbf{value}(\mathbf{heapIs})
\rho_{funcstart\_1032,1}.p1, 177).rem))._replace(p2 \rightarrow ((-35 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p2,
176).quot) + (172 * div(heapIs \rho_{funcstart\_1032,1}, this.r.value(heapIs)
\theta_{funcstart\_1032,1}.p2, 176).rem)))).\_replace(this.$r \rightarrow
this.$r.value(heapIs p_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\$heap_{funcstart\_1032,1},\, \textbf{this}.\$r.\textbf{value}(\textbf{heapIs}\,\,\$heap_{funcstart\_1032,1}).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.} \text{\$r.value}(\text{heapIs}))
\rho_{funcstart\_1032.1}.p1, 177).rem)._replace(p2 \rightarrow ((-35 * div(heapIs
\rho_{tuncstart\_1032.1}, this.r.value(heapIs \rho_{tuncstart\_1032.1}).p2,
176).quot) + (172 * div(heapIs $heap<sub>funcstart_1032.1</sub>, this.$r.value(heapIs
\theta_{funcstart\_1032,1}.p2, 176).rem))).\_replace(p3 \rightarrow
```

```
asType<P3Type>(($heap<sub>init</sub>.M3 *
asType<int>(static_cast<integer>(static_cast<signed
int>(operator^*(heapIs $heap_{1032,1;1054,8}, this).p3) < (int)0))) + temp3)))
\rightarrow [expand definition of constant 'M3' at prang.cpp (38,26)]
[61.12] heap_{funcend\_1032,1} == heap_{funcstart\_1032,1}._replace(this.$r \rightarrow
this.$r.value(heapIs \rho_{tuncstart\_1032.1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032.1}, \text{this.} \text{\$r.value}(\text{heapIs}))
\theta_{funcstart\_1032,1}.p1, 177).rem))))._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\ 1032.1}).replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.}\text{\$r.value}(\text{heapIs}))
\rho_{uncstart\_1032,1}.p1, 177).rem))._replace(p2 \rightarrow ((-35 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p2,
176).quot) + (172 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.}\text{\$r.value}(\text{heapIs}))
\theta_{funcstart\_1032,1}.p2, 176).rem)))).replace(this.r \rightarrow 0
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\$heap_{funcstart\_1032,1},\, \textbf{this}.\$r.\textbf{value}(\textbf{heapIs}\,\,\$heap_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(\mathbf{heapIs} \ \$heap_{funcstart\_1032,1}, \ \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
\verb§heap$_{funcstart\_1032,1}).p1,\ 177).rem))).\_\textbf{replace}(p2 \rightarrow ((-35 \ * \ div(\textbf{heapIs}
$heap_tuncstart_1032.1, this.$r.value(heapIs $heap_tuncstart_1032.1).p2,
176).quot) + (172 * div(heapIs $heap<sub>funcstart_1032.1</sub>, this.$r.value(heapIs
\theta_{funcstart\_1032,1}.p2, 176).rem))).\_replace(p3 \rightarrow
asType < P3Type > (((int)30323 *
asType<int>(static_cast<integer>(static_cast<signed
int>(operator*(heapIs $heap_{1032,1;1054,8}, this).p3) < (int)0))) + temp3)))
\rightarrow [simplify]
[61.13] heap_{funcend\_1032,1} == heap_{funcstart\_1032,1}._replace(this.$r \rightarrow
this.$r.value(heapIs $heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{tuncstart_{-1032.1}}, this.r.value(heapIs \rho_{tuncstart_{-1032.1}}).p1,
177).quot) + (171 * div(\mathbf{heapIs} \$heap_{funcstart\_1032,1}, \mathbf{this.\$r.value}(\mathbf{heapIs}))
\label{eq:continuous_function} $ \text{heap}_{funcstart\_1032,1} . \text{p1}, 177).rem)))).\_\textbf{replace}(\textbf{this}.\$r \rightarrow
this.$r.value(heapIs \theta_{funcstart\_1032,1})._replace(p1 \theta ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{heap}_{funcstart\_1032,1}, \text{this.} \text{$r.value}(\text{heapIs}))
\rho_{funcstart\_1032,1}.p1, 177).rem))._replace(p2 \rightarrow ((-35 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p2,
176).quot) + (172 * div(heapIs $heap<sub>funcstart_1032,1</sub>, this.$r.value(heapIs
\theta_{funcstart\_1032,1}.p2, 176).rem)))).\_replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\theta_{funcstart\_1032,1}, this.r.value(heapIs \theta_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs $heap<sub>funcstart_1032,1</sub>, this.$r.value(heapIs
\rho_{uncstart\_1032,1}.p1, 177).rem)._replace(p2 \rightarrow ((-35 * div(heapIs
$\text{heap}_{funcstart_1032.1}$, this.$\text{r.value}(\text{heapIs} \text{$heap}_{funcstart_1032.1}).p2$,
```

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176).quot) + (172 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.} \text{\$r.value}(\text{heapIs}))
\theta_{funcstart\_1032,1}.p2, 176).rem)))._replace(p3 \rightarrow
asType<P3Type>((30323 *
asType<int>(static_cast<integer>(static_cast<signed
int>(operator^*(heapIs $heap_{1032,1;1054,8}, this).p3) < (int)(0))) + temp3)))
\rightarrow [from term 57.33, $heap<sub>1032,1;1054,8</sub> is equal to
\$heap_{funcstart\_1032,1}.\_\textbf{replace}(\textbf{this.}\$r \rightarrow \textbf{this.}\$r.\textbf{value}(\textbf{heapIs}
heap_{funcstart\_1032,1}._replace(p1 \rightarrow ((-2 * div(heapIs $heap_{funcstart\_1032,1},
div(\mathbf{heapIs} \ \$heap_{funcstart\_1032,1}, \ \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
\theta_{funcstart\_1032,1}.p1, 177).rem)))).\_replace(this.\$r \rightarrow 0
this.$r.value(heapIs heap_{funcstart\_1032.1})._replace(p1 \rightarrow ((-2 * div(heapIs) + (-2 * div(heapIs) + (
heap_{funcstart\_1032,1}, this.r.value(heapIs heap_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(\mathbf{heapIs} \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}))
\$heap_{funcstart\_1032,1}).p1,\ 177).rem))).\_\mathbf{replace}(p2 \rightarrow (\text{-}35\ *\ div(\mathbf{heapIs}
heap_{funcstart\_1032,1}, this.r.value(heapIs heap_{funcstart\_1032,1}).p2,
176).quot) + (172 * div(heapIs $heap_{funcstart=1032.1}, this.$r.value(heapIs
heap_{funcstart\_1032,1}.p2, 176).rem)))]
[61.14] heap_{funcend\_1032,1} == heap_{funcstart\_1032,1}._replace(this.$r \rightarrow
\textbf{this.}\$r.\textbf{value}(\textbf{heapIs}~\$heap_{funcstart\_1032,1}).\_\textbf{replace}(p1 \rightarrow ((-2~*div(\textbf{heapIs})))))
\rho_{tuncstart\_1032.1}, this.r.value(heapIs \rho_{tuncstart\_1032.1}).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.} \text{\$r.value}(\text{heapIs}))
\label{eq:continuous_function} $ \text{heap}_{funcstart\_1032,1}.\text{p1},\ 177).\text{rem})))).$ \_\textbf{replace}(\textbf{this}.\$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{heap}_{funcstart\_1032,1}, \text{this.} \text{$r.value}(\text{heapIs}))
\rho_{uncstart\_1032,1}.p1, 177).rem))._replace(p2 \rightarrow ((-35 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p2,
176).quot) + (172 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.} \text{\$r.value}(\text{heapIs}))
\theta_{funcstart\_1032,1}.p2, 176).rem))))._replace(this.$r \rightarrow
\textbf{this.\$r.value}(\textbf{heapIs}~\$ heap_{funcstart\_1032,1}).\_\textbf{replace}(p1 \rightarrow ((-2~*div(\textbf{heapIs})))))
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{heap}_{funcstart\_1032,1}, \text{this.} \text{$r.value}(\text{heapIs}))
\rho_{funcstart\_1032,1}.p1, 177).rem))).\_replace(p2 \rightarrow ((-35 * div(heapIs)))._replace(p2 \rightarrow ((-35 * div(heapIs))))._replace(p3 + div(heapIs)))
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p2,
176).quot) + (172 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
\theta_{funcstart\_1032.1}, p2, 176).rem)))._replace(p3 \rightarrow
asType<P3Type>((30323 *
asType < int > (static\_cast < integer > (static\_cast < signed)
int>(operator^*(heapIs \ heap_{funcstart\_1032.1}.\_replace(this.\$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{tuncstart_{1032.1}}, this.r.value(heapIs \rho_{tuncstart_{1032.1}}).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.} \text{\$r.value}(\text{heapIs}))
\theta_{funcstart\_1032,1}.p1, 177).rem)))).\_replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\ 1032.1})._replace(p1 \rightarrow ((-2 * div(heapIs
```

```
\rho_{funcstart_1032,1}, this.\r.value(heapIs \rho_{funcstart_1032,1}).p1,
177).quot) + (171 * div(heapIs \theta_{funcstart\_1032,1}, this.r.value(heapIs)
\$heap_{funcstart\_1032,1}).p1,\,177).rem))).\_\mathbf{replace}(p2 \rightarrow (-35\ *\ div(\mathbf{heapIs}
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p2,
176).quot) + (172 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.}\text{\$r.value}(\text{heapIs}))
\text{Sheap}_{funcstart\_1032,1}.p2, 176).rem))), this).p3) < (int)0))) + temp3)))
→ [expand definition of operator '*' in class 'pointer' at built in declaration]
[61.15] heap_{funcend\_1032,1} == heap_{funcstart\_1032,1}._replace(this.$r \rightarrow
\textbf{this.}\$r.\textbf{value}(\textbf{heapIs}~\$\text{heap}_{funcstart\_1032,1}).\_\textbf{replace}(\text{p1} \rightarrow ((\text{-2}~*\text{div}(\textbf{heapIs}~
\$heap_{funcstart\_1032,1},\, \textbf{this}.\$r.\textbf{value}(\textbf{heapIs}\,\,\$heap_{funcstart\_1032.1}).p1,
177).quot) + (171 * div(\mathbf{heapIs} \$ heap_{funcstart\_1032,1}, \mathbf{this}.\$ r. \mathbf{value}(\mathbf{heapIs})
\theta_{tuncstart\_1032,1}.p1, 177).rem)))).\_replace(this.\$r \rightarrow
this.$r.value(heapIs p_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
\rho_{funcstart\_1032,1}.p1, 177).rem))._replace(p2 \rightarrow ((-35 * div(heapIs
\rho_{funcstart\_1032,1}, this. r.value(heapIs \rho_{funcstart\_1032,1}).p2,
176).quot) + (172 * div(heapIs $heap<sub>funcstart_1032.1</sub>, this.$r.value(heapIs
\theta_{funcstart\_1032,1}.p2, 176).rem)))).\_replace(this.\$r \rightarrow 0
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{tuncstart\_1032.1}, this.r.value(heapIs \rho_{tuncstart\_1032.1}).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.} \text{\$r.value}(\text{heapIs}))
\rho_{uncstart\_1032,1}.p1, 177).rem))).\_replace(p2 \rightarrow ((-35 * div(heapIs)))._replace(p2 \rightarrow ((-35 * div(heapIs))))._replace(p3 \rightarrow ((-35 * div(heapIs)))))
\rho_{funcstart_1032,1}, this. r.value(heapIs \rho_{funcstart_1032,1}).p2,
176).quot) + (172 * div(heapIs $heap<sub>funcstart_1032.1</sub>, this.$r.value(heapIs
\theta_{funcstart\_1032,1}.p2, 176).rem))._replace(p3 \rightarrow
asType<P3Type>((30323 *
asType{<}int{>}(static\_cast{<}integer{>}(static\_cast{<}signed
int>(this.r.value(heapIs \ heap_{funcstart \ 1032.1}.\_replace(this.\rdots \ )
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
\theta_{funcstart\_1032,1}.p1, 177).rem)))).replace(this.r \rightarrow 0
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(\mathbf{heapIs} \ \$heap_{funcstart\_1032,1}, \ \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
\rho_{uncstart\_1032,1}.p1, 177).rem))._replace(p2 \rightarrow ((-35 * div(heapIs
\rho_{funcstart\_1032,1}, this. r.value(heapIs \rho_{funcstart\_1032,1}).p2,
176).quot) + (172 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
\theta_{funcstart\_1032,1}.p2, 176).rem)))).p3) < (int)0))) + temp3)))
\rightarrow [evaluate dereferenced pointer into modified heap]
[61.16] $heap<sub>funcend_1032,1</sub> == $heap<sub>funcstart_1032,1</sub>._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032.1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{tuncstart_{1032.1}}, this. r.value(heapIs \rho_{tuncstart_{1032.1}}).p1,
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177).quot) + (171 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.} \text{\$r.value}(\text{heapIs}))
\theta_{funcstart\_1032,1}.p1, 177).rem))))._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.}\text{\$r.value}(\text{heapIs}))
\rho_{tuncstart\_1032,1}.p1, 177).rem))._replace(p2 \rightarrow ((-35 * div(heapIs
$heap_funcstart_1032,1, this.$r.value(heapIs $heap_funcstart_1032,1).p2,
176).quot) + (172 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032.1}, \text{this.} \text{\$r.value}(\text{heapIs}))
\theta_{tuncstart\_1032,1}.p2, 176).rem)))._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs \rho_{funcstart\_1032,1}, this.r.value(heapIs)
\rho_{uncstart\_1032,1}.p1, 177).rem))._replace(p2 \rightarrow ((-35 * div(heapIs
\rho_{uncstart\_1032,1}, this.r.value(heapIs \rho_{uncstart\_1032,1}).p2,
176).quot) + (172 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
\theta_{funcstart\_1032,1}.p2, 176).rem))).\_replace(p3 \rightarrow
asType<P3Type>((30323 *
asType < int > (static\_cast < integer > (static\_cast < signed\ int > (([this.\$r
== this.$r]: this.$r.value(heapIs \rho_{tuncstart\_1032.1})._replace(p1 \rightarrow ((-2
* div(heapIs $heap<sub>funcstart 1032.1</sub>, this.$r.value(heapIs
\text{Sheap}_{funcstart\_1032,1}.p1, 177).quot) + (171 * div(heapIs \text{Sheap}_{funcstart\_1032,1},
this.r.value(heapIs \ heap_{funcstart\_1032.1}).p1, 177).rem))).\_replace(p2 \rightarrow
(-35 * div(heapIs \$heap_{funcstart\_1032.1}, this.\$r.value(heapIs
\text{Sheap}_{funcstart\_1032,1}.p2, 176).quot) + (172 * div(heapIs \text{Sheap}_{funcstart\_1032,1},
this.r.value(heapIs $heap_{funcstart\_1032,1}).p2, 176).rem)), []:
this.$r.value(heapIs \theta_{funcstart\_1032,1}._replace(this.$r \to
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow (-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs \theta), this.$r.value(heapIs
\text{Sheap}_{funcstart\_1032.1}.p1, 177).rem)))).p3) < (int)0))) + temp3)))
→ [explicitly assert falsehood of skipped guards in subsequent guards]
[61.17] heap_{funcend\_1032,1} == heap_{funcstart\_1032,1}._replace(this.$r \rightarrow
\textbf{this.\$r.value}(\textbf{heapIs}~\$ heap_{funcstart\_1032,1}).\_\textbf{replace}(p1 \rightarrow ((-2~*div(\textbf{heapIs})))))
\rho_{funcstart_{-1032,1}}, this. r.value(heapIs \rho_{funcstart_{-1032,1}}).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.}\text{\$r.value}(\text{heapIs}))
\theta_{funcstart\_1032,1}.p1, 177).rem))))._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032.1})._replace(p1 \rightarrow ((-2 * div(heapIs
\$heap_{funcstart\_1032,1},\, \textbf{this}.\$r.\textbf{value}(\textbf{heapIs}\,\,\$heap_{funcstart\_1032,1}).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.} \text{\$r.value}(\text{heapIs}))
\label{eq:local_problem} $\operatorname{heap}_{funcstart\_1032,1}).p1,\ 177).rem))).$\_\mathbf{replace}(p2 \to ((-35\ *\ \mathrm{div}(\mathbf{heapIs}
\rho_{tuncstart\_1032.1}, this.r.value(heapIs \rho_{tuncstart\_1032.1}).p2,
176).quot) + (172 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
\label{eq:continuous_function} $ \text{heap}_{funcstart\_1032,1} . \text{p2}, \ 176).rem)))).$ \_\textbf{replace}(\textbf{this}.\$r \rightarrow
this.$r.value(heapIs $heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
```

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177).quot) + (171 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.} \text{\$r.value}(\text{heapIs}))
\rho_{funcstart\_1032,1}.p1, 177).rem)._replace(p2 \rightarrow ((-35 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p2,
176).quot) + (172 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.} \text{\$r.value}(\text{heapIs}))
\theta_{funcstart\_1032,1}.p2, 176).rem))._replace(p3 \rightarrow
asType<P3Type>((30323 *
asType<int>(static_cast<integer>(static_cast<signed int>(([this.$r
== this.$r]: this.$r.value(heapIs \rho_{tuncstart=1032.1})._replace(p1 \rightarrow ((-2)
* div(heapIs $heap<sub>funcstart_1032.1</sub>, this.$r.value(heapIs
\text{Sheap}_{funcstart\_1032,1}).p1, 177).quot) + (171 * div(heapIs \text{Sheap}_{funcstart\_1032,1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177).rem))).\_replace(p2 \rightarrow
(-35 * div(\mathbf{heapIs} \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}))
\text{Sheap}_{funcstart\_1032,1}.p2, 176).quot) + (172 * div(heapIs \text{Sheap}_{funcstart\_1032,1},
this.r.value(heapIs \ensuremath{\$}heap_{funcstart\_1032,1}).p2, 176).rem)), [!(this.\ensuremath{\$}r ==
this.$r.value(heapIs \rho_{funcstart\_1032,1}._replace(this.$r \rightarrow
this.$r.value(heapIs heapIs_{funcstart\_1032,1})._replace(p1 \rightarrow (-2 * div(heapIs
\rho_{tuncstart\_1032.1}, this.r.value(heapIs \rho_{tuncstart\_1032.1}).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.\$r.value}(\text{heapIs}))
\theta_{funcstart_1032,1}.p1, 177.rem)))).p3) < (int)0))) + temp3))
\rightarrow [simplify]
[61.25] heap_{funcend\_1032.1} == heap_{funcstart\_1032.1}._replace(this.r \rightarrow
this.$r.value(heapIs $heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.\r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(\mathbf{heapIs} \ \$heap_{funcstart\_1032,1}, \ \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
\theta_{tuncstart_1032.1}.p1, 177.rem)))._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
\rho_{uncstart\_1032,1}.p1, 177).rem))._replace(p2 \rightarrow ((-35 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p2,
176).quot) + (172 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
\theta_{funcstart\_1032,1}.p2, 176).rem)))).replace(this.r \rightarrow 0
this.$r.value(heapIs $heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.} \text{\$r.value}(\text{heapIs}))
\rho_{uncstart\_1032,1}.p1, 177).rem))._replace(p2 \rightarrow ((-35 * div(heapIs
\rho_{tuncstart\_1032.1}, this.r.value(heapIs \rho_{tuncstart\_1032.1}).p2,
176).quot) + (172 * div(\mathbf{heapIs} \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}))
\theta_{funcstart\_1032,1}.p2, 176).rem))).\_replace(p3 \rightarrow
\mathbf{asType} \hspace{-0.5mm} < \hspace{-0.5mm} \text{P3Type} \hspace{-0.5mm} > \hspace{-0.5mm} ((30323 * \mathbf{asType} \hspace{-0.5mm} < \hspace{-0.5mm} \mathbf{int} \hspace{-0.5mm} > \hspace{-0.5mm} (\mathbf{static\_cast} \hspace{-0.5mm} < \hspace{-0.5mm} \mathbf{int} \hspace{-0.5mm} < \hspace{-0.5mm} (\mathbf{static\_cast} \hspace{-0.5mm} < \hspace{-0.5mm} \mathbf{int} \hspace{-0.5mm} > \hspace{-0.5mm} (\mathbf{static\_cast} \hspace{-0.5mm} < \hspace{-0.5mm} < \hspace{-0.5mm} < \hspace{-0.5mm} < \hspace{-0.5mm} > \hspace{-0.5mm} (\mathbf{static\_cast} \hspace{-0.5mm} < \hspace{-0.
-this.$r.value(heapIs $heap<sub>funcstart_1032,1</sub>).p3))) + temp3)))
\rightarrow [from term 40.0, literala < -this.$r.value(heapIs $heap_{funcstart\_1032,1}).p3
is false whenever -2 < (0 + literala)
```

Proof of rule precondition:

```
\rightarrow [simplify]
    [61.25.2] true
[61.26] $heap<sub>funcend_1032,1</sub> == $heap<sub>funcstart_1032,1</sub>._replace(this.$r \rightarrow
this.$r.value(heapIs \rho_{uncstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs)
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
\label{eq:heap_funcstart_1032,1} $$ \text{heap}_{funcstart_1032,1}.\text{p1},\ 177).rem)))).$$ \_\textbf{replace}(\textbf{this}.\$r \rightarrow \texttt{replace}(\textbf{this}))) > \texttt{replace}(\texttt{this}).
this.$r.value(heapIs \theta_{funcstart=1032,1})._replace(p1 \theta ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.} \text{\$r.value}(\text{heapIs}))
\rho_{funcstart\_1032,1}.p1, 177).rem))._replace(p2 \rightarrow ((-35 * div(heapIs
\theta_{funcstart\_1032,1}, this.r.value(\theta_{funcstart\_1032,1}).p2,
176).quot) + (172 * div(heapIs $heap<sub>funcstart_1032.1</sub>, this.$r.value(heapIs
\theta_{funcstart\_1032,1}.p2, 176).rem))))._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this. r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{heap}_{funcstart\_1032.1}, \text{this.} \text{$r.value}(\text{heapIs}))
heap_{funcstart\_1032,1}.p1, 177.rem)._replace(p2 \rightarrow ((-35 * div(heapIs)
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p2,
176).quot) + (172 * div(heapIs \theta_{funcstart\_1032,1}, this.r.value(heapIs)
\theta_{funcstart\_1032,1}.p2, 176).rem))._replace(p3 \rightarrow
\mathbf{asType} \hspace{-0.05cm} < \hspace{-0.05cm} P3 \\ \text{Type} \hspace{-0.05cm} > \hspace{-0.05cm} ((30323 * \mathbf{asType} \hspace{-0.05cm} < \hspace{-0.05cm} \mathbf{int} \hspace{-0.05cm} > \hspace{-0.05cm} (\mathbf{static\_cast} \hspace{-0.05cm} < \hspace{-0.05cm} \mathbf{integer} \hspace{-0.05cm} > \hspace{-0.05cm} (\mathbf{false})))
+ \text{ temp3})))
\rightarrow [simplify]
[61.27] heap_{funcend\_1032,1} == heap_{funcstart\_1032,1}._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs \theta_{funcstart\_1032,1}, this.r.value(heapIs)
\theta_{tuncstart\_1032,1}.p1, 177).rem)))).\_replace(this.\$r \rightarrow
this.$r.value(heapIs \rho_{uncstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs)
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{heap}_{funcstart\_1032,1}, \text{this.} \text{$r.value}(\text{heapIs}))
\rho_{funcstart\_1032,1}.p1, 177).rem)._replace(p2 \rightarrow ((-35 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p2,
176).quot) + (172 * div(\mathbf{heapIs} \ \$heap_{funcstart\_1032,1}, \ \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
\theta_{funcstart\_1032,1}.p2, 176).rem))))._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\$heap_{funcstart\_1032,1},\, \textbf{this.} \$r. \textbf{value} (\textbf{heapIs} \,\,\$heap_{funcstart\_1032,1}).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.} \text{\$r.value}(\text{heapIs}))
heap_{funcstart\_1032,1}.p1, 177).rem)._replace(p2 \rightarrow ((-35 * div(heapIs)))._replace)
\rho_{funcstart_1032,1}, this. r.value(heapIs \rho_{funcstart_1032,1}).p2,
176).quot) + (172 * div(heapIs $heap<sub>funcstart_1032.1</sub>, this.$r.value(heapIs
```

[61.25.0] - 2 < (0 + 0)

```
\theta_{funcstart\_1032,1}.p2, 176).rem))).\_replace(p3 \rightarrow
\mathbf{asType} \!\! < \!\! \mathrm{P3Type} \!\! > \!\! ((30323 * \mathbf{asType} \!\! < \!\! \mathbf{int} \!\! > \!\! (([\mathbf{false}]\! : 1, \, []\! : \, 0))) + \mathrm{temp3})))
→ [explicitly assert falsehood of skipped guards in subsequent guards]
[61.28] heap_{funcend\_1032,1} == heap_{funcstart\_1032,1}._replace(this.$r \rightarrow
\textbf{this.}\$r.\textbf{value}(\textbf{heapIs}~\$heap_{funcstart\_1032,1}).\_\textbf{replace}(p1 \rightarrow ((-2~*div(\textbf{heapIs}
\rho_{funcstart=1032,1}, this.r.value(heapIs \rho_{funcstart=1032,1}).p1,
177).quot) + (171 * div(heapIs $heap<sub>funcstart_1032,1</sub>, this.$r.value(heapIs
\theta_{funcstart\_1032,1}.p1, 177).rem))))._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(\mathbf{heapIs} \$ heap_{funcstart\_1032,1}, \mathbf{this}.\$ r. \mathbf{value}(\mathbf{heapIs})
\$heap_{funcstart\_1032,1}).p1,\ 177).rem))).\_replace(p2 \rightarrow ((-35 * div(\textbf{heapIs}) + (-35 * div(\textbf{heapI
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p2,
176).quot) + (172 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
\theta_{funcstart\_1032,1}.p2, 176).rem)))).replace(this.r \rightarrow 0
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.} \text{\$r.value}(\text{heapIs}))
\rho_{funcstart\_1032,1}.p1, 177).rem))._replace(p2 \rightarrow ((-35 * div(heapIs
\rho_{funcstart\_1032,1}, this. r.value(heapIs \rho_{funcstart\_1032,1}).p2,
176).quot) + (172 * div(heapIs $heap<sub>funcstart_1032.1</sub>, this.$r.value(heapIs
\theta_{funcstart\_1032.1}, p2, 176).rem)))._replace(p3 \rightarrow
asType<P3Type>((30323 * asType<int>(([false]: 1, [true]: 0))) +
temp3)))
\rightarrow [simplify]
[61.31] heap_{funcend\_1032,1} == heap_{funcstart\_1032,1}._replace(this.$r \rightarrow
\mathbf{this.\$r.value}(\mathbf{heapIs}\ \$ \mathrm{heap}_{funcstart\_1032,1}).\_\mathbf{replace}(\mathrm{p1} \to ((\text{-}2\ *\ \mathrm{div}(\mathbf{heapIs}\ 
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.} \text{\$r.value}(\text{heapIs}))
\theta_{funcstart\_1032,1}.p1, 177).rem)))).\_replace(this.\$r \rightarrow 0
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\$heap_{funcstart\_1032,1},\, \textbf{this}.\$r.\textbf{value}(\textbf{heapIs}\,\,\$heap_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(\mathbf{heapIs} \ \$heap_{funcstart\_1032,1}, \ \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
\rho_{funcstart\_1032,1}.p1, 177).rem)._replace\rho_{funcstart\_1032,1}.p1, 177).rem)._replace
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p2,
176).quot) + (172 * div(heapIs \rho_{funcstart\_1032,1}, this.r.value(heapIs)
\theta_{funcstart\_1032,1}.p2, 176).rem)))._replace(this.$r \rightarrow
this.$r.value(heapIs p_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\$heap_{funcstart\_1032,1},\, \textbf{this}.\$r.\textbf{value}(\textbf{heapIs}\,\,\$heap_{funcstart\_1032,1}).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.} \text{\$r.value}(\text{heapIs}))
\rho_{funcstart\_1032,1}.p1, 177).rem))).\_replace(p2 \rightarrow ((-35 * div(heapIs)))._replace(p2 \rightarrow ((-35 * div(heapIs))))._replace(p2 \rightarrow ((-35 * div(heapIs)))))._replace(p3 * div(heapIs))))
\rho_{tuncstart\_1032.1}, this.r.value(heapIs \rho_{tuncstart\_1032.1}).p2,
176).quot) + (172 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032.1}, \text{this.} \text{\$r.value}(\text{heapIs}))
\rho_{funcstart\_1032,1}.p2, 176).rem))._replace(p3 \rightarrow asType<P3Type>(0 +
```

```
temp3)))
\rightarrow [from term 58.20, temp3 is equal to (-63 * div(heapIs $heap_{funcstart\_1032,1},
this.$r.value(heapIs heap_{funcstart\_1032,1}).p3, 178).quot) + (170 *
div(\mathbf{heapIs} \ \$heap_{funcstart\_1032,1}, \ \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
heap_{funcstart_{1032.1}}.p3, 178).rem
[61.32] heap_{funcend\_1032,1} == heap_{funcstart\_1032,1}._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
\theta_{tuncstart\ 1032.1}.p1,\ 177.rem)))._replace(this.r \rightarrow
this.$r.value(heapIs \frac{1}{2} heap\frac{1}{2} heap\frac{1}{2}
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs $heap<sub>funcstart_1032,1</sub>, this.$r.value(heapIs
\rho_{uncstart\_1032,1}.p1, 177).rem))).\_replace(p2 \rightarrow ((-35 * div(heapIs)))._replace(p2 \rightarrow ((-35 * div(heapIs))))._replace(p3 + div(heapIs)))
\rho_{funcstart_{-1032,1}}, this. r.value(heapIs \rho_{funcstart_{-1032,1}}).p2,
176).quot) + (172 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
\theta_{funcstart\_1032,1}.p2, 176).rem))))._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.\r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs \theta_{funcstart\_1032,1}, this.r.value(heapIs)
\theta_{funcstart\_1032,1}.p1, 177).rem))._replace(p2 \rightarrow ((-35 * div(heapIs
\rho_{tuncstart\_1032.1}, this.r.value(heapIs \rho_{tuncstart\_1032.1}).p2,
176).quot) + (172 * div(\mathbf{heapIs} \ \$heap_{funcstart\_1032,1}, \ \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
\rho_{uncstart\_1032,1}.p2, 176).rem))._replace(p3 \rightarrow asType<P3Type>(0 +
((-63 * div(heapIs \$heap_{funcstart\_1032.1}, this.\$r.value(heapIs))
\text{Sheap}_{funcstart\_1032,1}.\text{p3}, 178).\text{quot} + (170 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_1032,1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p3, 178).rem)))))
\rightarrow [simplify]
[61.35] heap_{funcend\_1032,1} == heap_{funcstart\_1032,1}._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
\theta_{tuncstart\_1032,1}.p1, 177).rem)))).\_replace(this.\$r \rightarrow
this.$r.value(heapIs p_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs \theta_{funcstart\_1032,1}, this.r.value(heapIs)
\rho_{uncstart\_1032,1}.p1, 177).rem))).\_replace(p2 \rightarrow ((-35 * div(heapIs)))._replace(p2 \rightarrow ((-35 * div(heapIs))))._replace(p3 + div(heapIs)))
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p2,
176).quot) + (172 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.}\text{\$r.value}(\text{heapIs}))
\theta_{funcstart\_1032,1}.p2, 176).rem)))).replace(this.r \rightarrow 0
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
$\text{heap}_{funcstart_1032.1}$, this.$\text{r.value}(\text{heapIs} \text{$heap}_{funcstart_1032.1}).p1,
177).quot) + (171 * div(heapIs $heap<sub>funcstart_1032.1</sub>, this.$r.value(heapIs
\rho_{funcstart\_1032,1}.p1, 177).rem))._replace(p2 \rightarrow ((-35 * div(heapIs
```

```
\rho_{tuncstart=1032.1}, this.r.value(heapIs \rho_{tuncstart=1032.1}).p2,
176).quot) + (172 * div(heapIs \theta), this.$r.value(heapIs
\rho_{uncstart\_1032,1}.p2, 176).rem))._replace(p3 \rightarrow ((-63 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p3,
178).quot) + (170 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.}\text{\$r.value}(\text{heapIs}))
heap_{funcstart_{1032,1}}.p3, 178).rem)))
[Take goal term]
[1.0]!(0.0 ==
asType<double>(static_cast<real>($heap_{tuncend_1032.1}.M1)))
\rightarrow [from term 61.35, $heap_{funcend\_1032,1}$ is equal to
$heap_{funcstart\_1032,1}.$_replace(this.$r \rightarrow this.$r.value(heapIs)
heap_{funcstart\_1032,1}._replace(p1 \rightarrow ((-2 * div(heapIs heap_{funcstart\_1032,1}),
this.r.value(heapIs \ \ heap_{funcstart\_1032.1}).p1, 177).quot) + (171 *
div(\mathbf{heapIs} \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
\theta_{funcstart\_1032,1}.p1, 177).rem)))).\_replace(this.\$r \rightarrow 0
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs)
heap_{funcstart\_1032,1}, this.r.value(heapIs heap_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs $heap_{tuncstart\_1032.1}, this.$r.value(heapIs
\rho_{tuncstart\_1032,1}.p1, 177).rem))._replace\rho_{tuncstart\_1032,1}.p1, 177).rem))
heap_{funcstart\_1032,1}, this.r.value(heapIs heap_{funcstart\_1032,1}).p2,
(176).quot) + (172*div(\mathbf{heapIs} \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}))
\theta_{tuncstart\_1032,1}.p2, 176).rem)))).\_replace(this.\$r \rightarrow 0
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
heap_{funcstart\_1032,1}, this.r.value(heapIs heap_{funcstart\_1032,1}).p1,
(177).quot) + (171 * div(\mathbf{heapIs} \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}))
\rho_{funcstart\_1032,1}.p1, 177).rem)))._replace\rho_{funcstart\_1032,1}.p1, 177).rem)))._replace
$heap_{funcstart\_1032,1}$, this. $r.value(heapIs $heap_{funcstart\_1032,1}).p2$,
(176).quot) + (172*div(\textbf{heapIs} \$heap_{funcstart\_1032,1}, \textbf{this}.\$r.\textbf{value}(\textbf{heapIs}))
heap_{funcstart\_1032,1}.p2, 176).rem))).\_replace(p3 \rightarrow (-63 * div(heapIs))).
$heap_tuncstart_1032.1, this.$r.value(heapIs $heap_tuncstart_1032.1).p3,
178).quot) + (170 * div(heapIs \$heap_{funcstart\_1032,1}, this.\$r.value(heapIs))
heap_{funcstart\_1032,1}.p3, 178.rem)))
[1.1] !(0.0 ==
\mathbf{asType} \small{<} \mathbf{double} \small{>} (\mathbf{static\_cast} \small{<} \mathbf{real} \small{>} (\$ \mathbf{heap}_{funcstart\_1032,1}. \mathbf{\_replace} (\mathbf{this}.\$ \mathbf{replace}))
\rightarrow this.$r.value(heap
Is $heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 *
{\rm div}(\mathbf{heapIs}~\$\mathrm{heap}_{funcstart\_1032,1},~\mathbf{this}.\$\mathrm{r.value}(\mathbf{heapIs}
\text{Sheap}_{funcstart\_1032,1}.p1, 177).quot) + (171 * div(heapIs \text{Sheap}_{funcstart\_1032,1},
this.r.value(heapIs \ensuremath{\$heap}_{funcstart\_1032,1}).p1, 177).rem)))).\_replace(this.\$r)
\rightarrow this.$r.value(heapIs $heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 *
div(\mathbf{heapIs} \$ heap_{funcstart\_1032.1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
\text{Sheap}_{funcstart\_1032.1}.p1, 177).quot) + (171 * div(heapIs \text{Sheap}_{funcstart\_1032.1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177).rem))).\_replace(p2 \rightarrow
((-35 * div(\mathbf{heapIs} \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}))
\text{Sheap}_{funcstart\_1032.1}.p2, 176).quot) + (172 * div(heapIs \text{Sheap}_{funcstart\_1032.1},
```

```
\mathbf{this.\$r.value(heapIs\ \$heap}_{funcstart\_1032,1}).p2,\ 176).rem)))).\_\mathbf{replace(this.\$r}
\rightarrow this.$r.value(heap
Is \rho_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 *
div(\mathbf{heapIs} \$ heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
\text{Sheap}_{funcstart\_1032,1}.p1, 177).quot) + (171 * div(heapIs \text{Sheap}_{funcstart\_1032,1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177).rem))).\_replace(p2 \rightarrow
((-35 * div(heapIs \$heap_{funcstart\_1032,1}, this.\$r.value(heapIs
\rho_{tuncstart_{1032.1}, p2, 176} = 176, quot \rho_{tuncstart_{1032.1}, p3} + 176
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p2, 176).rem))).\_replace(p3 \rightarrow
((-63 * div(heapIs \$heap_{funcstart\_1032,1}, this.\$r.value(heapIs
\rho_{tuncstart_{-1032.1}, p3, 178} = (170 * div(heapIs $heap_{tuncstart_{-1032.1}, p3, 178})
\mathbf{this.\$r.value(heapIs}\ \$heap_{funcstart\_1032,1}).p3,\ 178).rem)))).M1)))
→ [const member of object with modified fields]
asType < double > (static\_cast < real > (\$heap_{funcstart\_1032,1}.M1)))
\rightarrow [const static or extern object]
[1.5]!(0.0 == asType < double > (static_cast < real > ($heap_{init}.M1)))
→ [expand definition of constant 'M1' at prang.cpp (28,26)]
[1.6]!(0.0 == asType < double > (static_cast < real > ((int)30269)))
\rightarrow [simplify]
[1.12] true
Proof of verification condition: Precondition of 'operator /' satisfied
In the context of class: WHPrang, declared at:
C:\Escher\Customers\prang-cpp\prang.cpp (18,1)
Condition generated at: C:\Escher\Customers\prang-cpp\prang.cpp
(89,30)
Condition defined at: built in declaration
To prove: !(0.0 ==
asType<double>(static_cast<real>($heap_{funcend_1032.1}.M2)))
Given:
heap_{init}.LIMIT == (int)80
heap_{init}.class WHPrang \in M1 == (int)30269
heap_{init}.class WHPrang \in r1 == (int)171
heap_{init}.class WHPrang \in a1 == (int)177
heap_{init}.class WHPrang \in b1 == (int)2
heap_{init}.class WHPrang \in M2 == (int)30307
heap_{init}.class WHPrang \in r2 == (int)172
```

```
heap_{init}.class WHPrang \in a2 == (int)176
heap_{init}.class WHPrang \in b2 == (int)35
\text{$heap}_{init}.\mathbf{class} \text{ WHPrang} \in M3 == (\mathbf{int})30323
heap_{init}.class WHPrang \in r3 == (int)170
heap_{init}.class WHPrang \in a3 == (int)178
heap_{init}.class WHPrang \in b3 == (int)63
\operatorname{div1} == \operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_1032,1},
static\_cast < int > (operator*(heapIs $heap_{funcstart\_1032,1}, this).p1),
static\_cast < int > (\$heap_{funcstart\_1032,1}.a1))
(asType<integer>(static_cast<int>(operator*(heapIs
heap_{funcstart\_1032,1}, this).p1)) /
\mathbf{asType} {<} \mathbf{integer} {>} (\mathbf{static\_cast} {<} \mathbf{int} {>} (\$ \mathbf{heap}_{funcstart\_1032,1}.\mathbf{a1}))) = =
asType<integer>(div1.quot)
(asType < integer > (static\_cast < int > (operator*(heapIs)))
heap_{funcstart\_1032.1}, this).p1)
asType < integer > (static\_cast < int > (\$heap_{funcstart\_1032.1}.a1))) = =
asType<integer>(div1.rem)
(asType<integer>(operator*(heapIs $heap_{funcstart\_1032,1}, this).p1) <
asType < integer > (\$heap_{funcstart\_1032,1}.a1)) = >
(asType<integer>(div1.rem) == asType<integer>(operator*(heapIs
heap_{funcstart\_1032,1}, this).p1)
(\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathsf{heap}_{funcstart\_1032,1}.\mathsf{a1}) \leq
asType < integer > (operator*(heapIs $heap_{funcstart\_1032,1}, this).p1)) = (operator*(heapIs $heap_{funcstart\_1032,1}, this)) = (operator*(heapIs $heap_{funcstart\_1032,1}, this))) = (operator*(heapIs $heap_{funcstart\_1032,1}, this)))) = (operator*(heapIs $heap_{funcst
!(0 == asType < integer > (div1.quot))
!(0 == asType < integer > (div1.rem)) || !(0 ==
asType<integer>(div1.quot))
\operatorname{div2} == \operatorname{div}(\mathbf{heapIs} \ \operatorname{\$heap}_{funcstart\_1032,1},
\mathbf{static\_cast} < \mathbf{int} > (\mathbf{operator}^*(\mathbf{heapIs}\ \$ \mathbf{heap}_{funcstart\_1032,1},\ \mathbf{this}).\mathbf{p2}),
\mathbf{static\_cast}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_1032,1}.\mathrm{a2}))
(asType<integer>(static_cast<int>(operator*(heapIs
heap_{funcstart\_1032,1}, this).p2)) /
\mathbf{asType} < \mathbf{integer} > (\mathbf{static\_cast} < \mathbf{int} > (\$ \mathbf{heap}_{funcstart\_1032,1}.\mathbf{a2}))) = =
asType<integer>(div2.quot)
(asType < integer > (static\_cast < int > (operator*(heapIs
heap_{funcstart\_1032.1}, this).p2)
asType < integer > (static\_cast < int > (\$heap_{funcstart\_1032.1}.a2))) = =
asType<integer>(div2.rem)
(\mathbf{asType} < \mathbf{integer} > (\mathbf{operator}^*(\mathbf{heapIs}\ \$ \mathbf{heap}_{funcstart\_1032,1},\ \mathbf{this}).\mathtt{p2}) <
asType < integer > (\$heap_{funcstart\_1032,1}.a2)) = >
```

```
(asType<integer>(div2.rem) == asType<integer>(operator*(heapIs
heap_{funcstart\_1032,1}, this).p2)
(asType < integer > (\$heap_{funcstart\_1032,1}.a2) \le
asType < integer > (operator*(heapIs $heap_{funcstart\_1032,1}, this).p2)) = >
!(0 == asType < integer > (div2.quot))
!(0 == asType < integer > (div2.rem)) || !(0 ==
asType<integer>(div2.quot))
div3 == div(\mathbf{heapIs} \$heap_{funcstart\_1032,1},
\mathbf{static\_cast} < \mathbf{int} > (\mathbf{operator}^*(\mathbf{heapIs}\ \$ \mathbf{heap}_{funcstart\_1032,1},\ \mathbf{this}).\mathbf{p3}),
\mathbf{static\_cast}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_1032,1}.\mathrm{a3}))
(\mathbf{asType} {<} \mathbf{integer} {>} (\mathbf{static\_cast} {<} \mathbf{int} {>} (\mathbf{operator}^* (\mathbf{heapIs}
heap_{funcstart_1032,1}, this).p3) /
asType < integer > (static\_cast < int > (\$heap_{funcstart\_1032,1}.a3))) = =
asType<integer>(div3.quot)
(asType < integer > (static\_cast < int > (operator*(heapIs)))
heap_{funcstart\_1032.1}, this).p3)
asType < integer > (static\_cast < int > (\$heap_{funcstart\_1032.1}.a3))) = =
asType<integer>(div3.rem)
(\mathbf{asType}{<}\mathbf{integer}{>}(\mathbf{operator}^*(\mathbf{heapIs}\ \$\mathbf{heap}_{funcstart\_1032,1},\ \mathbf{this}).\mathrm{p3}) <
asType < integer > ($heap_{funcstart\_1032,1}.a3)) =>
(asType<integer>(div3.rem) == asType<integer>(operator*(heapIs
heap_{funcstart\_1032,1}, this).p3)
(asType < integer > (\$heap_{funcstart\_1032,1}.a3) \le
\mathbf{asType} < \mathbf{integer} > (\mathbf{operator}^*(\mathbf{heapIs} \ \$ \mathbf{heap}_{funcstart\_1032,1}, \ \mathbf{this}).\mathtt{p3})) = >
!(0 == asType < integer > (div3.quot))
!(0 == asType < integer > (div3.rem)) || !(0 ==
asType<integer>(div3.quot))
temp1 == (\$heap_{tuncstart\_1032.1}.r1 * static\_cast < signed int > (div1.rem)) -
($heap_funcstart_1032.1.b1 * static_cast<signed int>(div1.quot))
minof(signed\ int) \le temp1
temp1 \le maxof(signed int)
heap_{1032,1;1051,8} == heap_{funcstart\_1032,1}._replace(this.$r \rightarrow
operator*(heapIs heap_{funcstart\_1032.1}, this)._replace(p1 \rightarrow
asType<P1Type>(($heap<sub>funcstart</sub> 1032.1.M1 *
asType<int>(static_cast<integer>(static_cast<signed
int>(operator^*(heapIs \$heap_{funcstart\_1032,1}, this).p1) < (int)0))) +
temp1)))
temp2 == (\$heap_{1032,1;1051,8}.r2 * static\_cast < signed int > (div2.rem)) -
(\text{sheap}_{1032,1;1051,8}.\text{b2} * \text{static\_cast} < \text{signed int} > (\text{div2.quot}))
minof(signed int) \le temp2
```

```
temp2 < maxof(signed int)
\theta_{1032,1;1054,8} == \theta_{1032,1;1051,8}. replace(this.$r \to
operator*(heapIs heap_{1032,1;1051,8}, this)._replace(p2 \rightarrow
asType<P2Type>(($heap<sub>1032,1:1051.8</sub>.M2 *
asType<int>(static_cast<integer>(static_cast<signed
int>(operator^*(heapIs $heap_{1032,1;1051,8}, this).p2) < (int)0))) + temp2)))
temp3 == (\$heap_{1032,1;1054,8}.r3 * \mathbf{static\_cast} < \mathbf{signed\ int} > (div3.rem)) -
(\$heap_{1032,1;1054,8}.b3 * \mathbf{static\_cast} < \mathbf{signed\ int} > (\texttt{div}3.\texttt{quot}))
minof(signed\ int) \le temp3
temp3 \le maxof(signed\ int)
heap_{funcend\_1032,1} == heap_{1032,1;1054,8}._replace(this.$r \rightarrow
operator*(heapIs heap_{1032,1;1054,8}, this)._replace(p3 \rightarrow
asType<P3Type>(($heap<sub>1032,1;1054,8</sub>.M3 *
asType<int>(static_cast<integer>(static_cast<signed
int > (operator^*(heapIs \$heap_{1032,1;1054,8}, this).p3) < (int)0))) + temp3)))
raux1 == asType<double>(static_cast<real>(operator*(heapIs
heap_{funcend_{-1032.1}}, this).p1) /
asType < double > (static\_cast < real > ($heap_{funcend\_1032,1}.M1))
Proof:
[Take given term]
[2.0] \operatorname{div1} == \operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_1032,1},
\mathbf{static\_cast} < \mathbf{int} > (\mathbf{operator}^*(\mathbf{heapIs} \ \$ \mathbf{heap}_{funcstart\_1032,1}, \ \mathbf{this}).\mathtt{p1}),
static\_cast < int > (\$heap_{funcstart\_1032,1}.a1))
→ [expand definition of operator '*' in class 'pointer' at built in declaration]
[2.1] \operatorname{div1} == \operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_1032,1},
\mathbf{static\_cast} < \mathbf{int} > (\mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs} \$ \mathbf{heap}_{funcstart\_1032,1}).\mathbf{p1}),
\mathbf{static\_cast}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_1032,1}.\mathrm{a1}))
\rightarrow [simplify]
[2.2] \operatorname{div1} == \operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_1032,1}, \mathbf{this}.\$ r. \mathbf{value}(\mathbf{heapIs})
\theta_{funcstart\_1032,1}.p1, \theta_{funcstart\_1032,1}.p1, \theta_{funcstart\_1032,1}.a1))
\rightarrow [const static or extern object]
[2.3] \operatorname{div1} == \operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_1032,1}, \mathbf{this}.\$ r. \mathbf{value}(\mathbf{heapIs})
\theta_{nit}.a1).p1, static_cast<int>(\theta_{nit}.a1)
\rightarrow [expand definition of constant 'a1' at prang.cpp (30,26)]
[2.4] \text{ div1} == \text{div}(\text{heapIs } \text{heap}_{funcstart\_1032,1}, \text{this.}\text{\$r.value}(\text{heapIs})
\theta_{funcstart\_1032,1}.p1, \theta_{funcstart\_1032,1}.p1, \theta_{funcstart\_1032,1}.p1, \theta_{funcstart\_1032,1}.p1, \theta_{funcstart\_1032,1}.p1, \theta_{funcstart\_1032,1}.p1, \theta_{funcstart\_1032,1}.p2, \theta_{funcstart\_1032,1}.p2, \theta_{funcstart\_1032,1}.p2, \theta_{funcstart\_1032,1}.p2, \theta_{funcstart\_1032,1}.p2, \theta_{funcstart\_1032,1}.p3, \theta_{funcstart\_1032,1}.p4, \theta_{funcstart\_1032,1}.p4, \theta_{funcstart\_1032,1}.p4, \theta_{funcstart\_1032,1}.p4, \theta_{funcstart\_1032,1}.p5, \theta_{funcstart\_1032,1}.p5, \theta_{funcstart\_1032,1}.p5, \theta_{funcstart\_1032,1}.p5, \theta_{funcstart\_1032,1}.p5, \theta_{funcstart\_1032,1}.p5, \theta_{funcstart\_1032,1}.p5, \theta_{funcstart\_1032,1}.p5, \theta_{funcstart\_1032,1}.p5, \theta_{funcstart\_1032,1
\rightarrow [simplify]
[2.6] div1 == div(heapIs heapIs funcstart_{1032,1}, this.r.value(heapIs funcstart_{1032,1})
```

```
heap_{funcstart_{-1032,1}}.p1, 177
[Assume known post-assertion, class invariant or type constraint for term 2.6]
[7.0] (0 < asType<integer>(this.$r.value(heapIs
\theta_{funcstart\_1032,1}.p1) && (asType<integer>(this.$r.value(heapIs)
\$heap_{funcstart\_1032,1}).p1) < \mathbf{asType} < \mathbf{integer} > (\$heap.\mathbf{class} \ WHPrang \in \texttt{Constant}) < \mathsf{Constant} = \texttt{Constant} 
M1))
\rightarrow [simplify]
[7.2] (0 < this.\$r.value(heapIs \$heap_{funcstart\_1032,1}).p1) &&
(this.$r.value(heapIs heap_{funcstart\_1032,1}).p1 <
asType < integer > (\$heap.class WHPrang \in M1))
\rightarrow [const static or extern object]
[7.3] (0 < this.\$r.value(heapIs \$heap_{funcstart_1032.1}).p1) &&
(this.r.value(heapIs $heap_{funcstart\_1032.1}).p1 <
asType < integer > (\$heap_{init}.class WHPrang \in M1))
\rightarrow [expand definition of constant 'M1' at prang.cpp (28,26)]
[7.4] (0 < this.$r.value(heap
Is $heap_{funcstart\_1032,1}).p1) &&
(this.r.value(heapIs $heap_{funcstart\_1032,1}).p1 <
asType < integer > ((int)30269))
\rightarrow [simplify]
[7.10] (-30269 < -this.$r.value(heapIs heap_{funcstart\_1032,1}).p1) <math>\land (0 < 
this.r.value(heapIs $heap_{funcstart\_1032,1}).p1)
[Work on sub-term 2 of conjunction in term 7.10]
[8.0] 0 < this.$r.value(heapIs \rho_{funcstart\_1032,1}).p1
[Take given term]
[18.0] \operatorname{div2} == \operatorname{div}(\mathbf{heapIs} \ \operatorname{\$heap}_{funcstart\_1032,1},
\mathbf{static\_cast} < \mathbf{int} > (\mathbf{operator}^*(\mathbf{heapIs} \ \$ \mathbf{heap}_{funcstart\_1032,1}, \ \mathbf{this}).\mathtt{p2}),
\mathbf{static\_cast} < \mathbf{int} > (\$ \mathbf{heap}_{funcstart\_1032,1}.\mathbf{a2}))
→ [expand definition of operator '*' in class 'pointer' at built in declaration]
[18.1] \operatorname{div2} == \operatorname{div}(\mathbf{heapIs} \ \operatorname{\$heap}_{funcstart\_1032,1},
static_cast<int>(this.$r.value(heapIs $heap_{funcstart\_1032,1}).p2),
static\_cast < int > (\$heap_{funcstart\_1032,1}.a2))
\rightarrow [simplify]
[18.2] div2 == div(\mathbf{heapIs} \ \mathbf{heap}_{funcstart\_1032,1}, \ \mathbf{this.\$r.value}(\mathbf{heapIs})
\theta_{funcstart\_1032,1}.p2, \theta_{funcstart\_1032,1}.p2, \theta_{funcstart\_1032,1}.a2))
\rightarrow [const static or extern object]
[18.3] div2 == div(\mathbf{heapIs} \$ \mathbf{heap}_{funcstart\_1032,1}, \mathbf{this}.\$ \mathbf{r.value}(\mathbf{heapIs})
\theta_{funcstart\_1032,1}.p2, \theta_{funcstart\_1032,1
```

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\rightarrow [expand definition of constant 'a2' at prang.cpp (35,26)]
[18.4] \operatorname{div2} == \operatorname{div}(\mathbf{heapIs} \ \text{$heap}_{funcstart\_1032,1}, \ \mathbf{this}.\text{$r.value}(\mathbf{heapIs})
\theta_{funcstart\_1032,1}.p2, \theta_{funcstart\_1032,1}.p2, \theta_{funcstart\_1032,1}.p2, \theta_{funcstart\_1032,1}.p2
\rightarrow [simplify]
[18.6] div2 == div(heapIs $heap_{funcstart\_1032,1}, this.$r.value(heapIs)
heap_{funcstart_{1032,1}}.p2, 176
[Assume known post-assertion, class invariant or type constraint for term 18.6]
[23.0] (0 < asType<integer>(this.$r.value(heapIs
heap_{funcstart\_1032,1}.p2) && (asType<integer>(this.$r.value(heapIs)
\$heap_{funcstart\_1032,1}).p2) < \mathbf{asType} < \mathbf{integer} > (\$heap.\mathbf{class} \ WHPrang \in \texttt{Prang}) = \texttt{Prang} + 
M2))
\rightarrow [simplify]
[23.2] (0 < this.$r.value(heap
Is $heap_{funcstart\_1032,1}).p2) &&
(this.r.value(heapIs $heap_{funcstart\_1032,1}).p2 <
asType < integer > (\$heap.class WHPrang \in M2))
\rightarrow [const static or extern object]
[23.3] (0 < this.$r.value(heap
Is $heap_{tuncstart\_1032,1}).p2) &&
(this.$r.value(heapIs \rho_{funcstart\_1032,1}).p2 <
asType < integer > (\$heap_{init}.class WHPrang \in M2))
\rightarrow [expand definition of constant 'M2' at prang.cpp (33,26)]
[23.4] (0 < this.$r.value(heap
Is \rho_{uncstart\_1032,1}).p2) &&
(this.r.value(heapIs $heap_{funcstart\_1032,1}).p2 <
asType < integer > ((int)30307))
\rightarrow [simplify]
[23.10] (-30307 < -this.$r.value(heapIs $heap_{funcstart\_1032,1}).p2) \land (0 <
this.r.value(heapIs $heap_{funcstart\_1032,1}).p2)
[Work on sub-term 2 of conjunction in term 23.10]
[24.0] 0 < this.$r.value(heapIs \rho_{funcstart\_1032,1}).p2
[Take given term]
[34.0] div3 == div(heapIs heap_{funcstart\_1032,1},
static\_cast < int > (operator^*(heapIs \$heap_{funcstart\_1032,1}, this).p3),
\mathbf{static\_cast}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_1032,1}.\mathrm{a3}))
→ [expand definition of operator '*' in class 'pointer' at built in declaration]
[34.1] \operatorname{div3} == \operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_1032,1},
static\_cast < int > (this. r.value(heapIs $heap_{funcstart\_1032,1}).p3),
static\_cast < int > (\$heap_{funcstart\_1032.1}.a3))
\rightarrow [simplify]
```

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[34.2] \text{ div3} == \text{div}(\text{heapIs } \text{$heap}_{funcstart\_1032,1}, \text{this.}\text{$r.value}(\text{heapIs})
\theta_{funcstart\_1032,1}.p3, \theta_{funcstart\_1032,1}.p3, \theta_{funcstart\_1032,1}.a3))
\rightarrow [const static or extern object]
[34.3] div3 == div(heapIs $heap_{funcstart\_1032,1}, this.$r.value(heapIs)
\theta_{uncstart\_1032,1}.p3, \theta_{uncstart\_1032,1}.p4, \theta_{uncstart\_1032,1}.p3, \theta_{uncstart\_1032,1}.p4, \theta_{uncstart\_1032,1}.p5, \theta_{uncstart\_1032
\rightarrow [expand definition of constant 'a3' at prang.cpp (40,26)]
[34.4] \text{ div3} == \text{div(heapIs } \text{$heap}_{funcstart\_1032,1}, \text{this.} \text{$r.value(heapIs)}
\theta_{tuncstart\_1032.1}.p3, static_cast<int>((int)178))
\rightarrow [simplify]
[34.6] div3 == div(heapIs $heap<sub>funcstart_1032,1</sub>, this.$r.value(heapIs)
heap_{funcstart_{1032,1}}.p3, 178
[Assume known post-assertion, class invariant or type constraint for term 34.6]
[39.0] (0 < asType<integer>(this.$r.value(heapIs
\verb§heap$_{funcstart\_1032,1}).p3)) \&\& (\mathbf{asType} < \mathbf{integer} > (\mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}))) \&\& (\mathbf{asType} < \mathbf{integer} > (\mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}))) \&\& (\mathbf{asType} < \mathbf{integer} > (\mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})))) \&\& (\mathbf{asType} < \mathbf{integer} > (\mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}))))) \&\& (\mathbf{asType} < \mathbf{integer} > (\mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}))))) \&\& (\mathbf{asType} < \mathbf{integer} > (\mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}))))))
\rho_{tuncstart\_1032.1},p3) < asType<integer>(\rho_{tuncstart\_1032.1}).p3) < asType<integer>(\rho_{tuncstart\_1032.1}).p3)
M3))
\rightarrow [simplify]
[39.2] (0 < this.$r.value(heap
Is \rho_{uncstart\_1032,1}).p3) &&
(this.r.value(heapIs $heap_{funcstart\_1032,1}).p3 <
asType < integer > (\text{$heap.class WHPrang} \in M3))
\rightarrow [const static or extern object]
[39.3] (0 < this.$r.value(heap
Is \rho_{uncstart\_1032,1}).p3) &&
(this.$r.value(heapIs heap_{funcstart\_1032,1}).p3 <
asType < integer > (\$heap_{init}.class WHPrang \in M3))
\rightarrow [expand definition of constant 'M3' at prang.cpp (38,26)]
[39.4] (0 < this.$r.value(heapIs heap_{funcstart\_1032,1}).p3) &&
(this.r.value(heapIs $heap_{funcstart\_1032,1}).p3 <
asType<integer>((int)30323))
\rightarrow [simplify]
[39.10] (-30323 < -this.$r.value(heapIs \rho_{funcstart\_1032,1}).p3) \wedge (0 <
this.r.value(heapIs $heap_{funcstart\_1032,1}).p3)
[Work on sub-term 2 of conjunction in term 39.10]
\textit{[40.0]} \ 0 < \mathbf{this.\$r.value(heapIs} \ \$heap_{funcstart\_1032,1}).p3
[Take given term]
[50.0]\;((\$heap_{funcstart\_1032,1}.r1\;*\;\textbf{static\_cast}{<}\textbf{signed int}{>}(\text{div}1.rem))\;-
(\text{sheap}_{funcstart\_1032,1}.\text{b1 * static\_cast} < \text{signed int} > (\text{div1.quot}))) == \text{temp1}
\rightarrow [const static or extern object]
```

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[50.1] (($heap<sub>init</sub>.r1 * static_cast<signed int>(div1.rem)) -
(\text{sheap}_{funcstart\_1032,1}.\text{b1} * \text{static\_cast} < \text{signed int} > (\text{div1.quot}))) == \text{temp1}
\rightarrow [expand definition of constant 'r1' at prang.cpp (29,26)]
[50.2] (((int)171 * static_cast<signed int>(div1.rem)) -
(\text{sheap}_{funcstart\_1032,1}.\text{b1 * static\_cast} < \text{signed int} > (\text{div1.quot}))) == \text{temp1}
\rightarrow [simplify]
[50.3] ((171 * static_cast < signed int > (div1.rem)) - ($heap_funcstart_1032.1.b1
* static_cast<signed int>(div1.quot))) == temp1
\rightarrow [from term 2.6, div1 is equal to div(heapIs $heap_{funcstart\_1032,1}$,
this.r.value(heapIs $heap_{funcstart\_1032,1}).p1, 177)]
[50.4] ((171 * static_cast<signed int>(div(heapIs $heap_{funcstart\_1032.1},
this.r.value(heapIs $heap_{funcstart\_1032,1}).p1, 177).rem)) -
(\text{sheap}_{funcstart\_1032,1}.\text{b1 * static\_cast} < \text{signed int} > (\text{div1.quot}))) == \text{temp1}
\rightarrow [simplify]
[50.5] ((171 * div(heapIs $heap_{funcstart\_1032.1}, this.$r.value(heapIs)]
\text{Sheap}_{funcstart\_1032.1}.\text{p1}, 177).\text{rem} - (\text{Sheap}_{funcstart\_1032.1}.\text{b1} *
static_cast<signed int>(div1.quot))) == temp1
\rightarrow [const static or extern object]
[50.6] ((171 * div(heapIs $heap<sub>funcstart_1032,1</sub>, this.$r.value(heapIs)
\theta_{uncstart\_1032,1}.p1, 177).rem) - (\theta_{unit}.b1 * static_cast<signed
int>(div1.quot))) == temp1
\rightarrow [expand definition of constant 'b1' at prang.cpp (31,26)]
[50.7] ((171 * div(heapIs $heap_{funcstart\_1032,1}, this.$r.value(heapIs
\theta_{uncstart_{1032,1}}.p1, 177).rem - ((int)2 * static_cast < signed)
int>(div1.quot))) == temp1
\rightarrow [simplify]
[50.8] ((171 * div(heapIs $heap_{funcstart\_1032,1}, this.$r.value(heapIs
\theta_{funcstart\_1032,1}.p1, 177).rem - (2 * static\_cast < signed)
int>(div1.quot)) == temp1
\rightarrow [from term 2.6, div1 is equal to div(heapIs $heap_{funcstart\_1032,1},
this.$r.value(heapIs $heap_{tuncstart\_1032.1}).p1, 177)]
[50.9] ((171 * div(heapIs $heap_{funcstart\_1032,1}, this.$r.value(heapIs)]
\theta_{funcstart\_1032,1}.p1, 177).rem – (2 * static_cast<signed)
int>(div(heapIs \$heap_{tuncstart\_1032,1}, this.\$r.value(heapIs
\text{Sheap}_{funcstart\_1032,1}.\text{p1}, 177).\text{quot}))) == \text{temp1}
\rightarrow [simplify]
[50.14] 0 == (-\text{temp1} + (-2 * \text{div}(\text{heapIs} \$\text{heap}_{funcstart\_1032.1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177).quot) + (171 *
```

```
div(\mathbf{heapIs} \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
heap_{funcstart\_1032,1}.p1, 177.rem)
[Take given term]
[53.0] heap_{1032,1;1051,8} == heap_{funcstart\_1032,1}._replace(this.$r \rightarrow
operator*(heapIs heap_{funcstart\_1032,1}, this)._replace(p1 \rightarrow
asType<P1Type>(($heap<sub>funcstart_1032.1</sub>.M1 *
asType<int>(static_cast<integer>(static_cast<signed
int>(operator^*(heapIs \$heap_{funcstart\_1032,1}, this).p1) < (int)0))) +
temp1)))
→ [expand definition of operator '*' in class 'pointer' at built in declaration]
[53.1] \theta_{1032,1;1051,8} == \theta_{1032,1;1051,8} = \theta_{1032,1;1051,8} == \theta
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow
\mathbf{asType}{<}P1\mathsf{Type}{>}((\$\mathsf{heap}_{funcstart\_1032,1}.\mathsf{M1}\ *
as Type < int > (static\_cast < integer > (static\_cast < signed))
int>(operator^*(heapIs $heap_{funcstart\_1032,1}, this).p1) < (int)0))) +
temp1)))
\rightarrow [const static or extern object]
[53.2] heap_{1032,1;1051,8} == heap_{funcstart\_1032,1}._replace(this.r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow
asType<P1Type>(($heap<sub>init</sub>.M1 *
asType<int>(static_cast<integer>(static_cast<signed
int>(operator^*(heapIs \$heap_{funcstart\_1032,1}, this).p1) < (int)0))) +
temp1)))
\rightarrow [expand definition of constant 'M1' at prang.cpp (28,26)]
[53.3] heap_{1032,1;1051,8} == heap_{funcstart\_1032,1}._replace(this.$r \rightarrow
\mathbf{this.\$r.value}(\mathbf{heapIs}~\$\mathbf{heap}_{funcstart\_1032,1}).\_\mathbf{replace}(\mathbf{p1}\rightarrow
asType < P1Type > (((int)30269)^*)
asType<int>(static_cast<integer>(static_cast<signed
\mathbf{int} > (\mathbf{operator}^*(\mathbf{heapIs} \ \$ \mathbf{heap}_{funcstart\_1032,1}, \ \mathbf{this}).\mathtt{p1}) < (\mathbf{int})0))) \ +
temp1)))
\rightarrow [simplify]
[53.4] heap_{1032,1;1051,8} == heap_{funcstart\_1032,1}._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow
asType<P1Type>((30269 *
asType<int>(static_cast<integer>(static_cast<signed
int>(operator^*(heapIs $heap_{funcstart\_1032,1}, this).p1) < (int)0))) +
temp1)))
→ [expand definition of operator '*' in class 'pointer' at built in declaration]
[53.5] $heap<sub>1032,1;1051,8</sub> == $heap<sub>funcstart_1032,1</sub>._replace(this.$r \rightarrow
this.$r.value(heapIs $heap_{funcstart\_1032,1}).$_replace(p1 \rightarrow
asType<P1Type>((30269 *
```

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asType<int>(static_cast<integer>(static_cast<signed
\mathbf{int} > (\mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}~\$ \mathrm{heap}_{funcstart\_1032,1}).\mathrm{p1}) < (\mathbf{int})0))) + \mathrm{temp1})))
\rightarrow [simplify]
[53.9] heap_{1032,1;1051,8} == heap_{funcstart\_1032,1}._replace(this.$r \rightarrow
this.$r.value(heapIs \theta_{funcstart\_1032,1})._replace(p1 \rightarrow
\mathbf{asType} \small{<} \texttt{P1Type} \small{>} ((30269 \ ^* \ \mathbf{asType} \small{<} \mathbf{int} \small{>} (\mathbf{static\_cast} \small{<} \mathbf{integer} \small{>} (0 <
-this.r.value(heapIs heap_{funcstart\_1032,1}.p1)) + temp1)))
\rightarrow [from term 8.0, literala < -this.$r.value(heapIs $heap_{funcstart\_1032.1}).p1
is false whenever -2 < (0 + literala)
    Proof of rule precondition:
    [53.9.0] - 2 < (0 + 0)
    \rightarrow [simplify]
    [53.9.2] true
[53.10] $heap<sub>1032,1;1051,8</sub> == $heap<sub>funcstart_1032,1</sub>._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032.1})._replace(p1 \rightarrow
\mathbf{asType} \hspace{-0.5mm} < \hspace{-0.5mm} \text{P1Type} \hspace{-0.5mm} > \hspace{-0.5mm} ((30269 * \mathbf{asType} \hspace{-0.5mm} < \hspace{-0.5mm} \mathbf{int} \hspace{-0.5mm} > \hspace{-0.5mm} (\mathbf{static\_cast} \hspace{-0.5mm} < \hspace{-0.5mm} \mathbf{integer} \hspace{-0.5mm} > \hspace{-0.5mm} (\mathbf{false})))
+ \text{temp1})))
\rightarrow [simplify]
[53.11] heap_{1032,1;1051,8} == heap_{funcstart\_1032,1}._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow
asType < P1Type > ((30269 * asType < int > (([false]: 1, []: 0))) + temp1)))
→ [explicitly assert falsehood of skipped guards in subsequent guards]
[53.12] $heap<sub>1032,1;1051,8</sub> == $heap<sub>funcstart_1032,1</sub>._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow
asType<P1Type>((30269 * asType<int>(([false]: 1, [true]: 0))) +
temp1)))
\rightarrow [simplify]
[53.15] $heap<sub>1032,1;1051,8</sub> == $heap<sub>funcstart_1032,1</sub>._replace(this.$r \rightarrow
\textbf{this.}\$r.\textbf{value}(\textbf{heapIs}~\$heap_{funcstart\_1032,1}).\_\textbf{replace}(p1 \rightarrow
asType < P1Type > (0 + temp1)))
\rightarrow [from term 50.14, temp1 is equal to (-2 * div(heapIs $heap_{tuncstart\_1032.1},
this.r.value(heapIs \ heap_{funcstart\_1032.1}).p1, 177).quot) + (171 *
div(heapIs $heap_{funcstart\_1032,1}, this.$r.value(heapIs)
heap_{funcstart\_1032,1}.p1, 177).rem
[53.16] \$ heap_{1032,1;1051,8} == \$ heap_{funcstart\_1032,1}.\_\mathbf{replace}(\mathbf{this}.\$ r \rightarrow \texttt{funcstart\_1032,1}.\_\mathbf{replace}(\mathbf{this}.\$ r \rightarrow \texttt{funcstart\_1032,1})
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow
asType < P1Type > (0 + ((-2 * div(heapIs $heap_{funcstart\_1032.1},
this.$r.value(heapIs heap_{funcstart\_1032,1}).p1, 177).quot) + (171 *
div(\mathbf{heapIs} \$ heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
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heap_{funcstart_{-1032,1}}.p1, 177).rem))))
\rightarrow [simplify]
[53.19] $\text{heap}_{1032,1:1051.8} == $\text{heap}_{funcstart\_1032,1}.$\text{replace}(\text{this}.$\text{$r} \to \text{$}
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs \rho_{funcstart\_1032,1}, this.r.value(heapIs)
heap_{funcstart\_1032,1}.p1, 177).rem)))
[Take given term]
[54.0] (($heap_{1032,1;1051,8}.r2 * static_cast < signed int > (div2.rem)) -
(\text{sheap}_{1032.1:1051.8}.\text{b2} * \text{static\_cast} < \text{signed int} > (\text{div2.quot}))) == \text{temp2}
\rightarrow [from term 53.19, $heap<sub>1032,1;1051,8</sub> is equal to
heap_{funcstart\_1032,1}._replace(this.r \rightarrow this.r.value(heapIs)
heap_{funcstart\_1032,1}._replace(p1 \rightarrow (-2 * div(heapIs $heap_{funcstart\_1032,1}, 
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177).quot) + (171 *
div(\mathbf{heapIs}\ \$heap_{funcstart\_1032,1},\ \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}
heap_{funcstart_{1032.1}}.p1, 177).rem)))
[54.1] ((\text{heap}_{funcstart\_1032.1}._replace(this.\text{$r$} \to \text{this.}\text{$r$}.value(heapIs
\rho_{uncstart\_1032,1}._replace(p1 \rightarrow ((-2 * div(heapIs $heap_{uncstart\_1032,1}), heap_{uncstart\_1032,1})
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177).quot) + (171 *
div(\mathbf{heapIs} \$ heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
\rho_{tuncstart = 1032.1}, p_1, 177, p_2 * static_cast < signed
\mathbf{int}{>}(\mathrm{div2.rem})) - (\$\mathrm{heap}_{1032,1;1051,8}.\mathrm{b2} * \mathbf{static\_cast}{<} \mathbf{signed}
int>(div2.quot)) == temp2
\rightarrow [const member of object with modified fields]
[54.2]\;((\$heap_{funcstart\_1032,1}.r2\;*\;\textbf{static\_cast}{<}\textbf{signed int}{>}(\text{div}2.\text{rem}))\;-
(\text{sheap}_{1032,1;1051,8}.\text{b2} * \text{static\_cast} < \text{signed int} > (\text{div2.quot}))) == \text{temp2}
\rightarrow [const static or extern object]
[54.3] ((\theta_{init}.r2 * static\_cast < signed int > (div2.rem)) -
(\text{sheap}_{1032,1;1051,8}.\text{b2} * \text{static\_cast} < \text{signed int} > (\text{div}2.\text{quot}))) == \text{temp}2
\rightarrow [expand definition of constant 'r2' at prang.cpp (34,26)]
[54.4] (((int)172 * static_cast<signed int>(div2.rem)) -
(\$heap_{1032,1;1051,8}.b2 * \mathbf{static\_cast} < \mathbf{signed\ int} > (div2.quot))) == temp2
\rightarrow [simplify]
[54.5] ((172 * static_cast<signed int>(div2.rem)) - ($heap_{1032.1:1051.8}.b2 *
static_cast<signed int>(div2.quot))) == temp2
\rightarrow [from term 18.6, div2 is equal to div(heapIs $heap_{funcstart\_1032,1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p2, 176)
[54.6] ((172 * static_cast < signed int > (div(heapIs heap_{funcstart\_1032,1}),
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p2, 176).rem)) -
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(\text{sheap}_{1032.1:1051.8}.\text{b2} * \text{static\_cast} < \text{signed int} > (\text{div}2.\text{quot}))) == \text{temp}2
\rightarrow [simplify]
[54.7] ((172 * div(heapIs $heap_{funcstart\_1032,1}, this.$r.value(heapIs)
\text{$heap}_{funcstart\_1032,1}.p2, 176).rem) - (\text{$heap}_{1032,1;1051,8}.b2 *
static_cast<signed int>(div2.quot))) == temp2
\rightarrow [from term 53.19, $heap<sub>1032,1;1051,8</sub> is equal to
\$heap_{funcstart\_1032,1}.\_\textbf{replace}(\textbf{this}.\$r \rightarrow \textbf{this}.\$r.\textbf{value}(\textbf{heapIs}
heap_{funcstart\_1032,1}._replace(p1 \rightarrow (-2 * div(heapIs $heap_{funcstart\_1032,1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177).quot) + (171 *
div(\mathbf{heapIs} \ \$heap_{funcstart\_1032,1}, \ \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
heap_{funcstart\_1032,1}.p1, 177).rem)))]
[54.8] ((172 * \mathrm{div}(\mathbf{heapIs}\ \$\mathrm{heap}_{funcstart\_1032,1},\ \mathbf{this}.\$\mathrm{r.value}(\mathbf{heapIs}
\rho_{tuncstart\_1032,1}.p2, 176).rem – (\rho_{tuncstart\_1032,1}.replace(his.replace)
\rightarrow this.$r.value(heapIs $heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 *
div(\mathbf{heapIs} \$ heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
\text{Sheap}_{funcstart\_1032,1}.p1, 177).quot) + (171 * div(heapIs \text{Sheap}_{funcstart\_1032,1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177).rem)))).b2
static_cast<signed int>(div2.quot))) == temp2
→ [const member of object with modified fields]
[54.9] ((172 * div(heapIs $heap_{funcstart\_1032,1}, this.$r.value(heapIs
\text{Sheap}_{funcstart\_1032,1}.\text{p2}, 176).\text{rem} - (\text{Sheap}_{funcstart\_1032,1}.\text{b2}) *
static_cast<signed int>(div2.quot))) == temp2
\rightarrow [const static or extern object]
[54.10] ((172 * div(heapIs $heap<sub>funcstart_1032,1</sub>, this.$r.value(heapIs)
\rho_{uncstart\_1032,1}.p2, 176).rem – (\rho_{uncstart\_1032,1}.p2, 176).rem
int>(div2.quot)) == temp2
\rightarrow [expand definition of constant 'b2' at prang.cpp (36,26)]
[54.11] ((172 * div(heapIs \$heap_{funcstart\_1032,1}, this.\$r.value(heapIs
\rho_{funcstart\_1032.1}.p2, 176).rem - ((int)35 * static\_cast < signed)
int>(div2.quot)) == temp2
\rightarrow [simplify]
[54.12] ((172 * div(heapIs $heap_{funcstart\_1032,1}, this.$r.value(heapIs)]
\theta_{funcstart\_1032,1}.p2, 176).rem - (35 * static\_cast < signed)
int>(div2.quot)) = temp2
\rightarrow [from term 18.6, div2 is equal to div(heapIs $heap_{funcstart\_1032,1},
this.r.value(heapIs $heap_{funcstart\_1032,1}).p2, 176)]
[54.13] ((172 * div(heapIs $heap<sub>funcstart_1032,1</sub>, this.$r.value(heapIs
\rho_{tuncstart\_1032.1}.p2, 176).rem - (35 * static\_cast < signed)
int>(div(heapIs $heap_{tuncstart_1032.1}, this.$r.value(heapIs
\text{Sheap}_{funcstart\_1032,1}.p2, 176).quot))) == temp2
```

```
\rightarrow [simplify]
[54.18] 0 == (-\text{temp2} + (-35 * \text{div}(\text{heapIs } \text{$heap}_{funcstart\_1032,1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p2, 176).quot) + (172 *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_1032,1}, \ \mathbf{this}.\$ r. \mathbf{value}(\mathbf{heapIs}
heap_{funcstart_{1032.1}}.p2, 176).rem
[Take given term]
[57.0] $\text{heap}_{1032,1;1054,8} == \text{$heap}_{1032,1;1051,8}._\text{replace}(\text{this}.\text{$r} \rightarrow
operator*(heapIs heap_{1032,1;1051,8}, this)._replace(p2 \rightarrow
asType<P2Type>(($heap<sub>1032,1;1051,8</sub>.M2 *
asType<int>(static_cast<integer>(static_cast<signed
int>(operator^*(heapIs \$heap_{1032,1;1051,8}, this).p2) < (int)(0))) + temp(2)))
\rightarrow [from term 53.19, $heap<sub>1032,1:1051,8</sub> is equal to
$heap_{funcstart\_1032,1}.$_replace(this.$r \rightarrow this.$r.value(heapIs)
heap_{funcstart\_1032,1}._replace(p1 \rightarrow (-2 * div(heapIs heap_{funcstart\_1032,1}),
div(\mathbf{heapIs} \ \$heap_{funcstart\_1032,1}, \ \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
heap_{funcstart\_1032,1}.p1, 177).rem)))
[57.2] \theta_{1032,1;1054,8} == \theta_{1032,1;1054,8} = \theta_{1032,1;1054,8} == \theta
this.$r.value(heapIs $heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.} \text{\$r.value}(\text{heapIs}))
\theta_{funcstart\_1032,1}.p1, 177).rem)))._replace(this.$r \rightarrow operator*(heapIs)
\$heap_{funcstart\_1032,1}.\_\textbf{replace}(\textbf{this}.\$r \rightarrow \textbf{this}.\$r.\textbf{value}(\textbf{heapIs}
\rho_{funcstart\_1032,1}._replace(p1 \rightarrow (-2 * div(heapIs $heap_{funcstart\_1032,1}).
this.r.value(heapIs \ heap_{funcstart\_1032.1}).p1, 177).quot) + (171)
div(\mathbf{heapIs} \$ heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
\theta_{funcstart\_1032,1}.p1, 177).rem)), this)._replace(p2 \rightarrow
asType<P2Type>(($heap<sub>1032,1:1051,8</sub>.M2 *
asType<int>(static_cast<integer>(static_cast<signed
int > (operator^*(heapIs \$heap_{1032,1;1051,8}, this).p2) < (int)0))) + temp2)))
→ [expand definition of operator '*' in class 'pointer' at built in declaration]
[57.3] heap_{1032,1;1054,8} == heap_{funcstart\_1032,1}._replace(this.$r \rightarrow
this.$r.value(heapIs \frac{1}{2} heap\frac{1}{2} heap\frac{1}{2}
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.}\text{\$r.value}(\text{heapIs}))
\theta_{funcstart\_1032,1}.p1, 177).rem))))._replace(this.$r \rightarrow
this.$r.value(heapIs \rho_{funcstart\_1032,1}._replace(this.$r \rightarrow
this.$r.value(heapIs \frac{1}{2} heap\frac{1}{2} heap\frac{1}{2}
\rho_{funcstart=1032,1}, this.r.value(heapIs \rho_{funcstart=1032,1}).p1,
177).quot) + (171 * div(heapIs heapIs = 1032,1, this.r.value(heapIs)
\theta_{funcstart\_1032,1}.p1, 177).rem))))._replace(p2 \rightarrow
asType<P2Type>(($heap<sub>1032,1:1051,8</sub>.M2 *
asType<int>(static_cast<integer>(static_cast<signed
```

```
int>(operator^*(heapIs \$heap_{1032,1;1051,8}, this).p2) < (int)(0))) + temp(2)))
→ [evaluate dereferenced pointer into modified heap]
[57.4] heap_{1032,1;1054,8} == heap_{funcstart\_1032,1}._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.} \text{\$r.value}(\text{heapIs}))
\rho_{funcstart\_1032,1}.p1, 177).rem)))._replace(this.$r \rightarrow ([this.$r ==
this.$r]: this.$r.value(heap
Is $heap_{funcstart\_1032,1})._replace(p1 \rightarrow (-2 *
\operatorname{div}(\mathbf{heapIs}\ \$ \operatorname{heap}_{funcstart\_1032,1},\ \mathbf{this}.\$ r. \mathbf{value}(\mathbf{heapIs}
\text{Sheap}_{funcstart\_1032.1}, p1, 177).quot) + (171 * div(heapIs \text{Sheap}_{funcstart\_1032.1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177).rem)), []:
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p2 \rightarrow
asType<P2Type>(($heap<sub>1032,1:1051,8</sub>.M2 *
asType<int>(static_cast<integer>(static_cast<signed
\mathbf{int}{>}(\mathbf{operator}^*(\mathbf{heapIs}\ \$\mathrm{heap}_{1032,1;1051,8},\ \mathbf{this}).\mathrm{p2})<(\mathbf{int})0)))+\mathrm{temp2})))
→ [explicitly assert falsehood of skipped guards in subsequent guards]
[57.5] $heap<sub>1032,1;1054,8</sub> == $heap<sub>funcstart_1032,1</sub>._replace(this.$r \rightarrow
this.$r.value(heapIs \rho_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(\mathbf{heapIs} \$ heap_{funcstart\_1032,1}, \mathbf{this}.\$ r. \mathbf{value}(\mathbf{heapIs})
\rho_{funcstart\_1032,1}.p1, 177).rem)))._replace(this.$r \rightarrow ([this.$r ==
this.$r]: this.$r.value(heapIs \rho_{funcstart\_1032,1})._replace(p1 \rightarrow (-2 *
div(\mathbf{heapIs} \$heap_{funcstart\_1032.1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
heap_{funcstart\_1032,1}.p1, 177).quot + (171 * div(heapIs $heap_{funcstart\_1032,1}, 177).quot) + (171 * div(heapIs $heap_{funcstart\_1032,1}, 177).quot)
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177).rem)), [!(this.<math>r = 
this.$r)]: this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p2 \rightarrow
asType<P2Type>(($heap<sub>1032,1:1051,8</sub>.M2 *
asType<int>(static_cast<integer>(static_cast<signed
int>(operator^*(heapIs $heap_{1032,1;1051,8}, this).p2) < (int)0))) + temp2)))
\rightarrow [simplify]
[57.7] heap_{1032,1;1054,8} == heap_{funcstart\_1032,1}._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
\label{eq:continuous_function} $ \text{heap}_{funcstart\_1032,1} . \text{p1}, 177).rem)))).\_\textbf{replace}(\textbf{this}.\$r \rightarrow
this.$r.value(heapIs heapIs = funcstart_{-1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs \rho_{funcstart\_1032,1}, this.r.value(heapIs)
heap_{funcstart\_1032,1}.p1, 177).rem))._replace(p2 \rightarrow
asType<P2Type>(($heap<sub>1032,1;1051,8</sub>.M2 *
asType < int > (static\_cast < integer > (static\_cast < signed
int>(operator^*(heapIs $heap_{1032,1;1051,8}, this).p2) < (int)(0))) + temp(2)))
\rightarrow [from term 53.19, $heap_{1032,1;1051,8} is equal to
```

```
$heap_{funcstart\_1032,1}.$-replace(this.$r \rightarrow this.$r.value(heapIs)
heap_{funcstart\_1032,1}._replace(p1 \rightarrow (-2 * div(heapIs $heap_{funcstart\_1032,1}, 
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177).quot) + (171 *
div(heapIs $heap_{funcstart\_1032,1}, this.$r.value(heapIs)
heap_{funcstart_{1032,1}}.p1, 177).rem)))
[57.8] heap_{1032,1;1054,8} == heap_{funcstart\_1032,1}._replace(this.$r \rightarrow
\textbf{this.\$r.value}(\textbf{heapIs}~\$ heap_{funcstart\_1032,1}).\_\textbf{replace}(p1 \rightarrow ((-2 * div(\textbf{heapIs}) + (-2 * div(\textbf{heapI
\rho_{funcstart\_1032,1}, this.\r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
\theta_{funcstart\_1032,1}.p1, 177).rem)))).\_replace(this.\$r \rightarrow 0
this.$r.value(heapIs \rho_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{tuncstart_1032.1}, this.r.value(heapIs \rho_{tuncstart_1032.1}).p1,
177).quot) + (171 * div(heapIs $heap<sub>funcstart_1032.1</sub>, this.$r.value(heapIs
\theta_{funcstart\_1032,1}.p1, 177).rem)))._replace(p2 \rightarrow
asType < P2Type > ((\$heap_{funcstart\_1032,1}.\_replace(this.\$r \rightarrow
this.$r.value(heapIs \rho_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.} \text{\$r.value}(\text{heapIs}))
heap_{funcstart\_1032,1}.p1, 177).rem))).M2 *
asType < int > (static\_cast < integer > (static\_cast < signed
int>(operator*(heapIs $heap_{1032,1;1051.8}, this).p2) < (int)0))) + temp2)))
→ [const member of object with modified fields]
[57.9] heap_{1032,1;1054,8} == heap_{funcstart\_1032,1}._replace(this.$r \rightarrow
\textbf{this.\$r.value}(\textbf{heapIs}~\$ heap_{funcstart\_1032,1}).\_\textbf{replace}(p1 \rightarrow ((-2~*div(\textbf{heapIs})))))
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
\theta_{funcstart\_1032,1}.p1, 177).rem)))).\_replace(this.\$r \rightarrow 0
\textbf{this.\$r.value}(\textbf{heapIs}~\$ heap_{funcstart\_1032,1}).\_\textbf{replace}(p1 \rightarrow ((\text{-}2~*\text{div}(\textbf{heapIs}
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs $heap<sub>funcstart_1032.1</sub>, this.$r.value(heapIs
\theta_{funcstart\_1032,1}.p1, 177).rem)))._replace(p2 \rightarrow
asType<P2Type>(($heap_funcstart_1032,1.M2 *
asType < int > (static\_cast < integer > (static\_cast < signed
int>(operator^*(heapIs $heap_{1032.1:1051.8}, this).p2) < (int)(0))) + temp(2)))
\rightarrow [const static or extern object]
[57.10] $heap<sub>1032,1;1054,8</sub> == $heap<sub>funcstart_1032,1</sub>._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\$heap_{funcstart\_1032,1},\, \textbf{this.}\$r.\textbf{value}(\textbf{heapIs}\,\,\$heap_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
\theta_{uncstart\_1032,1}.p1, 177).rem)))).\_replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\theta_{funcstart\_1032,1}, this.r.value(heapIs \theta_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs heapIs = f_{uncstart_1032.1}, this.r.value(heapIs)
```

```
\label{eq:place} $\operatorname{heap}_{funcstart\_1032,1}).p1,\ 177).rem))).\_\mathbf{replace}(p2 \to
asType<P2Type>(($heap<sub>init</sub>.M2 *
as Type < int > (static\_cast < integer > (static\_cast < signed))
int>(operator^*(heapIs $heap_{1032,1;1051,8}, this).p2) < (int)0))) + temp2)))
\rightarrow [expand definition of constant 'M2' at prang.cpp (33,26)]
[57.11] $heap<sub>1032,1;1054,8</sub> == $heap<sub>funcstart_1032,1</sub>._replace(this.$r \rightarrow
this.$r.value(heapIs \rho_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.} \text{\$r.value}(\text{heapIs}))
\theta_{tuncstart\ 1032.1}.p1,\ 177.rem)))._replace(this.r \rightarrow
this.$r.value(heapIs \frac{1}{2} heap\frac{1}{2} line \frac{1}{2} heap\frac{1}{2} heap\frac{1}{2
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(\mathbf{heapIs} \ \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
\theta_{funcstart\_1032,1}.p1, 177).rem))).\_replace(p2 \rightarrow
asType < P2Type > (((int)30307 *
as Type < int > (static\_cast < integer > (static\_cast < signed))
int>(operator^*(heapIs $heap_{1032,1;1051,8}, this).p2) < (int)0))) + temp2)))
\rightarrow [simplify]
[57.12] $\text{heap}_{1032,1:1054.8} == $\text{heap}_{funcstart_1032,1}$._\text{replace}(\text{this}.\text{$\frac{1}{2}r$})
this.$r.value(heapIs p_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart=1032,1}, this.r.value(heapIs \rho_{funcstart=1032,1}).p1,
177).quot) + (171 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
\theta_{tuncstart\_1032.1}.p1, 177).rem)))).\_replace(this.\$r \rightarrow
this.$r.value(heapIs \theta_{funcstart\_1032,1})._replace(p1 \theta ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
\theta_{funcstart\_1032.1}.p1, 177).rem))._replace(p2 \rightarrow
asType<P2Type>((30307 *
asType < int > (static\_cast < integer > (static\_cast < signed
int>(operator^*(heapIs $heap_{1032.1:1051.8}, this).p2) < (int)(0))) + temp(2)))
\rightarrow [from term 53.19, $heap<sub>1032,1;1051,8</sub> is equal to
$heap_{funcstart\_1032,1}.$_replace(this.$r \rightarrow this.$r.value(heapIs)
heap_{funcstart\_1032,1}._replace(p1 \rightarrow (-2 * div(heapIs $heap_{funcstart\_1032,1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177).quot) + (171)
div(\mathbf{heapIs} \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
heap_{funcstart_{1032,1}}.p1, 177).rem)))
[57.13] $heap<sub>1032,1;1054,8</sub> == $heap<sub>funcstart_1032,1</sub>._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.}\text{\$r.value}(\text{heapIs}))
\theta_{tuncstart\_1032,1}.p1, 177).rem)))).\_replace(this.\$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
```

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177).quot) + (171 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.} \text{\$r.value}(\text{heapIs}))
\theta_{funcstart\_1032,1}.p1, 177).rem)))._replace(p2 \rightarrow
asType<P2Type>((30307 *
asType<int>(static_cast<integer>(static_cast<signed
int>(operator^*(heapIs \ heap_{funcstart\_1032,1}.\_replace(this.\$r \rightarrow
this.$r.value(heapIs heapIs $heapfuncstart_1032,1)._replace(p1 \rightarrow (-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs $heap<sub>funcstart_1032.1</sub>, this.$r.value(heapIs
heap_{funcstart_1032,1}.p1, 177).rem)), this).p2) < (int)0))) + temp2)))
→ [expand definition of operator '*' in class 'pointer' at built in declaration]
[57.14] $heap<sub>1032,1;1054,8</sub> == $heap<sub>funcstart_1032,1</sub>._replace(this.$r \rightarrow
this.$r.value(heapIs \rho_{uncstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs)
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs \theta), this.r.value(heapIs)
\label{eq:continuous_function} $ \text{heap}_{funcstart\_1032,1} . \text{p1}, 177).rem)))).$ \textbf{replace(this.} \$r \rightarrow $ \text{the properties of the prop
this.$r.value(heapIs \theta_{funcstart=1032,1})._replace(p1 \theta ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(\mathbf{heapIs} \$ heap_{funcstart\_1032,1}, \mathbf{this}.\$ r. \mathbf{value}(\mathbf{heapIs})
\theta_{funcstart\_1032,1}.p1, 177).rem))).\_replace(p2 \rightarrow
asType<P2Type>((30307 *
asType<int>(static_cast<integer>(static_cast<signed
int>(this.\$r.value(heapIs \$heap_{funcstart\_1032,1}.\_replace(this.\$r \rightarrow
\textbf{this.}\$r.\textbf{value}(\textbf{heapIs}~\$heap_{funcstart\_1032,1}).\_\textbf{replace}(p1 \rightarrow ((-2~*div(\textbf{heapIs})))))
\rho_{funcstart\_1032,1}, this.\r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(\mathbf{heapIs} \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}))
\theta_{funcstart\_1032,1}.p1, 177).rem)))).p2) < (int)0))) + temp2)))
→ [evaluate dereferenced pointer into modified heap]
[57.15] $\text{heap}_{1032,1;1054,8} == \text{$heap}_{funcstart\_1032,1}._\text{replace}(\text{this.}\text{$r} \to \text{$}
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{tuncstart_{-1032.1}}, this.r.value(heapIs \rho_{tuncstart_{-1032.1}}).p1,
177).quot) + (171 * div(\mathbf{heapIs} \ \$heap_{funcstart\_1032,1}, \ \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
\label{eq:continuous_function} $ \text{heap}_{funcstart\_1032,1} . \text{p1}, 177).rem)))).$ \_\textbf{replace}(\textbf{this}.\$r \rightarrow \texttt{p1}) $ $ \text{p1}, 177).rem) $ $ \text{p2}, 177).rem) $ $ \text{p2}, 177).rem $ $ \text{p3}, 177).rem $ 
this.$r.value(heapIs \theta_{funcstart\_1032,1})._replace(p1 \theta ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs \theta_{funcstart\_1032,1}, this.r.value(heapIs)
\theta_{funcstart\_1032,1}.p1, 177).rem))).\_replace(p2 \rightarrow
asType<P2Type>((30307 *
asType < int > (static\_cast < integer > (static\_cast < signed\ int > (([this.\$r])))) \\
== this.$r]: this.$r.value(heapIs \rho_{tuncstart\_1032.1})._replace(p1 \rightarrow (-2 *
div(\mathbf{heapIs} \$ heap_{funcstart\_1032.1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
\text{Sheap}_{funcstart\_1032.1}.p1, 177).quot) + (171 * div(heapIs \text{Sheap}_{funcstart\_1032.1},
this.$r.value(heapIs heap_{funcstart\_1032.1}).p1, 177).rem)), []:
this.r.value(heapIs \ heap_{funcstart\_1032.1}).p2) < (int)0)) + temp2)))
```

```
→ [explicitly assert falsehood of skipped guards in subsequent guards]
[57.16] $heap<sub>1032,1;1054,8</sub> == $heap<sub>funcstart_1032,1</sub>._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
\theta_{funcstart\_1032,1}.p1, 177).rem)))).\_replace(this.$r \rightarrow
\textbf{this.\$r.value}(\textbf{heapIs}~\$ heap_{funcstart\_1032,1}).\_\textbf{replace}(p1 \rightarrow ((-2 * div(\textbf{heapIs}) + (-2 * div(\textbf{heapI
\rho_{funcstart\_1032,1}, this.\r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs \rho_{funcstart\_1032,1}, this.r.value(heapIs)
\theta_{funcstart\_1032,1}.p1, 177).rem))).\_replace(p2 \rightarrow
asType<P2Type>((30307 *
asType < int > (static\_cast < integer > (static\_cast < signed\ int > (([this.\$r
== this.$r]: this.$r.value(heapIs \rho_{tynestart 1032.1})._replace(p1 \rightarrow (-2 *
div(\mathbf{heapIs} \$ heap_{funcstart\_1032.1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
\text{Sheap}_{funcstart\_1032.1}.p1, 177).quot) + (171 * div(heapIs \text{Sheap}_{funcstart\_1032.1},
this.r.value(heapIs \ heap_{funcstart\_1032.1}).p1, 177).rem)), [!(this.<math>r = 
this.$r.value(heapIs \rho_{funcstart\_1032,1}).p2) < (int)0))) +
temp2)))
\rightarrow [simplify]
[57.23] $heap<sub>1032,1;1054,8</sub> == $heap<sub>funcstart_1032,1</sub>._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
\theta_{funcstart\_1032,1}.p1, 177).rem)))).\_replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs \rho_{funcstart\_1032,1}, this.r.value(heapIs)
\theta_{funcstart\_1032,1}.p1, 177).rem))).\_replace(p2 \rightarrow
asType<P2Type>((30307 * asType<int>(static_cast<integer>(0 <
-this.$r.value(heapIs \theta_{funcstart\_1032.1}).p2))) + temp2)))
\rightarrow [from term 24.0, literala < -this.$r.value(heapIs $heap_{funcstart = 1032.1}).p2
is false whenever -2 < (0 + literala)
      Proof of rule precondition:
      [57.23.0] - 2 < (0 + 0)
      \rightarrow [simplify]
      [57.23.2] true
[57.24] $heap<sub>1032,1;1054,8</sub> == $heap<sub>funcstart_1032,1</sub>._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.} \text{\$r.value}(\text{heapIs}))
\theta_{tuncstart\_1032,1}.p1, 177).rem)))).\_replace(this.\$r \rightarrow
this.$r.value(heapIs \rho_{uncstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs)
```

```
\rho_{funcstart=1032,1}, this.r.value(heapIs \rho_{funcstart=1032,1}).p1,
177).quot) + (171 * div(heapIs \theta), this.$r.value(heapIs
\theta_{funcstart\_1032,1}.p1, 177).rem)))._replace(p2 \rightarrow
asType<P2Type>((30307 * asType<int>(static_cast<integer>(false)))
+ \text{temp2})))
\rightarrow [simplify]
[57.25] $heap<sub>1032,1:1054,8</sub> == $heap<sub>funcstart_1032,1</sub>._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.} \text{\$r.value}(\text{heapIs}))
\theta_{funcstart, 1032.1}.p1, 177.rem)))._replace(this.$r \rightarrow
\textbf{this.\$r.value}(\textbf{heapIs}~\$ heap_{funcstart\_1032,1}).\_\textbf{replace}(p1 \rightarrow ((-2~*div(\textbf{heapIs})))))
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
\theta_{funcstart\_1032,1}.p1, 177).rem))).\_replace(p2 \rightarrow
asType < P2Type > ((30307 * asType < int > (([false]: 1, []: 0))) + temp2)))
→ [explicitly assert falsehood of skipped guards in subsequent guards]
this.$r.value(heapIs heap_{funcstart=1032.1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs $heap<sub>funcstart_1032,1</sub>, this.$r.value(heapIs
\theta_{tuncstart\_1032.1}.p1, 177).rem)))._replace(this.$r \rightarrow
this.$r.value(heapIs \rho_{tuncstart\_1032.1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(\mathbf{heapIs} \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}))
\theta_{uncstart\_1032,1}.p1, 177).rem))).\_replace(p2 \rightarrow
asType<P2Type>((30307 * asType<int>(([false]: 1, [true]: 0))) +
temp2)))
\rightarrow [simplify]
[57.29] $heap<sub>1032,1;1054,8</sub> == $heap<sub>funcstart_1032,1</sub>._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{tuncstart\_1032.1}, this.r.value(heapIs \rho_{tuncstart\_1032.1}).p1,
177).quot) + (171 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
\label{eq:continuous_function} $ \text{heap}_{funcstart\_1032,1}.\text{p1},\ 177).\text{rem})))).$ \_\textbf{replace}(\textbf{this}.\$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart=1032,1}, this.r.value(heapIs \rho_{funcstart=1032,1}).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{heap}_{funcstart\_1032,1}, \text{this.}\text{$r.value}(\text{heapIs}))
\rho_{funcstart\_1032,1}.p1, 177).rem))._replace(p2 \rightarrow asType<P2Type>(0 +
\rightarrow [from term 54.18, temp2 is equal to (-35 * div(heapIs $heap_{funcstart\_1032.1},
this.$r.value(heapIs $heap_{funcstart_1032.1}).p2, 176).quot) + (172 *
div(\mathbf{heapIs} \ \$heap_{funcstart\_1032,1}, \ \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
heap_{funcstart\_1032,1}.p2, 176).rem
```

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[57.30] $\text{heap}_{1032,1;1054,8} == $\text{heap}_{funcstart\_1032,1}._\text{replace}(\text{this.}\text{$\frac{1}{2}}\text{$\text{op}})$
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
\theta_{tuncstart\_1032,1}.p1, 177).rem)))).\_replace(this.\$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs heapIs = f_{uncstart_1032,1}, this.r.value(heapIs)
\rho_{funcstart\_1032,1}.p1, 177).rem))._replace(p2 \rightarrow asType<P2Type>(0 +
((-35 * div(heapIs \$heap_{funcstart\_1032,1}, this.\$r.value(heapIs
\rho_{funcstart\_1032,1}.p2, 176).quot + (172 * div(heapIs $heap_{funcstart\_1032,1}), quot) + (172 * div(heapIs $heap_{funcstart\_1032,1}), q
this.r.value(heapIs \ heap_{funcstart\_1032.1}).p2, 176).rem))))
\rightarrow [simplify]
[57.33] heap_{1032,1;1054,8} == heap_{funcstart\_1032,1}._replace(this.r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart_1032,1}, this.r.value(heapIs \rho_{funcstart_1032,1}).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.} \text{\$r.value}(\text{heapIs}))
\theta_{funcstart\_1032,1}.p1, 177).rem))))._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\$heap_{funcstart\_1032,1},\, \textbf{this.} \$r. \textbf{value} (\textbf{heapIs} \,\,\$heap_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs $heap<sub>funcstart_1032.1</sub>, this.$r.value(heapIs
\$heap_{funcstart\_1032,1}).p1,\ 177).rem))).\_\mathbf{replace}(p2 \to ((-35\ *\ div(\mathbf{heapIs}
\rho_{funcstart\_1032,1}, this. r.value(heapIs \rho_{funcstart\_1032,1}).p2,
176).quot) + (172 * div(\mathbf{heapIs} \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}))
heap_{funcstart_{-1032.1}}.p2, 176).rem)))
[Take given term]
[58.0] (($heap<sub>1032.1:1054.8</sub>.r3 * static_cast<signed int>(div3.rem)) -
(\text{sheap}_{1032.1:1054.8}.\text{b3} * \text{static\_cast} < \text{signed int} > (\text{div3.quot}))) == \text{temp3}
\rightarrow [from term 57.33, \rho_{1032,1;1054,8} is equal to
heap_{funcstart\_1032,1}._replace(this.r \rightarrow this.r.value(heapIs)
heap_{funcstart\_1032,1}._replace(p1 \rightarrow ((-2 * div(heapIs $heap_{funcstart\_1032,1},
this.r.value(heapIs \ heap_{funcstart\_1032.1}).p1, 177).quot) + (171)
div(\mathbf{heapIs}\ \$heap_{funcstart\_1032,1},\ \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}
\theta_{funcstart\_1032,1}.p1, 177).rem)))).\_replace(this.\$r \rightarrow 0
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(\mathbf{heapIs} \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}))
heap_{funcstart\_1032,1}.p1, 177).rem))).\_replace(p2 \rightarrow (-35 * div(heapIs))).
$heap_funcstart_1032.1, this.$r.value(heapIs $heap_funcstart_1032.1).p2,
176).quot) + (172 * div(heapIs $heap_{tuncstart\_1032.1}, this.$r.value(heapIs
heap_{funcstart\_1032,1}.p2, 176).rem)))]
[58.1] \; ((\$ heap_{funcstart\_1032,1}.\_\textbf{replace}(\textbf{this}.\$r \rightarrow \textbf{this}.\$r.\textbf{value}(\textbf{heapIs}))) \\
\rho_{tuncstart\_1032.1}._replace(p1 \rightarrow ((-2 * div(heapIs \rho_{tuncstart\_1032.1})
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this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177).quot) + (171 *
{\rm div}(\mathbf{heapIs}~\$\mathrm{heap}_{funcstart\_1032,1},~\mathbf{this.\$r.value}(\mathbf{heapIs}
\theta_{tuncstart\_1032,1}.p1, 177).rem)))).\_replace(this.\$r \rightarrow
this.$r.value(heapIs \rho_{uncstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs)
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs $heap<sub>funcstart_1032,1</sub>, this.$r.value(heapIs
\rho_{uncstart\_1032,1}.p1, 177).rem))).\_replace(p2 \rightarrow ((-35 * div(heapIs)))._replace(p2 \rightarrow ((-35 * div(heapIs))))._replace(p3 + div(heapIs)))
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p2,
176).quot) + (172 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.}\text{\$r.value}(\text{heapIs}))
\rho_{funcstart_1032,1}.p2, 176).rem))).r3 * static_cast < signed
int>(div3.rem)) - (\$heap_{1032.1:1054.8}.b3 * static\_cast < signed
int > (div3.quot))) == temp3
→ [const member of object with modified fields]
[58.3] \; ((\$heap_{funcstart\_1032,1}.r3 * \textbf{static\_cast} < \textbf{signed int} > (\text{div3.rem})) \; - \\
(\$heap_{1032,1;1054,8}.b3 * \textbf{static\_cast} < \textbf{signed int} > (div3.quot))) == temp3
\rightarrow [const static or extern object]
[58.4]\;((\$\mathrm{heap}_{init}.\mathrm{r3}\;\ast\;\mathbf{static\_cast}{<}\mathbf{signed}\;\mathbf{int}{>}(\mathrm{div3.rem}))\;-
(\$heap_{1032,1;1054,8}.b3 * \mathbf{static\_cast} < \mathbf{signed\ int} > (div3.quot))) == temp3
\rightarrow [expand definition of constant 'r3' at prang.cpp (39,26)]
[58.5] (((int)170 * static_cast<signed int>(div3.rem)) -
(\text{sheap}_{1032.1:1054.8}.\text{b3} * \text{static\_cast} < \text{signed int} > (\text{div3.quot}))) = = \text{temp3}
\rightarrow [simplify]
[58.6] ((170 * static_cast < signed int > (div3.rem)) - ($heap_{1032.1:1054.8}.b3 *
static_cast<signed int>(div3.quot))) == temp3
\rightarrow [from term 34.6, div3 is equal to div(heapIs $heap_{funcstart\_1032,1},
this.r.value(heapIs $heap_{funcstart\_1032,1}).p3, 178)]
[58.7] ((170 * static_cast<signed int>(div(heapIs $heap_{tuncstart\_1032.1})
this.r.value(heapIs \ heap_{funcstart\_1032.1}).p3, 178).rem))
(\text{sheap}_{1032,1;1054,8}.\text{b3} * \text{static\_cast} < \text{signed int} > (\text{div}3.\text{quot}))) == \text{temp}_3
\rightarrow [simplify]
[58.8] ((170 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs = f_{uncstart\_1032,1})
\text{Sheap}_{funcstart\_1032,1}.p3, 178).rem) - (\text{Sheap}_{1032,1;1054,8}.b3 *
static_cast<signed int>(div3.quot))) == temp3
\rightarrow [from term 57.33, $heap<sub>1032,1:1054,8</sub> is equal to
\$heap_{funcstart\_1032,1}.\_\textbf{replace}(\textbf{this}.\$r \rightarrow \textbf{this}.\$r.\textbf{value}(\textbf{heapIs}
heap_{funcstart\_1032,1}._replace(p1 \rightarrow ((-2 * div(heapIs $heap_{funcstart\_1032,1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177).quot) + (171)
div(\mathbf{heapIs} \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
\theta_{funcstart\_1032,1}.p1, 177).rem)))).\_replace(this.\$r \rightarrow 0
this.r.value(heapIs \ heap_{funcstart\_1032.1})._replace(p1 \rightarrow ((-2 * div(heapIs
```

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heap_{funcstart\_1032,1}, this.r.value(heapIs heap_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs $heap_{funcstart\_1032,1}, this.$r.value(heapIs)
heap_{funcstart\_1032,1}.p1, 177).rem))).\_replace(p2 \rightarrow (-35 * div(heapIs))).
heap_{funcstart\_1032,1}, this.r.value(heapIs heap_{funcstart\_1032,1}).p2,
176).quot) + (172 * div(\mathbf{heapIs} \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}))
heap_{funcstart\_1032,1}.p2, 176).rem)))]
[58.9] ((170 * div(heapIs \rho_{funcstart\_1032,1}, this.r.value(heapIs)
\rho_{uncstart\_1032,1}.p3, 178.rem – (\rho_{uncstart\_1032,1}.p_{uncstart\_1032,1}.p_{uncstart\_1032,1}.p_{uncstart\_1032,1}.p_{uncstart\_1032,1}.p_{uncstart\_1032,1}.p_{uncstart\_1032,1}.p_{uncstart\_1032,1}.p_{uncstart\_1032,1}.p_{uncstart\_1032,1}.p_{uncstart\_1032,1}.p_{uncstart\_1032,1}.p_{uncstart\_1032,1}.p_{uncstart\_1032,1}.p_{uncstart\_1032,1}.p_{uncstart\_1032,1}.p_{uncstart\_1032,1}.p_{uncstart\_1032,1}.p_{uncstart\_1032,1}.p_{uncstart\_1032,1}.p_{uncstart\_1032,1}.p_{uncstart\_1032,1}.p_{uncstart\_1032,1}.p_{uncstart\_1032,1}.p_{uncstart\_1032,1}.p_{uncstart\_1032,1}.p_{uncstart\_1032,1}.p_{uncstart\_1032,1}.p_{uncstart\_1032,1}.p_{uncstart\_1032,1}.p_{uncstart\_1032,1}.p_{uncstart\_1032,1}.p_{uncstart\_1032,1}.p_{uncstart\_1032,1}.p_{uncstart\_1032,1}.p_{uncstart\_1032,1}.p_{uncstart\_1032,1}.p_{uncstart\_1032,1}.p_{uncstart\_1032,1}.p_{uncstart\_1032,1}.p_{uncstart\_1032,1}.p_{uncstart\_1032,1}.p_{uncstart\_1032,1}.p_{uncstart\_1032,1}.p_{uncstart\_1032,1}.p_{uncstart\_1032,1}.p_{uncstart\_1032,1}.p_{uncstart\_1032,1}.p_{uncstart\_1032,1}.p_{uncstart\_1032,1}.p_{uncstart\_1032,1}.p_{uncstart\_1032,1}.p_{uncstart\_1032,1}.p_{uncstart\_1032,1}.p_{uncstart\_1032,1}.p_{uncstart\_1032,1}.p_{uncstart\_1032,1}.p_{uncstart\_1032,1}.p_{uncstart\_1032,1}.p_{uncstart\_1032,1}.p_{uncstart\_1032,1}.p_{uncstart\_1032,1}.p_{uncstart\_1032,1}.p_{uncstart\_1032,1}.p_{uncstart\_1032,1}.p_{uncstart\_1032,1}.p_{uncstart\_1032,1}.p_{uncstart\_1032,1}.p_{uncstart\_1032,1}.p_{uncstart\_1032,1}.p_{uncstart\_1032,1}.p_{uncstart\_1032,1}.p_{uncstart\_1032,1}.p_{uncstart\_1032,1}.p_{uncstart\_1032,1}.p_{uncstart\_1032,1}.p_{uncstart\_1032,1}.p_{uncstart\_1032,1}.p_{uncstart\_1032,1}.p_{uncstart\_1032,1}.p_{uncstart\_1032,1}.p_{uncstart\_1032,1}.p_{uncstart\_1032,1}.p_{uncstart\_1032,1}.p_{uncstart\_1032,1}.p_{uncstart\_1032,1}.p_{uncstart\_1032,1}.p_{uncstart\_1032,1}.p_{uncstart\_1032,1}.p_{uncstart\_1032,1}.p_{uncstart\_1032,1}.p_{uncstart\_1032,1}.p_{uncstart\_1032,1}.p_{uncstart\_1032,1}.p_{uncstart\_1032,1}.p_{uncstart\_1032,1}.p_{uncstart\_1032,1}.p_{uncstart\_1032,1}.p_{uncstart\_1032,1}.p_{uncstart\_1032,1}.p_{uncs
\rightarrow this.$r.value(heap
Is \rho_{1032,1})._replace(p1 \rightarrow ((-2 *
div(\mathbf{heapIs} \$ heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
\text{Sheap}_{funcstart\_1032,1}.p1, 177).quot) + (171 * div(heapIs \text{Sheap}_{funcstart\_1032,1},
this.$r.value(heapIs $heap_funcstart_1032.1).p1, 177).rem))))._replace(this.$r
\rightarrow this.$r.value(heapIs $heap_{tuncstart, 1032, 1})._replace(p1 \rightarrow ((-2 *
div(\mathbf{heapIs} \$ heap_{funcstart\_1032.1}, \mathbf{this.}\$r.\mathbf{value}(\mathbf{heapIs})
\text{Sheap}_{funcstart\_1032,1}.p1, 177).quot) + (171 * div(heapIs \text{Sheap}_{funcstart\_1032,1},
this.r.value(heapIs \ heap_{funcstart\_1032.1}).p1, 177).rem))).\_replace(p2 \rightarrow
((-35 * div(heapIs \$heap_{funcstart\_1032,1}, this.\$r.value(heapIs
\text{Sheap}_{funcstart\_1032,1}.p2, 176).quot) + (172 * div(heapIs \text{Sheap}_{funcstart\_1032,1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p2, 176).rem)))).b3 *
static_cast<signed int>(div3.quot))) == temp3
→ [const member of object with modified fields]
[58.11] ((170 * div(heapIs \$heap_{funcstart\_1032,1}, this.\$r.value(heapIs
\rho_{funcstart\_1032,1}.p3, 178).rem - (\rho_{funcstart\_1032,1}.b3 * 
static_cast<signed int>(div3.quot))) == temp3
\rightarrow [const static or extern object]
[58.12] ((170 * div(heapIs $heap_{funcstart\_1032,1}, this.$r.value(heapIs
\rho_{uncstart\_1032,1}.p3, 178.rem – (\rho_{uncstart\_1032,1}.p3, 178.rem) – (\rho_{uncstart\_1032,1}.p3, 178.rem) – (\rho_{uncstart\_1032,1}.p3, 178.rem)
int>(div3.quot)) == temp3
\rightarrow [expand definition of constant 'b3' at prang.cpp (41,26)]
[58.13] ((170 * div(\mathbf{heapIs} \ \$heap_{funcstart\_1032,1}, \ \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
int>(div3.quot)) == temp3
\rightarrow [simplify]
[58.14] ((170 * div(heapIs heap_{funcstart\_1032,1}, this.r.value(heapIs)
\theta_{tuncstart=1032.1}.p3, 178).rem) - (63 * static_cast<signed)
int>(div3.quot)) == temp3
\rightarrow [from term 34.6, div3 is equal to div(heapIs $heap_{funcstart\_1032,1},
this.r.value(heapIs $heap_{funcstart\_1032,1}).p3, 178)]
[58.15] ((170 * div(heapIs $heap<sub>funcstart_1032,1</sub>, this.$r.value(heapIs
\rho_{tuncstart=1032.1}, p3, 178).rem) - (63 * static_cast<signed)
int>(div(heapIs $heap_{tuncstart 1032.1}, this.$r.value(heapIs
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\$heap_{funcstart\_1032,1}).p3,\,178).quot))) == temp3
\rightarrow [simplify]
[58.20] 0 == (-\text{temp3} + (-63 * \text{div}(\text{heapIs} \$\text{heap}_{funcstart\_1032.1})]
this.r.value(heapIs \ensuremath{\$}heap_{funcstart\_1032,1}).p3, 178).quot) + (170 *
\label{eq:continuous} \mbox{div}(\mathbf{heapIs} \ \$\mbox{heap}_{funcstart\_1032,1}, \ \mathbf{this}.\$\mbox{r.value}(\mathbf{heapIs} \ \mbox{heap}_{funcstart\_1032,1}, \ \mathbf{this}.\mbox{r.value}(\mathbf{heapIs} \ \mbox{heap}_{funcstart\_1032,1}, \ \mathbf{this}.\mbox{r.value}(\mathbf{heap}_{funcstart\_1032,1}, \ \mathbf{this}.\mbox{r.value}(\mathbf{heap}_{funcstart\_1032,1}, \ \mathbf{heap}_{funcstart\_1032,1}, \
heap_{funcstart_1032,1}.p3, 178.rem)
[Take given term]
[61.0] $heap_{funcend_1032.1} == $heap_{1032.1:1054.8}._replace(this.$r \to
operator*(heapIs heap_{1032,1:1054.8}, this)._replace(p3 \rightarrow
\mathbf{asType}{<}\mathrm{P3Type}{>}((\$\mathrm{heap}_{1032,1;1054,8}.\mathrm{M3}\ *
asType{<}int{>}(static\_cast{<}integer{>}(static\_cast{<}signed
int>(operator^*(heapIs \$heap_{1032,1:1054.8}, this).p3) < (int)0))) + temp3)))
\rightarrow [from term 57.33, $heap<sub>1032,1;1054,8</sub> is equal to
\$heap_{funcstart\_1032,1}.\_\textbf{replace}(\textbf{this}.\$r \rightarrow \textbf{this}.\$r.\textbf{value}(\textbf{heapIs}
heap_{funcstart\_1032.1}._replace(p1 \rightarrow ((-2 * div(heapIs heap_{funcstart\_1032.1}),
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177).quot) + (171 *
div(heapIs $heap_{funcstart_1032.1}, this.$r.value(heapIs
\theta_{funcstart\_1032,1}.p1, 177).rem)))).\_replace(this.\$r \rightarrow 0
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
heap_{funcstart\_1032,1}, this.r.value(heapIs heap_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(\textbf{heapIs} \$heap_{funcstart\_1032,1}, \textbf{this}.\$r.\textbf{value}(\textbf{heapIs}))
heap_{funcstart\_1032,1}.p1, 177).rem))).\_replace(p2 \rightarrow (-35 * div(heapIs)))
heap_{funcstart\_1032,1}, this.r.value(heapIs heap_{funcstart\_1032,1}).p2,
176).quot) + (172 * div(heapIs $heap_{tuncstart\_1032.1}, this.$r.value(heapIs
heap_{funcstart\_1032,1}.p2, 176).rem)))
[61.2] heap_{funcend\_1032,1} == heap_{funcstart\_1032,1}._replace(this.$r \rightarrow
this.$r.value(heapIs \theta_{funcstart\_1032,1})._replace(p1 \theta ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.} \text{\$r.value}(\text{heapIs}))
\theta_{funcstart\_1032,1}.p1, 177).rem))))._replace(this.$r \rightarrow
\textbf{this.}\$r.\textbf{value}(\textbf{heapIs}~\$heap_{funcstart\_1032,1}).\_\textbf{replace}(p1 \rightarrow ((\text{-}2~*\text{div}(\textbf{heapIs}
\rho_{tuncstart\_1032.1}, this.r.value(heapIs \rho_{tuncstart\_1032.1}).p1,
177).quot) + (171 * div(heapIs $heap_{funcstart\_1032,1}, this.$r.value(heapIs
\$heap_{funcstart\_1032,1}).p1,\ 177).rem))).\_\mathbf{replace}(p2 \to ((-35\ *\ div(\mathbf{heapIs}
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p2,
176).quot) + (172 * \text{div}(\text{heapIs } \text{heap}_{funcstart\_1032.1}, \text{this.} \text{$r.value}(\text{heapIs}))
\hat{p}_{funcstart\_1032,1}.p2, 176).rem)))).\_replace(this.\$r \rightarrow operator*(heapIs))
\rho_{funcstart\_1032,1}.\_replace(this.\$r \rightarrow this.\$r.value(heapIs)
heap_{funcstart\_1032,1}._replace(p1 \rightarrow ((-2 * div(heapIs heap_{funcstart\_1032,1}),
this.r.value(heapIs \ heap_{funcstart\_1032.1}).p1, 177).quot) + (171)
div(\mathbf{heapIs} \$ heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
\theta_{tuncstart\_1032,1}.p1, 177).rem)))).\_replace(this.\$r \rightarrow 0
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
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\rho_{funcstart_1032,1}, this.\r.value(heapIs \rho_{funcstart_1032,1}).p1,
177).quot) + (171 * div(heapIs \theta_{funcstart\_1032,1}, this.r.value(heapIs)
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p2,
176).quot) + (172 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.}\text{\$r.value}(\text{heapIs}))
\theta_{funcstart\_1032,1}, p2, 176).rem))), this)._replace(p3 \rightarrow
asType<P3Type>(($heap<sub>1032,1;1054,8</sub>.M3 *
asType<int>(static_cast<integer>(static_cast<signed
int>(operator^*(heapIs $heap_{1032,1;1054,8}, this).p3) < (int)(0))) + temp3)))
→ [expand definition of operator '*' in class 'pointer' at built in declaration]
[61.3] heap_{funcend\_1032,1} == heap_{funcstart\_1032,1}._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
\theta_{funcstart_{1032,1}}.p1, 177).rem))))._replace(this.$r \rightarrow
this.$r.value(heapIs \theta_{funcstart=1032,1})._replace(p1 \theta ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{heap}_{funcstart\_1032,1}, \text{this.} \text{$r.value}(\text{heapIs}))
\rho_{funcstart\_1032,1}.p1, 177).rem))._replace(p2 \rightarrow ((-35 * div(heapIs
\rho_{funcstart\_1032,1}, this. r.value(heapIs \rho_{funcstart\_1032,1}).p2,
176).quot) + (172 * div(heapIs $heap<sub>funcstart_1032.1</sub>, this.$r.value(heapIs
\theta_{funcstart\_1032.1}.p2, 176).rem))).\_replace(this.\$r \rightarrow 0
\mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}~\$ \mathrm{heap}_{funcstart\_1032,1}.\_\mathbf{replace}(\mathbf{this}.\$r \rightarrow
\textbf{this.}\$r.\textbf{value}(\textbf{heapIs}~\$heap_{funcstart\_1032,1}).\_\textbf{replace}(p1 \rightarrow ((\text{-}2~*\text{div}(\textbf{heapIs}
\rho_{funcstart=1032,1}, this.r.value(heapIs \rho_{funcstart=1032,1}).p1,
(177).quot + (171 * div(heapIs $heap_{funcstart\_1032,1}, this.$r.value(heapIs)
\theta_{funcstart\_1032,1}.p1, 177).rem))))._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs \theta_{funcstart\_1032,1}, this.r.value(heapIs)
\rho_{funcstart\_1032,1}.p1, 177).rem)._replace(p2 \rightarrow ((-35 * div(heapIs)
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p2,
176).quot) + (172 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.} \text{\$r.value}(\text{heapIs}))
\label{eq:continuous_function} $\operatorname{heap}_{funcstart\_1032,1}).p2,\ 176).rem))))].\_\mathbf{replace}(p3 \to
asType<P3Type>(($heap<sub>1032,1;1054,8</sub>.M3 *
asType<int>(static_cast<integer>(static_cast<signed
int>(operator^*(heapIs $heap_{1032,1;1054,8}, this).p3) < (int)0))) + temp3)))
→ [evaluate dereferenced pointer into modified heap]
[61.4] heap_{funcend\_1032,1} == heap_{funcstart\_1032,1}._replace(this.$r \rightarrow
this.$r.value(heapIs \rho_{uncstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs)
\$heap_{funcstart\_1032,1},\, \textbf{this.}\$r.\textbf{value}(\textbf{heapIs}\,\,\$heap_{funcstart\_1032,1}).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.} \text{\$r.value}(\text{heapIs}))
\theta_{funcstart\_1032,1}.p1, 177).rem)))).\_replace(this.\$r \rightarrow 0
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
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\rho_{funcstart_{-1032,1}}, this.r.value(heapIs \rho_{funcstart_{-1032,1}}).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{heap}_{funcstart\_1032,1}, \text{this.} \text{$r.value}(\text{heapIs}))
\rho_{uncstart\_1032,1}.p1, 177).rem))._replace(p2 \rightarrow ((-35 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p2,
176).quot) + (172 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.}\text{\$r.value}(\text{heapIs}))
\rho_{funcstart\_1032,1}.p2, 176).rem)))).\_replace(this.$r \rightarrow ([this.$r ==
this.$r]: this.$r.value(heapIs \rho_{tuncstart\_1032.1})._replace(p1 \rightarrow ((-2 *
div(\mathbf{heapIs} \$ heap_{funcstart\_1032,1}, \mathbf{this}.\$ r. \mathbf{value}(\mathbf{heapIs})
\text{Sheap}_{funcstart\_1032,1}.\text{p1}, 177).\text{quot} + (171 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_1032,1}),
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177).rem))).\_replace(p2 \rightarrow
(-35 * div(heapIs \$heap_{funcstart\_1032,1}, this.\$r.value(heapIs
\text{Sheap}_{funcstart\_1032,1}.p2, 176).quot) + (172 * div(heapIs \text{Sheap}_{funcstart\_1032,1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p2, 176).rem)), []:
this.r.value(heapIs \ heap_{funcstart\_1032,1}.\_replace(this.\r \rightarrow \r \ heap_{funcstart\_1032,1})
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow (-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs \rho_{funcstart\_1032,1}, this.r.value(heapIs)
\theta_{funcstart\_1032.1}.p1, 177).rem)))).\_replace(p3 \rightarrow
asType<P3Type>(($heap<sub>1032.1:1054.8</sub>.M3 *
asType<int>(static_cast<integer>(static_cast<signed
int > (operator^*(heapIs \$heap_{1032,1;1054,8}, this).p3) < (int)0))) + temp3)))
→ [explicitly assert falsehood of skipped guards in subsequent guards]
[61.5] \theta_{1.5} == \theta_{1.5} 
\textbf{this.}\$r.\textbf{value}(\textbf{heapIs}~\$\text{heap}_{funcstart\_1032,1}).\_\textbf{replace}(\text{p1} \rightarrow ((-2~*\text{div}(\textbf{heapIs}
\rho_{funcstart_1032,1}, this. r.value(heapIs \rho_{funcstart_1032,1}).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.} \text{\$r.value}(\text{heapIs}))
\theta_{funcstart\_1032,1}.p1, 177).rem))))._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(\mathbf{heapIs} \$ heap_{funcstart\_1032,1}, \mathbf{this}.\$ r. \mathbf{value}(\mathbf{heapIs})
\rho_{funcstart\_1032,1}.p1, 177).rem)._replace\rho_{funcstart\_1032,1}.p1, 177).rem)._replace
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p2,
176).quot) + (172 * div(heapIs \rho_{funcstart\_1032,1}, this.r.value(heapIs)
\theta_{uncstart_{1032,1}}.p2, 176).rem)))._replace(this.$r \rightarrow ([this.$r ==
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 *
div(\mathbf{heapIs} \$ heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
\text{Sheap}_{funcstart\_1032,1}.p1, 177).quot) + (171 * div(heapIs \text{Sheap}_{funcstart\_1032,1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177).rem))).\_replace(p2 \rightarrow
(-35 * div(heapIs \$heap_{funcstart\_1032,1}, this.\$r.value(heapIs
\text{Sheap}_{funcstart\_1032.1}.p2, 176).quot) + (172 * div(heapIs \text{Sheap}_{funcstart\_1032.1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p2, 176).rem)), [!(this.<math>r = 
\mathbf{this.\$r.value}(\mathbf{heapIs}~\$ \mathbf{heap}_{funcstart\_1032,1}.\_\mathbf{replace}(\mathbf{this.\$r} \rightarrow \mathbf{funcstart})
this.$r.value(heapIs heapIs_{funcstart\_1032,1})._replace(p1 \rightarrow (-2 * div(heapIs
\rho_{tuncstart_1032.1}, this.r.value(heapIs \rho_{tuncstart_1032.1}).p1,
177).quot) + (171 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
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\theta_{funcstart_1032,1}.p1, 177).rem))))._replace(p3 \rightarrow
asType<P3Type>(($heap<sub>1032,1:1054,8</sub>.M3 '
as Type < int > (static\_cast < integer > (static\_cast < signed))
int>(operator*(heapIs $heap_{1032,1;1054,8}, this).p3) < (int)0))) + temp3)))
\rightarrow [simplify]
[61.7] heap_{funcend\_1032,1} == heap_{funcstart\_1032,1}._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(\mathbf{heapIs} \$heap_{funcstart\_1032.1}, \mathbf{this.\$r.value}(\mathbf{heapIs}))
\theta_{tuncstart\ 1032.1}.p1,\ 177.rem)))._replace(this.r \rightarrow
this.$r.value(heapIs p_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\theta_{funcstart\_1032,1}, this.r.value(heapIs \theta_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs $heap<sub>funcstart_1032,1</sub>, this.$r.value(heapIs
\rho_{funcstart\_1032,1}.p1, 177).rem))._replace(p2 \rightarrow ((-35 * div(heapIs
\rho_{funcstart_{-1032,1}}, this. r.value(heapIs \rho_{funcstart_{-1032,1}}).p2,
176).quot) + (172 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
\theta_{funcstart\_1032,1}.p2, 176).rem))))._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this. r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
\rho_{funcstart\_1032,1}.p1, 177).rem))._replace(p2 \rightarrow ((-35 * div(heapIs
\rho_{tuncstart\_1032.1}, this.r.value(heapIs \rho_{tuncstart\_1032.1}).p2,
176).quot) + (172 * div(\mathbf{heapIs} \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}))
\theta_{funcstart\_1032,1}.p2, 176).rem))).\_replace(p3 \rightarrow
asType<P3Type>(($heap<sub>1032.1:1054.8</sub>.M3 *
asType<int>(static_cast<integer>(static_cast<signed
int>(operator^*(heapIs $heap_{1032,1;1054,8}, this).p3) < (int)(0))) + temp3)))
\rightarrow [from term 57.33, $heap<sub>1032,1:1054,8</sub> is equal to
\$heap_{funcstart\_1032,1}.\_\textbf{replace}(\textbf{this}.\$r \rightarrow \textbf{this}.\$r.\textbf{value}(\textbf{heapIs}
heap_{funcstart\_1032,1}._replace(p1 \rightarrow ((-2 * div(heapIs heap_{funcstart\_1032,1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177).quot) + (171)
div(\mathbf{heapIs} \ \$heap_{funcstart\_1032,1}, \ \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
\theta_{funcstart\_1032,1}.p1, 177).rem)))).\_replace(this.\$r \rightarrow 0
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
$heap_{tuncstart_1032.1}$, this.$r.value(heapIs $heap_{tuncstart_1032.1}).p1,
177).quot) + (171 * div(\mathbf{heapIs} * heap_{funcstart\_1032,1}, \mathbf{this}. \$r. \mathbf{value}(\mathbf{heapIs} * heap_{funcstart\_1032,1}, \mathbf{this}. \$r. \mathbf{value}(\mathbf{heap}))
\rho_{funcstart\_1032.1}.p1, 177).rem))).\_replace(p2 \rightarrow (-35 * div(heapIs))).\_replace(p2 \rightarrow (-35 * div(heapIs)))
heap_{funcstart\_1032,1}, this.r.value(heapIs heap_{funcstart\_1032,1}).p2,
(176).quot) + (172 * div(heapIs $heap_{funcstart\_1032,1}, this.$r.value(heapIs)]
heap_{funcstart_{1032,1}}.p2, 176).rem)))
[61.8] heap_{funcend\_1032,1} == heap_{funcstart\_1032,1}._replace(this.$r \rightarrow
\textbf{this.}\$r.\textbf{value}(\textbf{heapIs}~\$heap_{funcstart\_1032,1}).\_\textbf{replace}(p1 \rightarrow ((-2~*div(\textbf{heapIs})))))
\rho_{funcstart\_1032.1}, this.r.value(heapIs \rho_{funcstart\_1032.1}).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.} \text{\$r.value}(\text{heapIs}))
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\theta_{tuncstart_1032.1}.p1, 177).rem)))._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs $heap<sub>funcstart_1032,1</sub>, this.$r.value(heapIs
\theta_{funcstart\_1032,1}.p1, 177).rem))._replace(p2 \rightarrow ((-35 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p2,
176).quot) + (172 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.} \text{\$r.value}(\text{heapIs}))
\theta_{tuncstart_{1032,1}}.p2, 176).rem)))._replace(this.$r \rightarrow
this.$r.value(heapIs \frac{1}{2} heap\frac{1}{2} heap\frac{1}{2}
\rho_{funcstart_1032,1}, this. r.value(heapIs \rho_{funcstart_1032,1}).p1,
177).quot) + (171 * div(\mathbf{heapIs} \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}))
\rho_{uncstart\_1032,1}.p1, 177).rem))._replace(p2 \rightarrow ((-35 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p2,
176).quot) + (172 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.} \text{\$r.value}(\text{heapIs}))
\theta_{funcstart\_1032,1}.p2, 176).rem))).\_replace(p3 \rightarrow
asType < P3Type > ((\$heap_{funcstart\_1032,1}.\_replace(this.\$r \rightarrow funcstart\_1032,1))
this.$r.value(heapIs \theta_{funcstart\_1032,1})._replace(p1 \theta ((-2 * div(heapIs
\rho_{tuncstart_1032.1}, this.r.value(heapIs \rho_{tuncstart_1032.1}).p1,
177).quot) + (171 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
\theta_{funcstart\_1032,1}.p1, 177).rem)))).\_replace(this.\$r \rightarrow 0
this.$r.value(heapIs \rho_{tuncstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.} \text{\$r.value}(\text{heapIs}))
\rho_{funcstart\_1032,1}.p1, 177).rem))._replace(p2 \rightarrow ((-35 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p2,
176).quot) + (172 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
heap_{funcstart_{1032,1}}.p2, 176).rem))).M3 *
asType<int>(static_cast<integer>(static_cast<signed
int>(operator^*(heapIs $heap_{1032,1;1054,8}, this).p3) < (int)(0))) + temp3)))
→ [const member of object with modified fields]
[61.10] heap_{funcend\_1032,1} == heap_{funcstart\_1032,1}._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs \rho_{funcstart\_1032,1}, this.r.value(heapIs)
\theta_{uncstart\_1032,1}.p1, 177).rem)))).\_replace(this.\$r \rightarrow
\textbf{this.}\$r.\textbf{value}(\textbf{heapIs}~\$heap_{funcstart\_1032,1}).\_\textbf{replace}(p1 \rightarrow ((-2~*div(\textbf{heapIs})))))
\rho_{funcstart\_1032,1}, this. r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs \rho_{funcstart\_1032,1}, this.r.value(heapIs)
\rho_{funcstart\_1032,1}.p1, 177).rem))._replace(p2 \rightarrow ((-35 * div(heapIs
\rho_{tuncstart\_1032.1}, this.r.value(heapIs \rho_{tuncstart\_1032.1}).p2,
176).quot) + (172 * \text{div}(\text{heapIs } \text{heap}_{funcstart\_1032.1}, \text{this.}\text{$\text{r.value}(\text{heapIs})$})
\theta_{funcstart\_1032,1}.p2, 176).rem)))).\_replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart_{1032,1}}, this. r.value(heapIs \rho_{funcstart_{1032,1}}).p1,
177).quot) + (171 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
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\rho_{funcstart\_1032,1}.p1, 177).rem))._replace(p2 \rightarrow ((-35 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p2,
176).quot) + (172 * div(heapIs \theta_{funcstart\_1032,1}, this.r.value(heapIs)
\theta_{funcstart\_1032,1}.p2, 176).rem))._replace(p3 \rightarrow
asType<P3Type>(($heap_funcstart_1032,1.M3 *
asType < int > (static\_cast < integer > (static\_cast < signed)
int>(operator^*(heapIs $heap_{1032,1:1054,8}, this).p3) < (int)0))) + temp3)))
\rightarrow [const static or extern object]
[61.11] \text{sheap}_{funcend\_1032,1} == \text{sheap}_{funcstart\_1032,1}._replace(this.\text{sr} \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{tuncstart\_1032,1}, this.r.value(heapIs \rho_{tuncstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs \theta_{funcstart\_1032,1}, this.r.value(heapIs)
\theta_{tuncstart\_1032,1}.p1, 177).rem)))).\_replace(this.\$r \rightarrow 0
this.$r.value(heapIs \rho_{uncstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs)
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
\rho_{uncstart\_1032,1}.p1, 177).rem))).\_replace(p2 \rightarrow ((-35 * div(heapIs)))._replace(p2 \rightarrow ((-35 * div(heapIs))))._replace(p2 \rightarrow ((-35 * div(heapIs))))._replace(p3 + div(heapIs)))
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p2,
176).quot) + (172 * div(\mathbf{heapIs} \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}))
\label{eq:continuous_function} $ \text{heap}_{funcstart\_1032,1} . \text{p2}, 176).rem)))).$ \ref{eq:continuous_function}. $ \text{p2}, 176).rem))) $ $ \text{replace}( \textbf{this}.\$r \rightarrow 0.5) $ \text{p2}, 176).rem) $ \text{p3}, 176).rem) $ \text{p3}, 176).rem) $ $ \text{p3}, 176).rem $ \text{p3}, 176).rem
this.$r.value(heapIs \rho_{tuncstart\_1032.1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.} \text{\$r.value}(\text{heapIs}))
\rho_{tuncstart_1032.1}, this.r.value(heapIs \rho_{tuncstart_1032.1}).p2,
(176).\text{quot} + (172 * \text{div}(\text{heapIs } \text{heap}_{funcstart\_1032,1}, \text{this.}\text{r.value}(\text{heapIs}))
\theta_{funcstart\_1032,1}.p2, 176).rem)))._replace(p3 \rightarrow
\mathbf{asType} \!\!<\!\! \mathrm{P3Type} \!\!>\!\! ((\$ \mathrm{heap}_{init}.\mathrm{M3} *
asType<int>(static_cast<integer>(static_cast<signed
int>(operator^*(heapIs $heap_{1032,1;1054,8}, this).p3) < (int)(0))) + temp3)))
\rightarrow [expand definition of constant 'M3' at prang.cpp (38,26)]
[61.12] \theta_{1.12} \theta_{1.12} \theta_{1.12} \theta_{1.12} \theta_{1.12} \theta_{1.12} \theta_{1.12} \theta_{1.12} \theta_{1.12}
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{heap}_{funcstart\_1032,1}, \text{this.} \text{$r.value}(\text{heapIs}))
\theta_{funcstart\_1032,1}.p1, 177).rem)))).\_replace(this.\$r \rightarrow 0
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(\mathbf{heapIs} \$ heap_{funcstart\_1032,1}, \mathbf{this}.\$ r. \mathbf{value}(\mathbf{heapIs})
\rho_{tuncstart_{-1032,1}}.p1, 177).rem))._replace(p2 \rightarrow ((-35 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p2,
176).quot) + (172 * div(\mathbf{heapIs} \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}))
\theta_{funcstart\_1032,1}.p2, 176).rem))))._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
```

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\rho_{funcstart=1032,1}, this.r.value(heapIs \rho_{funcstart=1032,1}).p1,
177).quot) + (171 * div(heapIs \theta_{funcstart\_1032,1}, this.r.value(heapIs)
\rho_{uncstart\_1032,1}.p1, 177).rem))._replace(p2 \rightarrow ((-35 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p2,
176).quot) + (172 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.}\text{\$r.value}(\text{heapIs}))
heap_{funcstart\_1032,1}.p2, 176).rem)))._replace(p3 \rightarrow
asType<P3Type>(((int)30323 *
asType<int>(static_cast<integer>(static_cast<signed
int>(operator^*(heapIs $heap_{1032.1:1054.8}, this).p3) < (int)0))) + temp3)))
[61.13] \text{heap}_{funcend\_1032,1} == \text{heap}_{funcstart\_1032,1}._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
\theta_{funcstart_{1032,1}}.p1, 177).rem))))._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart=1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{heap}_{funcstart\_1032,1}, \text{this.}\text{\$r.value}(\text{heapIs}))
\rho_{funcstart\_1032,1}.p1, 177).rem))._replace(p2 \rightarrow ((-35 * div(heapIs
\rho_{funcstart\_1032,1}, this. r.value(heapIs \rho_{funcstart\_1032,1}).p2,
176).quot) + (172 * div(heapIs $heap<sub>funcstart_1032,1</sub>, this.$r.value(heapIs
\theta_{tuncstart\_1032.1}.p2, 176).rem)))._replace(this.$r \rightarrow
\textbf{this.\$r.value}(\textbf{heapIs}~\$ heap_{funcstart\_1032,1}).\_\textbf{replace}(p1 \rightarrow ((-2~*div(\textbf{heapIs}
\rho_{funcstart\_1032,1}, this.\r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.} \text{\$r.value}(\text{heapIs}))
heap_{funcstart\_1032,1}.p1, 177).rem)).\_replace(p2 \rightarrow ((-35 * div(heapIs)))._replace(p2 \rightarrow ((-35 * div(heapIs))))._replace(p2 \rightarrow ((-35 * div(heapIs)))))
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p2,
176).quot) + (172 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
\theta_{funcstart\_1032,1}.p2, 176).rem))._replace(p3 \rightarrow
asType<P3Type>((30323 *
asType<int>(static_cast<integer>(static_cast<signed
int>(operator^*(heapIs $heap_{1032.1:1054.8}, this).p3) < (int)0))) + temp3)))
\rightarrow [from term 57.33, $heap<sub>1032,1;1054,8</sub> is equal to
$heap_{funcstart\_1032.1}.$_replace(this.$r \rightarrow this.$r.value(heapIs)
heap_{funcstart\_1032.1}._replace(p1 \rightarrow ((-2 * div(heapIs heap_{funcstart\_1032.1}),
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177).quot) + (171 *
div(heapIs $heap_{tuncstart_1032.1}, this.$r.value(heapIs
\theta_{funcstart\_1032,1}.p1, 177).rem)))).\_replace(this.\$r \rightarrow 0
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
heap_{funcstart\_1032,1}, this.r.value(heapIs heap_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(\mathbf{heapIs} \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}))
heap_{funcstart\_1032,1}.p1, 177).rem))._replace(p2 \rightarrow (-35 * div(heapIs))
$heap_{funcstart\_1032,1}$, this. $r.value(heapIs $heap_{funcstart\_1032,1}).p2$,}
176).quot) + (172 * div(heapIs $heap_{funcstart\_1032,1}, this.$r.value(heapIs)
```

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heap_{funcstart_{-1032.1}}.p2, 176).rem)))
[61.14] heap_{funcend\_1032,1} == heap_{funcstart\_1032,1}._replace(this.$r \rightarrow
\textbf{this.\$r.value}(\textbf{heapIs}~\$ heap_{funcstart\_1032,1}).\_\textbf{replace}(p1 \rightarrow ((-2~*div(\textbf{heapIs})))))
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.} \text{\$r.value}(\text{heapIs}))
\theta_{funcstart\_1032,1}.p1, 177).rem)))).\_replace(this.\$r \rightarrow 0
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs)
\rho_{funcstart\_1032,1}, this.\r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs \rho_{funcstart\_1032,1}, this.r.value(heapIs)
\rho_{funcstart\_1032,1}.p1, 177).rem)._replace\rho_{funcstart\_1032,1}.p1, 177).rem)._replace
\theta_{funcstart\_1032,1}, this. r.value(heapIs \theta_{funcstart\_1032,1}).p2,
176).quot) + (172 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
\theta_{funcstart_{1032,1}}.p2, 176).rem))))._replace(this.$r \rightarrow
this.$r.value(heapIs p_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\label{eq:heapIs} $\operatorname{heap}_{funcstart\_1032,1},\ \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}\ \$\operatorname{heap}_{funcstart\_1032,1}).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.} \text{\$r.value}(\text{heapIs}))
\theta_{funcstart\_1032,1}.p1, 177).rem))._replace(p2 \rightarrow ((-35 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p2,
176).quot) + (172 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.}\text{\$r.value}(\text{heapIs}))
\theta_{funcstart\_1032,1}.p2, 176).rem)))._replace(p3 \rightarrow
asType<P3Type>((30323 *
asType < int > (static\_cast < integer > (static\_cast < signed
\mathbf{int}{>}(\mathbf{operator^*}(\mathbf{heapIs}\ \$\mathbf{heap}_{funcstart\_1032,1}.\_\mathbf{replace}(\mathbf{this}.\$\mathbf{r}\rightarrow
\textbf{this.}\$r.\textbf{value}(\textbf{heapIs}~\$heap_{funcstart\_1032,1}).\_\textbf{replace}(p1 \rightarrow ((-2~*div(\textbf{heapIs})))))
\rho_{tuncstart\_1032.1}, this.r.value(heapIs \rho_{tuncstart\_1032.1}).p1,
177).quot) + (171 * div(heapIs \rho_{funcstart\_1032,1}, this.r.value(heapIs)
\label{eq:continuous_function} $\operatorname{heap}_{funcstart\_1032,1}.p1,\ 177).rem)))).$\tt replace(this.\$r \rightarrow
this.$r.value(heapIs \rho_{tuncstart\_1032.1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.} \text{\$r.value}(\text{heapIs}))
\rho_{funcstart_1032,1}, this. r.value(heapIs \rho_{funcstart_1032,1}).p2,
176).quot) + (172 * \text{div}(\text{heapIs } \text{heap}_{funcstart\_1032,1}, \text{this.} \text{$r.value}(\text{heapIs}))
heap_{funcstart\_1032,1}.p2, 176).rem)), this).p3) < (int)0)) + temp3))
→ [expand definition of operator '*' in class 'pointer' at built in declaration]
[61.15] heap_{funcend\_1032,1} == heap_{funcstart\_1032,1}._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs \rho_{funcstart\_1032,1}, this.r.value(heapIs)
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs \rho_{funcstart\_1032,1}, this.r.value(heapIs)
\rho_{funcstart\_1032,1}.p1, 177).rem))._replace(p2 \rightarrow ((-35 * div(heapIs
```

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176).quot) + (172 * div(heapIs \theta), this.$r.value(heapIs
\theta_{funcstart\_1032,1}.p2, 176).rem))))._replace(this.$r \rightarrow
this.$r.value(heapIs p_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs $heap<sub>funcstart_1032,1</sub>, this.$r.value(heapIs
\rho_{uncstart\_1032,1}.p1, 177).rem))).\_replace(p2 \rightarrow ((-35 * div(heapIs)))._replace(p2 \rightarrow ((-35 * div(heapIs))))._replace(p3 + div(heapIs)))
$\text{heap}_{tuncstart_1032,1}$, this.$\text{r.value}(\text{heapIs} \text{$heap}_{tuncstart_1032,1}).p2,
176).quot) + (172 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032.1}, \text{this.} \text{\$r.value}(\text{heapIs}))
heap_{funcstart\_1032,1}.p2, 176).rem))).\_replace(p3 \rightarrow
asType < P3Type > ((30323 *
asType<int>(static_cast<integer>(static_cast<signed
int>(this.r.value(heapIs \ heap_{funcstart\_1032,1}.\_replace(this.\rdotsr)
\textbf{this.\$r.value}(\textbf{heapIs}~\$ heap_{funcstart\_1032,1}).\_\textbf{replace}(p1 \rightarrow ((-2 * div(\textbf{heapIs}) + (-2 * div(\textbf{heapI
\rho_{funcstart\_1032,1}, this. r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(\mathbf{heapIs} \$ heap_{funcstart\_1032,1}, \mathbf{this}.\$ r. \mathbf{value}(\mathbf{heapIs})
\theta_{funcstart\_1032,1}.p1, 177).rem)))).\_replace(this.\$r \rightarrow 0
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{tuncstart_{-1032.1}}, this.r.value(heapIs \rho_{tuncstart_{-1032.1}}).p1,
177).quot) + (171 * div(\mathbf{heapIs} \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}))
\rho_{funcstart\_1032,1}.p1, 177).rem))._replace(p2 \rightarrow ((-35 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p2,
176).quot) + (172 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.} \text{\$r.value}(\text{heapIs}))
\text{Sheap}_{funcstart\_1032,1}.\text{p2}, 176).\text{rem})))).\text{p3}) < (int)0))) + \text{temp3}))
→ [evaluate dereferenced pointer into modified heap]
[61.16] $heap<sub>funcend_1032,1</sub> == $heap<sub>funcstart_1032,1</sub>._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
\theta_{tuncstart\_1032,1}.p1, 177).rem)))).\_replace(this.\$r \rightarrow
\textbf{this.\$r.value}(\textbf{heapIs}~\$ heap_{funcstart\_1032,1}).\_\textbf{replace}(p1 \rightarrow ((-2~*div(\textbf{heapIs})))))
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs \theta_{funcstart\_1032,1}, this.r.value(heapIs)
\$heap_{funcstart\_1032,1}).p1,\ 177).rem))).\_\mathbf{replace}(p2 \to ((-35\ *\ div(\mathbf{heapIs})))).
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p2,
176).quot) + (172 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
\theta_{funcstart\_1032,1}.p2, 176).rem))))._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\$heap_{funcstart\_1032,1},\, \textbf{this.}\$r.\textbf{value}(\textbf{heapIs}\,\,\$heap_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs $heap<sub>funcstart_1032.1</sub>, this.$r.value(heapIs
\$heap_{funcstart\_1032,1}).p1,\ 177).rem))).\_\mathbf{replace}(p2 \to ((-35\ *\ div(\mathbf{heapIs}
\rho_{funcstart\_1032,1}, this.\r.value(heapIs \rho_{funcstart\_1032,1}).p2,
176).quot) + (172 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
\theta_{funcstart=1032.1}.p2, 176).rem))._replace(p3 \rightarrow
asType<P3Type>((30323 *
```

 $\rho_{funcstart=1032,1}$, this. $r.value(heapIs \rho_{funcstart=1032,1}).p2$,

```
asType<int>(static_cast<integer>(static_cast<signed int>(([this.$r
== this.$r]: this.$r.value(heapIs \theta_{funcstart\_1032,1})._replace(p1 \theta ((-2)
* div(\mathbf{heapIs} \$ heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
\text{Sheap}_{funcstart\_1032,1}.p1, 177).quot) + (171 * div(heapIs \text{Sheap}_{funcstart\_1032,1},
this.r.value(heapIs \ heap_{funcstart\_1032.1}).p1, 177).rem))).\_replace(p2 \rightarrow
(-35 * div(heapIs \$heap_{funcstart\_1032,1}, this.\$r.value(heapIs
\rho_{tuncstart_{1032.1}, p2, 176} = 176, quot \rho_{tuncstart_{1032.1}, p3} + 176 div \rho_{tuncstart_{1032.1}, p3} = 176
this.r.value(heapIs \ heap_{funcstart=1032.1}).p2, 176).rem)), []:
this.r.value(heapIs \ heap_{funcstart\_1032,1}.\_replace(this.\rdots)
this.$r.value(heapIs heapIs ._replace(p1 \rightarrow (-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.} \text{\$r.value}(\text{heapIs}))
\label{eq:heapfuncstart_1032,1} $ \text{heap}_{funcstart_1032,1}.\text{p1},\ 177).\text{rem})))).\text{p3}) < (\textbf{int})0))) + \text{temp3})) \\
→ [explicitly assert falsehood of skipped guards in subsequent guards]
[61.17] heap_{funcend\_1032,1} == heap_{funcstart\_1032,1}._replace(this.$r \rightarrow
this.$r.value(heapIs $heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{heap}_{funcstart\_1032,1}, \text{this.} \text{$r.value}(\text{heapIs}))
\label{eq:continuous_function} $ \text{heap}_{funcstart\_1032,1} . \text{p1}, 177).rem)))).$ \_\textbf{replace}(\textbf{this}.\$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{tuncstart\_1032.1}, this.r.value(heapIs \rho_{tuncstart\_1032.1}).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.} \text{\$r.value}(\text{heapIs}))
\$heap_{funcstart\_1032,1}).p1,\ 177).rem))).\_replace(p2 \rightarrow ((-35 * div(\textbf{heapIs}
\rho_{funcstart\_1032,1}, this.\r.value(heapIs \rho_{funcstart\_1032,1}).p2,
176).quot) + (172 * div(heapIs $heap<sub>funcstart_1032.1</sub>, this.$r.value(heapIs
\theta_{tuncstart\_1032,1}.p2, 176).rem)))).\_replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
\rho_{funcstart\_1032,1}.p1, 177).rem))._replace(p2 \rightarrow ((-35 * div(heapIs
\label{eq:heapIs} $\operatorname{heap}_{funcstart\_1032,1}, \ \mathbf{this}. $r. \mathbf{value} (\mathbf{heapIs} \ $\operatorname{heap}_{funcstart\_1032,1}). p2,
176).quot) + (172 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.} \text{\$r.value}(\text{heapIs}))
\$heap_{funcstart\_1032,1}).p2,\ 176).rem))).\_\mathbf{replace}(p3 \rightarrow
asType<P3Type>((30323 *
asType < int > (static\_cast < integer > (static\_cast < signed\ int > (([this.\$r])))) \\
== this.$r]: this.$r.value(heapIs \rho_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2
* div(heapIs $heap<sub>funcstart_1032.1</sub>, this.$r.value(heapIs
\text{Sheap}_{funcstart\_1032,1}.p1, 177).quot) + (171 * div(heapIs \text{Sheap}_{funcstart\_1032,1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177).rem))).\_replace(p2 \rightarrow
(-35 * div(heapIs $heap<sub>funcstart_1032.1</sub>, this.$r.value(heapIs
\text{Sheap}_{funcstart\_1032.1}.p2, 176).quot) + (172 * div(heapIs \text{Sheap}_{funcstart\_1032.1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p2, 176).rem)), [!(this.<math>r = 176).rem)
this.r.value(heapIs \ensuremath{\$}heap_{funcstart\_1032,1}.\_replace(this.\ensuremath{\$}r \to this.\ensuremath{\$}r.
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow (-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
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177).quot) + (171 * div(heapIs $heap<sub>funcstart_1032.1</sub>, this.$r.value(heapIs
\text{Sheap}_{funcstart\_1032,1}.\text{p1}, 177).\text{rem})))).\text{p3}) < (\text{int})0)) + \text{temp3}))
\rightarrow [simplify]
[61.25] heap_{funcend\_1032,1} == heap_{funcstart\_1032,1}._replace(this.$r \rightarrow
\textbf{this.}\$r.\textbf{value}(\textbf{heapIs}~\$heap_{funcstart\_1032,1}).\_\textbf{replace}(p1 \rightarrow ((-2~*div(\textbf{heapIs}
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs $heap<sub>funcstart_1032,1</sub>, this.$r.value(heapIs
\theta_{funcstart\_1032,1}.p1, 177).rem))))._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.} \text{\$r.value}(\text{heapIs}))
\$heap_{funcstart\_1032,1}).p1,\ 177).rem))).\_replace(p2 \rightarrow ((-35 * div(\textbf{heapIs}) + (-35 * div(\textbf{heapI
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p2,
176).quot) + (172 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
\theta_{funcstart\_1032,1}.p2, 176).rem)))).replace(this.r \rightarrow 0
this.$r.value(heapIs \theta_{funcstart=1032,1})._replace(p1 \theta ((-2 * div(heapIs
\$heap_{funcstart\_1032,1},\, \textbf{this}.\$r.\textbf{value}(\textbf{heapIs}\,\,\$heap_{funcstart\_1032,1}).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.} \text{\$r.value}(\text{heapIs}))
\rho_{funcstart\_1032,1}.p1, 177).rem))._replace(p2 \rightarrow ((-35 * div(heapIs
\$heap_{funcstart\_1032,1}, \ \textbf{this.} \$r. \textbf{value} (\textbf{heapIs} \ \$heap_{funcstart\_1032,1}).p2,
176).quot) + (172 * div(heapIs $heap<sub>funcstart_1032.1</sub>, this.$r.value(heapIs
\theta_{funcstart\_1032,1}.p2, 176).rem))).\_replace(p3 \rightarrow
\mathbf{asType} < \texttt{P3Type} > ((30323 * \mathbf{asType} < \mathbf{int} > (\mathbf{static\_cast} < \mathbf{integer} > (0 < \mathbf{otherwise}))
-\mathbf{this.\$r.value}(\mathbf{heapIs}\ \$\mathrm{heap}_{funcstart\_1032,1}).\mathrm{p3}))) + \mathrm{temp3})))
\rightarrow [from term 40.0, literala < -this.$r.value(heapIs $heap_{funcstart\_1032.1}).p3
is false whenever -2 < (0 + literala)
       Proof of rule precondition:
       [61.25.0] - 2 < (0 + 0)
       \rightarrow [simplify]
       [61.25.2] true
[61.26] $heap<sub>funcend_1032,1</sub> == $heap<sub>funcstart_1032,1</sub>._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\$heap_{funcstart\_1032,1},\, \textbf{this.}\$r.\textbf{value}(\textbf{heapIs}\,\,\$heap_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
\theta_{funcstart\_1032,1}.p1, 177).rem)))).\_replace(this.\$r \rightarrow 0
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs))
\rho_{funcstart\_1032,1}, this.\r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs \rho_{funcstart\_1032,1}, this.r.value(heapIs)
\rho_{funcstart\_1032,1}.p1, 177).rem)._replace(p2 \rightarrow ((-35 * div(heapIs
```

 $\rho_{funcstart_1032,1}$, this. $r.value(heapIs \rho_{funcstart_1032,1}).p2$, 176).quot) + (172 * div(heapIs $\rho_{funcstart_1032,1}$, this.r.value(heapIs)

 $\rho_{tuncstart_1032,1}.p2, 176).rem))))._replace(this.$r \rightarrow$

```
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.}\text{\$r.value}(\text{heapIs}))
\rho_{funcstart\_1032,1}.p1, 177).rem))._replace(p2 \rightarrow ((-35 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p2,
176).quot) + (172 * div(heapIs $heap<sub>funcstart_1032,1</sub>, this.$r.value(heapIs
\theta_{funcstart\_1032,1}.p2, 176).rem))).\_replace(p3 \rightarrow
asType<P3Type>((30323 * asType<int>(static_cast<integer>(false)))
+ \text{temp3})))
\rightarrow [simplify]
[61.27] heap_{funcend\_1032,1} == heap_{funcstart\_1032,1}._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
\theta_{funcstart_{1032,1}}.p1, 177).rem))))._replace(this.$r \rightarrow
this.$r.value(heapIs \theta_{funcstart=1032,1})._replace(p1 \theta ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs \rho_{funcstart\_1032,1}, this.r.value(heapIs)
\rho_{funcstart\_1032,1}.p1, 177).rem))._replace(p2 \rightarrow ((-35 * div(heapIs
\rho_{funcstart\_1032,1}, this.\r.value(heapIs \rho_{funcstart\_1032,1}).p2,
176).quot) + (172 * div(heapIs $heap<sub>funcstart_1032,1</sub>, this.$r.value(heapIs
\theta_{tuncstart\_1032.1}.p2, 176).rem)))._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.\r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{heap}_{funcstart\_1032.1}, \text{this.} \text{$r.value}(\text{heapIs}))
heap_{funcstart\_1032,1}.p1, 177).rem)).\_replace(p2 \rightarrow ((-35 * div(heapIs)))._replace(p2 \rightarrow ((-35 * div(heapIs))))._replace(p2 \rightarrow ((-35 * div(heapIs)))))
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p2,
176).quot) + (172 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.} \text{\$r.value}(\text{heapIs}))
\theta_{funcstart\_1032,1}.p2, 176).rem))._replace(p3 \rightarrow
asType < P3Type > ((30323 * asType < int > (([false]: 1, []: 0))) + temp3)))
→ [explicitly assert falsehood of skipped guards in subsequent guards]
[61.28] heap_{funcend\_1032,1} == heap_{funcstart\_1032,1}._replace(this.$r \rightarrow
\textbf{this.\$r.value}(\textbf{heapIs}~\$ heap_{funcstart\_1032,1}).\_\textbf{replace}(p1 \rightarrow ((-2~*div(\textbf{heapIs})))))
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{heap}_{funcstart\_1032,1}, \text{this.} \text{$r.value}(\text{heapIs}))
\theta_{funcstart\_1032,1}.p1, 177).rem)))).\_replace(this.\$r \rightarrow 0
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.}\text{\$r.value}(\text{heapIs}))
\rho_{tuncstart_{-1032,1}}.p1, 177).rem))._replace(p2 \rightarrow ((-35 * div(heapIs
\rho_{funcstart\_1032,1}, this. r.value(heapIs \rho_{funcstart\_1032,1}).p2,
176).quot) + (172 * div(heapIs $heap<sub>funcstart_1032.1</sub>, this.$r.value(heapIs
\theta_{funcstart\_1032,1}.p2, 176).rem))))._replace(this.$r \rightarrow
this.r.value(heapIs \ensuremath{\$}heap_{funcstart\_1032.1}).\_replace(p1 \rightarrow ((-2 * div(heapIs
```

```
\rho_{funcstart=1032,1}, this.r.value(heapIs \rho_{funcstart=1032,1}).p1,
177).quot) + (171 * div(heapIs \theta_{funcstart\_1032,1}, this.r.value(heapIs)
\rho_{uncstart\_1032,1}.p1, 177).rem))._replace(p2 \rightarrow ((-35 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p2,
176).quot) + (172 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.}\text{\$r.value}(\text{heapIs}))
heap_{funcstart\_1032,1}.p2, 176).rem)))._replace(p3 \rightarrow
asType<P3Type>((30323 * asType<int>(([false]: 1, [true]: 0))) +
temp3)))
\rightarrow [simplify]
[61.31] heap_{funcend\_1032,1} == heap_{funcstart\_1032,1}._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(\mathbf{heapIs} \ \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
\theta_{funcstart\_1032,1}.p1, 177).rem)))).\_replace(this.\$r \rightarrow 0
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart_1032,1}, this.r.value(heapIs \rho_{funcstart_1032,1}).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.} \text{\$r.value}(\text{heapIs}))
\rho_{uncstart\_1032,1}.p1, 177).rem)._replace(\rho_{2} \rightarrow ((-35 * div(heapIs)))._
\label{eq:heapIs} $ \text{heap}_{funcstart\_1032,1}, \, \textbf{this}. \\ $\text{s.-value}(\textbf{heapIs} \,\, \$ \text{heap}_{funcstart\_1032,1}).p2, $ \\ $\text{heap}_{funcstart\_1032,1}, \, \texttt{this}. \\ $\text{heap}_{funcstart\_1032,1}, 
176).quot) + (172 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.}\text{\$r.value}(\text{heapIs}))
\theta_{tuncstart\_1032.1}.p2, 176).rem)))._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.\r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(\mathbf{heapIs} \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}))
\rho_{uncstart_1032,1}.p1, 177).rem))._replace(p2 \rightarrow ((-35 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p2,
176).quot) + (172 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
\rho_{uncstart\_1032,1}.p2, 176).rem))._replace(p3 \rightarrow asType<P3Type>(0 +
temp3)))
\rightarrow [from term 58.20, temp3 is equal to (-63 * div(heapIs $heap_{funcstart\_1032.1},
div(\mathbf{heapIs} \ \$heap_{funcstart\_1032,1}, \ \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
heap_{funcstart\_1032,1}.p3, 178).rem
[61.32] heap_{funcend\_1032,1} == heap_{funcstart\_1032,1}._replace(this.$r \rightarrow
this.$r.value(heapIs \theta_{funcstart\_1032,1})._replace(p1 \theta ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this. r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs \theta_{funcstart\_1032,1}, this.r.value(heapIs)
\theta_{tuncstart\_1032,1}.p1, 177).rem)))).\_replace(this.\$r \rightarrow 0
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{tuncstart_{1032,1}}, this. r.value(heapIs \rho_{tuncstart_{1032,1}}).p1,
177).quot) + (171 * div(\mathbf{heapIs} \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}))
\rho_{funcstart\_1032.1}.p1, 177).rem))._replace(p2 \rightarrow ((-35 * div(heapIs
\rho_{tuncstart\_1032.1}, this.r.value(heapIs \rho_{tuncstart\_1032.1}).p2,
176).quot) + (172 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
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\theta_{funcstart\_1032,1}.p2, 176).rem)))).\_replace(this.$r \rightarrow
this.$r.value(heapIs \frac{1}{2} heap\frac{1}{2} heap\frac{1}{2}
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs $heap<sub>funcstart_1032,1</sub>, this.$r.value(heapIs
\theta_{funcstart\_1032,1}.p1, 177).rem))._replace(p2 \rightarrow ((-35 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p2,
176).quot) + (172 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.} \text{\$r.value}(\text{heapIs}))
\rho_{uncstart_1032.1}, p2, 176).rem)))._replace(p3 \rightarrow asType<P3Type>(0 +
((-63 * div(heapIs \$heap_{funcstart\_1032.1}, this.\$r.value(heapIs
\text{Sheap}_{funcstart\_1032.1}).p3, 178).quot) + (170 * div(heapIs \text{Sheap}_{funcstart\_1032.1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p3, 178).rem)))))
\rightarrow [simplify]
[61.35] heap_{funcend\_1032,1} == heap_{funcstart\_1032,1}._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(\mathbf{heapIs} \$ heap_{funcstart\_1032,1}, \mathbf{this}.\$ r. \mathbf{value}(\mathbf{heapIs})
\theta_{funcstart\_1032,1}.p1, 177).rem))))._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.\r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
\rho_{funcstart\_1032.1}.p1, 177).rem)._replace(p2 \rightarrow ((-35 * div(heapIs
\rho_{tuncstart\_1032.1}, this.r.value(heapIs \rho_{tuncstart\_1032.1}).p2,
176).quot) + (172 * div(\mathbf{heapIs} \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}))
\label{eq:continuous_function} $ \text{heap}_{funcstart\_1032,1} . \text{p2}, \ 176).rem)))).$ \_\textbf{replace}(\textbf{this}.\$r \rightarrow
this.$r.value(heapIs \rho_{tuncstart\_1032.1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
\rho_{uncstart\_1032,1}.p1, 177).rem))).\_replace(p2 \rightarrow ((-35 * div(heapIs)))._replace(p2 \rightarrow ((-35 * div(heapIs))))._replace(p3 + div(heapIs)))
$heap_funcstart_1032,1, this.$r.value(heapIs $heap_funcstart_1032,1).p2,
176).quot) + (172 * div(heapIs $heap_{funcstart\_1032,1}, this.$r.value(heapIs
\rho_{funcstart\_1032,1}.p2, 176).rem))._replace(p3 \rightarrow ((-63 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p3,
178).quot) + (170 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
\$heap_{funcstart\_1032,1}).p3,\ 178).rem))))
[Take goal term]
[1.0]!(0.0 ==
asType < double > (static\_cast < real > (\$heap_{funcend\_1032,1}.M2)))
\rightarrow [from term 61.35, $heap<sub>funcend_1032,1</sub> is equal to
\$heap_{funcstart\_1032,1}.\_\textbf{replace}(\textbf{this.}\$r \rightarrow \textbf{this.}\$r.\textbf{value}(\textbf{heapIs}
heap_{funcstart\_1032,1}._replace(p1 \rightarrow ((-2 * div(heapIs $heap_{funcstart\_1032,1},
this.r.value(heapIs \ \$heap_{funcstart\_1032,1}).p1, \ 177).quot) + (171 * 
div(\mathbf{heapIs} \ \$heap_{funcstart\_1032,1}, \ \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
\theta_{funcstart=1032.1}.p1, 177.rem)))._replace(this.$r \rightarrow
```

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this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs)))
heap_{funcstart\_1032,1}, this.r.value(heapIs heap_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(\mathbf{heapIs} \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}))
\rho_{funcstart\_1032,1}.p1, 177).rem))._replace\rho_{funcstart\_1032,1}.p1, 177).rem))._replace
\rho_{tuncstart\_1032,1}, this.r.value(heapIs \rho_{tuncstart\_1032,1}).p2,
176).quot) + (172 * div(\textbf{heapIs } \$heap_{funcstart\_1032,1}, \textbf{this.}\$r.\textbf{value}(\textbf{heapIs}))
heap_{funcstart\_1032,1}.p2, 176).rem)))).replace(this.$r \rightarrow
this.$r.value(heapIs heap_{tuncstart\_1032.1})._replace(p1 \rightarrow ((-2 * div(heapIs
heap_{funcstart\_1032,1}, this.r.value(heapIs heap_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs heap_{funcstart\_1032,1}, this.r.value(heapIs
heap_{funcstart\_1032,1}.p1, 177).rem))).\_replace(p2 \rightarrow ((-35 * div(heapIs)))._replace(p2 \rightarrow ((-35 * div(heapIs)))))._replace(p2 \rightarrow ((-35 * div(heapIs)))))
heap_{funcstart\_1032,1}, this.r.value(heapIs heap_{funcstart\_1032,1}).p2,
(176).quot) + (172 * div(\mathbf{heapIs} \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}))
heap_{funcstart\_1032,1}.p2, 176).rem))).\_replace(p3 \rightarrow (-63 * div(heapIs))).\_replace(p3 \rightarrow (-63 * div(heapIs))).\_replace(p3 \rightarrow (-63 * div(heapIs))).\_replace(p3 \rightarrow (-63 * div(heapIs)))).\_replace(p3 \rightarrow (-63 * div(heapIs)))).\_replace(p3 \rightarrow (-63 * div(heapIs)))).\_replace(p3 \rightarrow (-63 * div(heapIs))))
heap_{funcstart\_1032,1}, this.r.value(heapIs heap_{funcstart\_1032,1}).p3,
178).quot) + (170 * div(\textbf{heapIs} \$heap_{funcstart\_1032,1}, \textbf{this}.\$r.\textbf{value}(\textbf{heapIs}))
heap_{funcstart\_1032,1}.p3, 178).rem)))
[1.1]!(0.0 ==
\mathbf{asType} \small{<} \mathbf{double} \small{>} (\mathbf{static\_cast} \small{<} \mathbf{real} \small{>} (\$ \mathbf{heap}_{funcstart\_1032,1}. \mathbf{\_replace} (\mathbf{this}.\$ \mathbf{replace}))
\rightarrow this.$r.value(heapIs $heap_{tuncstart\_1032,1})._replace(p1 \rightarrow ((-2 *
div(\mathbf{heapIs} \$ heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
\text{Sheap}_{funcstart\_1032,1}.\text{p1}, 177).\text{quot} + (171 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_1032,1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177).rem)))).\_replace(this.\r
\rightarrow this.$r.value(heapIs $heap_{tuncstart\_1032.1})._replace(p1 \rightarrow ((-2 *
div(\mathbf{heapIs} \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
\rho_{funcstart\_1032,1}.p1, 177).quot + (171 * div(heapIs $heap_{funcstart\_1032,1}), 177).quot + (171 * div(h
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177).rem))).\_replace(p2 \rightarrow
((-35 * div(heapIs \$heap_{funcstart\_1032.1}, this.\$r.value(heapIs
\text{Sheap}_{funcstart\_1032,1}.p2, 176).quot) + (172 * div(heapIs \text{Sheap}_{funcstart\_1032,1},
\mathbf{this.\$r.value(heapIs}\ \$heap_{funcstart\_1032,1}).p2,\ 176).rem)))). \_\mathbf{replace(this.\$r}
\rightarrow this.$r.value(heap
Is \rho_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 *
div(\mathbf{heapIs} \$ heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
\text{Sheap}_{funcstart\_1032,1}.\text{p1}, 177).\text{quot} + (171 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_1032,1},
this.r.value(heapIs \ heap_{funcstart\_1032.1}).p1, 177).rem))).\_replace(p2 \rightarrow
((-35 * div(heapIs $heap_{funcstart\_1032,1}, this.$r.value(heapIs)]
\text{Sheap}_{funcstart\_1032.1}, p2, 176).quot) + (172 * div(heapIs \text{Sheap}_{funcstart\_1032.1},
\textbf{this.\$r.value}(\textbf{heapIs}~\$ heap_{funcstart\_1032,1}).p2,~176).rem))).\_\textbf{replace}(p3 \rightarrow
((-63 * div(\mathbf{heapIs} \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}))
\text{Sheap}_{funcstart\_1032,1}.p3, 178).quot) + (170 * div(heapIs \text{Sheap}_{funcstart\_1032,1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p3, 178).rem))).M2)))
→ [const member of object with modified fields]
[1.4]!(0.0 ==
asType<double>(static_cast<real>($heap_{funcstart\_1032.1}.M2)))
\rightarrow [const static or extern object]
```

```
[1.5]!(0.0 == asType < double > (static\_cast < real > ($heap_{init}.M2)))
\rightarrow [expand definition of constant 'M2' at prang.cpp (33,26)]
[1.6]!(0.0 == asType < double > (static_cast < real > ((int)30307)))
\rightarrow [simplify]
[1.12] true
Proof of verification condition: Precondition of 'operator /' satisfied
In the context of class: WHPrang, declared at:
C:\Escher\Customers\prang-cpp\prang.cpp (18,1)
Condition generated at: C:\Escher\Customers\prang-cpp\prang.cpp
(90,30)
Condition defined at: built in declaration
To prove: !(0.0 ==
asType < double > (static\_cast < real > ($heap_{funcend\_1032,1}.M3)))
Given:
heap_{init}.LIMIT == (int)80
heap_{init}.class WHPrang \in M1 == (int)30269
heap_{init}.class WHPrang \in r1 == (int)171
heap_{init}.class WHPrang \in a1 == (int)177
heap_{init}.class WHPrang \in b1 == (int)2
heap_{init}.class WHPrang \in M2 == (int)30307
heap_{init}.class WHPrang \in r2 == (int)172
heap_{init}.class WHPrang \in a2 == (int)176
heap_{init}.class WHPrang \in b2 == (int)35
heap_{init}.class WHPrang \in M3 == (int)30323
heap_{init}.class WHPrang \in r3 == (int)170
heap_{init}.class WHPrang \in a3 == (int)178
heap_{init}.class WHPrang \in b3 == (int)63
div1 == div(\mathbf{heapIs} \$ heap_{funcstart \ 1032.1},
static_cast<int>(operator*(heapIs $heap_{tuncstart\_1032.1}, this).p1),
\mathbf{static\_cast}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_1032,1}.\mathrm{a1}))
(asType < integer > (static\_cast < int > (operator*(heapIs
heap_{funcstart\_1032,1}, this).p1) /
asType < integer > (static\_cast < int > (\$heap_{funcstart\_1032,1}.a1))) = =
asType<integer>(div1.quot)
```

```
(asType<integer>(static_cast<int>(operator*(heapIs
heap_{funcstart\_1032,1}, this).p1) %
asType < integer > (static\_cast < int > (\$heap_{funcstart\_1032.1}.a1))) = =
asType<integer>(div1.rem)
(asType<integer>(operator*(heapIs $heap_{funcstart\_1032.1}, this).p1) <
asType < integer > (\$heap_{funcstart\_1032,1}.a1)) = >
(\mathbf{asType} < \mathbf{integer} > (\mathbf{div1.rem}) = = \mathbf{asType} < \mathbf{integer} > (\mathbf{operator}^*(\mathbf{heapIs}))
heap_{funcstart\_1032,1}, this).p1)
(asType < integer > (\$heap_{funcstart\_1032,1}.a1) \le
asType < integer > (operator*(heapIs $heap_{funcstart\_1032,1}, this).p1)) =>
!(0 == asTvpe < integer > (div1.quot))
!(0 == asType < integer > (div1.rem)) || !(0 ==
asType<integer>(div1.quot))
div2 == div(\mathbf{heapIs} \$heap_{funcstart\_1032,1},
static_cast<int>(operator*(heapIs $heap_{funcstart\_1032.1}, this).p2),
\mathbf{static\_cast}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_1032,1}.\mathrm{a2}))
(asType<integer>(static_cast<int>(operator*(heapIs
heap_{funcstart\_1032.1}, this).p2)
asType < integer > (static\_cast < int > (\$heap_{funcstart\_1032.1}.a2))) = =
asType<integer>(div2.quot)
(asType<integer>(static_cast<int>(operator*(heapIs
heap_{funcstart\_1032,1}, this).p2) %
asType < integer > (static\_cast < int > (\$heap_{funcstart\_1032.1}.a2))) = =
asType<integer>(div2.rem)
(\mathbf{asType}{<}\mathbf{integer}{>}(\mathbf{operator}^*(\mathbf{heapIs}\ \$\mathbf{heap}_{funcstart\_1032,1},\ \mathbf{this}).\mathtt{p2}) <
asType < integer > (\$heap_{funcstart\_1032.1}.a2)) = >
(asType<integer>(div2.rem) == asType<integer>(operator*(heapIs
heap_{funcstart\_1032.1}, this).p2)
(\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathsf{heap}_{funcstart\_1032,1}.\mathsf{a2}) \leq
asType<integer>(operator*(heapIs $heap_funcstart_1032,1, this).p2)) =>
!(0 == asType < integer > (div2.quot))
!(0 == asType < integer > (div2.rem)) || !(0 ==
asType<integer>(div2.quot))
div3 == div(\mathbf{heapIs} \$heap_{funcstart\_1032,1},
static\_cast < int > (operator*(heapIs $heap_{funcstart\_1032,1}, this).p3),
static\_cast < int > (\$heap_{funcstart\_1032,1}.a3))
(asType < integer > (static\_cast < int > (operator*(heapIs)))
heap_{funcstart\_1032.1}, this).p3)
asType < integer > (static\_cast < int > (\$heap_{funcstart\_1032.1}.a3))) = =
asType<integer>(div3.quot)
(asType < integer > (static\_cast < int > (operator*(heapIs)))
```

```
heap_{funcstart=1032.1}, this).p3)
\mathbf{asType} < \mathbf{integer} > (\mathbf{static\_cast} < \mathbf{int} > (\$ \mathbf{heap}_{funcstart\_1032,1}.\mathbf{a3}))) = =
asType<integer>(div3.rem)
(\mathbf{asType}{<}\mathbf{integer}{>}(\mathbf{operator}^*(\mathbf{heapIs}\ \$\mathbf{heap}_{funcstart\_1032,1},\ \mathbf{this}).\mathrm{p3}) <
asType < integer > (\$heap_{funcstart\_1032.1}.a3)) = >
(asType<integer>(div3.rem) == asType<integer>(operator*(heapIs
heap_{funcstart\_1032,1}, this).p3)
(\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathsf{heap}_{funcstart\_1032,1}.\mathsf{a3}) \leq
asType < integer > (operator*(heapIs $heap_{funcstart\_1032,1}, this).p3)) = >
!(0 == asType < integer > (div3.quot))
!(0 == asType < integer > (div3.rem)) || !(0 ==
asType<integer>(div3.quot))
temp1 == (\$heap_{funcstart\_1032,1}.r1 * \textbf{static\_cast} < \textbf{signed int} > (div1.rem)) -
(\text{sheap}_{funcstart\_1032.1}.\text{b1} * \text{static\_cast} < \text{signed int} > (\text{div1.quot}))
minof(signed int) < temp1
temp1 \le maxof(signed int)
\theta_{1032,1:1051,8} == \theta_{1032
operator*(heapIs heap_{funcstart\_1032,1}, this)._replace(p1 \rightarrow
asType < P1Type > ((\$heap_{funcstart\_1032,1}.M1 *
asType < int > (static\_cast < integer > (static\_cast < signed
int>(operator^*(heapIs \$heap_{funcstart\_1032,1}, this).p1) < (int)0))) +
temp1)))
temp2 == (\$heap_{1032,1;1051,8}.r2 * \textbf{static\_cast} < \textbf{signed int} > (div2.rem)) -
(\text{sheap}_{1032.1:1051.8}.\text{b2} * \text{static\_cast} < \text{signed int} > (\text{div2.quot}))
minof(signed int) \le temp2
temp2 < maxof(signed int)
\text{heap}_{1032,1;1054,8} == \text{heap}_{1032,1;1051,8}.\_\text{replace}(\text{this}.\$r \rightarrow
operator*(heapIs \theta_{1032,1;1051,8}, this)._replace(p2 \rightarrow
asType<P2Type>(($heap<sub>1032,1:1051,8</sub>.M2 *
asType<int>(static_cast<integer>(static_cast<signed
int>(operator^*(heapIs $heap_{1032,1;1051,8}, this).p2) < (int)(0))) + temp(2)))
temp3 == (\$heap_{1032,1;1054,8}.r3 * static\_cast < signed int > (div3.rem)) -
(\text{sheap}_{1032,1;1054,8}.\text{b3} * \text{static\_cast} < \text{signed int} > (\text{div3.quot}))
minof(signed int) \le temp3
temp3 < maxof(signed int)
heap_{funcend\_1032,1} == heap_{1032,1;1054,8}._replace(this.$r \rightarrow
operator*(heapIs heap_{1032,1;1054,8}, this)._replace(p3 \rightarrow
asType<P3Type>(($heap<sub>1032,1:1054,8</sub>.M3 *
as Type < int > (static\_cast < integer > (static\_cast < signed))
```

```
int>(operator^*(heapIs \$heap_{1032,1:1054.8}, this).p3) < (int)0))) + temp3)))
raux1 == asType<double>(static_cast<real>(operator*(heapIs
heap_{funcend\_1032,1}, this).p1) /
asType<double>(static_cast<real>($heap_{funcend\_1032.1}.M1))
raux2 == asType<double>(static_cast<real>(operator*(heapIs
heap_{funcend_{-1032,1}}, this(.p2))
asType < double > (static\_cast < real > ($heap_{funcend\_1032,1}.M2))
Proof:
[Take given term]
[2.0] \operatorname{div1} == \operatorname{div}(\mathbf{heapIs} \ \text{$heap}_{funcstart\_1032,1},
static_cast<int>(operator*(heapIs $heap_{funcstart\_1032,1}, this).p1),
static\_cast < int > (\$heap_{funcstart\_1032,1}.a1))
→ [expand definition of operator '*' in class 'pointer' at built in declaration]
[2.1] \operatorname{div1} == \operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_1032,1},
\mathbf{static\_cast} < \mathbf{int} > (\mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs} \$ \mathbf{heap}_{funcstart\_1032,1}).p1),
\mathbf{static\_cast}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_1032,1}.\mathrm{a1}))
\rightarrow [simplify]
[2.2] \operatorname{div1} == \operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_1032,1}, \mathbf{this.}\$ r. \mathbf{value}(\mathbf{heapIs})
\theta_{funcstart\_1032,1}.p1, \theta_{funcstart\_1032,1}.p1, \theta_{funcstart\_1032,1}.a1))
\rightarrow [const static or extern object]
[2.3] \text{ div1} == \text{div(heapIs } \text{$heap}_{funcstart\_1032,1}, \text{this.} \text{$r.value(heapIs)}
\theta_{nit}.a1).p1, static_cast<int>(\theta_{nit}.a1)
\rightarrow [expand definition of constant 'a1' at prang.cpp (30,26)]
[2.4] \text{ div1} == \text{div}(\text{heapIs } \text{heap}_{funcstart\_1032,1}, \text{this.}\text{\$r.value}(\text{heapIs})
\theta_{funcstart\_1032,1}.p1, \theta_{funcstart\_1032,1}.p1, \theta_{funcstart\_1032,1}.p1, \theta_{funcstart\_1032,1}.p1, \theta_{funcstart\_1032,1}.p1, \theta_{funcstart\_1032,1}.p1, \theta_{funcstart\_1032,1}.p2, \theta_{funcstart\_1032,1}.p2, \theta_{funcstart\_1032,1}.p2, \theta_{funcstart\_1032,1}.p2, \theta_{funcstart\_1032,1}.p2, \theta_{funcstart\_1032,1}.p3, \theta_{funcstart\_1032,1}.p4, \theta_{funcstart\_1032,1}.p4, \theta_{funcstart\_1032,1}.p4, \theta_{funcstart\_1032,1}.p4, \theta_{funcstart\_1032,1}.p5, \theta_{funcstart\_1032,1}.p5, \theta_{funcstart\_1032,1}.p5, \theta_{funcstart\_1032,1}.p5, \theta_{funcstart\_1032,1}.p5, \theta_{funcstart\_1032,1}.p5, \theta_{funcstart\_1032,1}.p5, \theta_{funcstart\_1032,1}.p5, \theta_{funcstart\_1032,1}.p5, \theta_{funcstart\_1032,1
\rightarrow [simplify]
[2.6] div1 == div(heapIs heap_{funcstart\_1032,1}, this.r.value(heapIs)
heap_{funcstart\_1032,1}.p1, 177)
[Assume known post-assertion, class invariant or type constraint for term 2.6]
[7.0] (0 < asType<integer>(this.$r.value(heapIs
\theta_{funcstart\_1032,1}.p1) && (asType<integer>(this.$r.value(heapIs)
\$heap_{funcstart\_1032,1}).p1) < \mathbf{asType} < \mathbf{integer} > (\$heap.\mathbf{class} \ WHPrang \in \texttt{Constant}) + \texttt{Constant} = \texttt{Constant} 
M1))
\rightarrow [simplify]
[7.2] (0 < this.$r.value(heapIs $heap_{funcstart\_1032,1}).p1) &&
(this.r.value(heapIs $heap_{funcstart\_1032.1}).p1 <
asType < integer > (\$heap.class WHPrang \in M1))
```

```
\rightarrow [const static or extern object]
[7.3] (0 < this.$r.value(heapIs \rho_{funcstart\_1032,1}).p1) &&
(this.r.value(heapIs $heap_{funcstart\_1032,1}).p1 <
asType < integer > (\$heap_{init}.class WHPrang \in M1))
\rightarrow [expand definition of constant 'M1' at prang.cpp (28,26)]
[7.4] (0 < this.\$r.value(heapIs \$heap_{funcstart\_1032.1}).p1) &&
(this.$r.value(heapIs $heap_{funcstart\_1032,1}).p1 <
asType < integer > ((int)30269))
\rightarrow [simplify]
[7.10] (-30269 < -this.$r.value(heap
Is \rho_{funcstart\_1032,1}).p1) <math display="inline">\land (0 <
this.r.value(heapIs $heap_{funcstart\_1032,1}).p1)
[Work on sub-term 2 of conjunction in term 7.10]
[8.0] 0 < this.$r.value(heapIs \theta_{funcstart\_1032,1}).p1
[Take given term]
[18.0] div2 == div(heapIs $heap_{funcstart\_1032,1},
static_cast<int>(operator*(heapIs $heap_{funcstart_1032,1}, this).p2),
\mathbf{static\_cast}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_1032,1}.\mathrm{a2}))
\rightarrow [expand definition of operator '*' in class 'pointer' at built in declaration]
[18.1] \operatorname{div2} == \operatorname{div}(\mathbf{heapIs} \ \operatorname{\$heap}_{funcstart\_1032,1},
static\_cast < int > (this. r.value(heapIs $heap_{funcstart\_1032,1}).p2),
static\_cast < int > (\$heap_{funcstart\_1032.1}.a2))
\rightarrow [simplify]
[18.2] \operatorname{div2} == \operatorname{div}(\mathbf{heapIs} \ \mathbf{\$heap}_{funcstart\_1032,1}, \ \mathbf{this.\$r.value}(\mathbf{heapIs})
\theta_{funcstart\_1032,1}.p2, \theta_{funcstart\_1032,1}.p2, \theta_{funcstart\_1032,1}.a2))
\rightarrow [const static or extern object]
[18.3] \operatorname{div2} == \operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_1032,1}, \ \mathbf{this}. \text{\$r.value}(\mathbf{heapIs})
\theta_{uncstart\_1032,1}.p2, \theta_{uncstart\_1032,1}.p3, \theta_{uncstart\_1032
\rightarrow [expand definition of constant 'a2' at prang.cpp (35,26)]
[18.4] \operatorname{div2} == \operatorname{div}(\mathbf{heapIs} \ \text{$heap}_{funcstart\_1032,1}, \ \mathbf{this}.\text{$r.value}(\mathbf{heapIs})
\theta_{funcstart\_1032,1}.p2, \theta_{funcstart\_1032,1}.p2, \theta_{funcstart\_1032,1}.p2, \theta_{funcstart\_1032,1}.p2
\rightarrow [simplify]
[18.6] div2 == div(\mathbf{heapIs} \$ \mathbf{heap}_{funcstart\_1032,1}, \mathbf{this}.\$ \mathbf{r.value}(\mathbf{heapIs})
heap_{funcstart_{-1032,1}}.p2, 176
[Assume known post-assertion, class invariant or type constraint for term 18.6]
[23.0] (0 < asType<integer>(this.$r.value(heapIs
$heap_funcstart_1032.1).p2)) && (asType<integer>(this.$r.value(heapIs
\$ heap_{funcstart\_1032,1}).p2) < \mathbf{asType} < \mathbf{integer} > (\$ heap.\mathbf{class} \ WHPrang \in \texttt{Prang}) < \mathsf{Constant} = \texttt{Constant} =
```

```
M2))
\rightarrow [simplify]
[23.2] (0 < this.$r.value(heap
Is \rho_{uncstart\_1032,1}).p2) &&
(this.$r.value(heapIs heap_{funcstart\_1032,1}).p2 <
asType < integer > (\text{$heap.class WHPrang} \in M2))
\rightarrow [const static or extern object]
[23.3] (0 < this.r.value(heapIs \ heap_{funcstart\_1032,1}).p2) \&\&
(this.r.value(heapIs $heap_{funcstart\_1032.1}).p2 <
asType < integer > (\$heap_{init}.class WHPrang \in M2))
\rightarrow [expand definition of constant 'M2' at prang.cpp (33,26)]
[23.4] (0 < this.$r.value(heap
Is \rho_{uncstart\_1032,1}).p2) &&
(this.r.value(heapIs $heap_{funcstart\_1032,1}).p2 <
asType < integer > ((int)30307))
\rightarrow [simplify]
[23.10] (-30307 < -this.$r.value(heapIs $heap_{funcstart\_1032,1}).p2) \land (0 <
this.r.value(heapIs $heap_{funcstart\_1032,1}).p2)
[Work on sub-term 2 of conjunction in term 23.10]
[24.0] 0 < this.$r.value(heapIs $heap_{funcstart\_1032,1}).p2
[Take given term]
[34.0] \operatorname{div3} == \operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_1032,1},
\mathbf{static\_cast} < \mathbf{int} > (\mathbf{operator}^*(\mathbf{heapIs} \ \$ \mathbf{heap}_{funcstart\_1032,1}, \ \mathbf{this}).\mathbf{p3}),
\mathbf{static\_cast} < \mathbf{int} > (\$ \mathbf{heap}_{funcstart\_1032,1}.\mathbf{a3}))
→ [expand definition of operator '*' in class 'pointer' at built in declaration]
[34.1] div3 == div(heapIs $heap<sub>funcstart_1032,1</sub>,
\mathbf{static\_cast} < \mathbf{int} > (\mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs} \$ \mathbf{heap}_{funcstart\_1032,1}).p3),
\mathbf{static\_cast}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_1032,1}.\mathrm{a3}))
\rightarrow [simplify]
[34.2]~{\rm div3} == {\rm div}(\mathbf{heapIs}~\$ \mathrm{heap}_{funcstart\_1032,1},~\mathbf{this}.\$ \mathrm{r.value}(\mathbf{heapIs}
\theta_{funcstart\_1032,1}.p3, \theta_{funcstart\_1032,1}.p3, \theta_{funcstart\_1032,1}.a3)
\rightarrow [const static or extern object]
[34.3] \text{ div3} == \text{div}(\text{heapIs } \text{$heap}_{funcstart\_1032,1}, \text{this.}\text{$r.value}(\text{heapIs})
\theta_{nit}.a3)
\rightarrow [expand definition of constant 'a3' at prang.cpp (40,26)]
[34.4] \text{ div3} == \text{div(heapIs } \text{$heap}_{funcstart\_1032,1}, \text{ this.} \text{$r.value(heapIs)}
\label{eq:cast_int} $$ \rho_{uncstart\_1032,1}.p3, \ \mathbf{static\_cast} < \mathbf{int} > ((\mathbf{int})178)) $$
\rightarrow [simplify]
```

```
[34.6] div3 == div(heapIs $heap<sub>funcstart_1032,1</sub>, this.$r.value(heapIs)
heap_{funcstart_{1032,1}}.p3, 178
[Assume known post-assertion, class invariant or type constraint for term 34.6]
[39.0] (0 < asType<integer>(this.$r.value(heapIs
\theta_{funcstart_1032,1}.p3) && (asType<integer>(this.$r.value(heapIs)
\theta_{funcstart\_1032,1}.p3 < asType<integer>(\theta_{funcstart\_1032,1}.p3) < asType<integer>(\theta_{funcstart\_1032,1}.p3)
M3))
\rightarrow [simplify]
[39.2] (0 < this.$r.value(heap
Is \rho_{uncstart\_1032,1}).p3) &&
(this.$r.value(heapIs heap_{funcstart\_1032,1}).p3 <
asType < integer > (\text{heap.class WHPrang} \in M3))
\rightarrow [const static or extern object]
[39.3] (0 < this.\$r.value(heapIs \$heap_{tuncstart_{-1032.1}}).p3) &&
(this.r.value(heapIs $heap_{funcstart\_1032.1}).p3 <
asType < integer > (\text{$heap}_{init}.class WHPrang \in M3))
\rightarrow [expand definition of constant 'M3' at prang.cpp (38,26)]
[39.4] (0 < this.$r.value(heap
Is $heap_{tuncstart\_1032,1}).p3) &&
(this.r.value(heapIs $heap_{funcstart\_1032,1}).p3 <
asType < integer > ((int)30323))
\rightarrow [simplify]
[39.10] (-30323 < -this.$r.value(heapIs heapIs = f_{uncstart_1032,1}).p3) \land (0 <
\textbf{this.}\$r.\textbf{value}(\textbf{heapIs}~\$heap_{funcstart\_1032,1}).p3)
[Work on sub-term 2 of conjunction in term 39.10]
[40.0] 0 < this.$r.value(heapIs \rho_{funcstart\_1032,1}).p3
[Take given term]
[50.0]\;((\$heap_{funcstart\_1032,1}.r1\;*\;\textbf{static\_cast}{<}\textbf{signed int}{>}(\text{div}1.rem))\;-
(\text{sheap}_{funcstart\_1032,1}.\text{b1 * static\_cast} < \text{signed int} > (\text{div1.quot}))) == \text{temp1}
\rightarrow [const static or extern object]
[50.1] (($heap<sub>init</sub>.r1 * static_cast<signed int>(div1.rem)) -
(\$heap_{funcstart\_1032,1}.b1 * \mathbf{static\_cast} < \mathbf{signed\ int} > (div1.quot))) == temp1
\rightarrow [expand definition of constant 'r1' at prang.cpp (29,26)]
[50.2] (((int)171 * static_cast<signed int>(div1.rem)) -
(\text{sheap}_{funcstart\_1032,1}.\text{b1} * \text{static\_cast} < \text{signed int} > (\text{div1.quot}))) == \text{temp1}
\rightarrow [simplify]
[50.3] ((171 * static_cast < signed int > (div1.rem)) - (partial = 1032, 1.81
* static_cast<signed int>(div1.quot))) == temp1
\rightarrow [from term 2.6, div1 is equal to div(heapIs $heap_{funcstart\_1032,1},
```

```
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177)]
[50.4] ((171 * static_cast<signed int>(div(heapIs \theta_{funcstart\_1032,1}),
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177).rem)) -
(\$heap_{funcstart\_1032,1}.b1 * \textbf{static\_cast} < \textbf{signed int} > (div1.quot))) == temp1
\rightarrow [simplify]
[50.5] ((171 * div(heapIs $heap_{funcstart\_1032,1}, this.$r.value(heapIs 
\text{Sheap}_{funcstart\_1032,1}.\text{p1}, 177).\text{rem} - (\text{Sheap}_{funcstart\_1032,1}.\text{b1} *
static_cast<signed int>(div1.quot))) == temp1
\rightarrow [const static or extern object]
[50.6] ((171 * \mathrm{div}(\mathbf{heapIs}\ \$\mathrm{heap}_{funcstart\_1032,1},\ \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}\ 
\theta_{nit}.b1 * static_cast < signed
int>(div1.quot))) == temp1
\rightarrow [expand definition of constant 'b1' at prang.cpp (31,26)]
[50.7] ((171 * div(heapIs $heap_{funcstart\_1032,1}, this.$r.value(heapIs)
\theta_{funcstart\_1032,1}.p1, 177).rem) - ((int)2 * static_cast<signed
int>(div1.quot)) == temp1
\rightarrow [simplify]
[50.8] ((171 * \mathrm{div}(\mathbf{heapIs}\ \$\mathrm{heap}_{funcstart\_1032,1},\ \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}
\theta_{funcstart\_1032,1}.p1, 177).rem - (2 * static\_cast < signed)
int>(div1.quot)) == temp1
\rightarrow [from term 2.6, div1 is equal to div(heapIs $heap_{funcstart\_1032,1},
this.r.value(heapIs $heap_{funcstart\_1032,1}).p1, 177)]
[50.9] ((171 * div(heapIs $heap_{funcstart\_1032,1}, this.$r.value(heapIs)]
\theta_{funcstart\_1032,1}.p1, 177).rem – (2 * static_cast<signed)
int>(div(heapIs $heap_{funcstart\_1032,1}, this.$r.value(heapIs
heap_{funcstart_1032,1}.p1, 177).quot))) == temp1
\rightarrow [simplify]
[50.14] 0 == (-\text{temp1} + (-2 * \text{div}(\text{heapIs } \text{$heap}_{funcstart\_1032,1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177).quot) + (171 *
div(\mathbf{heapIs} \$ heap_{funcstart\_1032.1}, \mathbf{this.}\$r.\mathbf{value}(\mathbf{heapIs})
heap_{funcstart\_1032,1}.p1, 177).rem))
[Take given term]
[53.0] \theta_{1032,1;1051,8} == \theta_{1032,1;1051,8} = \theta_{1032,1;1051,8} == \theta
operator*(heapIs heap_{funcstart\_1032,1}, this)._replace(p1 \rightarrow
\mathbf{asType}{<}P1\mathsf{Type}{>}((\$\mathsf{heap}_{funcstart\_1032,1}.\mathsf{M1}~*
asType < int > (static\_cast < integer > (static\_cast < signed)
int>(operator^*(heapIs $heap_{funcstart\_1032,1}, this).p1) < (int)0))) +
temp1)))
→ [expand definition of operator '*' in class 'pointer' at built in declaration]
```

```
[53.1] heap_{1032,1;1051,8} == heap_{funcstart\_1032,1}._replace(this.r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow
asType < P1Type > ((\$heap_{funcstart\_1032,1}.M1 *
asType<int>(static_cast<integer>(static_cast<signed
int>(operator^*(heapIs \$heap_{funcstart\_1032,1}, this).p1) < (int)0))) +
temp1)))
\rightarrow [const static or extern object]
[53.2] $heap<sub>1032,1;1051,8</sub> == $heap<sub>funcstart_1032,1</sub>._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow
asType < P1Type > ((\$heap_{init}.M1 *
asType<int>(static_cast<integer>(static_cast<signed
\mathbf{int} > (\mathbf{operator}^*(\mathbf{heapIs} \ \$ \mathbf{heap}_{funcstart\_1032,1}, \ \mathbf{this}).\mathtt{p1}) < (\mathbf{int})0))) \ +
temp1)))
\rightarrow [expand definition of constant 'M1' at prang.cpp (28,26)]
[53.3] $\text{heap}_{1032,1:1051,8} == \text{$heap}_{funcstart\_1032,1}.$\_\text{replace}(\text{this}.\text{$r} \rightarrow \text{$r$})
this.r.value(heapIs \ heap_{funcstart\_1032,1}).\_replace(p1 \rightarrow
asType < P1Type > (((int)30269 *
asType{<}int{>}(static\_cast{<}integer{>}(static\_cast{<}signed
int>(operator^*(heapIs \$heap_{funcstart\_1032,1}, this).p1) < (int)0))) +
temp1)))
\rightarrow [simplify]
\mathbf{this.\$r.value}(\mathbf{heapIs}~\$ \mathrm{heap}_{funcstart\_1032,1}).\_\mathbf{replace}(\mathrm{p1} \rightarrow
asType<P1Type>((30269 *
asType<int>(static_cast<integer>(static_cast<signed
int>(operator^*(heapIs \$heap_{funcstart\_1032,1}, this).p1) < (int)0))) +
temp1)))
→ [expand definition of operator '*' in class 'pointer' at built in declaration]
[53.5] $heap<sub>1032,1;1051,8</sub> == $heap<sub>funcstart_1032,1</sub>._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow
asType<P1Type>((30269 *
asType < int > (static\_cast < integer > (static\_cast < signed)
int>(this.\$r.value(heapIs \$heap_{funcstart\_1032,1}).p1) < (int)0))) + temp1)))
\rightarrow [simplify]
[53.9] heap_{1032,1;1051,8} == heap_{funcstart\_1032,1}._replace(this.$r \rightarrow
this.r.value(heapIs \ heap_{funcstart\_1032,1}).\_replace(p1 \rightarrow
asType<P1Type>((30269 * asType<int>(static_cast<integer>(0 <
-\mathbf{this.\$r.value}(\mathbf{heapIs}\ \$\mathrm{heap}_{funcstart\_1032,1}).\mathrm{p1}))) + \mathrm{temp1})))
\rightarrow [from term 8.0, literala < -this.$r.value(heapIs $heap_{funcstart\_1032,1}).p1
is false whenever -2 < (0 + literala)
```

Proof of rule precondition:

```
[53.9.0] - 2 < (0 + 0)
    \rightarrow [simplify]
    [53.9.2] true
[53.10] $heap<sub>1032,1;1051,8</sub> == $heap<sub>funcstart_1032,1</sub>._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow
asType<P1Type>((30269 * asType<int>(static_cast<integer>(false)))
+ \text{ temp1}))
\rightarrow [simplify]
[53.11] $\text{heap}_{1032,1;1051,8} == $\text{heap}_{funcstart\_1032,1}.$\text{-replace}(\text{this}.$\text{$r} \to \text{
\mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}~\$\mathrm{heap}_{funcstart\_1032,1}).\_\mathbf{replace}(\mathrm{p1}\to
asType < P1Type > ((30269 * asType < int > (([false]: 1, []: 0))) + temp1)))
→ [explicitly assert falsehood of skipped guards in subsequent guards]
[53.12] $\text{heap}_{1032,1;1051,8} == $\text{heap}_{funcstart\_1032,1}._\text{replace}(\text{this}.\text{$\frac{1}{2}r$})
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow
asType<P1Type>((30269 * asType<int>(([false]: 1, [true]: 0))) +
temp1)))
\rightarrow [simplify]
[53.15] $heap<sub>1032,1;1051,8</sub> == $heap<sub>funcstart_1032,1</sub>._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow
asType < P1Type > (0 + temp1))
\rightarrow [from term 50.14, temp1 is equal to (-2 * div(heapIs $heap_{funcstart\_1032,1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177).quot) + (171 *
div(\mathbf{heapIs} \ \$heap_{funcstart\_1032,1}, \ \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
heap_{funcstart\_1032.1}.p1, 177).rem
[53.16] $heap<sub>1032,1;1051,8</sub> == $heap<sub>funcstart_1032,1</sub>._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow
asType < P1Type > (0 + ((-2 * div(heapIs $heap_{funcstart\_1032,1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177).quot) + (171 *
div(\mathbf{heapIs} \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
heap_{funcstart_1032,1}.p1, 177.rem))))
\rightarrow [simplify]
[53.19] $heap<sub>1032,1;1051,8</sub> == $heap<sub>funcstart_1032,1</sub>._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.} \text{\$r.value}(\text{heapIs}))
heap_{funcstart_{-1032,1}}.p1, 177).rem)))
[Take given term]
[54.0] (($heap_{1032,1;1051,8}.r2 * static_cast < signed int > (div2.rem)) -
(\text{sheap}_{1032,1:1051,8}.\text{b2} * \text{static\_cast} < \text{signed int} > (\text{div2.quot}))) == \text{temp2}
```

```
\rightarrow [from term 53.19, $heap<sub>1032.1:1051.8</sub> is equal to
\$heap_{funcstart\_1032,1}.\_\textbf{replace}(\textbf{this}.\$r \rightarrow \textbf{this}.\$r.\textbf{value}(\textbf{heapIs}
heap_{funcstart\_1032,1}._replace(p1 \rightarrow (-2 * div(heapIs $heap_{funcstart\_1032,1}, 
this.r.value(heapIs \ heap_{funcstart\_1032.1}).p1, 177).quot) + (171)
div(heapIs $heap_funcstart_1032.1, this.$r.value(heapIs
heap_{funcstart_{1032,1}}.p1, 177).rem)))
[54.1] \; ((\$ heap_{funcstart\_1032,1}.\_\textbf{replace}(\textbf{this}.\$r \to \textbf{this}.\$r. \textbf{value}(\textbf{heapIs}))) \\
\text{Sheap}_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs \text{Sheap}_{funcstart\_1032,1},
this.r.value(heapIs \ heap_{funcstart\_1032.1}).p1, 177).quot) + (171 *
div(\mathbf{heapIs} \$ heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
\rho_{funcstart\_1032,1}.p1, 177).rem))).r2 * static_cast < signed
int>(div2.rem)) - ($heap_{1032.1:1051.8}.b2 * static_cast<signed
int>(div2.quot)) == temp2
\rightarrow [const member of object with modified fields]
[54.2] (({\rm sheap}_{funcstart\_1032,1}.r2 * static\_cast < signed int > (div2.rem)) -
(\text{sheap}_{1032,1;1051,8}.\text{b2} * \text{static\_cast} < \text{signed int} > (\text{div2.quot}))) == \text{temp2}
\rightarrow [const static or extern object]
[54.3] (($heap<sub>init</sub>.r2 * static_cast<signed int>(div2.rem)) -
(\text{sheap}_{1032.1:1051.8}.\text{b2} * \text{static\_cast} < \text{signed int} > (\text{div2.quot}))) == \text{temp2}
\rightarrow [expand definition of constant 'r2' at prang.cpp (34,26)]
[54.4] (((int)172 * static_cast<signed int>(div2.rem)) -
(\text{sheap}_{1032,1:1051.8}.\text{b2} * \text{static\_cast} < \text{signed int} > (\text{div2.quot}))) == \text{temp2}
\rightarrow [simplify]
[54.5] ((172 * static_cast < signed int > (div2.rem)) - ($heap_{1032.1:1051.8}.b2 *
static_cast<signed int>(div2.quot))) == temp2
\rightarrow [from term 18.6, div2 is equal to div(heapIs $heap_{funcstart\_1032,1},
this.r.value(heapIs $heap_{funcstart\_1032,1}).p2, 176)]
[54.6] ((172 * static_cast<signed int>(div(heapIs \theta_{funcstart\_1032,1}),
this.r.value(heapIs \ heap_{funcstart=1032.1}).p2, 176).rem)) -
(\text{sheap}_{1032,1:1051,8}.\text{b2} * \text{static\_cast} < \text{signed int} > (\text{div2.quot}))) == \text{temp2}
\rightarrow [simplify]
[54.7] ((172 * div(heapIs $heap<sub>funcstart_1032,1</sub>, this.$r.value(heapIs)
\text{heap}_{funcstart\_1032,1}.p2, 176).rem) - (\text{heap}_{1032,1;1051,8}.b2 *
static_cast<signed int>(div2.quot))) == temp2
\rightarrow [from term 53.19, $heap<sub>1032,1;1051,8</sub> is equal to
$heap_{funcstart\_1032,1}.$_replace(this.$r \rightarrow this.$r.value(heapIs)
heap_{funcstart\_1032.1}._replace(p1 \rightarrow (-2 * div(heapIs heap_{funcstart\_1032.1})
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177).quot) + (171 *
div(\mathbf{heapIs} \$heap_{funcstart\_1032.1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
heap_{funcstart\_1032,1}.p1, 177).rem)))
```

```
\rho_{funcstart\_1032,1}.p2, 176).rem – (\rho_{funcstart\_1032,1}.\_replace).
\rightarrow this.$r.value(heapIs $heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 *
div(\mathbf{heapIs} \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
\text{Sheap}_{funcstart\_1032,1}.p1, 177).quot) + (171 * div(heapIs \text{Sheap}_{funcstart\_1032,1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177).rem)))).b2 *
static_cast<signed int>(div2.quot))) == temp2
→ [const member of object with modified fields]
[54.9] ((172 * div(heapIs $heap_{funcstart\_1032,1}, this.$r.value(heapIs
\text{Sheap}_{funcstart\ 1032.1}.p2, 176).rem) - (\text{Sheap}_{funcstart\ 1032.1}.b2 *
static_cast<signed int>(div2.quot))) == temp2
\rightarrow [const static or extern object]
[54.10]~((172~^*~{\rm div}({\bf heap Is}~\${\rm heap}_{funcstart\_1032,1},~{\bf this.}\${\rm r.value}({\bf heap Is}
\theta_{nit}.b2 * static_cast < signed
int>(div2.quot)) == temp2
\rightarrow [expand definition of constant 'b2' at prang.cpp (36,26)]
[54.11] ((172 * div(heapIs \$heap_{funcstart\_1032,1}, this.\$r.value(heapIs
\rho_{funcstart\_1032.1}.p2, 176).rem - ((int)35 * static\_cast < signed)
int>(div2.quot)) == temp2
\rightarrow [simplify]
[54.12]~((172~^*~{\rm div}({\bf heap Is}~\${\rm heap}_{funcstart\_1032,1},~{\bf this.\$r.value}({\bf heap Is}
\rho_{funcstart\_1032.1}.p2, 176).rem) - (35 * static_cast<signed)
int>(div2.quot)) = temp2
\rightarrow [from term 18.6, div2 is equal to div(heapIs $heap_{funcstart\_1032,1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p2, 176)]
[54.13] ((172 * div(heapIs heap_{funcstart\_1032,1}, this.r.value(heapIs)
\rho_{tuncstart\_1032.1}.p2, 176).rem - (35 * static\_cast < signed)
int>(div(heapIs $heap_{tuncstart_1032.1}, this.$r.value(heapIs
\text{Sheap}_{funcstart\_1032,1}.p2, 176).quot))) == temp2
\rightarrow [simplify]
[54.18] 0 == (-\text{temp2} + (-35 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1},
this.r.value(heapIs \ensuremath{\$}heap_{funcstart\_1032,1}).p2, 176).quot) + (172 *
div(\mathbf{heapIs} \$ heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
heap_{funcstart\_1032,1}.p2, 176).rem
[Take given term]
[57.0] $\text{heap}_{1032,1;1054,8} == $\text{heap}_{1032,1;1051,8}._\text{replace}(\text{this}.$\text{$r} \to \text{
operator*(heapIs heap_{1032,1;1051,8}, this)._replace(p2 \rightarrow
asType<P2Type>(($heap<sub>1032,1:1051,8</sub>.M2 *
asType<int>(static_cast<integer>(static_cast<signed
int > (operator^*(heapIs $heap_{1032,1:1051.8}, this).p2) < (int)(0))) + temp(2)))
```

[54.8] ((172 * $\operatorname{div}(\mathbf{heapIs} \ \mathbf{sheap}_{funcstart_1032,1}, \ \mathbf{this}.\mathbf{sr.value}(\mathbf{heapIs})$

```
\rightarrow [from term 53.19, $heap<sub>1032,1;1051,8</sub> is equal to
\$heap_{funcstart\_1032,1}.\_\textbf{replace}(\textbf{this}.\$r \rightarrow \textbf{this}.\$r.\textbf{value}(\textbf{heapIs}
heap_{funcstart\_1032,1}._replace(p1 \rightarrow (-2 * div(heapIs p_{funcstart\_1032,1}).
this. $r.value(heapIs heap_{funcstart\_1032,1}).p1, 177).quot) + (171 heapIs
div(heapIs $heap_funcstart_1032.1, this.$r.value(heapIs
heap_{funcstart\_1032,1}.p1, 177).rem)))
[57.2] heap_{1032,1;1054,8} == heap_{funcstart\_1032,1}._replace(this.r \rightarrow
\textbf{this.}\$r.\textbf{value}(\textbf{heapIs}~\$\text{heap}_{funcstart\_1032,1}).\_\textbf{replace}(\text{p1} \rightarrow ((-2~*\text{div}(\textbf{heapIs}
\rho_{funcstart\_1032,1}, this.\r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs \rho_{funcstart\_1032,1}, this.r.value(heapIs)
\hat{p}_{funcstart\_1032,1}.p1, 177).rem)))_replace(this.$r \rightarrow operator*(heapIs)
\rho_{tuncstart\_1032.1}._replace(this.r \to this.r.value(heapIs)
heap_{funcstart\_1032,1}._replace(p1 \rightarrow (-2 * div(heapIs heap_{funcstart\_1032,1}),
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177).quot) + (171)
{\rm div}(\mathbf{heapIs}~\$\mathrm{heap}_{funcstart\_1032,1},~\mathbf{this.\$r.value}(\mathbf{heapIs}
\theta_{tuncstart_{1032,1}}.p1, 177).rem)), this).replace(p2 \rightarrow
asType<P2Type>(($heap<sub>1032,1:1051,8</sub>.M2 *
as Type < int > (static\_cast < integer > (static\_cast < signed))
int > (operator^*(heapIs \$heap_{1032,1;1051,8}, this).p2) < (int)0))) + temp2)))
→ [expand definition of operator '*' in class 'pointer' at built in declaration]
[57.3] heap_{1032,1;1054,8} == heap_{funcstart\_1032,1}._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(\mathbf{heapIs} \$ heap_{funcstart\_1032,1}, \mathbf{this}.\$ r. \mathbf{value}(\mathbf{heapIs})
\theta_{tuncstart\_1032,1}.p1, 177).rem)))).\_replace(this.\$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1}._replace(this.$r \rightarrow
this.$r.value(heapIs \rho_{tuncstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart=1032,1}, this.r.value(heapIs \rho_{funcstart=1032,1}).p1,
177).quot) + (171 * div(heapIs \theta_{funcstart\_1032,1}, this.r.value(heapIs)
\theta_{funcstart\_1032.1}.p1, 177).rem))))._replace(p2 \rightarrow
asType<P2Type>(($heap<sub>1032,1:1051,8</sub>.M2 *
as Type < int > (static\_cast < integer > (static\_cast < signed
int>(operator^*(heapIs $heap_{1032,1;1051,8}, this).p2) < (int)0))) + temp2)))
→ [evaluate dereferenced pointer into modified heap]
[57.4] heap_{1032,1;1054,8} == heap_{funcstart\_1032,1}._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{tuncstart_{1032.1}}, this. r.value(heapIs \rho_{tuncstart_{1032.1}}).p1,
177).quot) + (171 * div(heapIs \rho_{funcstart\_1032,1}, this.r.value(heapIs)
\theta_{uncstart\_1032,1}.p1, 177).rem))))._replace(this.$r \rightarrow ([this.$r ===
this.$r]: this.$r.value(heap
Is $heap_{funcstart\_1032,1})._replace(p1 \rightarrow (-2 *
div(\mathbf{heapIs} \$ heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
\text{Sheap}_{funcstart\_1032,1}.p1, 177).quot) + (171 * div(heapIs \text{Sheap}_{funcstart\_1032,1},
this.$r.value(heapIs heap_{funcstart\_1032,1}).p1, 177).rem)), []:
```

```
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p2 \rightarrow
asType<P2Type>(($heap<sub>1032,1;1051,8</sub>.M2 *
as Type < int > (static\_cast < integer > (static\_cast < signed))
int>(operator^*(heapIs \$heap_{1032,1;1051,8}, this).p2) < (int)0))) + temp2)))
→ [explicitly assert falsehood of skipped guards in subsequent guards]
[57.5] heap_{1032,1;1054,8} == heap_{funcstart\_1032,1}._replace(this.$r \rightarrow
this.$r.value(heapIs \rho_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
\$heap_{funcstart\_1032,1}).p1,\,177).rem)))).\_\mathbf{replace}(\mathbf{this}.\$r \rightarrow ([\mathbf{this}.\$r = =
this.$r]: this.$r.value(heap
Is \rho_{tart\_1032,1}).\_replace(p1 \rightarrow (-2 * large))
div(\mathbf{heapIs} \$ heap_{funcstart\_1032.1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
\text{Sheap}_{funcstart\_1032,1}.p1, 177).quot) + (171 * div(heapIs \text{Sheap}_{funcstart\_1032,1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177).rem)), [!(this.<math>r = 
this.$r)]: this.$r.value(heapIs \rho_{funcstart\_1032,1})._replace(p2 \rightarrow
asType<P2Type>(($heap<sub>1032,1;1051,8</sub>.M2 *
asType < int > (static\_cast < integer > (static\_cast < signed)
int>(operator^*(heapIs $heap_{1032.1:1051.8}, this).p2) < (int)(0))) + temp(2)))
\rightarrow [simplify]
[57.7] heap_{1032,1:1054,8} == heap_{funcstart\_1032,1}._replace(this.$r \rightarrow
\textbf{this.\$r.value}(\textbf{heapIs}~\$ heap_{funcstart\_1032,1}).\_\textbf{replace}(p1 \rightarrow ((\text{-}2~*\text{div}(\textbf{heapIs}
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(\mathbf{heapIs} \ \$heap_{funcstart\_1032,1}, \ \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
\theta_{funcstart\_1032.1}.p1, 177).rem)))._replace(this.$r \rightarrow
\textbf{this.}\$r.\textbf{value}(\textbf{heapIs}~\$heap_{funcstart\_1032,1}).\_\textbf{replace}(p1 \rightarrow ((\text{-}2~*\text{div}(\textbf{heapIs}
\rho_{funcstart\_1032,1}, this.\r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.\$r.value}(\text{heapIs}))
\theta_{funcstart\_1032,1}.p1, 177).rem))._replace(p2 \rightarrow
asType<P2Type>(($heap<sub>1032,1;1051,8</sub>.M2 *
asType<int>(static_cast<integer>(static_cast<signed
int > (operator^*(heapIs $heap_{1032,1:1051.8}, this).p2) < (int)(0))) + temp(2)))
\rightarrow [from term 53.19, $heap<sub>1032,1:1051,8</sub> is equal to
$heap_{funcstart\_1032,1}.$-replace(this.$r \rightarrow this.$r.value(heapIs)
heap_{funcstart\_1032,1}._replace(p1 \rightarrow (-2 * div(heapIs $heap_{funcstart\_1032,1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177).quot) + (171 *
div(heapIs $heap_{funcstart_1032.1}, this.$r.value(heapIs
heap_{funcstart_{1032,1}}.p1, 177).rem)))
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs $heap<sub>funcstart_1032,1</sub>, this.$r.value(heapIs
\theta_{funcstart\_1032,1}.p1, 177).rem)))).replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
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\theta_{funcstart_1032,1}, this.\r.value(heapIs \theta_{funcstart_1032,1}).p1,
177).quot) + (171 * div(heapIs \theta_{funcstart\_1032,1}, this.r.value(heapIs)
\theta_{funcstart\_1032,1}.p1, 177).rem))).\_replace(p2 \rightarrow
asType < P2Type > ((\$heap_{tuncstart\_1032,1}.\_replace(this.\$r \rightarrow
this.$r.value(heapIs \rho_{tuncstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
$heap_tuncstart_1032.1).p1, 177).rem)))).M2 *
asType<int>(static_cast<integer>(static_cast<signed
int>(operator^*(heapIs $heap_{1032,1;1051,8}, this).p2) < (int)(0))) + temp(2)))
→ [const member of object with modified fields]
[57.9] heap_{1032,1;1054,8} == heap_{funcstart\_1032,1}._replace(this.$r \rightarrow
this.$r.value(heapIs p_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
heap_{funcstart\_1032,1}, this.r.value(heapIs heap_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
\theta_{funcstart\_1032,1}.p1, 177).rem)))).\_replace(this.\$r \rightarrow 0
this.$r.value(heapIs \rho_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\$heap_{funcstart\_1032,1},\, \textbf{this}.\$r.\textbf{value}(\textbf{heapIs}\,\,\$heap_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
\theta_{funcstart\_1032,1}.p1, 177).rem))).\_replace(p2 \rightarrow
asType<P2Type>(($heap<sub>funcstart_1032.1</sub>.M2 *
asType<int>(static_cast<integer>(static_cast<signed
\mathbf{int}{>}(\mathbf{operator}^*(\mathbf{heapIs}\ \$\mathrm{heap}_{1032,1;1051,8},\ \mathbf{this}).\mathrm{p2})<(\mathbf{int})0)))+\mathrm{temp2})))
\rightarrow [const static or extern object]
[57.10] $heap<sub>1032,1;1054,8</sub> == $heap<sub>funcstart_1032,1</sub>._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{tuncstart\_1032.1}, this.r.value(heapIs \rho_{tuncstart\_1032.1}).p1,
177).quot) + (171 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
\theta_{funcstart\_1032,1}.p1, 177).rem)))).\_replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\theta_{funcstart\_1032,1}, this.\r.value(heapIs \theta_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs \rho_{funcstart\_1032,1}, this.r.value(heapIs)
\theta_{funcstart\_1032,1}.p1, 177).rem)))._replace(p2 \rightarrow
asType<P2Type>(($heap<sub>init</sub>.M2 *
asType<int>(static_cast<integer>(static_cast<signed
\mathbf{int}{>}(\mathbf{operator}^*(\mathbf{heapIs}\ \$\mathrm{heap}_{1032,1;1051,8},\ \mathbf{this}).\mathrm{p2})<(\mathbf{int})0)))+\mathrm{temp2})))
\rightarrow [expand definition of constant 'M2' at prang.cpp (33,26)]
[57.11] $heap<sub>1032,1;1054,8</sub> == $heap<sub>funcstart_1032,1</sub>._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs $heap<sub>funcstart_1032,1</sub>, this.$r.value(heapIs
\theta_{funcstart\_1032,1}.p1, 177).rem)))).replace(this.$r \rightarrow
this.$r.value(heapIs \rho_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
```

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\rho_{tuncstart=1032.1}, this.r.value(heapIs \rho_{tuncstart=1032.1}).p1,
177).quot) + (171 * div(heapIs \theta_{funcstart\_1032,1}, this.r.value(heapIs)
\theta_{funcstart\_1032,1}.p1, 177).rem))).\_replace(p2 \rightarrow
asType < P2Type > (((int)30307 *
asType<int>(static_cast<integer>(static_cast<signed
int > (operator^*(heapIs \$heap_{1032,1;1051,8}, this).p2) < (int)0))) + temp2)))
\rightarrow [simplify]
[57.12] $\text{heap}_{1032,1;1054,8} == $\text{heap}_{funcstart\_1032,1}._\text{replace}(\text{this}.$\text{$r} \to \text{$}
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\$heap_{funcstart\_1032,1},\, \textbf{this}.\$r.\textbf{value}(\textbf{heapIs}\,\,\$heap_{funcstart\_1032.1}).p1,
177).quot) + (171 * div(heapIs $heap<sub>funcstart_1032,1</sub>, this.$r.value(heapIs
\theta_{tuncstart\_1032,1}.p1, 177).rem)))).\_replace(this.\$r \rightarrow
this.$r.value(heapIs p_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\$heap_{funcstart\_1032,1},\, \textbf{this}.\$r.\textbf{value}(\textbf{heapIs}\,\,\$heap_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs \theta_{funcstart\_1032,1}, this.r.value(heapIs)
\theta_{funcstart\_1032,1}.p1, 177).rem))).\_replace(p2 \rightarrow
asType<P2Type>((30307 *
asType < int > (static\_cast < integer > (static\_cast < signed)
int>(operator^*(heapIs $heap_{1032,1:1051,8}, this).p2) < (int)(0))) + temp(2)))
\rightarrow [from term 53.19, $heap<sub>1032,1;1051,8</sub> is equal to
$heap_{funcstart\_1032,1}.$-replace(this.$r \rightarrow this.$r.value(heapIs)
heap_{funcstart\_1032,1}._replace(p1 \rightarrow (-2 * div(heapIs $heap_{funcstart\_1032,1}, 
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177).quot) + (171 * leapIs \ heap_{funcstart\_1032,1}).p1, 177).quot)
div(\mathbf{heapIs} \ \$heap_{funcstart\_1032,1}, \ \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
$heap_tuncstart_1032.1).p1, 177).rem)))]
[57.13] $heap<sub>1032,1;1054,8</sub> == $heap<sub>funcstart_1032,1</sub>._replace(this.$r \rightarrow
this.$r.value(heapIs \rho_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\theta_{funcstart\_1032,1}, this.r.value(heapIs \theta_{funcstart\_1032,1}).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.\$r.value}(\text{heapIs}))
\theta_{funcstart_{1032,1}}.p1, 177).rem))))._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{tuncstart = 1032.1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs $heap<sub>funcstart_1032,1</sub>, this.$r.value(heapIs
heap_{funcstart\_1032,1}.p1, 177).rem)))._replace(p2 \rightarrow
asType<P2Type>((30307 *
asType<int>(static_cast<integer>(static_cast<signed
\mathbf{int}{>}(\mathbf{operator}^*(\mathbf{heapIs}\ \$\mathbf{heap}_{funcstart\_1032,1}.\_\mathbf{replace}(\mathbf{this}.\$\mathbf{r}\rightarrow
this.$r.value(heapIs heapIs $heapfuncstart_1032,1)._replace(p1 \rightarrow (-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs $heap<sub>funcstart_1032,1</sub>, this.$r.value(heapIs
\text{Sheap}_{funcstart\_1032.1}.p1, 177).rem))), this).p2) < (int)0))) + temp2)))
→ [expand definition of operator '*' in class 'pointer' at built in declaration]
[57.14] $heap<sub>1032,1;1054,8</sub> == $heap<sub>funcstart_1032,1</sub>._replace(this.$r \rightarrow
```

```
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
\theta_{tuncstart\_1032,1}.p1, 177).rem)))).\_replace(this.\$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(\mathbf{heapIs} \ \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
heap_{funcstart=1032.1}, p1, 177).rem)))._replace(p2 \rightarrow
asType<P2Type>((30307 *
asType<int>(static_cast<integer>(static_cast<signed
\mathbf{int}{>}(\mathbf{this.\$r.value}(\mathbf{heapIs}\ \$\mathbf{heap}_{funcstart\_1032,1}.\mathbf{\_replace}(\mathbf{this.\$r} \to \mathbf{1032},1))
this.$r.value(heapIs \rho_{tuncstart\_1032.1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
\theta_{funcstart\_1032,1}.p1, 177).rem)))).p2) < (int)0))) + temp2)))
\rightarrow [evaluate dereferenced pointer into modified heap]
[57.15] $heap<sub>1032,1;1054,8</sub> == $heap<sub>funcstart_1032,1</sub>._replace(this.$r \rightarrow
\textbf{this.}\$r.\textbf{value}(\textbf{heapIs}~\$heap_{funcstart\_1032,1}).\_\textbf{replace}(p1 \rightarrow ((\text{-}2~*\text{div}(\textbf{heapIs}
\label{eq:heapIs} $ \text{heap}_{funcstart\_1032,1}, \, \textbf{this}. \\ \$r. \textbf{value}(\textbf{heapIs} \,\, \$ \text{heap}_{funcstart\_1032,1}). \\ \text{p1},
177).quot) + (171 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.} \text{\$r.value}(\text{heapIs}))
\theta_{tuncstart\_1032.1}.p1, 177).rem)))._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.\r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
\theta_{funcstart\_1032.1}.p1, 177).rem)))._replace(p2 \rightarrow
asType<P2Type>((30307 *
as Type < int > (static\_cast < integer > (static\_cast < signed\ int > (([this.\$r])))) \\
== this.$r]: this.$r.value(heapIs \rho_{uncstart\_1032,1})._replace(p1 \rightarrow (-2 *
{\rm div}(\mathbf{heapIs}\ \$ \mathrm{heap}_{funcstart\_1032,1},\ \mathbf{this}.\$ \mathrm{r.value}(\mathbf{heapIs}
\text{Sheap}_{funcstart\_1032,1}.p1, 177).quot) + (171 * div(heapIs \text{Sheap}_{funcstart\_1032,1},
this.r.value(heapIs \ heap_{funcstart\_1032.1}).p1, 177).rem)), []:
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p2) < (int)0))) + temp2)))
→ [explicitly assert falsehood of skipped guards in subsequent guards]
[57.16] $heap<sub>1032,1;1054,8</sub> == $heap<sub>funcstart_1032,1</sub>._replace(this.$r \rightarrow
this.$r.value(heapIs heapIs_{tuncstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.}\text{\$r.value}(\text{heapIs}))
\theta_{tuncstart\_1032,1}.p1, 177).rem)))).\_replace(this.\$r \rightarrow 0
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart_1032,1}, this.r.value(heapIs \rho_{funcstart_1032,1}).p1,
177).quot) + (171 * div(\mathbf{heapIs} \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}))
heap_{funcstart\_1032,1}.p1, 177).rem))).\_replace(p2 \rightarrow
asType<P2Type>((30307 *
asType<int>(static_cast<integer>(static_cast<signed int>(([this.$r
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== this.$r]: this.$r.value(heapIs \rho_{funcstart\_1032,1})._replace(p1 \rightarrow (-2 *
{\rm div}(\mathbf{heapIs}\ \$ \mathrm{heap}_{funcstart\_1032,1},\ \mathbf{this}.\$ \mathrm{r.value}(\mathbf{heapIs}
\text{Sheap}_{funcstart\_1032,1}.p1, 177).quot) + (171 * div(heapIs \text{Sheap}_{funcstart\_1032,1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177).rem)), [!(this.<math>r = 
this.$r)]: this.$r.value(heapIs \theta_{funcstart\_1032,1}).p2) < (int)0))) +
temp2)))
\rightarrow [simplify]
[57.23] heap_{1032,1;1054,8} == heap_{funcstart\_1032,1}._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs $heap<sub>funcstart_1032,1</sub>, this.$r.value(heapIs
\theta_{funcstart\_1032,1}.p1, 177).rem)))).replace(this.$r \rightarrow
this.$r.value(heapIs \frac{1}{2} heap\frac{1}{2} heap\frac{1}{2}
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(\mathbf{heapIs} \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
heap_{funcstart\_1032,1}.p1, 177).rem))).\_replace(p2 \rightarrow
asType<P2Type>((30307 * asType<int>(static_cast<integer>(0 <
-this.$r.value(heapIs \frac{1}{2}heap_{funcstart\_1032.1}).p2))) + temp2)))
\rightarrow [from term 24.0, literala < -this.$r.value(heapIs $heap_{funcstart = 1032.1}).p2
is false whenever -2 < (0 + literala)
          Proof of rule precondition:
          [57.23.0] - 2 < (0 + 0)
          \rightarrow [simplify]
          [57.23.2] true
[57.24] $heap<sub>1032,1;1054,8</sub> == $heap<sub>funcstart_1032,1</sub>._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.}\text{\$r.value}(\text{heapIs}))
\theta_{funcstart\_1032,1}.p1, 177).rem)))).\_replace(this.\$r \rightarrow 0
this.$r.value(heapIs \frac{1}{2} heap\frac{1}{2} line \frac{1}{2} heap\frac{1}{2} heap\frac{1}{2
\rho_{funcstart_1032,1}, this.r.value(heapIs \rho_{funcstart_1032,1}).p1,
177).quot) + (171 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
\theta_{funcstart\_1032,1}.p1, 177).rem)))._replace(p2 \rightarrow
asType<P2Type>((30307 * asType<int>(static_cast<integer>(false)))
+ \text{temp2})))
\rightarrow [simplify]
[57.25] $heap<sub>1032,1;1054,8</sub> == $heap<sub>funcstart_1032,1</sub>._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs))
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs \rho_{funcstart\_1032,1}, this.r.value(heapIs)
\label{eq:continuous_function} $ \text{heap}_{funcstart\_1032,1}.\text{p1},\ 177).\text{rem})))).$ \_\textbf{replace}(\textbf{this}.\$r \rightarrow
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\textbf{this.\$r.value}(\textbf{heapIs}~\$ heap_{funcstart\_1032,1}).\_\textbf{replace}(p1 \rightarrow ((-2~*div(\textbf{heapIs})))))
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
\theta_{funcstart\_1032,1}.p1, 177).rem))).\_replace(p2 \rightarrow
asType < P2Type > ((30307 * asType < int > (([false]: 1, []: 0))) + temp2)))
→ [explicitly assert falsehood of skipped guards in subsequent guards]
[57.26] $heap<sub>1032,1;1054,8</sub> == $heap<sub>funcstart_1032,1</sub>._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs $heap<sub>funcstart 1032.1</sub>, this.$r.value(heapIs
\theta_{funcstart, 1032.1}.p1, 177.rem)))._replace(this.$r \rightarrow
\textbf{this.\$r.value}(\textbf{heapIs}~\$ heap_{funcstart\_1032,1}).\_\textbf{replace}(p1 \rightarrow ((-2~*div(\textbf{heapIs})))))
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
\theta_{funcstart\_1032,1}.p1, 177).rem))).\_replace(p2 \rightarrow
\mathbf{asType} \hspace{-0.5em} < \hspace{-0.5em} \text{P2Type} \hspace{-0.5em} > \hspace{-0.5em} ((30307 * \mathbf{asType} \hspace{-0.5em} < \hspace{-0.5em} \mathbf{int} \hspace{-0.5em} > \hspace{-0.5em} (([\mathbf{false}] : 1, \, [\mathbf{true}] : \, 0))) + \\
temp2)))
\rightarrow [simplify]
[57.29] $\text{heap}_{1032,1:1054.8} == $\text{heap}_{funcstart_1032,1}$._\text{replace}(\text{this}.\text{$\frac{1}{2}r$})
this.$r.value(heapIs p_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart=1032,1}, this.r.value(heapIs \rho_{funcstart=1032,1}).p1,
177).quot) + (171 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
\theta_{tuncstart\_1032.1}.p1, 177).rem)))).\_replace(this.\$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.\r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.} \text{\$r.value}(\text{heapIs}))
\rho_{uncstart\_1032.1}, p1, 177).rem)))._replace(p2 \rightarrow asType<P2Type>(0 +
temp2)))
\rightarrow [from term 54.18, temp2 is equal to (-35 * div(heapIs $heap_{funcstart\_1032,1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p2,\ 176).quot) + (172 \ respectively)
div(heapIs $heap_{funcstart\_1032.1}, this.$r.value(heapIs
heap_{funcstart\_1032,1}.p2, 176).rem
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this. r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
\theta_{funcstart\_1032,1}.p1, 177).rem))))._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs $heap<sub>funcstart_1032,1</sub>, this.$r.value(heapIs
\rho_{funcstart\_1032,1}.p1, 177).rem))._replace(p2 \rightarrow asType<P2Type>(0 +
((-35 * div(heapIs \$heap_{funcstart\_1032,1}, this.\$r.value(heapIs
\rho_{tuncstart_{1032.1}, p2, 176} = 176 \cdot 176 \cdot 172 \cdot 176 \cdot 172 \cdot 176 \cdot
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this.r.value(heapIs \ heap_{funcstart\_1032.1}).p2, 176).rem))))
\rightarrow [simplify]
[57.33] $\text{heap}_{1032,1;1054,8} == \text{$heap}_{funcstart\_1032,1}._\text{replace}(\text{this.}\text{$r} \to \text{$}
this.$r.value(heapIs \rho_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.} \text{\$r.value}(\text{heapIs}))
\theta_{funcstart\_1032,1}.p1, 177).rem)))).\_replace(this.\$r \rightarrow 0
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.} \text{\$r.value}(\text{heapIs}))
\$heap_{funcstart\_1032,1}).p1,\ 177).rem))).\_\mathbf{replace}(p2 \to ((-35\ *\ div(\mathbf{heapIs}
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p2,
176).quot) + (172 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.} \text{\$r.value}(\text{heapIs}))
heap_{funcstart\_1032,1}.p2, 176).rem)))
[Take given term]
[58.0] \; ((\$ heap_{1032,1;1054,8}.r3 * \textbf{static\_cast} < \textbf{signed int} > (div3.rem)) \; - \;
(\text{sheap}_{1032,1:1054,8}.\text{b3} * \text{static\_cast} < \text{signed int} > (\text{div3.quot}))) == \text{temp3}
\rightarrow [from term 57.33, $heap_{1032,1;1054,8}$ is equal to
\$heap_{funcstart\_1032,1}.\_\textbf{replace}(\textbf{this}.\$r \rightarrow \textbf{this}.\$r.\textbf{value}(\textbf{heapIs}
heap_{funcstart\_1032.1}._replace(p1 \rightarrow ((-2 * div(heapIs heap_{funcstart\_1032.1}),
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177).quot) + (171 *
div(\mathbf{heapIs} \ \$heap_{funcstart\_1032,1}, \ \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
\theta_{funcstart\_1032,1}.p1, 177).rem)))).\_replace(this.\$r \rightarrow 0
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
heap_{funcstart\_1032,1}, this.r.value(heapIs heap_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs heapIs = 1032,1, this.r.value(heapIs
\rho_{tuncstart\_1032,1}.p1, 177).rem))).\_replace(p2 \rightarrow (-35 * div(heapIs))).
heap_{funcstart\_1032,1}, this.r.value(heapIs heap_{funcstart\_1032,1}).p2,
176).quot) + (172 * div(heapIs $heap_{funcstart\_1032,1}, this.$r.value(heapIs)
heap_{funcstart_{1032,1}}.p2, 176).rem)))
[58.1] ((\theta_{tuncstart\_1032.1}._replace(this.r \to this.r.value(heapIs)
\rho_{tuncstart\_1032.1}._replace(p1 \rightarrow ((-2 * div(heapIs \rho_{tuncstart\_1032.1})
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177).quot) + (171 *
\operatorname{div}(\mathbf{heapIs}\ \$ \mathrm{heap}_{funcstart\_1032,1},\ \mathbf{this}.\$ r. \mathbf{value}(\mathbf{heapIs}
\label{eq:continuous_function} $$ \hat{p}_{funcstart\_1032,1}.p1,\ 177).rem))).$$ $$ \_replace(this.$r \rightarrow 0.5] $$
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs \theta_{funcstart\_1032,1}, this.r.value(heapIs)
\rho_{uncstart\_1032,1}.p1, 177).rem))._replace(p2 \rightarrow ((-35 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p2,
176).quot) + (172 * div(heapIs $heap<sub>funcstart_1032,1</sub>, this.$r.value(heapIs
\rho_{funcstart\_1032,1}.p2, 176).rem))).r3 * static_cast < signed
int>(div3.rem)) - (\$heap_{1032,1;1054,8}.b3 * static\_cast < signed
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int>(div3.quot)) = temp3
\rightarrow [const member of object with modified fields]
[58.3]\;((\$heap_{funcstart\_1032,1}.r3\;*\;\textbf{static\_cast} < \textbf{signed int} > (\text{div3.rem}))\;-
(\text{sheap}_{1032,1:1054.8}.\text{b3} * \text{static\_cast} < \text{signed int} > (\text{div3.quot}))) == \text{temp3}
\rightarrow [const static or extern object]
[58.4]\;((\mathrm{\$heap}_{init}.\mathrm{r3}\; *\; \mathbf{static\_cast} {<} \mathbf{signed}\; \mathbf{int} {>} (\mathrm{div3.rem}))\; -
(\text{sheap}_{1032,1;1054,8}.\text{b3} * \text{static\_cast} < \text{signed int} > (\text{div3.quot}))) == \text{temp3}
\rightarrow [expand definition of constant 'r3' at prang.cpp (39,26)]
[58.5] (((int)170 * static_cast<signed int>(div3.rem)) -
(\text{sheap}_{1032,1;1054,8}.\text{b3} * \text{static\_cast} < \text{signed int} > (\text{div3.quot}))) == \text{temp3}
\rightarrow [simplify]
[58.6] ((170 * static_cast<signed int>(div3.rem)) - ($heap_{1032.1:1054.8}.b3 *
static_cast<signed int>(div3.quot))) == temp3
\rightarrow [from term 34.6, div3 is equal to div(heapIs $heap_{funcstart\_1032,1},
this.r.value(heapIs $heap_{funcstart\_1032,1}).p3, 178)]
[58.7] ((170 * static_cast<signed int>(div(heapIs $heap_{funcstart\_1032,1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p3, 178).rem)) -
(\text{sheap}_{1032,1:1054,8}.\text{b3} * \text{static\_cast} < \text{signed int} > (\text{div3.quot}))) == \text{temp3}
\rightarrow [simplify]
[58.8] ((170 * div(heapIs $heap_{funcstart\_1032,1}, this.$r.value(heapIs)]
\text{heap}_{funcstart\_1032,1}.p3, 178).rem) - (\text{heap}_{1032,1:1054,8}.b3 *
static_cast<signed int>(div3.quot))) == temp3
\rightarrow [from term 57.33, $heap<sub>1032.1:1054.8</sub> is equal to
$heap_{funcstart\_1032,1}.$_replace(this.$r \rightarrow this.$r.value(heapIs)
heap_{funcstart\_1032,1}._replace(p1 \rightarrow ((-2 * div(heapIs $heap_{funcstart\_1032,1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, \ 177).quot) + (171 * 
div(\mathbf{heapIs} \ \$heap_{funcstart\_1032,1}, \ \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
heap_{funcstart\_1032,1}.p1, 177).rem))).\_replace(this.$r \rightarrow
this.r.value(heapIs \ heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs))
$heap_funcstart_1032,1, this.$r.value(heapIs $heap_funcstart_1032,1).p1,
177).quot) + (171 * div(heapIs heapIs = 1032,1, this.r.value(heapIs
\$heap_{funcstart\_1032,1}).p1,\ 177).rem))).\_\mathbf{replace}(p2 \rightarrow (-35\ *div(\mathbf{heapIs}
heap_{funcstart\_1032,1}, this.r.value(heapIs heap_{funcstart\_1032,1}).p2,
176).quot) + (172 * div(heapIs $heap_{funcstart\_1032,1}, this.$r.value(heapIs
heap_{funcstart_{-1032,1}}.p2, 176).rem)))]
[58.9] ((170 * div(heapIs $heap_{funcstart\_1032,1}, this.$r.value(heapIs
\theta_{funcstart\_1032,1}.p3, 178).rem) - (\theta_{funcstart\_1032,1}._replace(this.$r
\rightarrow this.$r.value(heapIs $heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{$heap}_{funcstart\_1032.1}, \ \mathbf{this}. \ \text{$r.value}(\mathbf{heapIs})
\text{Sheap}_{funcstart\_1032,1}.p1, 177).quot) + (171 * div(heapIs \text{Sheap}_{funcstart\_1032,1},
```

```
this.r.value(heapIs \heap_{funcstart\_1032,1}).p1, 177).rem)))._replace(this.r.value(heapIs \heap_{funcstart\_1032,1}).p1, 177).rem)))
\rightarrow this.$r.value(heap
Is \rho_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 *
{\rm div}(\mathbf{heapIs}~\$\mathrm{heap}_{funcstart\_1032,1},~\mathbf{this.\$r.value}(\mathbf{heapIs}
\text{Sheap}_{funcstart\_1032,1}.p1, 177).quot) + (171 * div(heapIs \text{Sheap}_{funcstart\_1032,1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177).rem))).\_replace(p2 \rightarrow
((-35 * div(heapIs \$heap_{funcstart\_1032,1}, this.\$r.value(heapIs
\rho_{tuncstart\_1032,1}.p2, 176).quot + (172 * div(heapIs $heap_{funcstart\_1032,1})
this.$r.value(heapIs $heap_{tuncstart_1032.1}).p2, 176).rem)))).b3 *
static_cast<signed int>(div3.quot))) == temp3
\rightarrow [const member of object with modified fields]
[58.11] ((170 * div(\mathbf{heapIs} \ \$heap_{funcstart\_1032,1}, \ \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
\text{Sheap}_{funcstart\_1032,1}.p3, 178).rem) - (\text{Sheap}_{funcstart\_1032,1}.b3 *
static_cast<signed int>(div3.quot))) == temp3
\rightarrow [const static or extern object]
[58.12] ((170 * div(heapIs heapI_{tuncstart\_1032,1}, this.r.value(heapIs)
\rho_{uncstart\_1032,1}.p3, 178.rem – (\rho_{uncstart\_1032,1}.p3, 178.rem) – (\rho_{uncstart\_1032,1}.p3, 178.rem) – (\rho_{uncstart\_1032,1}.p3, 178.rem)
int>(div3.quot)) == temp3
\rightarrow [expand definition of constant 'b3' at prang.cpp (41,26)]
[58.13] ((170 * div(\mathbf{heapIs} \ \$heap_{funcstart\_1032,1}, \ \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
\theta_{100} = \theta_{1000} - ((int)63 * static_cast < signed
int>(div3.quot)) == temp3
\rightarrow [simplify]
[58.14] ((170 * div(heapIs $heap<sub>funcstart_1032,1</sub>, this.$r.value(heapIs)
\theta_{funcstart\_1032,1}.p3, 178).rem - (63 * static_cast < signed)
int>(div3.quot)) == temp3
\rightarrow [from term 34.6, div3 is equal to div(heapIs $heap_{funcstart\_1032,1},
this.r.value(heapIs $heap_{funcstart\_1032,1}).p3, 178)
[58.15] ((170 * div(heapIs $heap_{funcstart\_1032,1}, this.$r.value(heapIs
heap_{funcstart\_1032,1}.p3, 178.rem) - (63 * static\_cast < signed
int>(div(heapIs \$heap_{funcstart\_1032,1}, this.\$r.value(heapIs
\$ \operatorname{heap}_{funcstart\_1032,1}).\operatorname{p3},\ 178).\operatorname{quot}))) == \operatorname{temp3}
\rightarrow [simplify]
[58.20] 0 == (-\text{temp3} + (-63 * \text{div}(\text{heapIs} \$\text{heap}_{funcstart\_1032.1})]
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p3, 178).quot) + (170 *
div(\mathbf{heapIs} \$ heap_{funcstart\_1032.1}, \mathbf{this.}\$r.\mathbf{value}(\mathbf{heapIs})
heap_{funcstart_{1032,1}}.p3, 178).rem
[Take given term]
[61.0] $heap<sub>funcend_1032,1</sub> == $heap<sub>1032,1;1054,8</sub>._replace(this.$r \rightarrow
operator*(heapIs heap_{1032.1:1054.8}, this)._replace(p3 \rightarrow
asType<P3Type>(($heap<sub>1032.1:1054.8</sub>.M3 *
```

```
asType<int>(static_cast<integer>(static_cast<signed
int>(operator^*(heapIs $heap_{1032,1;1054,8}, this).p3) < (int)(0))) + temp3)))
\rightarrow [from term 57.33, $heap<sub>1032,1;1054,8</sub> is equal to
\$heap_{funcstart\_1032,1}.\_\textbf{replace(this.}\$r \rightarrow \textbf{this.}\$r.\textbf{value(heapIs}
heap_{funcstart\_1032.1}._replace(p1 \rightarrow ((-2 * div(heapIs $heap_{funcstart\_1032.1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, \ 177).quot) + (171 *
div(\mathbf{heapIs} \ \$heap_{funcstart\_1032,1}, \ \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
\theta_{funcstart\_1032,1}.p1, 177).rem)))).\_replace(this.\$r \rightarrow 0
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs) + div(heapIs)))
\$heap_{funcstart\_1032,1}, \ \textbf{this}.\$r. \textbf{value(heapIs} \ \$heap_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(\mathbf{heapIs} * heap_{funcstart\_1032,1}, \mathbf{this}. * r.value(\mathbf{heapIs} 
\rho_{funcstart\_1032.1}.p1, 177).rem))).\_replace(p2 \rightarrow (-35 * div(heapIs))).
heap_{funcstart\_1032.1}, this.r.value(heapIs heap_{funcstart\_1032.1}).p2,
(176).quot) + (172 * div(\mathbf{heapIs} \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}))
heap_{funcstart\_1032,1}.p2, 176).rem)))
[61.2] heap_{funcend\_1032,1} == heap_{funcstart\_1032,1}._replace(this.$r \rightarrow
this.$r.value(heapIs \theta_{funcstart\_1032,1})._replace(p1 \theta ((-2 * div(heapIs
\theta_{funcstart\_1032,1}, this.r.value(heapIs \theta_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(\mathbf{heapIs} \ \$heap_{funcstart\_1032,1}, \ \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
\theta_{funcstart\_1032,1}.p1, 177).rem)))).\_replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs \rho_{funcstart\_1032,1}, this.r.value(heapIs)
\theta_{funcstart\_1032,1}.p1, 177).rem))._replace(p2 \rightarrow ((-35 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p2,
176).quot) + (172 * div(\mathbf{heapIs} \$heap_{funcstart\_1032.1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}))
\rho_{funcstart\_1032,1}.p2, 176).rem)))._replace(this.$r \rightarrow operator*(heapIs)
\$heap_{funcstart\_1032,1}.\_\textbf{replace}(\textbf{this}.\$\textbf{r}\rightarrow\textbf{this}.\$\textbf{r}.\textbf{value}(\textbf{heapIs}
\rho_{tuncstart\_1032,1}._replace(p1 \rightarrow ((-2 * div(heapIs $heap_{tuncstart\_1032,1}), _replace(p1 \rightarrow (1-2 * div(heapIs $heap_{tuncstart\_1032,1}), _replace(
this.r.value(heapIs \ heap_{funcstart\_1032.1}).p1, 177).quot) + (171 *
div(\mathbf{heapIs} \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
\theta_{tuncstart\_1032,1}.p1, 177).rem)))).\_replace(this.\$r \rightarrow
this.$r.value(heapIs $heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.} \text{\$r.value}(\text{heapIs}))
\rho_{funcstart\_1032,1}.p1, 177).rem))._replace(p2 \rightarrow (-35 * div(heapIs
\rho_{funcstart\_1032,1}, this. r.value(heapIs \rho_{funcstart\_1032,1}).p2,
176).quot) + (172 * div(heapIs \rho_{funcstart\_1032,1}, this.r.value(heapIs)
\theta_{funcstart\_1032,1}.p2, 176).rem)), this)._replace(p3 \rightarrow
asType<P3Type>(($heap<sub>1032.1:1054.8</sub>.M3 *
asType<int>(static_cast<integer>(static_cast<signed
int>(operator^*(heapIs $heap_{1032,1;1054,8}, this).p3) < (int)0))) + temp3)))
→ [expand definition of operator '*' in class 'pointer' at built in declaration]
[61.3] heap_{funcend\_1032,1} == heap_{funcstart\_1032,1}._replace(this.$r \rightarrow
```

```
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
\theta_{tuncstart\_1032,1}.p1, 177).rem)))).\_replace(this.\$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs $heap<sub>funcstart_1032,1</sub>, this.$r.value(heapIs
\rho_{uncstart\_1032,1}.p1, 177).rem))).\_replace(p2 \rightarrow ((-35 * div(heapIs)))._replace(p2 \rightarrow ((-35 * div(heapIs))))._replace(p2 \rightarrow ((-35 * div(heapIs))))._replace(p3 \rightarrow ((-35 * div(heapIs)))))._replace(p3 \rightarrow ((-35 * div(heapIs)))))._replace(p3 \rightarrow ((-35 * div(heapIs)))))._replace(p3 \rightarrow ((-35 * div(heapIs)))))._replace(p3 \rightarrow ((-35 * div(heapIs)))))
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p2,
176).quot) + (172 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.}\text{\$r.value}(\text{heapIs}))
\theta_{funcstart\_1032,1}.p2, 176).rem))))._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1}._replace(this.$r \rightarrow
\textbf{this.\$r.value}(\textbf{heapIs}~\$ heap_{funcstart\_1032,1}).\_\textbf{replace}(p1 \rightarrow ((-2 * div(\textbf{heapIs}) + (-2 * div(\textbf{heapI
\$heap_{funcstart\_1032,1},\, \textbf{this.}\$r.\textbf{value}(\textbf{heapIs}\,\,\$heap_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
\theta_{funcstart\_1032,1}.p1, 177).rem)))).\_replace(this.$r \rightarrow
this.$r.value(heapIs \rho_{tuncstart\_1032.1})._replace(p1 \rightarrow ((-2 * div(heapIs
\$heap_{funcstart\_1032,1},\, \textbf{this.}\$r.\textbf{value}(\textbf{heapIs}\,\,\$heap_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs $heap<sub>funcstart_1032.1</sub>, this.$r.value(heapIs
\rho_{uncstart\_1032,1}.p1, 177).rem))._replace(p2 \rightarrow ((-35 * div(heapIs
\$heap_{funcstart\_1032,1},\ \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}\ \$heap_{funcstart\_1032,1}).p2,
176).quot) + (172 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.}\text{\$r.value}(\text{heapIs}))
heap_{funcstart\_1032,1}.p2, 176).rem))))._replace(p3 \rightarrow
asType<P3Type>(($heap<sub>1032,1:1054,8</sub>.M3 *
asType{<}int{>}(static\_cast{<}integer{>}(static\_cast{<}signed
int>(operator^*(heapIs $heap_{1032,1;1054,8}, this).p3) < (int)0))) + temp3)))
→ [evaluate dereferenced pointer into modified heap]
[61.4] heap_{funcend\_1032,1} == heap_{funcstart\_1032,1}._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\ 1032.1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs \theta_{funcstart\_1032,1}, this.r.value(heapIs)
\theta_{funcstart\_1032,1}.p1, 177).rem)))).replace(this.r \rightarrow 0
this.$r.value(heapIs $heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.} \text{\$r.value}(\text{heapIs}))
\theta_{funcstart\_1032,1}.p1, 177).rem))._replace(p2 \rightarrow ((-35 * div(heapIs
\rho_{tuncstart\_1032.1}, this.r.value(heapIs \rho_{tuncstart\_1032.1}).p2,
176).quot) + (172 * div(heapIs \rho_{funcstart\_1032,1}, this.r.value(heapIs)
\rho_{funcstart\_1032,1}.p2, 176).rem)))).\_replace(this.\$r \rightarrow ([this.\$r ==
this.$r.value(heapIs \rho_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 *
div(\mathbf{heapIs} \$ heap_{funcstart\_1032.1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
\text{Sheap}_{funcstart\_1032.1}.p1, 177).quot) + (171 * div(heapIs \text{Sheap}_{funcstart\_1032.1},
\textbf{this.\$r.value}(\textbf{heapIs}~\$\text{heap}_{funcstart\_1032,1}).\text{p1},~177).\text{rem}))).\_\textbf{replace}(\text{p2}\rightarrow
(-35 * div(heapIs $heap_{funcstart\_1032,1}, this.$r.value(heapIs)]
\text{Sheap}_{funcstart\_1032,1}.\text{p2}, 176).\text{quot} + (172 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_1032,1},
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this.\$r.value(heapIs $\rho_{funcstart_1032,1}$)._replace(p1 \rightarrow ((-2 * div(heapIs

```
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p2, 176).rem)), []:
this.$r.value(heap
Is $heap_{funcstart\_1032,1}.\_replace(this.$r \rightarrow
this.$r.value(heapIs heapIs ._replace(p1 \rightarrow (-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.}\text{\$r.value}(\text{heapIs}))
heap_{funcstart\_1032,1}.p1, 177).rem)))))._replace(p3 \rightarrow
asType<P3Type>(($heap<sub>1032,1;1054,8</sub>.M3 *
asType<int>(static_cast<integer>(static_cast<signed
int>(operator^*(heapIs $heap_{1032.1:1054.8}, this).p3) < (int)0))) + temp3)))
→ [explicitly assert falsehood of skipped guards in subsequent guards]
[61.5] heap_{funcend\_1032,1} == heap_{funcstart\_1032,1}._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
\label{eq:heap_funcstart_1032,1} $$ \text{heap}_{funcstart_1032,1}.\text{p1},\ 177).\text{rem})))).$$ $$ \textbf{replace(this.\$r} \rightarrow $$
this.$r.value(heapIs heap_{funcstart=1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs $heap_{funcstart\_1032,1}, this.$r.value(heapIs
\rho_{funcstart\_1032.1}.p1, 177).rem)._replace(p2 \rightarrow ((-35 * div(heapIs
\theta_{funcstart\_1032,1}, this.r.value(\theta_{funcstart\_1032,1}).p2,
176).quot) + (172 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.} \text{\$r.value}(\text{heapIs}))
\theta_{uncstart\_1032,1}.p2, 176).rem)))._replace(this.$r \rightarrow ([this.$r ===
this.$r.value(heapIs \rho_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs}\ \$ \mathrm{heap}_{funcstart\_1032,1},\ \mathbf{this}.\$ \mathbf{r.value}(\mathbf{heapIs}
\text{Sheap}_{funcstart\_1032.1}.p1, 177).quot) + (171 * div(heapIs \text{Sheap}_{funcstart\_1032.1},
this.$r.value(heapIs \rho_{tuncstart\_1032,1}).p1, 177).rem)))._replace(p2 \rightarrow
(-35 * div(\mathbf{heapIs} \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}))
\text{Sheap}_{funcstart\_1032,1}.\text{p2}, 176).\text{quot} + (172 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_1032,1},
\mathbf{this.\$r.value(heapIs}\ \$heap_{funcstart\_1032,1}).p2,\ 176).rem)),\ [!(\mathbf{this.\$r}==
this.r.value(heapIs $heap_{funcstart\_1032,1}.\_replace(this.$r \rightarrow funcstart\_1032,1})
\textbf{this.\$r.value}(\textbf{heapIs}~\$ heap_{funcstart\_1032,1}).\_\textbf{replace}(p1 \rightarrow (-2~*div(\textbf{heapIs}
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs \rho_{funcstart\_1032,1}, this.r.value(heapIs)
\label{eq:condition} $\operatorname{heap}_{funcstart\_1032,1}).p1,\ 177).rem))))).\_\mathbf{replace}(p3 \to
asType<P3Type>(($heap<sub>1032,1;1054,8</sub>.M3 *
asType < int > (static\_cast < integer > (static\_cast < signed
int > (operator^*(heapIs \$heap_{1032,1;1054,8}, this).p3) < (int)0))) + temp3)))
\rightarrow [simplify]
[61.7] heap_{funcend\_1032,1} == heap_{funcstart\_1032,1}._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\$heap_{funcstart\_1032,1},\, \textbf{this.}\$r.\textbf{value}(\textbf{heapIs}\,\,\$heap_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(\mathbf{heapIs} \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}))
\theta_{funcstart\_1032,1}.p1, 177).rem)))).\_replace(this.\$r \rightarrow 0
this.r.value(heapIs \ensuremath{\$}heap_{funcstart\_1032.1}).\_replace(p1 \rightarrow ((-2 * div(heapIs
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\rho_{funcstart_1032,1}, this.\r.value(heapIs \rho_{funcstart_1032,1}).p1,
177).quot) + (171 * div(heapIs \theta), this.$r.value(heapIs
\rho_{uncstart\_1032,1}.p1, 177).rem))).\_replace(p2 \rightarrow ((-35 * div(heapIs)))._replace(p2 \rightarrow ((-35 * div(heapIs))))._replace(p3 + div(heapIs)))
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p2,
176).quot) + (172 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.}\text{\$r.value}(\text{heapIs}))
\theta_{funcstart\_1032,1}.p2, 176).rem)))).\_replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, his.\r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.} \text{\$r.value}(\text{heapIs}))
\rho_{uncstart_1032,1}.p1, 177).rem))._replace(p2 \rightarrow ((-35 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p2,
176).quot) + (172^{*} \text{ div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.} \text{\$r.value}(\text{heapIs}))
\label{eq:continuous_function} $\operatorname{heap}_{funcstart\_1032,1}).p2,\ 176).rem))).\_\mathbf{replace}(p3 \to
asType<P3Type>(($heap<sub>1032,1;1054,8</sub>.M3 *
asType<int>(static_cast<integer>(static_cast<signed
int>(operator^*(heapIs $heap_{1032.1:1054.8}, this).p3) < (int)0))) + temp3)))
\rightarrow [from term 57.33, $heap<sub>1032.1:1054.8</sub> is equal to
\$heap_{funcstart\_1032,1}.\_\textbf{replace}(\textbf{this}.\$r \rightarrow \textbf{this}.\$r.\textbf{value}(\textbf{heapIs}
heap_{funcstart\_1032,1}._replace(p1 \rightarrow ((-2 * div(heapIs $heap_{funcstart\_1032,1},
div(\mathbf{heapIs} \ \$heap_{funcstart\_1032,1}, \ \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
heap_{funcstart\_1032,1}.p1, 177).rem)))).replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\$heap_{funcstart\_1032,1}, \ \mathbf{this}.\$r.\mathbf{value(heapIs}\ \$heap_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(\mathbf{heapIs} \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}))
heap_{funcstart\_1032,1}.p1, 177).rem))).\_replace(p2 \rightarrow (-35 * div(heapIs))).
heap_{funcstart\_1032,1}, this.r.value(heapIs heap_{funcstart\_1032,1}).p2,
176).quot) + (172 * div(heapIs $heap_{tuncstart\_1032.1}, this.$r.value(heapIs
heap_{funcstart_{1032,1}}.p2, 176).rem)))
[61.8] heap_{funcend\_1032,1} == heap_{funcstart\_1032,1}._replace(this.$r \rightarrow
\textbf{this.\$r.value}(\textbf{heapIs}~\$ heap_{funcstart\_1032,1}).\_\textbf{replace}(p1 \rightarrow ((-2~*div(\textbf{heapIs})))))
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{heap}_{funcstart\_1032,1}, \text{this.} \text{$r.value}(\text{heapIs}))
\theta_{funcstart\_1032,1}.p1, 177).rem)))).\_replace(this.\$r \rightarrow 0
this.$r.value(heapIs p_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(\mathbf{heapIs} \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}))
\theta_{funcstart\_1032,1}.p1, 177).rem))._replace(p2 \rightarrow ((-35 * div(heapIs
\$heap_{funcstart\_1032,1},\, \textbf{this.}\$r.\textbf{value}(\textbf{heapIs}\,\,\$heap_{funcstart\_1032,1}).p2,
176).quot) + (172 * div(heapIs $heap<sub>funcstart_1032,1</sub>, this.$r.value(heapIs
\theta_{funcstart\_1032,1}.p2, 176).rem)))).\_replace(this.\$r \rightarrow 0
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.\r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs $heap<sub>funcstart_1032.1</sub>, this.$r.value(heapIs
\text{Sheap}_{funcstart\_1032,1}.\text{p1}, 177).\text{rem}))._replace(p2 \rightarrow ((-35 * div(heapIs)
```

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\rho_{tuncstart_1032.1}, this.$r.value(heapIs \rho_{tuncstart_1032.1}).p2,
176).quot) + (172 * div(heapIs \theta), this.$r.value(heapIs
\theta_{funcstart\_1032,1}.p2, 176).rem))).\_replace(p3 \rightarrow
asType < P3Type > ((\$heap_{tuncstart\_1032,1}.\_replace(this.\$r \rightarrow
this.$r.value(heapIs \frac{1}{2} heap\frac{1}{2} line \frac{1}{2} heap\frac{1}{2} heap\frac{1}{2
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
\theta_{tuncstart_{1032,1}}.p1, 177.rem)))._replace(this.$r \rightarrow
this.$r.value(heapIs p_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart_1032,1}, this.r.value(heapIs \rho_{funcstart_1032,1}).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.} \text{\$r.value}(\text{heapIs}))
\rho_{uncstart\_1032,1}.p1, 177).rem))._replace(p2 \rightarrow ((-35 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p2,
176).quot) + (172 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
heap_{funcstart\_1032,1}.p2, 176).rem))).M3 *
asType < int > (static\_cast < integer > (static\_cast < signed
int>(operator^*(heapIs $heap_{1032.1:1054.8}, this).p3) < (int)0))) + temp3)))
\rightarrow [const member of object with modified fields]
[61.10] heap_{funcend\_1032,1} == heap_{funcstart\_1032,1}._replace(this.$r \rightarrow
this.$r.value(heapIs $heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{tuncstart\_1032.1}, this.r.value(heapIs \rho_{tuncstart\_1032.1}).p1,
177).quot) + (171 * div(heapIs $heap<sub>funcstart_1032.1</sub>, this.$r.value(heapIs
\label{eq:continuous_function} $ \text{heap}_{funcstart\_1032,1} . \text{p1}, 177).rem)))).$ \_\textbf{replace}(\textbf{this}.\$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\theta_{funcstart_{1032,1}}, this. r.value(heapIs \theta_{funcstart_{1032,1}}).p1,
(177).quot + (171 * div(heapIs $heap_{funcstart\_1032,1}, this.$r.value(heapIs)
\theta_{funcstart\_1032,1}.p1, 177).rem))._replace(p2 \rightarrow ((-35 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p2,
176).quot) + (172 * div(heapIs $heap<sub>funcstart 1032.1</sub>, this.$r.value(heapIs
\theta_{funcstart\_1032,1}.p2, 176).rem))))._replace(this.$r \rightarrow
\textbf{this.\$r.value}(\textbf{heapIs}~\$ heap_{funcstart\_1032,1}).\_\textbf{replace}(p1 \rightarrow ((-2~*div(\textbf{heapIs}
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(\mathbf{heapIs} \ \$heap_{funcstart\_1032,1}, \ \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
\$heap_{funcstart\_1032,1}).p1,\ 177).rem))).\_\mathbf{replace}(p2 \to ((-35\ *\ div(\mathbf{heapIs})))).
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p2,
176).quot) + (172 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
\theta_{funcstart\_1032.1}, p2, 176).rem)))._replace(p3 \rightarrow
asType<P3Type>(($heap_funcstart_1032,1.M3 *
asType < int > (static\_cast < integer > (static\_cast < signed
int>(operator^*(heapIs $heap_{1032.1:1054.8}, this).p3) < (int)0))) + temp3)))
\rightarrow [const static or extern object]
[61.11] heap_{funcend\_1032,1} == heap_{funcstart\_1032,1}._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{tuncstart_{1032.1}}, this. r.value(heapIs \rho_{tuncstart_{1032.1}}).p1,
```

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177).quot) + (171 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.} \text{\$r.value}(\text{heapIs}))
\theta_{funcstart\_1032,1}.p1, 177).rem))))._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(\mathbf{heapIs} \$ heap_{funcstart\_1032,1}, \mathbf{this}.\$ r. \mathbf{value}(\mathbf{heapIs})
\rho_{tuncstart\_1032,1}.p1, 177).rem))._replace(p2 \rightarrow ((-35 * div(heapIs
$heap_funcstart_1032,1, this.$r.value(heapIs $heap_funcstart_1032,1).p2,
176).quot) + (172 * \text{div}(\text{heapIs} \$\text{heap}_{tuncstart\_1032.1}, \text{this}.\$\text{r.value}(\text{heapIs}))
\theta_{funcstart\_1032,1}.p2, 176).rem)))).\_replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs $heap_{funcstart\_1032,1}, this.$r.value(heapIs
\rho_{funcstart\_1032,1}.p1, 177).rem)._replace(p2 \rightarrow ((-35 * div(heapIs
\theta_{funcstart\_1032,1}, this.r.value(heapIs \theta_{funcstart\_1032,1}).p2,
176).quot) + (172 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
\theta_{funcstart\_1032,1}.p2, 176).rem))).\_replace(p3 \rightarrow
asType<P3Type>(($heap<sub>init</sub>.M3 *
asType < int > (static\_cast < integer > (static\_cast < signed
int>(operator^*(heapIs \$heap_{1032,1:1054.8}, this).p3) < (int)0))) + temp3)))
\rightarrow [expand definition of constant 'M3' at prang.cpp (38,26)]
[61.12] heap_{funcend\_1032.1} == heap_{funcstart\_1032.1}._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.\r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(\mathbf{heapIs} \$ heap_{funcstart\_1032,1}, \mathbf{this}.\$ r. \mathbf{value}(\mathbf{heapIs})
\theta_{tuncstart_1032.1}.p1, 177.rem)))._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
\rho_{uncstart\_1032,1}.p1, 177).rem))._replace(p2 \rightarrow ((-35 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p2,
176).quot) + (172 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
\theta_{funcstart\_1032,1}.p2, 176).rem)))).replace(this.$r \rightarrow
this.$r.value(heapIs $heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
heap_{funcstart\_1032,1}, this.r.value(heapIs heap_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs \theta_{funcstart\_1032,1}, this.r.value(heapIs)
\rho_{funcstart\_1032,1}.p1, 177).rem)._replace(p2 \rightarrow ((-35 * div(heapIs
\rho_{tuncstart\_1032.1}, this.r.value(heapIs \rho_{tuncstart\_1032.1}).p2,
176).quot) + (172 * div(heapIs \rho_{funcstart\_1032,1}, this.r.value(heapIs)
\theta_{funcstart\_1032,1}.p2, 176).rem))._replace(p3 \rightarrow
asType < P3Type > (((int)30323 *
asType<int>(static_cast<integer>(static_cast<signed
int>(operator^*(heapIs \$heap_{1032,1:1054.8}, this).p3) < (int)0))) + temp3)))
\rightarrow [simplify]
[61.13] heap_{funcend\_1032,1} == heap_{funcstart\_1032,1}._replace(this.$r \rightarrow
```

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this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.}\text{\$r.value}(\text{heapIs}))
\theta_{tuncstart\_1032,1}.p1, 177).rem)))).\_replace(this.\$r \rightarrow
this.$r.value(heapIs \rho_{tuncstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{tuncstart\_1032,1}, this.r.value(heapIs \rho_{tuncstart\_1032,1}).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032.1}, \text{this.} \text{\$r.value}(\text{heapIs}))
\rho_{uncstart\_1032,1}.p1, 177).rem))).\_replace(p2 \rightarrow ((-35 * div(heapIs)))._replace(p2 \rightarrow ((-35 * div(heapIs))))._replace(p2 \rightarrow ((-35 * div(heapIs))))._replace(p3 \rightarrow ((-35 * div(heapIs)))))._replace(p3 \rightarrow ((-35 * div(heapIs)))))._replace(p3 \rightarrow ((-35 * div(heapIs)))))._replace(p3 \rightarrow ((-35 * div(heapIs)))))._replace(p3 \rightarrow ((-35 * div(heapIs)))))
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p2,
176).quot) + (172 * div(heapIs \theta_{funcstart\_1032,1}, this.r.value(heapIs)
\theta_{funcstart\_1032,1}.p2, 176).rem))))._replace(this.$r \rightarrow
this.$r.value(heapIs \rho_{tuncstart\_1032.1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
\rho_{uncstart\_1032,1}.p1, 177).rem))._replace(p2 \rightarrow ((-35 * div(heapIs
\rho_{funcstart\_1032,1}, this.\r.value(heapIs \rho_{funcstart\_1032,1}).p2,
176).quot) + (172 * div(\mathbf{heapIs} \ \$heap_{funcstart\_1032,1}, \ \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
\theta_{funcstart\_1032.1}.p2, 176).rem)))._replace(p3 \rightarrow
asType<P3Type>((30323 *
asType<int>(static_cast<integer>(static_cast<signed
int>(operator*(heapIs $heap_{1032,1;1054.8}, this).p3) < (int)(0))) + temp3)))
\rightarrow [from term 57.33, $heap<sub>1032,1;1054,8</sub> is equal to
heap_{funcstart\_1032.1}._replace(this.r \rightarrow this.r.value(heapIs)
heap_{funcstart\_1032.1}._replace(p1 \rightarrow ((-2 * div(heapIs $heap_{funcstart\_1032.1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177).quot) + (171 *
div(\mathbf{heapIs} \ \$heap_{funcstart\_1032,1}, \ \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
\theta_{funcstart\_1032,1}.p1, 177).rem)))).\_replace(this.\$r \rightarrow 0
this.$r.value(heapIs heap_{funcstart\_1032.1})._replace(p1 \rightarrow ((-2 * div(heapIs) + (-2 * div(heapIs) + (
\$heap_{funcstart\_1032,1}, \ \textbf{this}.\$r. \textbf{value} (\textbf{heapIs} \ \$heap_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(\textbf{heapIs} \$heap_{funcstart\_1032,1}, \textbf{this}.\$r.\textbf{value}(\textbf{heapIs}))
heap_{funcstart\_1032,1}.p1, 177).rem))).\_replace(p2 \rightarrow (-35 * div(heapIs))).
heap_{funcstart\_1032,1}, this.r.value(heapIs heap_{funcstart\_1032,1}).p2,
176).quot) + (172 * div(\mathbf{heapIs} \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}))
heap_{funcstart\_1032,1}.p2, 176).rem)))
[61.14] \theta_{1.032,1} == \theta_{1.032,1}.\_replace(this.\$r \rightarrow 0.014)
this.$r.value(heapIs \theta_{funcstart\_1032,1})._replace(p1 \theta ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs \rho_{funcstart\_1032,1}, this.r.value(heapIs)
\theta_{funcstart\_1032,1}.p1, 177).rem)))).\_replace(this.$r \rightarrow
this.$r.value(heapIs \rho_{uncstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{tuncstart\_1032.1}, this.r.value(heapIs \rho_{tuncstart\_1032.1}).p1,
177).quot) + (171 * div(\mathbf{heapIs} \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}))
\$heap_{funcstart\_1032,1}).p1,\ 177).rem))).\_\mathbf{replace}(p2 \to ((-35\ *\ div(\mathbf{heapIs}
\rho_{funcstart=1032,1}, this.r.value(heapIs \rho_{funcstart=1032,1}).p2,
176).quot) + (172 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.} \text{\$r.value}(\text{heapIs}))
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\theta_{funcstart=1032,1}.p2, 176).rem)))._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs $heap<sub>funcstart_1032,1</sub>, this.$r.value(heapIs
\theta_{funcstart\_1032,1}.p1, 177).rem))._replace(p2 \rightarrow ((-35 * div(heapIs
$heap_funcstart_1032,1, this.$r.value(heapIs $heap_funcstart_1032,1).p2,
176).quot) + (172 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.} \text{\$r.value}(\text{heapIs}))
heap_{funcstart=1032.1}, p2, 176).rem)))._replace(p3 \rightarrow
asType<P3Type>((30323 *
asType<int>(static_cast<integer>(static_cast<signed
\mathbf{int}{>}(\mathbf{operator^*}(\mathbf{heapIs}\ \$\mathbf{heap}_{funcstart\_1032,1}.\_\mathbf{replace}(\mathbf{this}.\$\mathbf{r}\rightarrow
this.$r.value(heapIs \rho_{uncstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this. r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
\theta_{funcstart\_1032,1}.p1, 177).rem)))).\_replace(this.\$r \rightarrow 0
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.} \text{\$r.value}(\text{heapIs}))
\rho_{funcstart\_1032.1}.p1, 177).rem)._replace(p2 \rightarrow (-35 * div(heapIs
$\text{heap}_{funcstart=1032.1}$, this.$\text{r.value}(\text{heapIs} \text{$heap}_{funcstart=1032.1}).p2,
176).quot) + (172 * \text{div}(\text{heapIs } \text{heap}_{funcstart\_1032,1}, \text{this.} \text{$r.value}(\text{heapIs}))
heap_{funcstart\_1032,1}.p2, 176).rem)), this).p3) < (int)0)) + temp3))
→ [expand definition of operator '*' in class 'pointer' at built in declaration]
[61.15] \theta_{1.15} == \theta_{1.15} == \theta_{1.15}._replace(this.$r \theta_{1.15}
this.$r.value(heapIs $heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
\label{eq:continuous_function} $ \text{heap}_{funcstart\_1032,1} . \text{p1}, 177).rem)))).\_\textbf{replace}(\textbf{this}.\$r \rightarrow
this.$r.value(heapIs heap_{funcstart\ 1032.1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs \theta_{funcstart\_1032,1}, this.r.value(heapIs)
\rho_{funcstart_1032,1}, this.r.value(heapIs \rho_{funcstart_1032,1}).p2,
176).quot) + (172 * div(heapIs \rho_{funcstart\_1032,1}, this.r.value(heapIs)
\theta_{uncstart\_1032,1}.p2, 176).rem)))._replace(this.$r \rightarrow
\textbf{this.}\$r.\textbf{value}(\textbf{heapIs}~\$heap_{funcstart\_1032,1}).\_\textbf{replace}(p1 \rightarrow ((\text{-}2~*\text{div}(\textbf{heapIs}
\rho_{funcstart\_1032,1}, this. r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs \rho_{funcstart\_1032,1}, this.r.value(heapIs)
\rho_{funcstart\_1032,1}.p1, 177).rem))._replace(p2 \rightarrow ((-35 * div(heapIs
$\text{heap}_{funcstart_1032.1}$, this.$\text{r.value}(\text{heapIs} \text{$heap}_{funcstart_1032.1}).p2,
176).quot) + (172 * div(\mathbf{heapIs} \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}))
\theta_{funcstart\_1032,1}.p2, 176).rem))._replace(p3 \rightarrow
asType<P3Type>((30323 *
asType{<}int{>}(static\_cast{<}integer{>}(static\_cast{<}signed
int>(this.$r.value(heapIs \rho_{tuncstart 1032.1}._replace(this.$r \rightarrow
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this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
\theta_{tuncstart\_1032,1}.p1, 177).rem)))).\_replace(this.\$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs $heap<sub>funcstart_1032,1</sub>, this.$r.value(heapIs
\rho_{uncstart\_1032,1}.p1, 177).rem))._replace(p2 \rightarrow ((-35 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p2,
176).quot) + (172 * div(heapIs \theta_{funcstart\_1032,1}, this.r.value(heapIs)
\theta_{funcstart\_1032,1}.p2, 176).rem)))).p3) < (int)0))) + temp3))
→ [evaluate dereferenced pointer into modified heap]
[61.16] $heap<sub>funcend_1032,1</sub> == $heap<sub>funcstart_1032,1</sub>._replace(this.$r \rightarrow
this.$r.value(heapIs p_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(\mathbf{heapIs} \$ heap_{funcstart\_1032,1}, \mathbf{this}.\$ r. \mathbf{value}(\mathbf{heapIs})
\theta_{funcstart\_1032,1}.p1, 177).rem))))._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.\r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
\rho_{funcstart\_1032.1}.p1, 177).rem))._replace(p2 \rightarrow ((-35 * div(heapIs
\rho_{tuncstart\_1032.1}, this.r.value(heapIs \rho_{tuncstart\_1032.1}).p2,
176).quot) + (172 * div(\mathbf{heapIs} \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}))
\label{eq:continuous_function} $ \text{heap}_{funcstart\_1032,1} . \text{p2}, \ 176).rem)))).$ \_\textbf{replace}(\textbf{this}.\$r \rightarrow
this.$r.value(heapIs \rho_{tuncstart\_1032.1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(\mathbf{heapIs} \ \$heap_{funcstart\_1032,1}, \ \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
\rho_{uncstart\_1032,1}.p1, 177).rem))).\_replace(p2 \rightarrow ((-35 * div(heapIs)))._replace(p2 \rightarrow ((-35 * div(heapIs))))._replace(p3 + div(heapIs)))
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p2,
176).quot) + (172 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.} \text{\$r.value}(\text{heapIs}))
\$heap_{funcstart\_1032,1}).p2,\ 176).rem))).\_\textbf{replace}(p3 \rightarrow
asType<P3Type>((30323 *
asType < int > (static\_cast < integer > (static\_cast < signed int > (([this.$r
== this.$r]: this.$r.value(heapIs \theta_{funcstart\_1032.1})._replace(p1 \theta ((-2)
* div(\mathbf{heapIs} \ \mathbf{sheap}_{funcstart\_1032,1}, \ \mathbf{this.sr.value}(\mathbf{heapIs})
\text{Sheap}_{funcstart\_1032,1}.p1, 177).quot) + (171 * div(heapIs \text{Sheap}_{funcstart\_1032,1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177).rem))).\_replace(p2 \rightarrow
(-35 * div(heapIs \$heap_{funcstart\_1032,1}, this.\$r.value(heapIs
\rho_{funcstart\_1032,1}.p2, 176).quot + (172 * div(heapIs $heap_{funcstart\_1032,1})
this.$r.value(heapIs heap_{funcstart\_1032.1}).p2, 176).rem)), []:
this.$r.value(heapIs heap_{funcstart\_1032.1}._replace(this.$r \rightarrow
this.$r.value(heapIs heapIs_{funcstart\_1032,1})._replace(p1 \rightarrow (-2 * div(heapIs
\rho_{tuncstart_{1032.1}}, this.r.value(heapIs \rho_{tuncstart_{1032.1}}).p1,
177).quot) + (171 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
\text{Sheap}_{funcstart\_1032,1}.\text{p1}, 177).\text{rem})))).\text{p3} < (int)0)) + \text{temp3}))
```

```
→ [explicitly assert falsehood of skipped guards in subsequent guards]
[61.17] heap_{funcend\_1032,1} == heap_{funcstart\_1032,1}._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.} \text{\$r.value}(\text{heapIs}))
\theta_{funcstart\_1032,1}.p1, 177).rem)))).\_replace(this.$r \rightarrow
\textbf{this.\$r.value}(\textbf{heapIs}~\$ heap_{funcstart\_1032,1}).\_\textbf{replace}(p1 \rightarrow ((-2 * div(\textbf{heapIs}) + (-2 * div(\textbf{heapI
\rho_{funcstart\_1032,1}, this.\r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.} \text{\$r.value}(\text{heapIs}))
\rho_{funcstart\_1032,1}.p1, 177).rem))._replace(p2 \rightarrow ((-35 * div(heapIs
\rho_{funcstart\_1032,1}, this.\r.value(heapIs \rho_{funcstart\_1032,1}).p2,
176).quot) + (172 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
\theta_{funcstart_{1032,1}}.p2, 176).rem))))._replace(this.$r \rightarrow
this.$r.value(heapIs \rho_{tuncstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\label{eq:heapIs} $\operatorname{heap}_{funcstart\_1032,1},\ \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}\ \$\operatorname{heap}_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs $heap<sub>funcstart_1032,1</sub>, this.$r.value(heapIs
\rho_{funcstart\_1032,1}.p1, 177).rem)._replace(p2 \rightarrow ((-35 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p2,
176).quot) + (172 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.}\text{\$r.value}(\text{heapIs}))
\theta_{funcstart\_1032,1}.p2, 176).rem)))._replace(p3 \rightarrow
asType<P3Type>((30323 *
asType<int>(static_cast<integer>(static_cast<signed int>(([this.$r
== this.$r]: this.$r.value(heapIs \theta_{funcstart\_1032,1})._replace(p1 \theta ((-2)
* div(heapIs heap_{funcstart\_1032,1}, this.r.value(heapIs)
\text{Sheap}_{funcstart\_1032,1}.\text{p1}, 177).\text{quot} + (171 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_1032,1},
\textbf{this.\$r.value}(\textbf{heapIs}~\$\text{heap}_{funcstart\_1032,1}).\text{p1},~177).\text{rem}))).\_\textbf{replace}(\text{p2}\rightarrow
(-35 * div(heapIs \$heap_{funcstart\_1032,1}, this.\$r.value(heapIs
\text{Sheap}_{funcstart\_1032.1}.p2, 176).quot) + (172 * div(heapIs \text{Sheap}_{funcstart\_1032.1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p2, 176).rem)), [!(this.<math>r = 
\textbf{this.\$r.value}(\textbf{heapIs}~\$ heap_{funcstart\_1032,1}.\_\textbf{replace}(\textbf{this.\$r} \rightarrow \texttt{a.s.}))
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow (-2 * div(heapIs
\rho_{tuncstart=1032.1}, this.r.value(heapIs \rho_{tuncstart=1032.1}).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.}\text{\$r.value}(\text{heapIs}))
\rightarrow [simplify]
[61.25] heap_{funcend\_1032,1} == heap_{funcstart\_1032,1}._replace(this.$r \rightarrow
this.$r.value(heapIs $heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(\mathbf{heapIs} \ \$heap_{funcstart\_1032,1}, \ \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
\label{eq:continuous_function} $ \text{heap}_{funcstart\_1032,1}.\text{p1, 177}.\text{rem})))).$ \_\textbf{replace}(\textbf{this}.\$\text{r} \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.} \text{\$r.value}(\text{heapIs}))
\rho_{funcstart\_1032,1}.p1, 177).rem))._replace(p2 \rightarrow ((-35 * div(heapIs
```

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\rho_{funcstart=1032,1}, this.r.value(heapIs \rho_{funcstart=1032,1}).p2,
176).quot) + (172 * div(heapIs \theta_{funcstart\_1032,1}, this.r.value(heapIs)
\theta_{funcstart\_1032,1}.p2, 176).rem))))._replace(this.$r \rightarrow
this.$r.value(heapIs \frac{1}{2} heap\frac{1}{2} heap\frac{1}{2}
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs $heap<sub>funcstart_1032,1</sub>, this.$r.value(heapIs
\rho_{uncstart\_1032,1}.p1, 177).rem))).\_replace(p2 \rightarrow ((-35 * div(heapIs)))._replace(p2 \rightarrow ((-35 * div(heapIs))))._replace(p3 + div(heapIs)))
$\text{heap}_{tuncstart_1032,1}$, this.$\text{r.value}(\text{heapIs} \text{$heap}_{tuncstart_1032,1}).p2,
176).quot) + (172 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032.1}, \text{this.} \text{\$r.value}(\text{heapIs}))
heap_{funcstart\_1032,1}.p2, 176).rem))).\_replace(p3 \rightarrow
asType<P3Type>((30323 * asType<int>(static_cast<integer>(0 <
-\mathbf{this.\$r.value}(\mathbf{heapIs}\ \$\mathbf{heap}_{funcstart\_1032,1}).\mathbf{p3}))) + \mathbf{temp3})))
\rightarrow [from term 40.0, literala < -this.$r.value(heapIs $heap_{funcstart = 1032.1}).p3
is false whenever -2 < (0 + literala)
       Proof of rule precondition:
       [61.25.0] - 2 < (0 + 0)
       \rightarrow [simplify]
       [61.25.2] true
[61.26] heap_{funcend\_1032,1} == heap_{funcstart\_1032,1}._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.}\text{\$r.value}(\text{heapIs}))
\theta_{tuncstart\_1032,1}.p1, 177).rem)))).\_replace(this.\$r \rightarrow
this.$r.value(heapIs p_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this. r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(\mathbf{heapIs} \$ heap_{funcstart\_1032,1}, \mathbf{this}.\$ r. \mathbf{value}(\mathbf{heapIs})
\rho_{funcstart\_1032,1}.p1, 177).rem)._replace(p2 \rightarrow ((-35 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p2,
176).quot) + (172 * div(\mathbf{heapIs} \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}))
\theta_{funcstart\_1032,1}.p2, 176).rem))))._replace(this.$r \rightarrow
\textbf{this.}\$r.\textbf{value}(\textbf{heapIs}~\$heap_{funcstart\_1032,1}).\_\textbf{replace}(p1 \rightarrow ((\text{-}2~*\text{div}(\textbf{heapIs}
\rho_{tuncstart\_1032.1}, this.r.value(heapIs \rho_{tuncstart\_1032.1}).p1,
177).quot) + (171 * div(heapIs \theta_{funcstart\_1032,1}, this.r.value(heapIs)
\$heap_{funcstart\_1032,1}).p1,\ 177).rem))).\_\mathbf{replace}(p2 \to ((-35\ *\ div(\mathbf{heapIs}
\rho_{funcstart_1032,1}, this. r.value(heapIs \rho_{funcstart_1032,1}).p2,
176).quot) + (172 * div(heapIs $heap<sub>funcstart_1032.1</sub>, this.$r.value(heapIs
heap_{funcstart\_1032,1}.p2, 176).rem))._replace(p3 \rightarrow
asType<P3Type>((30323 * asType<int>(static_cast<integer>(false)))
+ \text{temp3})))
\rightarrow [simplify]
[61.27] heap_{funcend\_1032,1} == heap_{funcstart\_1032,1}._replace(this.$r \rightarrow
```

this.\$r.value(heapIs $heap_{funcstart_1032,1}$)._replace(p1 \rightarrow ((-2 * div(heapIs

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\rho_{funcstart=1032,1}, this.r.value(heapIs \rho_{funcstart=1032,1}).p1,
177).quot) + (171 * div(heapIs \theta), this.$r.value(heapIs
\theta_{funcstart\_1032,1}.p1, 177).rem))))._replace(this.$r \rightarrow
this.$r.value(heapIs \frac{1}{2} heap\frac{1}{2} line \frac{1}{2} heap\frac{1}{2} heap\frac{1}{2
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs $heap<sub>funcstart_1032,1</sub>, this.$r.value(heapIs
\rho_{uncstart\_1032,1}.p1, 177).rem))).\_replace(p2 \rightarrow ((-35 * div(heapIs)))._replace(p2 \rightarrow ((-35 * div(heapIs))))._replace(p3 + div(heapIs)))
$\text{heap}_{tuncstart_1032,1}$, this.$\text{r.value}(\text{heapIs} \text{$heap}_{tuncstart_1032,1}).p2,
176).quot) + (172 * div(heapIs $heap<sub>funcstart_1032,1</sub>, this.$r.value(heapIs
\theta_{funcstart\_1032,1}.p2, 176).rem)))).\_replace(this.\$r \rightarrow 0
\textbf{this.\$r.value}(\textbf{heapIs}~\$ heap_{funcstart\_1032,1}).\_\textbf{replace}(p1 \rightarrow ((-2~*div(\textbf{heapIs}
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
\rho_{funcstart\_1032,1}.p1, 177).rem))._replace(p2 \rightarrow ((-35 * div(heapIs
\rho_{funcstart\_1032,1}, this.\r.value(heapIs \rho_{funcstart\_1032,1}).p2,
176).quot) + (172 * \text{div}(\text{heapIs } \text{heap}_{funcstart\_1032,1}, \text{this.} \text{$r.value}(\text{heapIs}))
\theta_{funcstart\_1032,1}.p2, 176).rem))).\_replace(p3 \rightarrow
asType<P3Type>((30323 * asType<int>(([false]: 1, []: 0))) + temp3)))
→ [explicitly assert falsehood of skipped guards in subsequent guards]
[61.28] heap_{funcend\_1032,1} == heap_{funcstart\_1032,1}._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.} \text{\$r.value}(\text{heapIs}))
\label{eq:continuous_function} $ \text{heap}_{funcstart\_1032,1} . \text{p1}, 177).rem)))).\_\textbf{replace}(\textbf{this}.\$r \rightarrow
this.$r.value(heapIs \rho_{tuncstart\_1032.1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs \rho_{funcstart\_1032,1}, this.r.value(heapIs)
\rho_{uncstart\_1032,1}.p1, 177).rem))).\_replace(p2 \rightarrow ((-35 * div(heapIs)))._replace(p2 \rightarrow ((-35 * div(heapIs))))._replace(p3 + div(heapIs)))
$\text{heap}_{tuncstart=1032.1}$, this.$\text{r.value}(\text{heapIs} \text{$heap}_{tuncstart=1032.1}).p2,
176).quot) + (172 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
\theta_{funcstart\_1032,1}.p2, 176).rem)))).replace(this.$r \rightarrow
this.$r.value(heapIs heapIs_{tuncstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\$heap_{funcstart\_1032,1},\, \textbf{this}.\$r.\textbf{value}(\textbf{heapIs}\,\,\$heap_{funcstart\_1032.1}).p1,
177).quot) + (171 * div(\mathbf{heapIs} \$ heap_{funcstart\_1032,1}, \mathbf{this}.\$ r. \mathbf{value}(\mathbf{heapIs})
\rho_{funcstart\_1032,1}.p1, 177).rem)._replace(p2 \rightarrow ((-35 * div(heapIs
\rho_{funcstart\_1032,1}, this. r.value(heapIs \rho_{funcstart\_1032,1}).p2,
176).quot) + (172 * \text{div}(\text{heapIs } \text{heap}_{funcstart\_1032.1}, \text{this.}\text{$\text{r.value}(\text{heapIs})$})
heap_{funcstart\_1032.1}.p2, 176).rem)).\_replace(p3 \rightarrow
asType<P3Type>((30323 * asType<int>(([false]: 1, [true]: 0))) +
temp3)))
\rightarrow [simplify]
[61.31] heap_{funcend\_1032.1} == heap_{funcstart\_1032.1}._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{tuncstart\_1032.1}, this.r.value(heapIs \rho_{tuncstart\_1032.1}).p1,
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177).quot) + (171 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.} \text{\$r.value}(\text{heapIs}))
\theta_{funcstart\_1032,1}.p1, 177).rem))))._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.}\text{\$r.value}(\text{heapIs}))
\rho_{tuncstart\_1032,1}.p1, 177).rem))._replace(p2 \rightarrow ((-35 * div(heapIs
$heap_funcstart_1032,1, this.$r.value(heapIs $heap_funcstart_1032,1).p2,
176).quot) + (172 * div(heapIs $heap<sub>funcstart_1032,1</sub>, this.$r.value(heapIs
\theta_{tuncstart\_1032,1}.p2, 176).rem)))._replace(this.$r \rightarrow
\textbf{this.\$r.value}(\textbf{heapIs}~\$ heap_{funcstart\_1032,1}).\_\textbf{replace}(p1 \rightarrow ((-2~*div(\textbf{heapIs})))))
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs \rho_{funcstart\_1032,1}, this.r.value(heapIs)
\rho_{uncstart\_1032,1}.p1, 177).rem))._replace(p2 \rightarrow ((-35 * div(heapIs
\rho_{uncstart\_1032,1}, this.r.value(heapIs \rho_{uncstart\_1032,1}).p2,
176).quot) + (172 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
\rho_{uncstart\_1032.1}.p2, 176).rem))._replace(p3 \rightarrow asType<P3Type>(0 +
temp3)))
\rightarrow [from term 58.20, temp3 is equal to (-63 * div(heapIs $heap_{funcstart\_1032,1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p3, 178).quot) + (170 *
div(heapIs $heap_{funcstart\_1032,1}, this.$r.value(heapIs)
heap_{funcstart_{1032,1}}.p3, 178).rem
[61.32] heap_{funcend\_1032,1} == heap_{funcstart\_1032,1}._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.\r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.} \text{\$r.value}(\text{heapIs}))
\theta_{funcstart\_1032,1}.p1, 177).rem)))._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
\rho_{funcstart\_1032,1}.p1, 177).rem))._replace(p2 \rightarrow ((-35 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p2,
176).quot) + (172 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.} \text{\$r.value}(\text{heapIs}))
\theta_{funcstart\_1032,1}.p2, 176).rem)))).replace(this.r \rightarrow 0
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
\rho_{uncstart\_1032,1}.p1, 177).rem))._replace(p2 \rightarrow ((-35 * div(heapIs
\rho_{funcstart\_1032,1}, this. r.value(heapIs \rho_{funcstart\_1032,1}).p2,
176).quot) + (172 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.} \text{\$r.value}(\text{heapIs}))
\rho_{tuncstart\_1032.1}.p2, 176).rem))._replace(p3 \rightarrow asType<P3Type>(0 +
((-63 * div(heapIs $heap<sub>funcstart 1032.1</sub>, this.$r.value(heapIs
\text{Sheap}_{funcstart\_1032.1}.p3, 178).quot) + (170 * div(heapIs \text{Sheap}_{funcstart\_1032.1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p3, 178).rem)))))
\rightarrow [simplify]
```

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[61.35] heap_{funcend\_1032,1} == heap_{funcstart\_1032,1}._replace(this.$r \rightarrow
this.$r.value(heapIs \theta_{funcstart\_1032,1})._replace(p1 \theta ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
\theta_{tuncstart\_1032,1}.p1, 177).rem)))).\_replace(this.\$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032.1}, \text{this.} \text{\$r.value}(\text{heapIs}))
\rho_{funcstart\_1032,1}.p1, 177).rem))._replace(p2 \rightarrow ((-35 * div(heapIs
$heap_funcstart_1032,1, this.$r.value(heapIs $heap_funcstart_1032,1).p2,
176).quot) + (172 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.} \text{\$r.value}(\text{heapIs}))
\theta_{funcstart\_1032,1}.p2, 176).rem))))._replace(this.$r \rightarrow
\textbf{this.}\$r.\textbf{value}(\textbf{heapIs}~\$heap_{funcstart\_1032,1}).\_\textbf{replace}(p1 \rightarrow ((-2~*div(\textbf{heapIs})))))
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(\mathbf{heapIs} \ \$heap_{funcstart\_1032,1}, \ \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
\rho_{uncstart\_1032,1}.p1, 177).rem))._replace(p2 \rightarrow ((-35 * div(heapIs
$heap_tuncstart_1032.1, this.$r.value(heapIs $heap_tuncstart_1032.1).p2,
176).quot) + (172 * div(\mathbf{heapIs} \ \$heap_{funcstart\_1032,1}, \ \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
\rho_{tuncstart_{-1032,1}}.p2, 176).rem))._replace(p3 \rightarrow ((-63 * div(heapIs
$\text{heap}_{funcstart=1032.1}$, this.$\text{r.value}(\text{heapIs} $\text{heap}_{funcstart=1032.1}).p3,
178).quot) + (170 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.} \text{\$r.value}(\text{heapIs}))
heap_{funcstart\_1032,1}.p3, 178.rem)))
[Take goal term]
[1.0]!(0.0 ==
asType<double>(static_cast<real>($heap_{funcend\_1032.1}.M3)))
\rightarrow [from term 61.35, $heap<sub>funcend_1032,1</sub> is equal to
\$heap_{funcstart\_1032,1}.\_\textbf{replace}(\textbf{this}.\$r \rightarrow \textbf{this}.\$r.\textbf{value}(\textbf{heapIs}
heap_{funcstart\_1032,1}._replace(p1 \rightarrow ((-2 * div(heapIs $heap_{funcstart\_1032,1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177).quot) + (171)
div(heapIs $heap_{tuncstart\_1032.1}, this.$r.value(heapIs
\theta_{funcstart\_1032,1}.p1, 177).rem)))).\_replace(this.\$r \rightarrow 0
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
heap_{funcstart\_1032,1}, this.r.value(heapIs heap_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs \$heap_{funcstart\_1032,1}, this.\$r.value(heapIs
\rho_{funcstart\_1032,1}.p1, 177).rem))).\_replace(p2 \rightarrow ((-35 * div(heapIs))).\_replace(p2 \rightarrow ((-35 * div(heapIs)))).\_replace(p2 \rightarrow ((-35 * div(heapIs)))))
heap_{funcstart\_1032,1}, this.r.value(heapIs heap_{funcstart\_1032,1}).p2,
176).quot) + (172 * div(\textbf{heapIs } \$heap_{funcstart\_1032,1}, \textbf{this.}\$r.\textbf{value}(\textbf{heapIs}))
heap_{funcstart\_1032,1}.p2, 176).rem)))._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
heap_{funcstart\_1032,1}, this.r.value(heapIs heap_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(\mathbf{heapIs} \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}))
heap_{funcstart\_1032,1}.p1, 177).rem))._replace(p2 \rightarrow ((-35 * div(heapIs)))._
$heap_{funcstart\_1032,1}$, this. $r.value(heapIs $heap_{funcstart\_1032,1}).p2$,}
(176).quot) + (172*div(\textbf{heapIs} \$heap_{funcstart\_1032,1}, \textbf{this}.\$r.\textbf{value}(\textbf{heapIs}))
```

```
heap_{funcstart\_1032,1}.p2, 176).rem)))\_replace(p3 \rightarrow (-63 * div(heapIs)))
heap_{funcstart\_1032,1}, this.r.value(heapIs heap_{funcstart\_1032,1}).p3,
178).quot) + (170 * div(heapIs $heap_{funcstart\_1032,1}, this.$r.value(heapIs)
heap_{funcstart\_1032,1}.p3, 178.rem)))
[1.1]!(0.0 ==
as Type < double > (static\_cast < real > (\$heap_{funcstart\_1032,1}.\_replace(this.\$r
\rightarrow this.$r.value(heap
Is \rho_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 *
div(\mathbf{heapIs} \$ heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
\text{Sheap}_{funcstart\_1032.1}.p1, 177).quot) + (171 * div(heapIs \text{Sheap}_{funcstart\_1032.1},
\mathbf{this.\$r.value(heapIs\ \$heap}_{funcstart\_1032,1}).p1,\ 177).rem)))).\_\mathbf{replace(this.\$r}
\rightarrow this.$r.value(heapIs $heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 *
div(\mathbf{heapIs} \$ heap_{funcstart\_1032.1}, \mathbf{this.}\$ r. \mathbf{value}(\mathbf{heapIs})
\text{Sheap}_{funcstart\_1032.1}.p1, 177).quot) + (171 * div(heapIs \text{Sheap}_{funcstart\_1032.1},
this.r.value(heapIs \ heap_{funcstart\_1032.1}).p1, 177).rem))).\_replace(p2 \rightarrow
((-35 * div(heapIs \$heap_{funcstart\_1032,1}, this.\$r.value(heapIs
\rho_{tuncstart_{1032.1}, p2, 176} = 176, quot \rho_{tuncstart_{1032.1}, p3} + 176
this.r.value(heapIs \ensuremath{\$heap}_{funcstart\_1032,1}).p2, 176).rem)))).\_replace(this.\$r)
\rightarrow this.$r.value(heapIs $heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 *
div(\mathbf{heapIs} \$ heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
\text{Sheap}_{funcstart\_1032,1}.p1, 177).quot) + (171 * div(heapIs \text{Sheap}_{funcstart\_1032,1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177).rem))).\_replace(p2 \rightarrow
((-35 * div(\mathbf{heapIs} \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}))
\text{Sheap}_{funcstart\_1032.1}.p2, 176).quot) + (172 * div(heapIs \text{Sheap}_{funcstart\_1032.1},
this.$r.value(heapIs \theta_{funcstart\_1032.1}).p2, 176).rem)))._replace(p3 \rightarrow
((-63 * div(\mathbf{heapIs} \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}))
\text{Sheap}_{funcstart\_1032.1}.p3, 178).quot) + (170 * div(heapIs \text{Sheap}_{funcstart\_1032.1},
\mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}~\$\mathrm{heap}_{funcstart\_1032,1}).\mathrm{p3},~178).\mathrm{rem})))).\mathrm{M3})))
\rightarrow [const member of object with modified fields]
[1.4]!(0.0 ==
asType < double > (static\_cast < real > ($heap_{funcstart\_1032.1}.M3)))
\rightarrow [const static or extern object]
[1.5]!(0.0 == asType < double > (static_cast < real > ($heap_{init}.M3)))
\rightarrow [expand definition of constant 'M3' at prang.cpp (38,26)]
[1.6]!(0.0 == asType < double > (static_cast < real > ((int)30323)))
\rightarrow [simplify]
[1.12] true
Proof of verification condition: Assertion valid
```

In the context of class: WHPrang, declared at: C:\Escher\Customers\prang-cpp\prang.cpp (18,1)

Condition generated at: C:\Escher\Customers\prang-cpp\prang.cpp

```
(94,26)
To prove: asType<real>((double)0.0) < ((asType<real>(raux2) +
asType<real>(raux1)) + asType<real>(raux3))
Given:
heap_{init}.LIMIT == (int)80
heap_{init}.class WHPrang \in M1 == (int)30269
heap_{init}.class WHPrang \in r1 == (int)171
\text{heap}_{init}.\mathbf{class} \text{ WHPrang } \in \text{a1} == (\mathbf{int})177
heap_{init}.class WHPrang \in b1 == (int)2
heap_{init}.class WHPrang \in M2 == (int)30307
heap_{init}.class WHPrang \in r2 == (int)172
heap_{init}.class WHPrang \in a2 == (int)176
heap_{init}.class WHPrang \in b2 == (int)35
heap_{init}.class WHPrang \in M3 == (int)30323
heap_{init}.class WHPrang \in r3 == (int)170
heap_{init}.class WHPrang \in a3 == (int)178
heap_{init}.class WHPrang \in b3 == (int)63
\operatorname{div1} == \operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_1032,1},
\mathbf{static\_cast} < \mathbf{int} > (\mathbf{operator*}(\mathbf{heapIs} \ \$ \mathbf{heap}_{funcstart\_1032,1}, \ \mathbf{this}).\mathtt{p1}),
\mathbf{static\_cast}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_1032,1}.\mathrm{a1}))
(asType < integer > (static\_cast < int > (operator*(heapIs)))
heap_{funcstart\_1032,1}, this).p1) /
\mathbf{asType} {<} \mathbf{integer} {>} (\mathbf{static\_cast} {<} \mathbf{int} {>} (\$ \mathbf{heap}_{funcstart\_1032,1}.\mathbf{a1}))) = =
asType<integer>(div1.quot)
(asType < integer > (static\_cast < int > (operator*(heapIs)))
heap_{funcstart\_1032.1}, this).p1) %
asType < integer > (static\_cast < int > (\$heap_{funcstart\_1032.1}.a1))) = =
asType<integer>(div1.rem)
(\mathbf{asType}{<}\mathbf{integer}{>}(\mathbf{operator}^*(\mathbf{heapIs}\ \$\mathbf{heap}_{funcstart\_1032,1},\ \mathbf{this}).\mathtt{p1}) <
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathrm{heap}_{funcstart\_1032,1}.\mathrm{a1})) =>
(asType<integer>(div1.rem) == asType<integer>(operator*(heapIs
heap_{funcstart\_1032,1}, this).p1)
(\mathbf{asType} < \mathbf{integer} > (\$ \mathbf{heap}_{funcstart\_1032,1}.\mathbf{a1}) \le
\mathbf{asType} < \mathbf{integer} > (\mathbf{operator}^*(\mathbf{heapIs} \ \$ \mathbf{heap}_{funcstart\_1032,1}, \ \mathbf{this}).\mathtt{p1})) = >
!(0 == asType < integer > (div1.quot))
!(0 == asType < integer > (div1.rem)) || !(0 ==
asType<integer>(div1.quot))
```

```
\operatorname{div2} == \operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_1032,1},
\mathbf{static\_cast} {<} \mathbf{int} {>} (\mathbf{operator^*(heapIs}\ \$heap_{funcstart\_1032,1},\ \mathbf{this}).p2),
\mathbf{static\_cast}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_1032,1}.\mathrm{a2}))
(asType<integer>(static_cast<int>(operator*(heapIs
heap_{funcstart\_1032.1}, this).p2) /
asType < integer > (static\_cast < int > (\$heap_{funcstart\_1032,1}.a2))) = =
asType<integer>(div2.quot)
(asType<integer>(static_cast<int>(operator*(heapIs
\theta_{funcstart\_1032,1},\, \mathbf{this}).p2)) %
asType<integer>(static_cast<int>($heap_{funcstart_1032.1}.a2))) ==
asType<integer>(div2.rem)
(\mathbf{asType}{<}\mathbf{integer}{>}(\mathbf{operator}^*(\mathbf{heapIs}\ \$\mathbf{heap}_{funcstart\_1032,1},\ \mathbf{this}).\mathbf{p2})<
asType < integer > (\$heap_{funcstart\_1032,1}.a2)) = >
(asType<integer>(div2.rem) == asType<integer>(operator*(heapIs
heap_{funcstart\_1032,1}, this).p2)
(asType < integer > (\$heap_{funcstart\_1032,1}.a2) \le
\mathbf{asType}{<}\mathbf{integer}{>}(\mathbf{operator*}(\mathbf{heapIs}\ \$\mathbf{heap}_{funcstart\_1032,1},\ \mathbf{this}).\mathtt{p2})) =>
!(0 == asType < integer > (div2.quot))
!(0 == asType < integer > (div2.rem)) || !(0 ==
asType<integer>(div2.quot))
div3 == div(\mathbf{heapIs} \$ heap_{funcstart\_1032,1},
\mathbf{static\_cast} {<} \mathbf{int} {>} (\mathbf{operator*}(\mathbf{heapIs}\ \$\mathbf{heap}_{funcstart\_1032,1},\ \mathbf{this}).\mathbf{p3}),
\mathbf{static\_cast}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_1032,1}.\mathrm{a3}))
(asType < integer > (static\_cast < int > (operator*(heapIs)))
heap_{funcstart\_1032,1}, this).p3) /
\mathbf{asType} < \mathbf{integer} > (\mathbf{static\_cast} < \mathbf{int} > (\$ \mathbf{heap}_{funcstart\_1032,1}.\mathbf{a3}))) = =
asType<integer>(div3.quot)
(asType<integer>(static_cast<int>(operator*(heapIs
\theta_{funcstart_{1032,1}}, this).p3)) \%
asType < integer > (static\_cast < int > (\$heap_{funcstart\_1032.1}.a3))) = =
asType<integer>(div3.rem)
(\mathbf{asType}{<}\mathbf{integer}{>}(\mathbf{operator}^*(\mathbf{heapIs}\ \$\mathbf{heap}_{funcstart\_1032,1},\ \mathbf{this}).\mathrm{p3}) <
asType < integer > (\$heap_{funcstart\_1032,1}.a3)) = >
(asType<integer>(div3.rem) == asType<integer>(operator*(heapIs
heap_{funcstart_1032.1}, this).p3)
(asType < integer > (\$heap_{funcstart\_1032,1}.a3) \le
\mathbf{asType}{<}\mathbf{integer}{>}(\mathbf{operator*}(\mathbf{heapIs}\ \$\mathbf{heap}_{funcstart\_1032,1},\ \mathbf{this}).\mathrm{p3})) =>
!(0 == asType < integer > (div3.quot))
!(0 == asType < integer > (div3.rem)) || !(0 ==
asType<integer>(div3.quot))
temp1 == (\$heap_{funcstart\_1032,1}.r1 * static\_cast < signed int > (div1.rem)) -
```

```
(\text{\$heap}_{funcstart\_1032.1}.\text{b1} * \text{static\_cast} < \text{signed int} > (\text{div1.quot}))
minof(signed\ int) \le temp1
temp1 \le maxof(signed int)
\theta_{1032,1:1051,8} == \theta_{1032
operator*(heapIs heap_{funcstart\_1032,1}, this)._replace(p1 \rightarrow
asType < P1Type > ((\$heap_{tuncstart\_1032,1}.M1 *
asType<int>(static_cast<integer>(static_cast<signed
int>(operator^*(heapIs $heap_{funcstart\_1032,1}, this).p1) < (int)0))) +
temp1)))
temp2 == (\$heap_{1032.1:1051.8}.r2 * static\_cast < signed int > (div2.rem)) -
(\text{sheap}_{1032,1:1051.8}.\text{b2} * \text{static\_cast} < \text{signed int} > (\text{div}2.\text{quot}))
minof(signed\ int) \le temp2
temp2 \le maxof(signed int)
\theta_{1032,1;1054,8} == \theta_{1032,1;1051,8}. replace(this.$r \to
operator*(heapIs \theta_{1032,1;1051,8}, this)._replace(p2 \rightarrow
asType<P2Type>(($heap<sub>1032,1:1051,8</sub>.M2 *
asType<int>(static_cast<integer>(static_cast<signed
int>(operator*(heapIs $heap_{1032,1;1051,8}, this).p2) < (int)0))) + temp2)))
temp3 == (\$heap_{1032,1:1054.8}.r3 * static\_cast < signed int > (div3.rem)) -
(\text{sheap}_{1032,1:1054.8}.\text{b3} * \text{static\_cast} < \text{signed int} > (\text{div}3.\text{quot}))
minof(signed\ int) \le temp3
temp3 \le maxof(signed int)
heap_{funcend\_1032,1} == heap_{1032,1;1054,8}._replace(this.$r \rightarrow
operator*(heapIs heap_{1032,1;1054,8}, this)._replace(p3 \rightarrow
asType<P3Type>(($heap<sub>1032,1:1054,8</sub>.M3 *
asType<int>(static_cast<integer>(static_cast<signed
int>(operator^*(heapIs $heap_{1032,1;1054,8}, this).p3) < (int)(0))) + temp3)))
raux1 == asType<double>(static_cast<real>(operator*(heapIs
heap_{funcend\_1032,1}, this).p1)
asType<double>(static_cast<real>($heap_{funcend\_1032.1}.M1))
raux2 == asType<double>(static_cast<real>(operator*(heapIs
heap_{funcend\_1032,1}, this).p2)
asType < double > (static\_cast < real > (\$heap_{funcend\_1032.1}.M2))
raux3 == asType<double>(static_cast<real>(operator*(heapIs
\theta_{1032,1}, \theta_{1032,1}, \theta_{1032,1}
asType < double > (static\_cast < real > (\$heap_{funcend\_1032,1}.M3))
asType<real>((double)0.0) < asType<real>(raux1)
asType<real>((double)0.0) < asType<real>(raux2)
```

```
asType<real>((double)0.0) < asType<real>(raux3)
Proof:
[Take given term]
[2.0] \operatorname{div1} == \operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_1032,1},
\mathbf{static\_cast} < \mathbf{int} > (\mathbf{operator}^*(\mathbf{heapIs} \ \$ \mathbf{heap}_{funcstart\_1032,1}, \ \mathbf{this}).\mathtt{p1}),
\mathbf{static\_cast}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_1032,1}.\mathrm{a1}))
→ [expand definition of operator '*' in class 'pointer' at built in declaration]
[2.1] \operatorname{div1} == \operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_1032,1},
\mathbf{static\_cast} < \mathbf{int} > (\mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs} \$ \mathbf{heap}_{funcstart\_1032,1}).\mathbf{p1}),
\mathbf{static\_cast}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_1032,1}.\mathrm{a1}))
\rightarrow [simplify]
[2.2]~{\rm div1} == {\rm div}(\mathbf{heapIs}~\$ \mathrm{heap}_{funcstart\_1032,1},~\mathbf{this}.\$ \mathrm{r.value}(\mathbf{heapIs}
\rho_{funcstart\_1032,1}.p1, static_cast<int>(\rho_{funcstart\_1032,1}.a1)
\rightarrow [const static or extern object]
[2.3] \operatorname{div1} == \operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_1032,1}, \mathbf{this}.\$ r. \mathbf{value}(\mathbf{heapIs}))
\theta_{uncstart=1032.1}.p1, static_cast<int>(\theta_{unit}.a1))
\rightarrow [expand definition of constant 'a1' at prang.cpp (30,26)]
[2.4] \text{ div1} == \text{div}(\text{heapIs } \text{heap}_{funcstart\_1032,1}, \text{this.}\text{\$r.value}(\text{heapIs})
\theta_{funcstart\_1032,1}.p1, \theta_{funcstart\_1032,1}.p1, \theta_{funcstart\_1032,1}.p1, \theta_{funcstart\_1032,1}.p1, \theta_{funcstart\_1032,1}.p1, \theta_{funcstart\_1032,1}.p1, \theta_{funcstart\_1032,1}.p2, \theta_{funcstart\_1032,1}.p2, \theta_{funcstart\_1032,1}.p2, \theta_{funcstart\_1032,1}.p2, \theta_{funcstart\_1032,1}.p2, \theta_{funcstart\_1032,1}.p3, \theta_{funcstart\_1032,1}.p4, \theta_{funcstart\_1032,1}.p4, \theta_{funcstart\_1032,1}.p4, \theta_{funcstart\_1032,1}.p4, \theta_{funcstart\_1032,1}.p5, \theta_{funcstart\_1032,1
\rightarrow [simplify]
[2.6] \operatorname{div1} == \operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_1032,1}, \mathbf{this.}\$ r.\mathbf{value}(\mathbf{heapIs})
heap_{funcstart_{-1032,1}}.p1, 177
[Assume known post-assertion, class invariant or type constraint for term 2.6]
[7.0] (0 < asType<integer>(this.$r.value(heapIs
$\text{heap}_{funcstart_1032.1}\text{).p1})\text{\&&} (asType<integer>(this.\frac{\text{sr.value}(heapIs)}{\text{heap}}\text{\text{sr.value}(heapIs)}
\theta_{funcstart\_1032,1}.p1 < asType<integer>(\theta_{funcstart\_1032,1}).p1) < asType<integer>(\theta_{funcstart\_1032,1}).p1)
M1))
\rightarrow [simplify]
[7.2] (0 < this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1) \&\&
(this.r.value(heapIs $heap_{funcstart\_1032,1}).p1 <
asType < integer > (\$heap.class WHPrang \in M1))
\rightarrow [const static or extern object]
[7.3] (0 < this.$r.value(heap
Is $heap_{funcstart\_1032,1}).p1) &&
(this.$r.value(heap
Is \rho_{funcstart\_1032,1}).p1 <
asType < integer > (\$heap_{init}.class WHPrang \in M1))
\rightarrow [expand definition of constant 'M1' at prang.cpp (28,26)]
[7.4] (0 < this.\$r.value(heapIs \$heap_{funcstart_1032,1}).p1) &&
```

```
(this.$r.value(heap
Is \rho_{funcstart\_1032,1}).p1 <
\mathbf{asType}{<}\mathbf{integer}{>}((\mathbf{int})30269))
\rightarrow [simplify]
[7.10] (-30269 < -this.$r.value(heap
Is \rho_{funcstart\_1032,1}).p1) <math display="inline">\land (0 <
this.r.value(heapIs $heap_{funcstart\_1032,1}).p1)
[Work on sub-term 2 of conjunction in term 7.10]
[8.0] 0 < this.$r.value(heapIs \theta_{funcstart\_1032,1}).p1
[Take given term]
[18.0] div2 == div(heapIs $heap_{funcstart\_1032,1},
static_cast<int>(operator*(heapIs $heap_{funcstart\_1032,1}, this).p2),
static\_cast < int > (\$heap_{funcstart\_1032,1}.a2))
→ [expand definition of operator '*' in class 'pointer' at built in declaration]
[18.1] \operatorname{div2} == \operatorname{div}(\mathbf{heapIs} \ \operatorname{\$heap}_{funcstart\_1032,1},
\mathbf{static\_cast} < \mathbf{int} > (\mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}~\$ \mathbf{heap}_{funcstart\_1032,1}).\mathbf{p2}),
static\_cast < int > (\$heap_{funcstart\_1032.1}.a2))
\rightarrow [simplify]
[18.2] \operatorname{div2} == \operatorname{div}(\mathbf{heapIs} \ \text{$heap}_{funcstart\_1032,1}, \ \mathbf{this}. \text{$r.value}(\mathbf{heapIs})
\theta_{funcstart\_1032,1}.p2, \theta_{funcstart\_1032,1}.a2))
\rightarrow [const static or extern object]
[18.3] div2 == div(\mathbf{heapIs} \ \hat{\mathbf{s}}_{heap}), \mathbf{this.} \cdot \mathbf{r.value}(\mathbf{heapIs})
\theta_{funcstart\_1032,1}.p2, \theta_{funcstart\_1032,1
\rightarrow [expand definition of constant 'a2' at prang.cpp (35,26)]
[18.4] \text{ div2} == \text{div(heapIs $heap}_{funcstart\_1032,1}, \text{ this.} \text{\$r.value(heapIs)}
\theta_{funcstart\_1032,1}.p2, \theta_{funcstart} = \theta_{funcstart}.p2, \theta_{funcstart} = \theta_{funcstart}.p3, \theta_{funcstart} = \theta_{funcstart}.p4, \theta_{funcstart} = \theta_{funcstart}.p4, \theta_{funcstart} = \theta_{funcstart}.p5, \theta_{funcstart} = \theta_{funcstart}.p7, \theta
\rightarrow [simplify]
[18.6] div2 == div(heapIs $heap<sub>funcstart_1032,1</sub>, this.$r.value(heapIs)
heap_{funcstart\_1032,1}.p2, 176)
[Assume known post-assertion, class invariant or type constraint for term 18.6]
[23.0] (0 < asType<integer>(this.$r.value(heapIs
\verb§heap$_{funcstart\_1032,1}).p2)) \&\& (\mathbf{asType} < \mathbf{integer} > (\mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}))) \&\& (\mathbf{asType} < \mathbf{integer} > (\mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})))) \&\& (\mathbf{asType} < \mathbf{integer} > (\mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})))) \&\& (\mathbf{asType} < \mathbf{integer} > (\mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})))) \&\& (\mathbf{asType} < \mathbf{integer} > (\mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})))))
\text{Sheap}_{funcstart=1032,1}).p2) < asType<integer>(\text{Sheap.class WHPrang} \in
M2))
\rightarrow [simplify]
[23.2] (0 < this.$r.value(heap
Is $heap_{funcstart\_1032,1}).p2) &&
(this.$r.value(heapIs heap_{funcstart\_1032,1}).p2 <
asType < integer > (\text{$heap.class WHPrang} \in M2))
\rightarrow [const static or extern object]
```

```
[23.3] (0 < this.$r.value(heap
Is \rho_{uncstart\_1032,1}).p2) &&
(this.$r.value(heapIs \theta_{funcstart\_1032,1}).p2 <
asType < integer > (\$heap_{init}.class WHPrang \in M2))
\rightarrow [expand definition of constant 'M2' at prang.cpp (33,26)]
[23.4] (0 < this.$r.value(heapIs \rho_{funcstart\_1032,1}).p2) &&
(this.r.value(heapIs $heap_{funcstart\_1032,1}).p2 <
asType < integer > ((int)30307))
\rightarrow [simplify]
[23.10] (-30307 < -this.$r.value(heapIs \rho_{funcstart\_1032,1}).p2) \wedge (0 <
\textbf{this.\$r.value}(\textbf{heapIs}~\$\text{heap}_{funcstart\_1032,1}).\text{p2})
[Work on sub-term 2 of conjunction in term 23.10]
[24.0] 0 < this.$r.value(heapIs $heap_{tuncstart\_1032.1}).p2
[Take given term]
[34.0] div3 == div(heapIs heap_{funcstart\_1032,1},
static_cast<int>(operator*(heapIs $heap_{tuncstart\_1032.1}, this).p3),
\mathbf{static\_cast} < \mathbf{int} > (\$ \mathbf{heap}_{funcstart\_1032,1}.\mathbf{a3}))
→ [expand definition of operator '*' in class 'pointer' at built in declaration]
[34.1] \operatorname{div3} == \operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_1032,1},
static_cast<int>(this.$r.value(heapIs $heap_{funcstart\_1032,1}).p3),
static\_cast < int > (\$heap_{funcstart\_1032,1}.a3))
\rightarrow [simplify]
[34.2] div3 == div(heapIs $heap_{funcstart\_1032,1}, this.$r.value(heapIs)
\rho_{tuncstart_{1032,1}}, p3, static_cast<int>(\rho_{tuncstart_{1032,1}})
\rightarrow [const static or extern object]
[34.3] div3 == div(heapIs heapIs heapIs this.r.value(heapIs
\theta_{tuncstart\_1032,1}.p3, \theta_{tuncstart\_1032,1}.p4, \theta_{tuncstart\_1032,1}.p4, \theta_{tuncstart\_1032,1}.p4, \theta_{tuncstart\_1032,1}.p4, \theta_{tuncstart\_1032,1}.p5, \theta_{tuncstart\_1032,1}.p5, \theta_{tuncstart\_1032,1}.p5, \theta_{tuncstart\_1032,1
\rightarrow [expand definition of constant 'a3' at prang.cpp (40,26)]
[34.4] \text{ div3} == \text{div(heapIs $heap}_{funcstart\_1032,1}, \text{ this.} \text{$r.value(heapIs)}
heap_{funcstart\_1032,1}.p3, static\_cast < int > ((int)178)
\rightarrow [simplify]
[34.6] div3 == div(heapIs $heap<sub>funcstart_1032,1</sub>, this.$r.value(heapIs)
heap_{funcstart\_1032,1}.p3, 178)
[Assume known post-assertion, class invariant or type constraint for term 34.6]
[39.0] (0 < asType<integer>(this.$r.value(heapIs
\theta_{funcstart\_1032,1}.p3) && (asType<integer>(this.$r.value(heapIs)
\label{eq:class} \$ heap_{funcstart\_1032,1}).p3) < \mathbf{asType} < \mathbf{integer} > (\$ heap.\mathbf{class} \ WHPrang \in \texttt{Constart} = \texttt{Consta
M3))
```

```
\rightarrow [simplify]
[39.2] (0 < this.$r.value(heap
Is $heap_{funcstart\_1032,1}).p3) &&
(this.r.value(heapIs $heap_{funcstart\_1032,1}).p3 <
asType < integer > (\text{$heap.class WHPrang} \in M3))
\rightarrow [const static or extern object]
[39.3] (0 < this.$r.value(heap
Is $heap_{funcstart\_1032,1}).p3) &&
(this.r.value(heapIs $heap_{funcstart\_1032,1}).p3 <
asType < integer > (\$heap_{init}.class WHPrang \in M3))
→ [expand definition of constant 'M3' at prang.cpp (38,26)]
[39.4] (0 < this.$r.value(heap
Is \rho_{uncstart\_1032,1}).p3) &&
(this.$r.value(heapIs heap_{funcstart\_1032,1}).p3 <
asType < integer > ((int)30323))
\rightarrow [simplify]
[39.10] (-30323 < -this.$r.value(heapIs $heap_{funcstart\_1032.1}).p3) \land (0 <
this.r.value(heapIs $heap_{funcstart\_1032,1}).p3)
[Work on sub-term 2 of conjunction in term 39.10]
[40.0] 0 < this.$r.value(heapIs $heap_{funcstart\_1032.1}).p3
[Take given term]
[50.0] \; ((\$ heap_{funcstart\_1032,1}.r1 \; * \; \textbf{static\_cast} < \textbf{signed int} > (\text{div1.rem})) \; - \; \text{div1.rem})) \; - \; \text{div1.rem}) \; + \; \text{div
($heap_tuncstart_1032.1.b1 * static_cast<signed int>(div1.quot))) == temp1
\rightarrow [const static or extern object]
[50.1] (($heap<sub>init</sub>.rl * static_cast<signed int>(div1.rem)) -
($heap_tuncstart_1032.1.b1 * static_cast<signed int>(div1.quot))) == temp1
\rightarrow [expand definition of constant 'r1' at prang.cpp (29,26)]
[50.2] (((int)171 * static_cast<signed int>(div1.rem)) -
(\$heap_{funcstart\_1032,1}.b1 * \textbf{static\_cast} < \textbf{signed int} > (\text{div1.quot}))) == \text{temp1}
\rightarrow [simplify]
[50.3] ((171 * static_cast<signed int>(div1.rem)) - ($heap_{funcstart\_1032,1}.b1]
* static_cast<signed int>(div1.quot))) == temp1
\rightarrow [from term 2.6, div1 is equal to div(heapIs $heap_{funcstart\_1032,1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177)]
[50.4] ((171 * static_cast < signed int > (div(heapIs heapIs funcstart_{1032,1}),
this.r.value(heapIs \ heap_{funcstart\_1032.1}).p1, 177).rem)) -
(\$heap_{funcstart\_1032,1}.b1 * \textbf{static\_cast} < \textbf{signed int} > (div1.quot))) == temp1
\rightarrow [simplify]
[50.5] ((171 * div(heapIs \$heap_{funcstart\_1032,1}, this.\$r.value(heapIs
\text{Sheap}_{funcstart\_1032,1}.p1, 177).rem) - (\text{Sheap}_{funcstart\_1032,1}.b1 *
```

```
static_cast<signed int>(div1.quot))) == temp1
\rightarrow [const static or extern object]
[50.6] ((171 * \operatorname{div}(\mathbf{heapIs} \ \mathbf{sheap}_{funcstart\_1032,1}, \ \mathbf{this}.\mathbf{sr.value}(\mathbf{heapIs})
\theta_{funcstart\_1032,1}.p1, 177).rem) - (\theta_{funcstart\_1032,1}.rem) - (\theta_{funcstart\_1032,1}).p1, 177).rem)
int>(div1.quot)) == temp1
\rightarrow [expand definition of constant 'b1' at prang.cpp (31,26)]
[50.7] ((171 * div(heapIs $heap<sub>funcstart_1032,1</sub>, this.$r.value(heapIs)
\theta_{funcstart\_1032,1}.p1, 177).rem - ((int)2 * static\_cast < signed)
int>(div1.quot)) = temp1
\rightarrow [simplify]
[50.8] ((171 * div(heapIs $heap_{funcstart\_1032,1}, this.$r.value(heapIs 
\theta_{funcstart\_1032.1}.p1, 177).rem) - (2 * static_cast<signed)
int>(div1.quot)) == temp1
\rightarrow [from term 2.6, div1 is equal to div(heapIs $heap_{funcstart\_1032,1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177)]
[50.9] ((171 * \operatorname{div}(\mathbf{heapIs} \ \mathbf{sheap}_{funcstart\_1032,1}, \ \mathbf{this}.\mathbf{sr.value}(\mathbf{heapIs})
\theta_{funcstart\_1032,1}.p1, 177).rem - (2 * static\_cast < signed)
int>(div(heapIs \$heap_{funcstart\_1032,1}, this.\$r.value(heapIs
\text{Sheap}_{funcstart\_1032,1}).p1, 177).quot))) == temp1
\rightarrow [simplify]
[50.14] 0 == (-\text{temp1} + (-2 * \text{div}(\text{heapIs } \text{$heap}_{funcstart\_1032,1},
this.r.value(heapIs \ensuremath{\$}heap_{funcstart\_1032,1}).p1, 177).quot) + (171 *
div(\mathbf{heapIs} \$ heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
heap_{funcstart_{1032.1}}.p1, 177).rem
[Take given term]
[53.0] heap_{1032,1;1051,8} == heap_{funcstart\_1032,1}._replace(this.$r \rightarrow
operator*(heapIs heap_{funcstart\_1032,1}, this)._replace(p1 \rightarrow
asType < P1Type > ((\$heap_{funcstart\_1032,1}.M1 *
asType<int>(static_cast<integer>(static_cast<signed
int>(operator^*(heapIs \$heap_{tuncstart\_1032.1}, this).p1) < (int)0))) +
→ [expand definition of operator '*' in class 'pointer' at built in declaration]
[53.1] \theta_{1032,1;1051,8} == \theta_{funcstart\_1032,1}._replace(this.$r \to
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow
asType<P1Type>(($heap<sub>funcstart_1032.1</sub>.M1 *
asType<int>(static_cast<integer>(static_cast<signed
int>(operator^*(heapIs \$heap_{funcstart\_1032,1}, this).p1) < (int)0))) +
temp1)))
\rightarrow [const static or extern object]
```

```
[53.2] \theta_{1032,1;1051,8} == \theta_{funcstart_{-1032,1}}.replace(this.$r \to
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow
asType<P1Type>(($heap<sub>init</sub>.M1 *
asType<int>(static_cast<integer>(static_cast<signed
int>(operator^*(heapIs \$heap_{funcstart\_1032,1}, this).p1) < (int)0))) +
temp1)))
\rightarrow [expand definition of constant 'M1' at prang.cpp (28,26)]
[53.3] $heap<sub>1032,1;1051,8</sub> == $heap<sub>funcstart_1032,1</sub>._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow
asType<P1Type>(((int)30269 *
asType<int>(static_cast<integer>(static_cast<signed
\mathbf{int} > (\mathbf{operator}^*(\mathbf{heapIs} \ \$ \mathbf{heap}_{funcstart\_1032,1}, \ \mathbf{this}).\mathtt{p1}) < (\mathbf{int})0))) \ +
temp1)))
\rightarrow [simplify]
[53.4] heap_{1032,1;1051,8} == heap_{funcstart\_1032,1}._replace(this.r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow
asType<P1Type>((30269 *
asType{<}int{>}(static\_cast{<}integer{>}(static\_cast{<}signed
int>(operator^*(heapIs $heap_{funcstart\_1032,1}, this).p1) < (int)0))) +
temp1)))
→ [expand definition of operator '*' in class 'pointer' at built in declaration]
[53.5] heap_{1032,1;1051,8} == heap_{funcstart\_1032,1}._replace(this.$r \rightarrow
\mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}~\$heap_{funcstart\_1032,1}).\_\mathbf{replace}(p1 \rightarrow
asType<P1Type>((30269 *
asType<int>(static_cast<integer>(static_cast<signed
int>(this.\$r.value(heapIs \$heap_{funcstart\_1032,1}).p1) < (int)0))) + temp1)))
\rightarrow [simplify]
[53.9] heap_{1032,1;1051,8} == heap_{funcstart\_1032,1}._replace(this.r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow
asType<P1Type>((30269 * asType<int>(static_cast<integer>(0 <
-\mathbf{this.}\$r.\mathbf{value}(\mathbf{heapIs}\ \$\mathrm{heap}_{funcstart\_1032,1}).\mathrm{p1}))) + \mathrm{temp1})))
\rightarrow [from term 8.0, literala < -this.$r.value(heapIs $heap_{funcstart\_1032.1}).p1
is false whenever -2 < (0 + literala)
    Proof of rule precondition:
    [53.9.0] - 2 < (0 + 0)
    \rightarrow [simplify]
    [53.9.2] true
[53.10] $\text{heap}_{1032,1;1051,8} == $\text{heap}_{funcstart\_1032,1}._\text{replace}(\text{this}.\text{$\frac{1}{2}r$})
this.$r.value(heapIs $heap_{tuncstart\_1032,1}).$replace(p1 $\rightarrow$ asType<P1Type>((30269 * asType<int>(static_cast<integer>(false)))
```

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+ \text{temp1})))
\rightarrow [simplify]
[53.11] heap_{1032,1:1051,8} == heap_{funcstart\_1032,1}._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow
asType < P1Type > ((30269 * asType < int > (([false]: 1, []: 0))) + temp1)))
→ [explicitly assert falsehood of skipped guards in subsequent guards]
[53.12] $heap<sub>1032,1;1051,8</sub> == $heap<sub>funcstart_1032,1</sub>._replace(this.$r \rightarrow
this.$r.value(heapIs \rho_{funcstart\_1032,1})._replace(p1 \rightarrow
temp1)))
\rightarrow [simplify]
[53.15] $heap<sub>1032,1;1051,8</sub> == $heap<sub>funcstart_1032,1</sub>._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow
asType < P1Type > (0 + temp1))
\rightarrow [from term 50.14, temp1 is equal to (-2 * div(heapIs $heap_{funcstart\_1032,1},
this.$r.value(heapIs $heap_{tuncstart\_1032,1}).p1, 177).quot) + (171 *
div(\mathbf{heapIs}\ \$heap_{funcstart\_1032,1},\ \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}
heap_{funcstart_{-1032,1}}.p1, 177).rem
[53.16] heap_{1032,1;1051,8} == heap_{funcstart\_1032,1}.\_replace(this.$r \rightarrow funcstart\_1032,1]
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow
asType < P1Type > (0 + ((-2 * div(heapIs $heap_{tuncstart\_1032.1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177).quot) + (171 *
div(heapIs $heap<sub>funcstart_1032,1</sub>, this.$r.value(heapIs
heap_{funcstart_1032,1}.p1, 177.rem))))
\rightarrow [simplify]
[53.19] $\text{heap}_{1032,1;1051,8} == $\text{heap}_{funcstart\_1032,1}._\text{replace}(\text{this.}\text{$\frac{1}{2}}\text{$\text{op}}]$
\textbf{this.}\$r.\textbf{value}(\textbf{heapIs}~\$heap_{funcstart\_1032,1}).\_\textbf{replace}(p1 \rightarrow ((\text{-}2~*\text{div}(\textbf{heapIs}
\rho_{tuncstart=1032.1}, this.r.value(heapIs \rho_{tuncstart=1032.1}).p1,
177).quot) + (171 * div(heapIs \rho_{funcstart\_1032,1}, this.r.value(heapIs)
heap_{funcstart\_1032,1}.p1, 177.rem)))
[Take given term]
[54.0] \; ((\$heap_{1032,1;1051,8}.r2 * \mathbf{static\_cast} < \mathbf{signed int} > (div2.rem)) \; - \\
(\text{sheap}_{1032.1:1051.8}.\text{b2} * \text{static\_cast} < \text{signed int} > (\text{div2.quot}))) == \text{temp2}
\rightarrow [from term 53.19, $heap<sub>1032,1;1051,8</sub> is equal to
$heap_{funcstart\_1032,1}.$_replace(this.$r \rightarrow this.$r.value(heapIs)
heap_{funcstart\_1032,1}._replace(p1 \rightarrow (-2 * div(heapIs heap_{funcstart\_1032,1}),
div(\mathbf{heapIs} \ \$heap_{funcstart\_1032,1}, \ \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}
heap_{funcstart\_1032,1}.p1, 177.rem)))
[54.1] \; ((\$ heap_{funcstart\_1032,1}.\_\mathbf{replace}(\mathbf{this}.\$r \to \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}))) \\
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\text{Sheap}_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs \text{Sheap}_{funcstart\_1032,1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177).quot) + (171)
div(\mathbf{heapIs} \$ heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
\rho_{funcstart\_1032,1}.p1, 177).rem))).r2 * static_cast < signed
int>(div2.rem)) - (\$heap_{1032,1;1051,8}.b2 * static\_cast < signed
int > (div2.quot))) == temp2
\rightarrow [const member of object with modified fields]
[54.2]\;((\$heap_{funcstart\_1032,1}.r2\;*\;\textbf{static\_cast}{<}\textbf{signed int}{>}(\text{div}2.\text{rem}))\;-
(\text{\$heap}_{1032,1;1051,8}.\text{b2} * \textbf{static\_cast} < \textbf{signed int} > (\text{div2.quot}))) = \text{temp2}
\rightarrow [const static or extern object]
[54.3] (($heap<sub>init</sub>.r2 * static_cast<signed int>(div2.rem)) -
(\text{sheap}_{1032,1;1051,8}.\text{b2} * \text{static\_cast} < \text{signed int} > (\text{div2.quot}))) == \text{temp2}
\rightarrow [expand definition of constant 'r2' at prang.cpp (34,26)]
[54.4] (((int)172 * static_cast<signed int>(div2.rem)) -
(\$heap_{1032,1;1051,8}.b2 * \textbf{static\_cast} < \textbf{signed int} > (\texttt{div2}.\texttt{quot}))) == temp2
\rightarrow [simplify]
[54.5] ((172 * static_cast<signed int>(div2.rem)) - ($heap_{1032.1:1051.8}.b2 *
static_cast<signed int>(div2.quot))) == temp2
\rightarrow [from term 18.6, div2 is equal to div(heapIs $heap_{funcstart\_1032,1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p2, 176)
[54.6] ((172 * static_cast<signed int>(div(heapIs $heap_{funcstart\_1032,1},
this.r.value(heapIs $heap_{funcstart\_1032,1}).p2, 176).rem)) -
(\text{sheap}_{1032.1:1051.8}.\text{b2} * \text{static\_cast} < \text{signed int} > (\text{div2.quot}))) == \text{temp2}
\rightarrow [simplify]
[54.7] ((172 * div(heapIs $heap<sub>funcstart_1032,1</sub>, this.$r.value(heapIs)
\text{Sheap}_{tuncstart\_1032.1}.p2, 176).rem) - (\text{Sheap}_{1032.1:1051.8}.b2 *
static_cast<signed int>(div2.quot))) == temp2
\rightarrow [from term 53.19, $heap<sub>1032,1;1051,8</sub> is equal to
$heap_{funcstart\_1032,1}.$_replace(this.$r \rightarrow this.$r.value(heapIs)
heap_{funcstart\_1032,1}._replace(p1 \rightarrow (-2 * div(heapIs p_{funcstart\_1032,1})
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177).quot) + (171 *
div(\mathbf{heapIs} \ \$heap_{funcstart\_1032,1}, \ \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
heap_{funcstart\_1032,1}.p1, 177).rem)))]
[54.8] ((172 * div(heap
Is \rho_{funcstart\_1032,1}, this.\r.value(heap
Is
\rho_{tuncstart\_1032.1}.p2, 176).rem – (\rho_{tuncstart\_1032.1}.replace)

ightarrow this.$r.value(heapIs $heap_{funcstart\_1032,1})._replace(p1 
ightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_1032,1}, \ \mathbf{this}.\$ r. \mathbf{value}(\mathbf{heapIs}
\rho_{funcstart_{1032,1}}.p1, 177).quot + (171 * div(heapIs $heap_{funcstart_{1032,1}})
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177).rem)))).b2 *
static_cast<signed int>(div2.quot))) == temp2
```

```
\rightarrow [const member of object with modified fields]
[54.9] ((172 * div(heapIs $heap<sub>funcstart_1032,1</sub>, this.$r.value(heapIs
\text{Sheap}_{funcstart\_1032,1}.p2, 176).rem) - (\text{Sheap}_{funcstart\_1032,1}.b2 *
static_cast<signed int>(div2.quot))) == temp2
\rightarrow [const static or extern object]
[54.10] ((172 * div(heapIs $heap_{funcstart\_1032,1}, this.$r.value(heapIs
\rho_{tuncstart\_1032,1}.p2, 176).rem – (\rho_{tuncstart\_1032,1}.p2, 176).rem
int>(div2.quot)) == temp2
\rightarrow [expand definition of constant 'b2' at prang.cpp (36,26)]
[54.11] ((172 * div(heapIs heap_{funcstart\_1032,1}, this.r.value(heapIs)
\theta_{nucstart\_1032,1}.p2, 176).rem - ((int)35 * static_cast < signed
int>(div2.quot))) == temp2
\rightarrow [simplify]
[54.12] ((172 * div(heapIs $heap<sub>funcstart_1032,1</sub>, this.$r.value(heapIs)
\theta_{funcstart\_1032,1}.p2, 176).rem) - (35 * static_cast<signed)
int>(div2.quot)) == temp2
\rightarrow [from term 18.6, div2 is equal to div(heapIs $heap_{funcstart\_1032,1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p2, 176)]
[54.13] ((172 * div(heapIs $heap<sub>funcstart_1032,1</sub>, this.$r.value(heapIs)
\theta_{funcstart\_1032,1}.p2, 176).rem) - (35 * static_cast<signed)
int>(div(heapIs \$heap_{funcstart\_1032,1}, this.\$r.value(heapIs
\$ \mathrm{heap}_{funcstart\_1032,1}).\mathrm{p2},\, 176).\mathrm{quot}))) == \, \mathrm{temp2}
\rightarrow [simplify]
[54.18] 0 == (-\text{temp2} + (-35 * \text{div}(\text{heapIs} \$\text{heap}_{funcstart\_1032,1})]
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p2, 176).quot) + (172 *
div(\mathbf{heapIs} \$ heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
heap_{funcstart_{1032,1}}.p2, 176).rem
[Take given term]
[57.0] $\text{heap}_{1032,1;1054,8} == $\text{heap}_{1032,1;1051,8}._\text{replace}(\text{this}.$\text{$r} \to \text{
operator*(heapIs heap_{1032,1;1051,8}, this)._replace(p2 \rightarrow
asType<P2Type>(($heap<sub>1032,1;1051.8</sub>.M2 *
asType<int>(static_cast<integer>(static_cast<signed
int>(operator^*(heapIs $heap_{1032,1;1051,8}, this).p2) < (int)(0))) + temp(2)))
\rightarrow [from term 53.19, $heap<sub>1032,1;1051,8</sub> is equal to
heap_{funcstart\_1032.1}._replace(this.r \rightarrow this.r.value(heapIs)
heap_{funcstart\_1032,1}._replace(p1 \rightarrow (-2 * div(heapIs p_{funcstart\_1032,1}).
this.$r.value(heapIs heap_{funcstart\_1032,1}).p1, 177).quot) + (171 *
div(\mathbf{heapIs} \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
heap_{funcstart_{-1032.1}}.p1, 177).rem)))
```

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[57.2] heap_{1032,1;1054,8} == heap_{funcstart\_1032,1}._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.} \text{\$r.value}(\text{heapIs}))
\rho_{funcstart\_1032,1}.p1, 177).rem)))._replace(this.$r \rightarrow operator*(heapIs)
\rho_{funcstart\_1032,1}._replace(this.r \to this.r.value(heapIs)
heap_{funcstart\_1032,1}._replace(p1 \rightarrow (-2 * div(heapIs p_{funcstart\_1032,1}).
this.$r.value(heapIs heap_{funcstart_{-1032,1}}).p1, 177).quot) + (171 *
div(\mathbf{heapIs} \$ heap_{funcstart\_1032.1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
\theta_{tuncstart_{1032,1}}.p1, 177).rem)), this).replace(p2 \rightarrow
\mathbf{asType}{<} \text{P2Type}{>} ((\$\text{heap}_{1032,1;1051,8}.\text{M2} *
asType<int>(static_cast<integer>(static_cast<signed
int>(operator^*(heapIs $heap_{1032,1;1051,8}, this).p2) < (int)0))) + temp2)))
→ [expand definition of operator '*' in class 'pointer' at built in declaration]
[57.3] heap_{1032,1;1054,8} == heap_{funcstart\_1032,1}._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032.1}, \text{this.} \text{\$r.value}(\text{heapIs}))
\theta_{funcstart\_1032,1}.p1, 177).rem))))._replace(this.$r \rightarrow
this.$r.value(heap
Is $heap_{funcstart\_1032,1}._replace(this.$r \rightarrow
this.$r.value(heapIs \rho_{tuncstart\_1032.1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{tuncstart\_1032.1}, this.r.value(heapIs \rho_{tuncstart\_1032.1}).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.} \text{\$r.value}(\text{heapIs}))
\theta_{funcstart\_1032,1}.p1, 177).rem))))).\_replace(p2 \rightarrow
asType<P2Type>(($heap<sub>1032.1:1051.8</sub>.M2 *
asType<int>(static_cast<integer>(static_cast<signed
int>(operator^*(heapIs $heap_{1032,1;1051,8}, this).p2) < (int)(0))) + temp(2)))
→ [evaluate dereferenced pointer into modified heap]
[57.4] heap_{1032,1;1054,8} == heap_{funcstart\_1032,1}._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\theta_{funcstart\_1032,1}, this.\r.value(heapIs \theta_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs \rho_{funcstart\_1032,1}, this.r.value(heapIs)
\rho_{funcstart\_1032.1}.p1, 177).rem)))._replace(this.$r \rightarrow ([this.$r ==
this.$r]: this.$r.value(heapIs \rho_{tuncstart\_1032,1})._replace(p1 \rightarrow (-2 *
div(\mathbf{heapIs} \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
\text{Sheap}_{funcstart\_1032,1}.p1, 177).quot) + (171 * div(heapIs \text{Sheap}_{funcstart\_1032,1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177).rem)), []:
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p2 \rightarrow
asType<P2Type>(($heap<sub>1032,1:1051,8</sub>.M2 *
asType < int > (static\_cast < integer > (static\_cast < signed
int>(operator^*(heapIs $heap_{1032.1:1051.8}, this).p2) < (int)(0))) + temp(2)))
→ [explicitly assert falsehood of skipped guards in subsequent guards]
[57.5] $heap<sub>1032,1:1054,8</sub> == $heap<sub>funcstart_1032,1</sub>._replace(this.$r \rightarrow
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this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.}\text{\$r.value}(\text{heapIs}))
\rho_{funcstart\_1032,1}.p1, 177).rem)))._replace(this.$r \rightarrow ([this.$r ==
this.$r]: this.$r.value(heapIs \rho_{tuncstart\_1032,1})._replace(p1 \rightarrow (-2 *
div(\mathbf{heapIs} \$ heap_{funcstart\_1032.1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
\text{Sheap}_{funcstart\_1032.1}.p1, 177).quot) + (171 * div(heapIs \text{Sheap}_{funcstart\_1032.1},
this.r.value(heapIs \heap_{funcstart\_1032.1}).p1, 177).rem)), [!(this.<math>r = 
this.$r)]: this.$r.value(heapIs \rho_{funcstart\_1032,1})._replace(p2 \rightarrow
asType<P2Type>(($heap<sub>1032,1;1051,8</sub>.M2 *
asType < int > (static\_cast < integer > (static\_cast < signed
int>(operator^*(heapIs \$heap_{1032,1:1051.8}, this).p2) < (int)0))) + temp2)))
\rightarrow [simplify]
[57.7] heap_{1032,1;1054,8} == heap_{funcstart\_1032,1}._replace(this.r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart_1032,1}, this.r.value(heapIs \rho_{funcstart_1032,1}).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.} \text{\$r.value}(\text{heapIs}))
\theta_{funcstart\_1032,1}.p1, 177).rem))))._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this. r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs $heap<sub>funcstart_1032.1</sub>, this.$r.value(heapIs
\theta_{funcstart\_1032.1}.p1, 177).rem)))._replace(p2 \rightarrow
asType<P2Type>(($heap<sub>1032.1:1051.8</sub>.M2 *
asType < int > (static\_cast < integer > (static\_cast < signed
int>(operator^*(heapIs \$heap_{1032,1;1051,8}, this).p2) < (int)(0))) + temp(2)))
\rightarrow [from term 53.19, $heap<sub>1032.1:1051.8</sub> is equal to
\$heap_{funcstart\_1032,1}.\_\textbf{replace}(\textbf{this}.\$r \rightarrow \textbf{this}.\$r.\textbf{value}(\textbf{heapIs}
heap_{funcstart\_1032,1}._replace(p1 \rightarrow (-2 * div(heapIs $heap_{funcstart\_1032,1}).
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177).quot) + (171)
div(heapIs $heap_{funcstart_1032.1}, this.$r.value(heapIs
heap_{funcstart\_1032,1}.p1, 177).rem)))]
[57.8] heap_{1032,1;1054,8} == heap_{funcstart\_1032,1}._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.} \text{\$r.value}(\text{heapIs}))
\theta_{funcstart\_1032,1}.p1, 177).rem)))).\_replace(this.\$r \rightarrow 0
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.}\text{\$r.value}(\text{heapIs}))
\theta_{funcstart\_1032,1}.p1, 177).rem))).\_replace(p2 \rightarrow
asType < P2Type > ((\$heap_{tuncstart\_1032.1}.\_replace(this.\$r \rightarrow
this.$r.value(heapIs \rho_{tuncstart\_1032.1})._replace(p1 \rightarrow ((-2 * div(heapIs
$\text{heap}_{funcstart_1032.1}$, this.$\text{r.value}(\text{heapIs} \text{$heap}_{funcstart_1032.1}).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.} \text{\$r.value}(\text{heapIs}))
```

```
\theta_{funcstart_{-1032,1}}.p1, 177).rem)))).M2 *
asType<int>(static_cast<integer>(static_cast<signed
int>(operator^*(heapIs $heap_{1032,1;1051,8}, this).p2) < (int)(0))) + temp(2)))
→ [const member of object with modified fields]
[57.9] heap_{1032,1;1054,8} == heap_{funcstart\_1032,1}._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032.1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{heap}_{funcstart\_1032,1}, \text{this.}\text{$r.value}(\text{heapIs}))
\theta_{funcstart\_1032,1}.p1, 177).rem))))._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\ 1032.1}).replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs \theta_{funcstart\_1032,1}, this.r.value(heapIs)
\theta_{funcstart\_1032,1}.p1, 177).rem))._replace(p2 \rightarrow
asType < P2Type > ((\$heap_{funcstart\_1032,1}.M2)^*
asType<int>(static_cast<integer>(static_cast<signed
int > (operator^*(heapIs \$heap_{1032,1;1051,8}, this).p2) < (int)0))) + temp2)))
\rightarrow [const static or extern object]
[57.10] $heap<sub>1032,1;1054,8</sub> == $heap<sub>funcstart_1032,1</sub>._replace(this.$r \rightarrow
this.$r.value(heapIs \rho_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.}\text{\$r.value}(\text{heapIs}))
\theta_{funcstart\_1032,1}.p1, 177).rem))))._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032.1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this. r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.} \text{\$r.value}(\text{heapIs}))
\theta_{funcstart\_1032,1}.p1, 177).rem))).\_replace(p2 \rightarrow
asType < P2Type > ((\$heap_{init}.M2 *
asType<int>(static_cast<integer>(static_cast<signed
int>(operator^*(heapIs $heap_{1032,1;1051,8}, this).p2) < (int)0))) + temp2)))
\rightarrow [expand definition of constant 'M2' at prang.cpp (33,26)]
[57.11] $heap<sub>1032,1;1054,8</sub> == $heap<sub>funcstart_1032,1</sub>._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
\label{eq:continuous_function} $ \text{heap}_{funcstart\_1032,1} . \text{p1}, 177).rem)))).\_\textbf{replace}(\textbf{this}.\$r \rightarrow
this.$r.value(heapIs heapIs_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs \rho_{funcstart\_1032,1}, this.r.value(heapIs)
\theta_{funcstart\_1032,1}.p1, 177).rem))).\_replace(p2 \rightarrow
asType < P2Type > (((int)30307 *
asType<int>(static_cast<integer>(static_cast<signed
int>(operator^*(heapIs $heap_{1032,1;1051,8}, this).p2) < (int)(0))) + temp(2)))
\rightarrow [simplify]
```

```
[57.12] $\text{heap}_{1032,1;1054,8} == $\text{heap}_{funcstart\_1032,1}._\text{replace}(\text{this.}\text{$\frac{1}{2}}\)
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
\theta_{tuncstart\_1032,1}.p1, 177).rem)))).\_replace(this.\$r \rightarrow 0
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs $heap<sub>funcstart_1032.1</sub>, this.$r.value(heapIs
\theta_{funcstart\_1032,1}.p1, 177).rem))._replace(p2 \rightarrow
asType<P2Type>((30307 *
asType < int > (static\_cast < integer > (static\_cast < signed
int>(operator^*(heapIs \$heap_{1032,1;1051,8}, this).p2) < (int)(0))) + temp(2)))
\rightarrow [from term 53.19, $heap<sub>1032,1:1051,8</sub> is equal to
heap_{funcstart\_1032,1}._replace(this.r \rightarrow this.r.value(heapIs)
heap_{funcstart\_1032,1}._replace(p1 \rightarrow (-2 * div(heapIs $heap_{funcstart\_1032,1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, \ 177).quot) + (171)
div(\mathbf{heapIs} \ \$heap_{funcstart\_1032,1}, \ \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
heap_{funcstart\_1032,1}.p1, 177).rem)))
[57.13] $heap<sub>1032,1;1054,8</sub> == $heap<sub>funcstart_1032,1</sub>._replace(this.$r \rightarrow
\textbf{this.}\$r.\textbf{value}(\textbf{heapIs}~\$heap_{funcstart\_1032,1}).\_\textbf{replace}(p1 \rightarrow ((\text{-}2~*\text{div}(\textbf{heapIs}
$heap_tuncstart_1032.1, this.$r.value(heapIs $heap_tuncstart_1032.1).p1,
177).quot) + (171 * div(heapIs \theta_{funcstart\_1032,1}, this.r.value(heapIs)
\label{eq:continuous_function} $ \text{heap}_{funcstart\_1032,1}.\text{p1},\ 177).\text{rem})))).$ \_\textbf{replace}(\textbf{this}.\$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
(177).quot + (171 * div(heapIs $heap_{funcstart\_1032,1}, this.$r.value(heapIs)
\theta_{funcstart\_1032,1}.p1, 177).rem)))._replace(p2 \rightarrow
\mathbf{asType}{<}\mathrm{P2Type}{>}((30307~*
asType<int>(static_cast<integer>(static_cast<signed
int>(operator^*(heapIs \ heap_{funcstart\_1032,1}.\_replace(this.\$r \rightarrow
\textbf{this.\$r.value}(\textbf{heapIs}~\$ heap_{funcstart\_1032,1}).\_\textbf{replace}(p1 \rightarrow (-2~*div(\textbf{heapIs}
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs \theta_{funcstart\_1032,1}, this.r.value(heapIs)
\text{Sheap}_{funcstart\_1032,1}.\text{p1}, 177).\text{rem})), \text{this}.\text{p2}) < (\text{int})0)) + \text{temp2}))
→ [expand definition of operator '*' in class 'pointer' at built in declaration]
[57.14] $heap<sub>1032,1;1054,8</sub> == $heap<sub>funcstart_1032,1</sub>._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.}\text{\$r.value}(\text{heapIs}))
\theta_{funcstart\_1032,1}.p1, 177).rem)))).replace(this.r \rightarrow 0
this.$r.value(heapIs $heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
$\text{heap}_{funcstart_1032.1}$, this.$\text{r.value}(\text{heapIs} \text{$heap}_{funcstart_1032.1}).p1,
177).quot) + (171 * div(heapIs $heap<sub>funcstart_1032.1</sub>, this.$r.value(heapIs
\theta_{funcstart\_1032,1}.p1, 177).rem))).\_replace(p2 \rightarrow
```

```
asType<P2Type>((30307 *
asType<int>(static_cast<integer>(static_cast<signed
\mathbf{int}{>}(\mathbf{this.\$r.value}(\mathbf{heapIs}\ \$\mathbf{heap}_{funcstart\_1032,1}.\_\mathbf{replace}(\mathbf{this.\$r} \to \mathbf{funcstart}))
this.$r.value(heapIs \frac{1}{2} heap\frac{1}{2} line \frac{1}{2} heap\frac{1}{2} heap\frac{1}{2
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs \theta_{funcstart\_1032,1}, this.r.value(heapIs)
\theta_{funcstart_{1032,1}}.p1, 177).rem)))).p2) < (int)0))) + temp2)))
\rightarrow [evaluate dereferenced pointer into modified heap]
[57.15] $heap<sub>1032,1;1054,8</sub> == $heap<sub>funcstart_1032,1</sub>._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs \theta_{funcstart\_1032,1}, this.r.value(heapIs)
\theta_{tuncstart\_1032,1}.p1, 177).rem)))).\_replace(this.$r \rightarrow
this.$r.value(heapIs $heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.} \text{\$r.value}(\text{heapIs}))
\theta_{uncstart\_1032,1}.p1, 177).rem))).\_replace(p2 \rightarrow
asType<P2Type>((30307 *
asType<int>(static_cast<integer>(static_cast<signed int>(([this.$r
== this.$r]: this.$r.value(heapIs \rho_{tangle} = 1032,1)._replace(p1 \rho (-2 *
div(\mathbf{heapIs} \$ heap_{funcstart\_1032.1}, \mathbf{this}.\$ r. \mathbf{value}(\mathbf{heapIs})
\text{Sheap}_{funcstart\_1032,1}.p1, 177).quot) + (171 * div(heapIs \text{Sheap}_{funcstart\_1032,1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177).rem)), []:
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p2) < (int)0))) + temp2)))
→ [explicitly assert falsehood of skipped guards in subsequent guards]
[57.16] $\text{heap}_{1032,1;1054,8} == $\text{heap}_{funcstart\_1032,1}._\text{replace}(\text{this.}\text{$\frac{1}{2}}\text{$\text{op}}]$
this.$r.value(heapIs \rho_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\theta_{funcstart\_1032,1}, this.r.value(heapIs \theta_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(\mathbf{heapIs} \ \$heap_{funcstart\_1032,1}, \ \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
\theta_{funcstart\_1032,1}.p1, 177).rem))))._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\$heap_{funcstart\_1032,1},\, \textbf{this}.\$r.\textbf{value}(\textbf{heapIs}\,\,\$heap_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs \theta_{funcstart\_1032,1}, this.r.value(heapIs)
heap_{funcstart\_1032,1}.p1, 177).rem)))._replace(p2 \rightarrow
asType<P2Type>((30307 *
asType<int>(static_cast<integer>(static_cast<signed int>(([this.$r
== this.$r]: this.$r.value(heapIs \rho_{funcstart\_1032,1})._replace(p1 \rightarrow (-2 *
{\rm div}(\mathbf{heapIs}\ \$ \mathrm{heap}_{funcstart\_1032,1},\ \mathbf{this}.\$ \mathrm{r.value}(\mathbf{heapIs}
\text{Sheap}_{funcstart\_1032,1}.p1, 177).quot) + (171 * div(heapIs \text{Sheap}_{funcstart\_1032,1},
\mathbf{this.\$r.value(heapIs\ \$heap_{funcstart\_1032,1}).p1,\ 177).rem)),\ [!(\mathbf{this.\$r}==
this.r.value(heapIs $heap_{funcstart\_1032.1}).p2) < (int)0))) +
temp2)))
\rightarrow [simplify]
```

```
[57.23] $heap<sub>1032,1;1054,8</sub> == $heap<sub>funcstart_1032,1</sub>._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
\theta_{tuncstart\_1032,1}.p1, 177).rem)))).\_replace(this.\$r \rightarrow 0
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs heapIs f_{uncstart_1032,1}, this. r.value(heapIs)
\theta_{tuncstart_1032.1},p1, 177).rem)))._replace(p2 \rightarrow
asType<P2Type>((30307 * asType<int>(static_cast<integer>(0 <
-\mathbf{this.\$r.value}(\mathbf{heapIs}\ \$\mathrm{heap}_{funcstart\_1032,1}).\mathrm{p2}))) + \mathrm{temp2})))
\rightarrow [from term 24.0, literala < -this.$r.value(heapIs $heap_{funcstart\_1032,1}).p2
is false whenever -2 < (0 + literala)
   Proof of rule precondition:
   [57.23.0] - 2 < (0 + 0)
   \rightarrow [simplify]
   [57.23.2] true
[57.24] $\text{heap}_{1032,1;1054,8} == $\text{heap}_{funcstart\_1032,1}._\text{replace}(\text{this}.\text{$\frac{1}{2}r$})
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
\theta_{tuncstart\_1032,1}.p1, 177).rem)))).\_replace(this.\$r \rightarrow
this.$r.value(heapIs \rho_{uncstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs)
\rho_{funcstart_1032,1}, this.\r.value(heapIs \rho_{funcstart_1032,1}).p1,
177).quot) + (171 * div(heapIs $heap<sub>funcstart_1032,1</sub>, this.$r.value(heapIs
\theta_{funcstart\_1032,1}.p1, 177).rem))).\_replace(p2 \rightarrow
asType<P2Type>((30307 * asType<int>(static_cast<integer>(false)))
+ \text{temp2})))
\rightarrow [simplify]
[57.25] $heap<sub>1032,1;1054,8</sub> == $heap<sub>funcstart_1032,1</sub>._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart_1032,1}, this.r.value(heapIs \rho_{funcstart_1032,1}).p1,
177).quot) + (171 * div(\mathbf{heapIs} \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}))
\theta_{tuncstart\_1032.1}.p1, 177).rem)))).\_replace(this.\$r \rightarrow 0
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\theta_{funcstart\_1032,1}, this.\r.value(heapIs \theta_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(\mathbf{heapIs} \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}))
\theta_{funcstart\_1032,1}.p1, 177).rem))._replace(p2 \rightarrow
asType < P2Type > ((30307 * asType < int > (([false]: 1, []: 0))) + temp2)))
→ [explicitly assert falsehood of skipped guards in subsequent guards]
[57.26] $\text{heap}_{1032,1;1054,8} == $\text{heap}_{funcstart\_1032,1}._\text{replace}(\text{this}.$\text{$\frac{1}{2}}\rightarrow$)
```

```
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
\theta_{tuncstart\_1032,1}.p1, 177).rem)))).\_replace(this.\$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs $heap<sub>funcstart_1032,1</sub>, this.$r.value(heapIs
\theta_{tuncstart_{-1032.1}}.p1, 177).rem))._replace(p2 \rightarrow
asType<P2Type>((30307 * asType<int>(([false]: 1, [true]: 0))) +
temp2)))
\rightarrow [simplify]
[57.29] $\text{heap}_{1032,1;1054,8} == $\text{heap}_{funcstart\_1032,1}$._\text{replace}(\text{this}.$\text{$r} \to \text{
this.$r.value(heapIs \rho_{uncstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs)
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
\theta_{funcstart\_1032,1}.p1, 177).rem)))).replace(this.r \rightarrow 0
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\$heap_{funcstart\_1032,1},\, \textbf{this.}\$r.\textbf{value}(\textbf{heapIs}\,\,\$heap_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
\rho_{uncstart\_1032.1}, p1, 177).rem)))._replace(p2 \rightarrow asType<P2Type>(0 +
temp2)))
\rightarrow [from term 54.18, temp2 is equal to (-35 * div(heapIs $heap_{funcstart\_1032,1},
this.r.value(heapIs \ heap_{funcstart\_1032.1}).p2, 176).quot) + (172)
div(heapIs $heap_funcstart_1032.1, this.$r.value(heapIs
$heap_tuncstart_1032.1).p2, 176).rem)]
[57.30] $heap<sub>1032,1;1054,8</sub> == $heap<sub>funcstart_1032,1</sub>._replace(this.$r \rightarrow
this.$r.value(heapIs $heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{tuncstart\_1032.1}, this.r.value(heapIs \rho_{tuncstart\_1032.1}).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.\$r.value}(\text{heapIs}))
\theta_{funcstart\_1032,1}.p1, 177).rem)))).replace(this.r \rightarrow
this.$r.value(heapIs \rho_{tuncstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\$heap_{funcstart\_1032,1},\, \textbf{this.}\$r.\textbf{value}(\textbf{heapIs}\,\,\$heap_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(\mathbf{heapIs} \ \$heap_{funcstart\_1032,1}, \ \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
\theta_{tuncstart\_1032,1}.p1, 177).rem))._replace(p2 \rightarrow asType<P2Type>(0 +
((-35 * div(\mathbf{heapIs} \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}))
\text{Sheap}_{funcstart\_1032,1}.p2, 176).quot) + (172 * div(heapIs \text{Sheap}_{funcstart\_1032,1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p2, 176).rem)))))
\rightarrow [simplify]
[57.33] $\text{heap}_{1032,1;1054,8} == $\text{heap}_{funcstart\_1032,1}._\text{replace}(\text{this}.\text{$\frac{1}{2}r$})
this.$r.value(heapIs \rho_{tuncstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
\theta_{funcstart\_1032,1}.p1, 177).rem)))).replace(this.r \rightarrow 0
```

```
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.}\text{\$r.value}(\text{heapIs}))
\rho_{funcstart\_1032,1}.p1, 177).rem))._replace(p2 \rightarrow ((-35 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p2,
176).quot) + (172 * div(heapIs $heap<sub>funcstart_1032,1</sub>, this.$r.value(heapIs
heap_{funcstart\_1032,1}.p2, 176).rem)))
[Take given term]
[58.0] (($heap_{1032,1:1054,8}.r3 * static_cast < signed int > (div3.rem)) -
(\text{sheap}_{1032,1:1054.8}.\text{b3} * \text{static\_cast} < \text{signed int} > (\text{div3.quot}))) == \text{temp3}
\rightarrow [from term 57.33, $heap<sub>1032,1;1054,8</sub> is equal to
\$heap_{funcstart\_1032,1}.\_\textbf{replace}(\textbf{this}.\$r \rightarrow \textbf{this}.\$r.\textbf{value}(\textbf{heapIs}
heap_{funcstart\_1032.1}._replace(p1 \rightarrow ((-2 * div(heapIs heap_{funcstart\_1032.1}),
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, \ 177).quot) + (171 \ *funcstart\_1032,1).p1
div(heapIs $heap_{tuncstart\_1032.1}, this.$r.value(heapIs
\theta_{funcstart\_1032,1}.p1, 177).rem)))).\_replace(this.\$r \rightarrow 0
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
heap_{funcstart\_1032.1}, this.r.value(heapIs heap_{funcstart\_1032.1}).p1,
177).quot) + (171 * div(\mathbf{heapIs} \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}))
heap_{funcstart\_1032,1}.p1, 177).rem))).\_replace(p2 \rightarrow (-35 * div(heapIs))).
heap_{funcstart\_1032,1}, this.r.value(heapIs heap_{funcstart\_1032,1}).p2,
176).quot) + (172 * div(heapIs $heap_{funcstart\_1032,1}, this.$r.value(heapIs
heap_{funcstart\_1032,1}.p2, 176).rem)))
[58.1] ((\$heap_{funcstart\_1032,1}._replace(this.\$r \rightarrow this.\$r.value(heapIs
\rho_{funcstart\_1032,1}._replace(p1 \rightarrow ((-2 * div(heapIs $heap_{funcstart\_1032,1}),
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177).quot) + (171 *
div(\mathbf{heapIs} \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
\theta_{funcstart\_1032,1}.p1, 177).rem))))._replace(this.$r \rightarrow
\textbf{this.}\$r.\textbf{value}(\textbf{heapIs}~\$heap_{funcstart\_1032,1}).\_\textbf{replace}(p1 \rightarrow ((-2~*div(\textbf{heapIs})))))
$heap_funcstart_1032.1, this.$r.value(heapIs $heap_funcstart_1032.1).p1,
177).quot) + (171 * div(heapIs $heap<sub>funcstart_1032,1</sub>, this.$r.value(heapIs
\rho_{uncstart\_1032,1}.p1, 177).rem))._replace(p2 \rightarrow ((-35 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p2,
176).quot) + (172 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.} \text{\$r.value}(\text{heapIs}))
\rho_{funcstart\_1032,1}.p2, 176).rem))).r3 * static_cast < signed
int>(div3.rem)) - (\$heap_{1032,1:1054,8}.b3 * static\_cast < signed)
int>(div3.quot))) == temp3
→ [const member of object with modified fields]
[58.3]\;((\$heap_{funcstart\_1032,1}.r3\;*\;\textbf{static\_cast} < \textbf{signed int} > (\text{div3.rem}))\;-
(\text{sheap}_{1032,1:1054,8}.\text{b3} * \text{static\_cast} < \text{signed int} > (\text{div3.quot}))) == \text{temp3}
\rightarrow [const static or extern object]
[58.4] (($heap<sub>init</sub>.r3 * static_cast<signed int>(div3.rem)) -
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(\text{sheap}_{1032,1:1054,8}.\text{b3} * \text{static\_cast} < \text{signed int} > (\text{div3.quot}))) == \text{temp3}
\rightarrow [expand definition of constant 'r3' at prang.cpp (39,26)]
[58.5] (((int)170 * static_cast<signed int>(div3.rem)) -
(\$heap_{1032,1;1054,8}.b3 * \mathbf{static\_cast} < \mathbf{signed\ int} > (div3.quot))) == temp3
\rightarrow [simplify]
[58.6] ((170 * static_cast<signed int>(div3.rem)) - ($heap_{1032.1:1054.8}.b3 *
static_cast<signed int>(div3.quot))) == temp3
\rightarrow [from term 34.6, div3 is equal to div(heapIs $heap_{funcstart\_1032,1},
this.r.value(heapIs $heap_{funcstart\_1032,1}).p3, 178)
[58.7] ((170 * static_cast<signed int>(div(heapIs $heap_{funcstart\_1032,1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p3, 178).rem)) -
(\text{sheap}_{1032,1;1054,8}.\text{b3} * \text{static\_cast} < \text{signed int} > (\text{div3.quot}))) == \text{temp3}
\rightarrow [simplify]
[58.8] \; ((170 \; * \; \mathrm{div}(\mathbf{heapIs} \; \$ \mathrm{heap}_{funcstart\_1032,1}, \; \mathbf{this}.\$ r. \mathbf{value}(\mathbf{heapIs} \;
\text{Sheap}_{funcstart\_1032.1}.p3, 178).rem) - (\text{Sheap}_{1032.1:1054.8}.b3 *
static_cast<signed int>(div3.quot))) == temp3
\rightarrow [from term 57.33, $heap<sub>1032.1:1054.8</sub> is equal to
\$heap_{funcstart\_1032,1}.\_\textbf{replace}(\textbf{this}.\$r \rightarrow \textbf{this}.\$r.\textbf{value}(\textbf{heapIs}
heap_{funcstart\_1032,1}._replace(p1 \rightarrow ((-2 * div(heapIs $heap_{funcstart\_1032,1},
this.r.value(heapIs \ \ heap_{funcstart\_1032.1}).p1, \ 177).quot) + (171)^2
div(\textbf{heapIs}~\$heap_{funcstart\_1032,1},~\textbf{this.}\$r.\textbf{value}(\textbf{heapIs}
\theta_{tuncstart\_1032.1}.p1, 177).rem)))).\_replace(this.\$r \rightarrow 0
this.r.value(heapIs \ heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs))
heap_{funcstart\_1032,1}, this.r.value(heapIs heap_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(\mathbf{heapIs} \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}))
heap_{funcstart\_1032,1}.p1, 177).rem))).\_replace(p2 \rightarrow (-35 * div(heapIs))).
$heap_funcstart_1032.1, this.$r.value(heapIs $heap_funcstart_1032.1).p2,
(176).quot) + (172 * div(heapIs $heap_{funcstart\_1032,1}, this.$r.value(heapIs)]
heap_{funcstart\_1032,1}.p2, 176).rem)))]
[58.9] ((170 * \mathrm{div}(\mathbf{heapIs}\ \$\mathrm{heap}_{funcstart\_1032,1},\ \mathbf{this}.\$\mathrm{r.value}(\mathbf{heapIs}
\rho_{funcstart\_1032,1}.p3, 178).rem – (\rho_{funcstart\_1032,1}.p_{funcstart\_1032,1}.p_{funcstart\_1032,1}.p_{funcstart\_1032,1}.p_{funcstart\_1032,1}.p_{funcstart\_1032,1}.p_{funcstart\_1032,1}.p_{funcstart\_1032,1}.p_{funcstart\_1032,1}.p_{funcstart\_1032,1}.p_{funcstart\_1032,1}.p_{funcstart\_1032,1}.p_{funcstart\_1032,1}.p_{funcstart\_1032,1}.p_{funcstart\_1032,1}.p_{funcstart\_1032,1}.p_{funcstart\_1032,1}.p_{funcstart\_1032,1}.p_{funcstart\_1032,1}.p_{funcstart\_1032,1}.p_{funcstart\_1032,1}.p_{funcstart\_1032,1}.p_{funcstart\_1032,1}.p_{funcstart\_1032,1}.p_{funcstart\_1032,1}.p_{funcstart\_1032,1}.p_{funcstart\_1032,1}.p_{funcstart\_1032,1}.p_{funcstart\_1032,1}.p_{funcstart\_1032,1}.p_{funcstart\_1032,1}.p_{funcstart\_1032,1}.p_{funcstart\_1032,1}.p_{funcstart\_1032,1}.p_{funcstart\_1032,1}.p_{funcstart\_1032,1}.p_{funcstart\_1032,1}.p_{funcstart\_1032,1}.p_{funcstart\_1032,1}.p_{funcstart\_1032,1}.p_{funcstart\_1032,1}.p_{funcstart\_1032,1}.p_{funcstart\_1032,1}.p_{funcstart\_1032,1}.p_{funcstart\_1032,1}.p_{funcstart\_1032,1}.p_{funcstart\_1032,1}.p_{funcstart\_1032,1}.p_{funcstart\_1032,1}.p_{funcstart\_1032,1}.p_{funcstart\_1032,1}.p_{funcstart\_1032,1}.p_{funcstart\_1032,1}.p_{funcstart\_1032,1}.p_{funcstart\_1032,1}.p_{funcstart\_1032,1}.p_{funcstart\_1032,1}.p_{funcstart\_1032,1}.p_{funcstart\_1032,1}.p_{funcstart\_1032,1}.p_{funcstart\_1032,1}.p_{funcstart\_1032,1}.p_{funcstart\_1032,1}.p_{funcstart\_1032,1}.p_{funcstart\_1032,1}.p_{funcstart\_1032,1}.p_{funcstart\_1032,1}.p_{funcstart\_1032,1}.p_{funcstart\_1032,1}.p_{funcstart\_1032,1}.p_{funcstart\_1032,1}.p_{funcstart\_1032,1}.p_{funcstart\_1032,1}.p_{funcstart\_1032,1}.p_{funcstart\_1032,1}.p_{funcstart\_1032,1}.p_{funcstart\_1032,1}.p_{funcstart\_1032,1}.p_{funcstart\_1032,1}.p_{funcstart\_1032,1}.p_{funcstart\_1032,1}.p_{funcstart\_1032,1}.p_{funcstart\_1032,1}.p_{funcstart\_1032,1}.p_{funcstart\_1032,1}.p_{funcstart\_1032,1}.p_{funcstart\_1032,1}.p_{funcstart\_1032,1}.p_{funcstart\_1032,1}.p_{funcstart\_1032,1}.p_{funcstart\_1032,1}.p_{funcstart\_1032,1}.p_{funcstart\_1032,1}.p_{funcstart\_1032,1}.p_{funcstart\_1032,1}.p_{funcsta
\rightarrow this.$r.value(heapIs $heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 *
div(\mathbf{heapIs} \$ heap_{funcstart\_1032.1}, \mathbf{this.}\$ r. \mathbf{value}(\mathbf{heapIs})
\text{Sheap}_{funcstart\_1032,1}.p1, 177).quot) + (171 * div(heapIs \text{Sheap}_{funcstart\_1032,1},
this.$r.value(heapIs $heap_funcstart_1032,1).p1, 177).rem))))._replace(this.$r
\rightarrow this.$r.value(heapIs $heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_1032,1}, \ \mathbf{this}.\$ r. \mathbf{value}(\mathbf{heapIs}
\text{Sheap}_{funcstart\_1032,1}.p1, 177).quot) + (171 * div(heapIs \text{Sheap}_{funcstart\_1032,1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177).rem))).\_replace(p2 \rightarrow
((-35 * div(heapIs \$heap_{funcstart\_1032.1}, this.\$r.value(heapIs
\text{Sheap}_{funcstart\_1032,1}.p2, 176).quot) + (172 * div(heapIs \text{Sheap}_{funcstart\_1032,1},
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this.r.value(heapIs \ heap_{funcstart\_1032,1}).p2, 176).rem)))).b3 *
static_cast<signed int>(div3.quot))) == temp3
\rightarrow [const member of object with modified fields]
[58.11] ((170 * div(heapIs $heap_{funcstart\_1032,1}, this.$r.value(heapIs
\text{Sheap}_{funcstart\_1032,1}.\text{p3}, 178).\text{rem} - (\text{Sheap}_{funcstart\_1032,1}.\text{b3} *
static_cast<signed int>(div3.quot))) == temp3
\rightarrow [const static or extern object]
[58.12] ((170 * div(heapIs $heap<sub>funcstart_1032,1</sub>, this.$r.value(heapIs
\rho_{funcstart\_1032,1}.p3, 178).rem – (\rho_{funcstart\_1032,1}.p3, 178).rem
int>(div3.quot))) == temp3
\rightarrow [expand definition of constant 'b3' at prang.cpp (41,26)]
[58.13] ((170 * div(heapIs \$heap_{funcstart\_1032,1}, this.\$r.value(heapIs
\rho_{tuncstart\_1032.1}, p3, 178).rem) - ((int)63 * static_cast<signed)
int>(div3.quot)) = temp3
\rightarrow [simplify]
[58.14] ((170 * div(heapIs heap_{funcstart\_1032,1}, this.r.value(heapIs)
\theta_{funcstart\_1032,1}.p3, 178).rem - (63 * static\_cast < signed)
int>(div3.quot)) == temp3
\rightarrow [from term 34.6, div3 is equal to div(heapIs $heap_{funcstart\_1032,1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p3, 178)
[58.15] ((170 * div(heapIs $heap<sub>funcstart_1032,1</sub>, this.$r.value(heapIs
\rho_{funcstart\_1032.1}.p3, 178).rem) - (63 * static_cast<signed
int>(div(heapIs \$heap_{funcstart\_1032,1}, this.\$r.value(heapIs
\text{Sheap}_{funcstart\_1032,1}.p3, 178).quot))) == temp3
\rightarrow [simplify]
[58.20] 0 == (-\text{temp3} + (-63 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032.1})]
this.$r.value(heapIs heap_{funcstart\_1032,1}).p3, 178).quot) + (170 *
div(\mathbf{heapIs} \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
heap_{funcstart\_1032,1}.p3, 178).rem
[Take given term]
[61.0] $heap_{funcend\_1032,1} == $heap_{1032,1;1054,8}._replace(this.$r \rightarrow
\mathbf{operator}^*(\mathbf{heapIs}~\$\mathrm{heap}_{1032,1;1054,8},~\mathbf{this}).\_\mathbf{replace}(\mathrm{p3}\rightarrow
asType<P3Type>(($heap<sub>1032.1:1054.8</sub>.M3 *
asType{<}int{>}(static\_cast{<}integer{>}(static\_cast{<}signed
int>(operator^*(heapIs $heap_{1032.1:1054.8}, this).p3) < (int)0))) + temp3)))
\rightarrow [from term 57.33, $heap<sub>1032,1:1054,8</sub> is equal to
$heap_{funcstart\_1032,1}.$_replace(this.$r \rightarrow this.$r.value(heapIs)
heap_{funcstart\_1032,1}._replace(p1 \rightarrow ((-2 * div(heapIs $heap_{funcstart\_1032,1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, \ 177).quot) + (171)
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div(\mathbf{heapIs} \ \$heap_{funcstart\_1032,1}, \ \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
\theta_{funcstart\_1032,1}.p1, 177).rem)))._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
heap_{funcstart\_1032,1}, this.r.value(heapIs heap_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(\mathbf{heapIs} \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}))
\rho_{funcstart\_1032,1}.p1, 177).rem))._replace\rho_{funcstart\_1032,1}.p1, 177).rem))
$heap_funcstart_1032,1, this.$r.value(heapIs $heap_funcstart_1032,1).p2,
176).quot) + (172 * div(heapIs $heap_{tuncstart_1032.1}, this.$r.value(heapIs
heap_{funcstart_1032,1}.p2, 176).rem)))]
[61.2] heap_{funcend\_1032,1} == heap_{funcstart\_1032,1}._replace(this.$r \rightarrow
\textbf{this.}\$r.\textbf{value}(\textbf{heapIs}~\$heap_{funcstart\_1032,1}).\_\textbf{replace}(p1 \rightarrow ((-2~*div(\textbf{heapIs}
\rho_{tuncstart_1032.1}, this.r.value(heapIs \rho_{tuncstart_1032.1}).p1,
177).quot) + (171 * div(heapIs $heap<sub>funcstart_1032.1</sub>, this.$r.value(heapIs
\theta_{funcstart\_1032,1}.p1, 177).rem))))._replace(this.$r \rightarrow
\textbf{this.\$r.value}(\textbf{heapIs}~\$ heap_{funcstart\_1032,1}).\_\textbf{replace}(p1 \rightarrow ((-2~*div(\textbf{heapIs})))))
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs $heap<sub>funcstart_1032,1</sub>, this.$r.value(heapIs
\rho_{funcstart\_1032,1}.p1, 177).rem))._replace(p2 \rightarrow ((-35 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p2,
176).quot) + (172 * div(heapIs $heap<sub>funcstart_1032,1</sub>, this.$r.value(heapIs
\theta_{uncstart\_1032,1}.p2, 176).rem)))._replace(this.$r \rightarrow operator*(heapIs)
\theta_{funcstart\_1032,1}.\_replace(this.\$r \rightarrow this.\$r.value(heapIs)
heap_{funcstart\_1032,1}._replace(p1 \rightarrow ((-2 * div(heapIs p_{funcstart\_1032,1}),
this.r.value(heapIs \ heap_{funcstart\_1032.1}).p1, 177).quot) + (171 *
div(\mathbf{heapIs} \$ heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
\label{eq:continuous_function} $ \text{heap}_{funcstart\_1032,1}.\text{p1},\ 177).\text{rem})))).$ \_\textbf{replace}(\textbf{this}.\$r \rightarrow
\textbf{this.}\$r.\textbf{value}(\textbf{heapIs}~\$heap_{funcstart\_1032,1}).\_\textbf{replace}(p1 \rightarrow ((\text{-}2~*\text{div}(\textbf{heapIs}
\rho_{tuncstart_{1032.1}}, this.$r.value(heapIs \rho_{tuncstart_{1032.1}}).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.} \text{\$r.value}(\text{heapIs}))
\$heap_{funcstart\_1032,1}).p1,\ 177).rem))).\_\mathbf{replace}(p2 \to (-35\ *\ div(\mathbf{heapIs}
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p2,
176).quot) + (172 * div(\mathbf{heapIs} \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}))
\theta_{funcstart\_1032,1}.p2, 176).rem)), this)._replace(p3 \rightarrow
asType<P3Type>(($heap<sub>1032,1;1054,8</sub>.M3 *
asType<int>(static_cast<integer>(static_cast<signed
int>(operator^*(heapIs $heap_{1032,1;1054,8}, this).p3) < (int)(0))) + temp3)))
→ [expand definition of operator '*' in class 'pointer' at built in declaration]
[61.3] heap_{funcend\_1032,1} == heap_{funcstart\_1032,1}._replace(this.r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs))
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.} \text{\$r.value}(\text{heapIs}))
\theta_{funcstart\_1032,1}.p1, 177).rem)))).\_replace(this.\$r \rightarrow 0
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\theta_{funcstart\_1032,1}, this.r.value(heapIs \theta_{funcstart\_1032,1}).p1,
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\rho_{funcstart\_1032,1}.p1, 177).rem)._replace\rho_{funcstart\_1032,1}.p1, 177).rem)._replace
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p2,
176).quot) + (172 * div(heapIs $heap<sub>funcstart_1032,1</sub>, this.$r.value(heapIs
\theta_{funcstart\_1032,1}.p2, 176).rem)))).\_replace(this.$r \rightarrow
this.$r.value(heapIs \rho_{funcstart\_1032,1}._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
$\text{heap}_{funcstart_1032.1}$, this.$\text{r.value}(\text{heapIs} \text{$heap}_{funcstart_1032.1}).p1,
177).quot) + (171 * div(\mathbf{heapIs} \$ heap_{funcstart\_1032,1}, \mathbf{this}.\$ r. \mathbf{value}(\mathbf{heapIs})
\theta_{tuncstart_{1032,1}}.p1, 177).rem)))._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
\rho_{funcstart\_1032,1}.p1, 177).rem)._replace\rho_{funcstart\_1032,1}.p1, 177).rem)._replace
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p2,
176).quot) + (172 * \text{div}(\text{heapIs } \text{heap}_{funcstart\_1032,1}, \text{this.} \text{$r.value}(\text{heapIs}))
\theta_{funcstart\_1032,1}.p2, 176).rem))))._replace(p3 \rightarrow
asType<P3Type>(($heap<sub>1032.1:1054.8</sub>.M3 *
asType<int>(static_cast<integer>(static_cast<signed
int>(operator^*(heapIs $heap_{1032,1;1054,8}, this).p3) < (int)0))) + temp3)))
→ [evaluate dereferenced pointer into modified heap]
[61.4] heap_{funcend\_1032,1} == heap_{funcstart\_1032,1}._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.\r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.} \text{\$r.value}(\text{heapIs}))
\theta_{funcstart\_1032,1}.p1, 177).rem)))._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
\rho_{funcstart\_1032,1}.p1, 177).rem))._replace(p2 \rightarrow ((-35 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p2,
176).quot) + (172 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.} \text{\$r.value}(\text{heapIs}))
\$heap_{funcstart\_1032,1}).p2,\ 176).rem)))).\_\mathbf{replace}(\mathbf{this}.\$r \rightarrow ([\mathbf{this}.\$r = =
this.$r]: this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 *
div(\mathbf{heapIs} \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
\text{Sheap}_{funcstart\_1032,1}.p1, 177).quot) + (171 * div(heapIs \text{Sheap}_{funcstart\_1032,1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177).rem))).\_replace(p2 \rightarrow
(-35 * div(heapIs \$heap_{funcstart\_1032,1}, this.\$r.value(heapIs
\rho_{funcstart\_1032,1}.p2, 176).quot + (172 * div(heapIs $heap_{funcstart\_1032,1})
this.$r.value(heapIs heap_{funcstart\_1032.1}).p2, 176).rem)), []:
this.r.value(heapIs \ heap_{funcstart\_1032,1}.\_replace(this.\rdotsr) \rightarrow
this.$r.value(heapIs heapIs_{funcstart\_1032,1})._replace(p1 \rightarrow (-2 * div(heapIs
\$heap_{funcstart\_1032,1},\, \textbf{this.}\$r.\textbf{value}(\textbf{heapIs}\,\,\$heap_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
\theta_{funcstart\_1032,1}.p1, 177).rem))))._replace(p3 \rightarrow
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177).quot) + (171 * div(heapIs $heapIs = f_{uncstart_1032,1}$, this.r.value(heapIs)

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asType<P3Type>(($heap<sub>1032,1:1054,8</sub>.M3 *
asType<int>(static_cast<integer>(static_cast<signed
int>(operator^*(heapIs $heap_{1032,1;1054,8}, this).p3) < (int)(0))) + temp3)))
→ [explicitly assert falsehood of skipped guards in subsequent guards]
[61.5] heap_{funcend\_1032,1} == heap_{funcstart\_1032,1}._replace(this.$r \rightarrow
this.$r.value(heapIs \rho_{tuncstart\_1032.1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(\mathbf{heapIs} \$heap_{funcstart\_1032.1}, \mathbf{this.\$r.value}(\mathbf{heapIs}))
\theta_{funcstart\_1032,1}.p1, 177).rem))))._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\ 1032.1}).replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.}\text{\$r.value}(\text{heapIs}))
\rho_{uncstart\_1032,1}.p1, 177).rem))._replace(p2 \rightarrow ((-35 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p2,
176).quot) + (172 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.}\text{\$r.value}(\text{heapIs}))
\rho_{uncstart\_1032,1}.p2, 176).rem)))).\_replace(this.$r \rightarrow ([this.$r ==
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 *
div(\mathbf{heapIs} \$heap_{funcstart\_1032.1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
\text{Sheap}_{funcstart\_1032,1}.\text{p1}, 177).\text{quot} + (171 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_1032,1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177).rem))).\_replace(p2 \rightarrow
(-35 * div(heapIs \$heap_{funcstart\_1032.1}, this.\$r.value(heapIs
\text{Sheap}_{funcstart\_1032.1}.p2, 176).quot) + (172 * div(heapIs \text{Sheap}_{funcstart\_1032.1},
\mathbf{this.\$r.value(heapIs}\ \$heap_{funcstart\_1032,1}).p2,\ 176).rem)),\ [!(\mathbf{this.\$r}==
this.r.value(heapIs p_{funcstart\_1032,1}.replace(this.r \rightarrow funcstart\_1032,1.
this.$r.value(heapIs $heap_{tuncstart\_1032,1})._replace(p1 \rightarrow (-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
heap_{funcstart\_1032,1}.p1, 177).rem))))._replace(p3 \rightarrow
asType<P3Type>(($heap<sub>1032.1:1054.8</sub>.M3 *
asType<int>(static_cast<integer>(static_cast<signed
int>(operator^*(heapIs $heap_{1032,1;1054,8}, this).p3) < (int)(0))) + temp3)))
\rightarrow [simplify]
[61.7] heap_{funcend\_1032,1} == heap_{funcstart\_1032,1}._replace(this.$r \rightarrow
this.$r.value(heapIs \rho_{uncstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs)
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{heap}_{funcstart\_1032,1}, \text{this.} \text{$r.value}(\text{heapIs}))
\theta_{tuncstart\_1032,1}.p1, 177).rem)))).\_replace(this.\$r \rightarrow 0
this.$r.value(heapIs p_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart_1032,1}, this.r.value(heapIs \rho_{funcstart_1032,1}).p1,
177).quot) + (171 * div(heapIs $heap<sub>funcstart_1032,1</sub>, this.$r.value(heapIs
\rho_{funcstart\_1032.1}.p1, 177).rem)._replace(p2 \rightarrow ((-35 * div(heapIs
$\text{heap}_{funcstart_1032.1}$, this.$\text{r.value}(\text{heapIs} \text{$heap}_{funcstart_1032.1}).p2,
176).quot) + (172 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.}\text{\$r.value}(\text{heapIs}))
\theta_{funcstart\_1032,1}.p2, 176).rem))))._replace(this.$r \rightarrow
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this.$r.value(heapIs heap_{tuncstart=1032.1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.}\text{\$r.value}(\text{heapIs}))
\text{Sheap}_{funcstart\_1032,1}.p1, 177).rem)))._replace(p2 \rightarrow ((-35 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p2,
176).quot) + (172 * div(heapIs $heap<sub>funcstart_1032,1</sub>, this.$r.value(heapIs
heap_{funcstart\_1032,1}.p2, 176).rem)))._replace(p3 \rightarrow
asType<P3Type>(($heap<sub>1032.1:1054.8</sub>.M3 *
asType<int>(static_cast<integer>(static_cast<signed
int>(operator^*(heapIs $heap_{1032,1;1054,8}, this).p3) < (int)(0))) + temp3)))
\rightarrow [from term 57.33, $heap<sub>1032,1;1054,8</sub> is equal to
$heap_{funcstart\_1032,1}.$replace(this.$r \rightarrow this.$r.value(heapIs)
heap_{funcstart\_1032.1}._replace(p1 \rightarrow ((-2 * div(heapIs $heap_{funcstart\_1032.1},
this.r.value(heapIs \ \ heap_{funcstart\_1032.1}).p1, \ 177).quot) + (171)
div(\mathbf{heapIs} \ \$heap_{funcstart\_1032.1}, \ \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
heap_{funcstart\_1032,1}.p1, 177).rem)))). replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs) + (-2 * div(heapIs) + (
heap_{funcstart\_1032,1}, this.r.value(heapIs heap_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(\mathbf{heapIs} \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}))
heap_{funcstart\_1032,1}.p1, 177).rem))).\_replace(p2 \rightarrow (-35 * div(heapIs))).
$heap_{funcstart\_1032,1}$, this. $r.value(heapIs $heap_{funcstart\_1032,1}).p2$,
176).quot) + (172 * div(\textbf{heapIs } \$heap_{funcstart\_1032,1}, \textbf{this.}\$r.\textbf{value}(\textbf{heapIs}))
heap_{funcstart_{1032.1}}.p2, 176).rem)))]
[61.8] heap_{funcend\_1032,1} == heap_{funcstart\_1032,1}._replace(this.$r \rightarrow
this.$r.value(heapIs \rho_{tuncstart\_1032.1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
\theta_{funcstart\_1032,1}.p1, 177).rem))))._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart = 1032.1}).replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs \theta_{funcstart\_1032,1}, this.r.value(heapIs)
\rho_{uncstart\_1032,1}.p1, 177).rem))._replace(p2 \rightarrow ((-35 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p2,
176).quot) + (172 * div(heapIs \rho_{funcstart\_1032,1}, this.r.value(heapIs)
\theta_{uncstart\_1032,1}.p2, 176).rem)))._replace(this.$r \rightarrow
\textbf{this.}\$r.\textbf{value}(\textbf{heapIs}~\$heap_{funcstart\_1032,1}).\_\textbf{replace}(p1 \rightarrow ((-2~*div(\textbf{heapIs})))))
\rho_{tuncstart\_1032.1}, this.r.value(heapIs \rho_{tuncstart\_1032.1}).p1,
177).quot) + (171 * div(heapIs \rho_{funcstart\_1032,1}, this.r.value(heapIs)
\rho_{uncstart\_1032,1}.p1, 177).rem))._replace(p2 \rightarrow ((-35 * div(heapIs
$\text{heap}_{funcstart_1032.1}$, this.$\text{r.value}(\text{heapIs} \text{$heap}_{funcstart_1032.1}).p2,
176).quot) + (172 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.}\text{\$r.value}(\text{heapIs}))
\theta_{funcstart\_1032,1}.p2, 176).rem))).\_replace(p3 \rightarrow
asType < P3Type > ((\$heap_{funcstart\_1032,1}.\_replace(this.\$r \rightarrow funcstart\_1032,1))
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
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177).quot) + (171 * \text{div}(\text{heapIs } \text{heap}_{funcstart\_1032.1}, \text{this.}\text{$\$r.value}(\text{heapIs}))
\theta_{funcstart\_1032,1}.p1, 177).rem))))._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.}\text{\$r.value}(\text{heapIs}))
\rho_{uncstart\_1032,1}.p1, 177).rem))._replace(p2 \rightarrow ((-35 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p2,
176).quot) + (172 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032.1}, \text{this.} \text{\$r.value}(\text{heapIs}))
heap_{funcstart_1032,1}.p2, 176).rem))).M3 *
asType<int>(static_cast<integer>(static_cast<signed
int>(operator^*(heapIs $heap_{1032.1:1054.8}, this).p3) < (int)0))) + temp3)))
→ [const member of object with modified fields]
[61.10] heap_{funcend\_1032,1} == heap_{funcstart\_1032,1}._replace(this.$r \rightarrow
this.$r.value(heapIs \rho_{tuncstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
\theta_{funcstart\_1032,1}.p1, 177).rem))))._replace(this.$r \rightarrow
\textbf{this.}\$r.\textbf{value}(\textbf{heapIs}~\$heap_{funcstart\_1032,1}).\_\textbf{replace}(p1 \rightarrow ((\text{-}2~*\text{div}(\textbf{heapIs}
\theta_{funcstart\_1032,1}, this.r.value(\theta_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
\rho_{funcstart\_1032.1}.p1, 177).rem)._replace(p2 \rightarrow ((-35 * div(heapIs
\rho_{tuncstart\_1032.1}, this.r.value(heapIs \rho_{tuncstart\_1032.1}).p2,
176).quot) + (172 * div(\mathbf{heapIs} \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}))
\label{eq:continuous_function} $ \text{heap}_{funcstart\_1032,1} . \text{p2}, \ 176).rem)))).$ \_\textbf{replace}(\textbf{this}.\$r \rightarrow
this.$r.value(heapIs \rho_{tuncstart\_1032.1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs \theta_{funcstart\_1032,1}, this.r.value(heapIs)
\rho_{uncstart\_1032,1}.p1, 177).rem))).\_replace(p2 \rightarrow ((-35 * div(heapIs)))._replace(p2 \rightarrow ((-35 * div(heapIs))))._replace(p3 + div(heapIs)))
$\text{heap}_{funcstart=1032.1}$, this.$\text{r.value}(\text{heapIs} \text{$heap}_{funcstart=1032.1}).p2,
176).quot) + (172 * div(heapIs \theta_{funcstart\_1032,1}, this.r.value(heapIs)
\rho_{funcstart\_1032,1}.p2, 176).rem))).\_replace(p3 \rightarrow
asType<P3Type>(($heap<sub>funcstart_1032,1</sub>.M3 *
asType<int>(static_cast<integer>(static_cast<signed
int>(operator^*(heapIs $heap_{1032,1;1054,8}, this).p3) < (int)(0))) + temp3)))
\rightarrow [const static or extern object]
[61.11] \theta_{1.11} \theta
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.}\text{\$r.value}(\text{heapIs}))
\theta_{funcstart\_1032,1}.p1, 177).rem)))).replace(this.r \rightarrow 0
this.$r.value(heapIs $heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
$\text{heap}_{funcstart_1032.1}$, this.$\text{r.value}(\text{heapIs} \text{$heap}_{funcstart_1032.1}).p1,
177).quot) + (171 * div(heapIs $heap<sub>funcstart_1032.1</sub>, this.$r.value(heapIs
\rho_{funcstart\_1032,1}.p1, 177).rem))._replace(p2 \rightarrow ((-35 * div(heapIs
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\rho_{funcstart=1032,1}, this.r.value(heapIs \rho_{funcstart=1032,1}).p2,
176).quot) + (172 * div(heapIs \theta_{funcstart\_1032,1}, this.r.value(heapIs)
\theta_{funcstart\_1032,1}.p2, 176).rem))))._replace(this.$r \rightarrow
this.$r.value(heapIs \frac{1}{2} heap\frac{1}{2} line \frac{1}{2} heap\frac{1}{2} heap\frac{1}{2
\$heap_{funcstart\_1032,1},\, \textbf{this}.\$r.\textbf{value}(\textbf{heapIs}\,\,\$heap_{funcstart\_1032.1}).p1,
177).quot) + (171 * div(heapIs $heap<sub>funcstart_1032,1</sub>, this.$r.value(heapIs
\rho_{uncstart\_1032,1}.p1, 177).rem))).\_replace(p2 \rightarrow ((-35 * div(heapIs)))._replace(p2 \rightarrow ((-35 * div(heapIs))))._replace(p3 + div(heapIs)))
$\text{heap}_{tuncstart_1032,1}$, this.$\text{r.value}(\text{heapIs} \text{$heap}_{tuncstart_1032,1}).p2,
176).quot) + (172 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032.1}, \text{this.} \text{\$r.value}(\text{heapIs}))
heap_{funcstart\_1032,1}.p2, 176).rem))._replace(p3 \rightarrow
asType < P3Type > ((\$heap_{init}.M3 *
asType<int>(static_cast<integer>(static_cast<signed
int>(operator*(heapIs $heap_{1032,1;1054,8}, this).p3) < (int)0))) + temp3)))
\rightarrow [expand definition of constant 'M3' at prang.cpp (38.26)]
[61.12] heap_{funcend\_1032,1} == heap_{funcstart\_1032,1}._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart=1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032.1}, \text{this.} \text{\$r.value}(\text{heapIs}))
\theta_{funcstart\_1032,1}.p1, 177).rem))))._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
$heap_tuncstart_1032.1, this.$r.value(heapIs $heap_tuncstart_1032.1).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.} \text{\$r.value}(\text{heapIs}))
\rho_{uncstart\_1032,1}.p1, 177).rem))).\_replace(p2 \rightarrow ((-35 * div(heapIs)))._replace(p2 \rightarrow ((-35 * div(heapIs))))._replace(p3 \rightarrow ((-35 * div(heapIs)))))
\rho_{funcstart_1032,1}, this. r.value(heapIs \rho_{funcstart_1032,1}).p2,
176).quot) + (172 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032.1}, \text{this.} \text{\$r.value}(\text{heapIs}))
\theta_{tuncstart\_1032,1}.p2, 176).rem)))).\_replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
\rho_{funcstart\_1032,1}.p1, 177).rem))._replace(p2 \rightarrow ((-35 * div(heapIs
\label{eq:heapIs} $\operatorname{heap}_{funcstart\_1032,1},\ \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}\ \$\operatorname{heap}_{funcstart\_1032,1}).p2,
176).quot) + (172 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.} \text{\$r.value}(\text{heapIs}))
\theta_{funcstart\_1032,1}.p2, 176).rem))).\_replace(p3 \rightarrow
\mathbf{asType}{<}\mathrm{P3Type}{>}(((\mathbf{int})30323\ ^{*}
asType < int > (static\_cast < integer > (static\_cast < signed
int>(operator*(heapIs $heap_{1032,1;1054,8}, this).p3) < (int)0))) + temp3)))
\rightarrow [simplify]
[61.13] \text{Sheap}_{funcend\_1032,1} == \text{Sheap}_{funcstart\_1032,1}._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart=1032,1}, this.r.value(heapIs \rho_{funcstart=1032,1}).p1,
177).quot) + (171 * div(heapIs \$heap_{funcstart\_1032,1}, this.\$r.value(heapIs
\theta_{tuncstart\_1032.1}.p1, 177.rem)))).\_replace(this.$r \rightarrow
\textbf{this.}\$r.\textbf{value}(\textbf{heapIs}~\$heap_{funcstart\_1032,1}).\_\textbf{replace}(p1 \rightarrow ((\text{-}2~*\text{div}(\textbf{heapIs}
\rho_{tuncstart_{1032.1}}, this. r.value(heapIs \rho_{tuncstart_{1032.1}}).p1,
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177).quot) + (171 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
\rho_{funcstart\_1032,1}.p1, 177).rem)._replace\rho_{funcstart\_1032,1}.p1, 177).rem)._replace
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p2,
176).quot) + (172 * div(heapIs $heap<sub>funcstart_1032,1</sub>, this.$r.value(heapIs
\theta_{funcstart\_1032,1}.p2, 176).rem)))).\_replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs heapIs f_{uncstart_1032,1}, this. r.value(heapIs)
\rho_{uncstart\_1032,1}.p1, 177).rem))._replace(p2 \rightarrow ((-35 * div(heapIs
\rho_{uncstart_{-1032,1}}, this.r.value(heapIs \rho_{uncstart_{-1032,1}}).p2,
176).quot) + (172 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.} \text{\$r.value}(\text{heapIs}))
\theta_{funcstart\_1032,1}.p2, 176).rem))).\_replace(p3 \rightarrow
asType<P3Type>((30323 *
asType<int>(static_cast<integer>(static_cast<signed
int>(operator*(heapIs $heap_{1032,1;1054,8}, this).p3) < (int)0))) + temp3)))
\rightarrow [from term 57.33, $heap<sub>1032,1:1054,8</sub> is equal to
$heap_{funcstart\_1032,1}$.$replace(this.$r \rightarrow this.$r.value(heapIs)
heap_{funcstart\_1032,1}._replace(p1 \rightarrow ((-2 * div(heapIs $heap_{funcstart\_1032,1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177).quot) + (171 *
div(heapIs $heap_{funcstart\_1032,1}, this.$r.value(heapIs)
\theta_{tuncstart\_1032.1}.p1, 177).rem)))).\_replace(this.\$r \rightarrow 0
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs))
heap_{funcstart\_1032,1}, this.r.value(heapIs heap_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(\mathbf{heapIs} \$heap_{funcstart\_1032.1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}))
heap_{funcstart\_1032,1}.p1, 177).rem)))._replace(p2 \rightarrow (-35 * div(heapIs)))._replace(p2 \rightarrow (-35 * div(heapIs))))._replace(p2 \rightarrow (-35 * div(heapIs))))
heap_{funcstart\_1032,1}, this.r.value(heapIs heap_{funcstart\_1032,1}).p2,
(176).quot) + (172*div(\textbf{heapIs} \$heap_{funcstart\_1032,1}, \textbf{this}.\$r.\textbf{value}(\textbf{heapIs}))
heap_{funcstart_{1032.1}}.p2, 176).rem)))]
[61.14] heap_{funcend\_1032,1} == heap_{funcstart\_1032,1}._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
\theta_{funcstart\_1032,1}.p1, 177).rem)))).replace(this.r \rightarrow 0
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(\mathbf{heapIs} \ \$heap_{funcstart\_1032,1}, \ \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
\rho_{uncstart\_1032,1}.p1, 177).rem))._replace(p2 \rightarrow ((-35 * div(heapIs
\rho_{funcstart\_1032,1}, this. r.value(heapIs \rho_{funcstart\_1032,1}).p2,
176).quot) + (172 * div(\mathbf{heapIs} \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}))
\theta_{funcstart\_1032,1}.p2, 176).rem))))._replace(this.$r \rightarrow
this.$r.value(heapIs \rho_{tuncstart\_1032.1})._replace(p1 \rightarrow ((-2 * div(heapIs
\$heap_{funcstart\_1032,1},\, \textbf{this.}\$r.\textbf{value}(\textbf{heapIs}\,\,\$heap_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
\text{Sheap}_{funcstart\_1032.1}.p1, 177).rem)))._replace(p2 \rightarrow ((-35 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p2,
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176).quot) + (172 * \text{div}(\text{heapIs } \text{heap}_{funcstart\_1032,1}, \text{this.} \text{$r.value}(\text{heapIs}))
heap_{funcstart\_1032,1}.p2, 176).rem)))._replace(p3 \rightarrow
asType<P3Type>((30323 *
asType<int>(static_cast<integer>(static_cast<signed
int>(operator^*(heapIs \$heap_{funcstart\_1032,1}.\_replace(this.\$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs heapIs f_{uncstart_1032,1}, this. r.value(heapIs)
\theta_{funcstart\_1032,1}.p1, 177).rem)))).\_replace(this.\$r \rightarrow 0
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs \rho_{funcstart\_1032,1}, this.r.value(heapIs)
\theta_{funcstart\_1032,1}, this.r.value(heapIs \theta_{funcstart\_1032,1}).p2,
176).quot) + (172 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
\theta_{funcstart\_1032,1}.p2, 176).rem)), this).p3) < (int)0))) + temp3)))
→ [expand definition of operator '*' in class 'pointer' at built in declaration]
[61.15] heap_{funcend\_1032.1} == heap_{funcstart\_1032.1}._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs))
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs $heap<sub>funcstart_1032.1</sub>, this.$r.value(heapIs
\theta_{funcstart\_1032,1}.p1, 177).rem)))).\_replace(this.\$r \rightarrow 0
\textbf{this.\$r.value}(\textbf{heapIs}~\$ heap_{funcstart\_1032,1}).\_\textbf{replace}(p1 \rightarrow ((-2~*div(\textbf{heapIs})))))
\rho_{funcstart\_1032,1}, this.\r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{heap}_{funcstart\_1032.1}, \text{this.} \text{$r.value}(\text{heapIs}))
heap_{funcstart\_1032,1}.p1, 177).rem))._replace(p2 \rightarrow ((-35 * div(heapIs)
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p2,
176).quot) + (172 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
\theta_{funcstart\_1032,1}.p2, 176).rem))))._replace(this.$r \rightarrow
this.$r.value(heapIs p_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\$heap_{funcstart\_1032,1},\, \textbf{this}.\$r.\textbf{value}(\textbf{heapIs}\,\,\$heap_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs $heap<sub>funcstart_1032,1</sub>, this.$r.value(heapIs
\rho_{funcstart\_1032,1}.p1, 177).rem)._replace\rho_{funcstart\_1032,1}.p1, 177).rem)._replace
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p2,
176).quot) + (172 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.} \text{\$r.value}(\text{heapIs}))
\theta_{funcstart\_1032,1}.p2, 176).rem))).\_replace(p3 \rightarrow
asType<P3Type>((30323 *
asType < int > (static\_cast < integer > (static\_cast < signed)
\mathbf{int}{>}(\mathbf{this.\$r.value}(\mathbf{heapIs}\ \$\mathbf{heap}_{funcstart\_1032,1}.\_\mathbf{replace}(\mathbf{this.\$r}\ \rightarrow\ 
this.$r.value(heapIs $heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs)).
\rho_{tuncstart\_1032.1}, this.r.value(heapIs \rho_{tuncstart\_1032.1}).p1,
177).quot) + (171 * div(heapIs \rho_{funcstart\_1032,1}, this.r.value(heapIs)
\label{eq:continuous_function} $ \text{heap}_{funcstart\_1032,1} \text{.p1, 177}.rem)))).\_\textbf{replace}(\textbf{this}.\$r \rightarrow
this.$r.value(heapIs $heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
```

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177).quot) + (171 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
\rho_{funcstart\_1032,1}.p1, 177).rem)._replace\rho_{funcstart\_1032,1}.p1, 177).rem)._replace
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p2,
176).quot) + (172 * div(heapIs $heap<sub>funcstart_1032,1</sub>, this.$r.value(heapIs
→ [evaluate dereferenced pointer into modified heap]
[61.16] heap_{funcend\_1032,1} == heap_{funcstart\_1032,1}._replace(this.r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs $heap<sub>funcstart 1032.1</sub>, this.$r.value(heapIs
\theta_{funcstart, 1032.1}.p1, 177.rem)))._replace(this.$r \rightarrow
\textbf{this.\$r.value}(\textbf{heapIs}~\$ heap_{funcstart\_1032,1}).\_\textbf{replace}(p1 \rightarrow ((-2~*div(\textbf{heapIs})))))
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
\rho_{uncstart\_1032,1}.p1, 177).rem))).\_replace(p2 \rightarrow ((-35 * div(heapIs)))._replace(p2 \rightarrow ((-35 * div(heapIs))))._replace(p3 + div(heapIs)))
\rho_{funcstart_1032,1}, this.r.value(heapIs \rho_{funcstart_1032,1}).p2,
176).quot) + (172 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.} \text{\$r.value}(\text{heapIs}))
\theta_{funcstart\_1032,1}.p2, 176).rem))))._replace(this.$r \rightarrow
this.$r.value(heapIs \rho_{tuncstart\_1032.1})._replace(p1 \rightarrow ((-2 * div(heapIs
\$heap_{funcstart\_1032,1},\, \textbf{this.}\$r.\textbf{value}(\textbf{heapIs}\,\,\$heap_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs $heap_{tuncstart\_1032.1}, this.$r.value(heapIs
\$heap_{funcstart\_1032,1}).p1,\ 177).rem))).\_\mathbf{replace}(p2 \to ((-35\ *\ div(\mathbf{heapIs}
\rho_{funcstart\_1032,1}, this.\r.value(heapIs \rho_{funcstart\_1032,1}).p2,
176).quot) + (172 * div(\mathbf{heapIs} \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}))
\theta_{funcstart\_1032,1}.p2, 176).rem))).\_replace(p3 \rightarrow
asType<P3Type>((30323 *
as Type < int > (static\_cast < integer > (static\_cast < signed\ int > (([this.\$r])))) \\
== this.$r]: this.$r.value(heapIs \rho_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2
* div(\mathbf{heapIs} \ \$heap_{funcstart\_1032,1}, \ \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
\text{Sheap}_{funcstart\_1032,1}.p1, 177).quot) + (171 * div(heapIs \text{Sheap}_{funcstart\_1032,1},
this.r.value(heapIs \ heap_{funcstart\_1032.1}).p1, 177).rem))).\_replace(p2 \rightarrow
(-35 * div(heapIs heap_{funcstart\_1032,1}, this.$r.value(heapIs
\text{Sheap}_{funcstart\_1032.1}, p2, 176).quot) + (172 * div(heapIs \text{Sheap}_{funcstart\_1032.1},
this.$r.value(heapIs heap_{funcstart\_1032,1}).p2, 176).rem)), []:
this.$r.value(heapIs \rho_{funcstart\_1032,1}._replace(this.$r \rightarrow
this.$r.value(heapIs $heap_{funcstart\_1032,1})._replace(p1 \rightarrow (-2 * div(heapIs
\rho_{tuncstart_{1032.1}}, this.$r.value(heapIs \rho_{tuncstart_{1032.1}}).p1,
177).quot) + (171 * div(heapIs \rho_{funcstart\_1032,1}, this.r.value(heapIs)
\text{Sheap}_{funcstart\_1032,1}.\text{p1}, 177).\text{rem}))))).\text{p3}) < (int)0))) + \text{temp3}))
→ [explicitly assert falsehood of skipped guards in subsequent guards]
[61.17] heap_{funcend\_1032,1} == heap_{funcstart\_1032,1}._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.\r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
```

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this.$r.value(heapIs \rho_{tuncstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs $heap<sub>funcstart_1032,1</sub>, this.$r.value(heapIs
\theta_{funcstart\_1032,1}.p1, 177).rem))._replace(p2 \rightarrow ((-35 * div(heapIs
$\text{heap}_{funcstart_1032,1}$, this.$\text{r.value}(\text{heapIs} $\text{heap}_{funcstart_1032,1}).p2$,
176).quot) + (172 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.} \text{\$r.value}(\text{heapIs}))
\rho_{tuncstart=1032.1}, p2, 176).rem))))._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart=1032,1}, this.r.value(heapIs \rho_{funcstart=1032,1}).p1,
177).quot) + (171 * div(\mathbf{heapIs} \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}))
\rho_{uncstart\_1032,1}.p1, 177).rem))._replace(p2 \rightarrow ((-35 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p2,
176).quot) + (172 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
\theta_{funcstart\_1032,1}.p2, 176).rem))).\_replace(p3 \rightarrow
asType<P3Type>((30323 *
asType < int > (static\_cast < integer > (static\_cast < signed\ int > (([this.\$r
== this.$r]: this.$r.value(heapIs \theta_{funcstart\_1032,1})._replace(p1 \theta ((-2)
* div(heapIs $heap<sub>funcstart_1032.1</sub>, this.$r.value(heapIs
\text{Sheap}_{funcstart\_1032,1}.p1, 177).quot) + (171 * div(heapIs \text{Sheap}_{funcstart\_1032,1},
this.r.value(heapIs \ heap_{funcstart\_1032.1}).p1, 177).rem))).\_replace(p2 \rightarrow
(-35 * div(heapIs \$heap_{funcstart\_1032,1}, this.\$r.value(heapIs
\text{Sheap}_{funcstart\_1032,1}.p2, 176).quot) + (172 * div(heapIs \text{Sheap}_{funcstart\_1032,1},
\mathbf{this.\$r.value(heapIs}\ \$heap_{funcstart\_1032,1}).p2,\ 176).rem)),\ [!(\mathbf{this.\$r}==
this.r.value(heapIs \ensuremath{\$}heap_{funcstart\_1032,1}.\_replace(this.\ensuremath{\$}r)
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow (-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
\text{Sheap}_{funcstart\_1032,1}.\text{p1}, 177).\text{rem}))))).\text{p3}) < (int)0))) + \text{temp3}))
\rightarrow [simplify]
[61.25] heap_{funcend\_1032,1} == heap_{funcstart\_1032,1}._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs \theta_{funcstart\_1032,1}, this.r.value(heapIs)
\theta_{uncstart\_1032,1}.p1, 177).rem)))).\_replace(this.\$r \rightarrow 0
\textbf{this.}\$r.\textbf{value}(\textbf{heapIs}~\$heap_{funcstart\_1032,1}).\_\textbf{replace}(p1 \rightarrow ((-2~*div(\textbf{heapIs})))))
\rho_{funcstart\_1032,1}, this. r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs \rho_{funcstart\_1032,1}, this.r.value(heapIs)
\rho_{uncstart\_1032,1}.p1, 177).rem))._replace(p2 \rightarrow ((-35 * div(heapIs
\rho_{funcstart\_1032,1}, this. r.value(heapIs \rho_{funcstart\_1032,1}).p2,
176).quot) + (172 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.}\text{\$r.value}(\text{heapIs}))
\theta_{funcstart\_1032,1}.p2, 176).rem)))).\_replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart_{1032,1}}, his. r.value(heapIs \rho_{funcstart_{1032,1}}).p1,
177).quot) + (171 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
```

 $\theta_{tuncstart_1032.1}.p1, 177).rem)))$._replace(this.\$r \rightarrow

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\$heap_{funcstart\_1032,1}).p1,\ 177).rem))).\_\mathbf{replace}(p2 \to ((-35\ *\ div(\mathbf{heapIs}
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p2,
176).quot) + (172 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.}\text{\$r.value}(\text{heapIs}))
\theta_{funcstart\_1032,1}.p2, 176).rem))._replace(p3 \rightarrow
asType<P3Type>((30323 * asType<int>(static_cast<integer>(0 <
-this.r.value(heapIs heap_{funcstart\_1032,1}.p3))) + temp3)))
\rightarrow [from term 40.0, literala < -this.$r.value(heapIs $heap_{funcstart\_1032.1}).p3
is false whenever -2 < (0 + literala)
   Proof of rule precondition:
   [61.25.0] - 2 < (0 + 0)
   \rightarrow [simplify]
   [61.25.2] true
[61.26] heap_{funcend\_1032.1} == heap_{funcstart\_1032.1}._replace(this.r \rightarrow
this.$r.value(heapIs \rho_{tuncstart\_1032.1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.\r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs \$heap_{funcstart\_1032,1}, this.\$r.value(heapIs))
\theta_{funcstart\_1032,1}.p1, 177).rem)))).\_replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\$heap_{funcstart\_1032,1},\, \textbf{this}.\$r.\textbf{value}(\textbf{heapIs}\,\,\$heap_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
\rho_{uncstart\_1032,1}.p1, 177).rem))._replace(p2 \rightarrow ((-35 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p2,
176).quot) + (172 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.} \text{\$r.value}(\text{heapIs}))
\theta_{funcstart\_1032,1}.p2, 176).rem)))).replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032.1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart_1032,1}, this.r.value(heapIs \rho_{funcstart_1032,1}).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.}\text{\$r.value}(\text{heapIs}))
\theta_{funcstart\_1032,1}.p1, 177).rem))._replace(p2 \rightarrow ((-35 * div(heapIs
\rho_{funcstart\_1032,1}, this. r.value(heapIs \rho_{funcstart\_1032,1}).p2,
176).quot) + (172 * div(\mathbf{heapIs} \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}))
heap_{funcstart\_1032.1}.p2, 176).rem))._replace(p3 \rightarrow
asType<P3Type>((30323 * asType<int>(static_cast<integer>(false)))
+ \text{ temp3})))
\rightarrow [simplify]
[61.27] heap_{funcend\_1032,1} == heap_{funcstart\_1032,1}._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs))
\rho_{funcstart\_1032,1}, this.\r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs \rho_{funcstart\_1032,1}, this.r.value(heapIs)
\theta_{funcstart\_1032,1}.p1, 177).rem)))).\_replace(this.\$r \rightarrow 0
this.$r.value(heapIs \rho_{uncstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart_1032,1}, this. r.value(heapIs \rho_{funcstart_1032,1}).p1,
177).quot) + (171 * div(heapIs $heap<sub>funcstart_1032,1</sub>, this.$r.value(heapIs
```

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\theta_{funcstart\_1032,1}.p1, 177).rem))).\_replace(p2 \rightarrow ((-35 * div(heapIs)))._replace(p2 \rightarrow ((-35 * div(heapIs))))._replace(p3 + div(heapIs)))
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p2,
176).quot) + (172 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.}\text{\$r.value}(\text{heapIs}))
\theta_{funcstart\_1032,1}.p2, 176).rem)))).\_replace(this.\$r \rightarrow 0
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032.1}, \text{this.} \text{\$r.value}(\text{heapIs}))
\rho_{uncstart\_1032,1}.p1, 177).rem))._replace(p2 \rightarrow ((-35 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p2,
176).quot) + (172 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
heap_{funcstart\_1032,1}.p2, 176).rem)))._replace(p3 \rightarrow
asType<P3Type>((30323 * asType<int>(([false]: 1, []: 0))) + temp3)))
→ [explicitly assert falsehood of skipped guards in subsequent guards]
[61.28] heap_{funcend\_1032,1} == heap_{funcstart\_1032,1}._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart_1032,1}, this.r.value(heapIs \rho_{funcstart_1032,1}).p1,
177).quot) + (171 * div(\mathbf{heapIs} \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}))
\theta_{funcstart\_1032,1}.p1, 177).rem))))._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\$heap_{funcstart\_1032,1},\, \textbf{this.}\$r.\textbf{value}(\textbf{heapIs}\,\,\$heap_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs $heap<sub>funcstart_1032.1</sub>, this.$r.value(heapIs
\$heap_{funcstart\_1032,1}).p1,\ 177).rem))).\_\mathbf{replace}(p2 \to ((-35\ *\ div(\mathbf{heapIs}
\rho_{funcstart\_1032,1}, this.\r.value(heapIs \rho_{funcstart\_1032,1}).p2,
176).quot) + (172 * div(\mathbf{heapIs} \ \$heap_{funcstart\_1032,1}, \ \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
\rho_{tuncstart_1032,1}.p2, 176).rem)))._replace(this.$r \rightarrow
this.$r.value(heapIs p_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
\rho_{uncstart\_1032,1}.p1, 177).rem))._replace(p2 \rightarrow ((-35 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p2,
176).quot) + (172 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
heap_{funcstart\_1032,1}.p2, 176).rem)))._replace(p3 \rightarrow
asType<P3Type>((30323 * asType<int>(([false]: 1, [true]: 0))) +
temp3)))
\rightarrow [simplify]
[61.31] heap_{funcend\_1032,1} == heap_{funcstart\_1032,1}._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.}\text{\$r.value}(\text{heapIs}))
\theta_{funcstart\_1032,1}.p1, 177).rem)))).replace(this.r \rightarrow 0
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
$\text{heap}_{funcstart_1032.1}$, this.$\text{r.value}(\text{heapIs} \text{$heap}_{funcstart_1032.1}).p1,
177).quot) + (171 * div(heapIs $heap<sub>funcstart_1032.1</sub>, this.$r.value(heapIs
\rho_{funcstart\_1032,1}.p1, 177).rem))._replace(p2 \rightarrow ((-35 * div(heapIs
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\rho_{funcstart=1032,1}, this.r.value(heapIs \rho_{funcstart=1032,1}).p2,
176).quot) + (172 * div(heapIs \theta), this.$r.value(heapIs
\theta_{funcstart\_1032,1}.p2, 176).rem)))._replace(this.$r \rightarrow
this.$r.value(heapIs \frac{1}{2} heap\frac{1}{2} line \frac{1}{2} heap\frac{1}{2} heap\frac{1}{2
\$heap_{funcstart\_1032,1},\, \textbf{this}.\$r.\textbf{value}(\textbf{heapIs}\,\,\$heap_{funcstart\_1032.1}).p1,
177).quot) + (171 * div(heapIs $heap<sub>funcstart_1032,1</sub>, this.$r.value(heapIs
\rho_{uncstart\_1032,1}.p1, 177).rem))).\_replace(p2 \rightarrow ((-35 * div(heapIs)))._replace(p2 \rightarrow ((-35 * div(heapIs))))._replace(p3 + div(heapIs)))
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p2,
176).quot) + (172 * div(heapIs $heap<sub>funcstart_1032,1</sub>, this.$r.value(heapIs
\rho_{funcstart\_1032,1}.p2, 176).rem))._replace(p3 \rightarrow asType<P3Type>(0 +
temp3)))
\rightarrow [from term 58.20, temp3 is equal to (-63 * div(heapIs $heap_{funcstart\_1032.1},
div(heapIs $heap_{tuncstart 1032.1}, this.$r.value(heapIs
heap_{funcstart_{1032,1}}.p3, 178.rem
[61.32] heap_{funcend\_1032,1} == heap_{funcstart\_1032,1}._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs $heap_{funcstart\_1032,1}, this.$r.value(heapIs
\label{eq:continuous_function} $ \text{heap}_{funcstart\_1032,1} . \text{p1}, 177).rem)))).$ \_\textbf{replace}(\textbf{this}.\$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032.1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{tuncstart\_1032.1}, this.r.value(heapIs \rho_{tuncstart\_1032.1}).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.} \text{\$r.value}(\text{heapIs}))
\theta_{uncstart_1032,1}.p1, 177).rem)))._replace(p2 \rightarrow ((-35 * div(heapIs)))._replace(p2 \rightarrow ((-35 * div(heapIs))))._replace(p3 + div(heapIs)))
\rho_{tuncstart=1032.1}, this.r.value(heapIs \rho_{tuncstart=1032.1}).p2,
(176).\text{quot} + (172 * \text{div}(\text{heapIs } \text{heap}_{funcstart\_1032,1}, \text{this.}\text{$r.value}(\text{heapIs}))
\theta_{funcstart\_1032,1}.p2, 176).rem))))._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(\mathbf{heapIs} \$ heap_{funcstart\_1032,1}, \mathbf{this}.\$ r. \mathbf{value}(\mathbf{heapIs})
\rho_{funcstart\_1032,1}.p1, 177).rem)._replace(p2 \rightarrow ((-35 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p2,
176).quot) + (172 * div(heapIs $heap_{funcstart\_1032,1}, this.$r.value(heapIs
\label{eq:linear_funcstart_1032,1} $$ \text{heap}_{funcstart_1032,1}.$p2, 176).$rem))).$$ \textbf{_replace}(p3 \rightarrow \textbf{asType} < P3Type > (0 + 1)).$$
((-63 * div(heapIs \$heap_{funcstart\_1032,1}, this.\$r.value(heapIs
\text{Sheap}_{funcstart\_1032,1}.p3, 178).quot) + (170 * div(heapIs \text{Sheap}_{funcstart\_1032,1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p3, 178).rem))))
\rightarrow [simplify]
[61.35] heap_{funcend\_1032,1} == heap_{funcstart\_1032,1}._replace(this.$r \rightarrow
\textbf{this.\$r.value}(\textbf{heapIs}~\$ heap_{funcstart\_1032,1}).\_\textbf{replace}(p1 \rightarrow ((-2~*div(\textbf{heapIs})))))
\$heap_{funcstart\_1032,1},\, \textbf{this}.\$r.\textbf{value}(\textbf{heapIs}\,\,\$heap_{funcstart\_1032,1}).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.}\text{\$r.value}(\text{heapIs}))
\theta_{funcstart\_1032,1}.p1, 177).rem)))).\_replace(this.\$r \rightarrow 0
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
```

```
\rho_{funcstart_1032,1}, this.\r.value(heapIs \rho_{funcstart_1032,1}).p1,
177).quot) + (171 * div(heapIs \theta_{funcstart\_1032,1}, this.r.value(heapIs)
\rho_{uncstart\_1032,1}.p1, 177).rem))).\_replace(p2 \rightarrow ((-35 * div(heapIs)))._replace(p2 \rightarrow ((-35 * div(heapIs))))._replace(p3 + div(heapIs)))
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p2,
176).quot) + (172 * div(heapIs heapIs = f_{uncstart\_1032.1}, this.r.value(heapIs)
\theta_{funcstart\_1032,1}.p2, 176).rem)))).\_replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.} \text{\$r.value}(\text{heapIs}))
\rho_{uncstart_1032,1}.p1, 177).rem))._replace(p2 \rightarrow ((-35 * div(heapIs
\rho_{funcstart\_1032,1}, this. r.value(heapIs \rho_{funcstart\_1032,1}).p2,
176).quot) + (172 * div(heapIs heapIs = 1032,1, this.r.value(heapIs)
\rho_{funcstart\_1032,1}.p2, 176).rem))._replace(p3 \rightarrow ((-63 * div(heapIs
\rho_{uncstart\_1032,1}, this.r.value(heapIs \rho_{uncstart\_1032,1}).p3,
178).quot) + (170^{\circ} * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.} \text{\$r.value}(\text{heapIs}))
heap_{funcstart\_1032,1}.p3, 178.rem)))
[Take given term]
[62.0] (asType<double>(static_cast<real>(operator*(heapIs
\theta_{funcend\_1032,1}, this).p1)) /
\mathbf{asType} < \mathbf{double} > (\mathbf{static\_cast} < \mathbf{real} > (\$ \operatorname{heap}_{funcend\_1032,1}.\operatorname{M1}))) == \operatorname{raux1}
\rightarrow [from term 61.35, $heap<sub>funcend_1032,1</sub> is equal to
\$heap_{funcstart\_1032,1}.\_\textbf{replace}(\textbf{this}.\$r \rightarrow \textbf{this}.\$r.\textbf{value}(\textbf{heapIs}
heap_{funcstart\_1032,1}._replace(p1 \rightarrow ((-2 * div(heapIs heap_{funcstart\_1032,1}),
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177).quot) + (171 *
div(heapIs $heap_funcstart_1032.1, this.$r.value(heapIs
heap_{funcstart_1032,1}.p1, 177).rem)))._replace(this.$r \rightarrow
this.$r.value(heapIs $heap_{funcstart\_1032,1}).\_replace(p1 \rightarrow ((-2 * div(heapIs
heap_{funcstart\_1032,1}, this.r.value(heapIs heap_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(\mathbf{heapIs} * heap_{funcstart\_1032,1}, \mathbf{this}. \$r. \mathbf{value}(\mathbf{heapIs} * heap_{funcstart\_1032,1}, \mathbf{this}. \$r. \mathbf{value}(\mathbf{heap}))
\rho_{funcstart\_1032,1}.p1, 177).rem))._replace\rho_{funcstart\_1032,1}.p1, 177).rem))
heap_{funcstart\_1032,1}, this.r.value(heapIs heap_{funcstart\_1032,1}).p2,
(176).quot) + (172 * div(heapIs $heap_{funcstart\_1032,1}, this.$r.value(heapIs)
heap_{funcstart\_1032,1}.p2, 176).rem)))._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
$heap_{tuncstart_1032.1}$, this.$r.value(heapIs $heap_{tuncstart_1032.1}).p1,
177).quot) + (171 * div(\mathbf{heapIs} \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}))
\rho_{funcstart\_1032.1}.p1, 177).rem))._replace\rho_{funcstart\_1032.1}.p1, 177).rem))
$heap_funcstart_1032,1, this.$r.value(heapIs $heap_funcstart_1032,1).p2,
(176).quot) + (172 * div(\mathbf{heapIs} \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}))
heap_{funcstart\_1032,1}.p2, 176).rem)))._replace(p3 \rightarrow (-63 * div(heapIs)))
heap_{funcstart\_1032,1}, this.r.value(heapIs heap_{funcstart\_1032,1}).p3,
178).quot) + (170 * div(\textbf{heapIs } \$heap_{funcstart\_1032,1}, \textbf{this.}\$r.\textbf{value(heapIs}))
heap_{funcstart\_1032,1}.p3, 178).rem)))]
[62.1] (asType<double>(static_cast<real>(operator*(heapIs
```

```
\rho_{tuncstart=1032.1}.-replace(this.$r \rightarrow this.$r.value(heapIs)
\rho_{tuncstart\_1032,1}._replace(p1 \rightarrow ((-2 * div(heapIs \rho_{tuncstart\_1032,1})
this.$r.value(heapIs heap_{funcstart\_1032.1}).p1, 177).quot) + (171 *
div(\mathbf{heapIs} \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
\theta_{funcstart\_1032,1}.p1, 177).rem))))._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032.1}, \text{this.} \text{\$r.value}(\text{heapIs}))
\rho_{uncstart\_1032,1}.p1, 177).rem))._replace(p2 \rightarrow ((-35 * div(heapIs
$heap_funcstart_1032,1, this.$r.value(heapIs $heap_funcstart_1032,1).p2,
176).quot) + (172 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.} \text{\$r.value}(\text{heapIs}))
\theta_{funcstart\_1032,1}.p2, 176).rem))))._replace(this.$r \rightarrow
this.$r.value(heapIs $heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs)).
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(\mathbf{heapIs} \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}))
\rho_{funcstart\_1032,1}.p1, 177).rem))._replace(p2 \rightarrow ((-35 * div(heapIs
\rho_{tuncstart\_1032.1}, this.r.value(heapIs \rho_{tuncstart\_1032.1}).p2,
176).quot) + (172 * div(\mathbf{heapIs} \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}))
\rho_{uncstart_1032.1}, p2, 176).rem)))._replace(p3 \rightarrow (-63 * div(heapIs
$heap_tuncstart_1032.1, this.$r.value(heapIs $heap_tuncstart_1032.1).p3,
178).quot) + (170 * \text{div}(\text{heapIs } \text{heap}_{funcstart\_1032,1}, \text{this.} \text{$r.value}(\text{heapIs}))
heap_{funcstart\_1032,1}.p3, 178).rem)), this).p1)) /
\mathbf{asType} < \mathbf{double} > (\mathbf{static\_cast} < \mathbf{real} > (\$ \operatorname{heap}_{funcend\_1032,1}.\operatorname{M1}))) == \operatorname{raux1}
→ [expand definition of operator '*' in class 'pointer' at built in declaration]
[62.2] (asType<double>(static_cast<real>(this.$r.value(heapIs
\rho_{funcstart\_1032,1}.\_replace(this.\$r \rightarrow this.\$r.value(heapIs)
heap_{funcstart\_1032,1}._replace(p1 \rightarrow ((-2 * div(heapIs heap_{funcstart\_1032,1}),
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177).quot) + (171 *
div(\mathbf{heapIs} \$ heap_{funcstart\_1032.1}, \mathbf{this.}\$r.\mathbf{value}(\mathbf{heapIs})
\theta_{tuncstart\_1032,1}.p1, 177).rem)))).\_replace(this.\$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs))
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{heap}_{funcstart\_1032,1}, \text{this.} \text{$r.value}(\text{heapIs}))
\$heap_{funcstart\_1032,1}).p1,\ 177).rem))).\_\mathbf{replace}(p2 \to ((-35\ *\ div(\mathbf{heapIs})))).
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p2,
176).quot) + (172 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
\theta_{funcstart\_1032,1}.p2, 176).rem))))._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\$heap_{funcstart\_1032,1},\, \textbf{this.}\$r.\textbf{value}(\textbf{heapIs}\,\,\$heap_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs $heap_{tuncstart\_1032.1}, this.$r.value(heapIs
\$heap_{funcstart\_1032,1}).p1,\ 177).rem))).\_\mathbf{replace}(p2 \to ((-35\ *\ div(\mathbf{heapIs}
\rho_{funcstart\_1032,1}, this.\r.value(heapIs \rho_{funcstart\_1032,1}).p2,
176).quot) + (172 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
\rho_{funcstart\_1032.1}.p2, 176).rem))._replace(p3 \rightarrow ((-63 * div(heapIs
\rho_{funcstart\_1032,1}, this. r.value(heapIs \rho_{funcstart\_1032,1}).p3,
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178).quot) + (170 * \text{div}(\text{heapIs } \text{heap}_{funcstart\_1032,1}, \text{this.} \text{$r.value}(\text{heapIs}))
heap_{funcstart_1032,1}.p3, 178.rem)))).p1)) /
\mathbf{asType} < \mathbf{double} > (\mathbf{static\_cast} < \mathbf{real} > (\$ \operatorname{heap}_{funcend\_1032,1}.\operatorname{M1}))) == \operatorname{raux1}
→ [evaluate dereferenced pointer into modified heap]
[62.3] (asType<double>(static_cast<real>(([this.$r == this.$r]:
this.$r.value(heapIs \rho_{tuncstart\_1032.1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{heap}_{funcstart\_1032,1}, \text{this.} \text{$r.value}(\text{heapIs}))
\rho_{tuncstart\_1032,1}.p1, 177).rem))._replace(p2 \rightarrow ((-35 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p2,
176).quot) + (172 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.}\text{\$r.value}(\text{heapIs}))
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p3,
178).quot) + (170 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
\theta_{funcstart=1032,1}.p3, 178.rem), []: this.r.value(heapIs)
\rho_{funcstart\_1032,1}.\_replace(this.\$r \rightarrow this.\$r.value(heapIs)
heap_{funcstart\_1032,1}._replace(p1 \rightarrow ((-2 * div(heapIs heap_{funcstart\_1032,1}),
this.r.value(heapIs \ heap_{funcstart\_1032.1}).p1, 177).quot) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_1032,1}, \ \mathbf{this}.\$ r. \mathbf{value}(\mathbf{heapIs}
\theta_{tuncstart\_1032.1}.p1, 177).rem)))).\_replace(this.\$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.} \text{\$r.value}(\text{heapIs}))
\$heap_{funcstart\_1032,1}).p1,\ 177).rem))).\_\textbf{replace}(p2 \rightarrow (-35\ *\ div(\textbf{heapIs}
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p2,
(176).\text{quot} + (172 * \text{div}(\text{heapIs } \text{heap}_{funcstart\_1032,1}, \text{this.}\text{r.value}(\text{heapIs}))
heap_{funcstart\_1032,1}.p2, 176).rem)))).p1)) /
\mathbf{asType} < \mathbf{double} > (\mathbf{static\_cast} < \mathbf{real} > (\$ \operatorname{heap}_{funcend\_1032,1}.\operatorname{M1}))) == \operatorname{raux1}
→ [explicitly assert falsehood of skipped guards in subsequent guards]
[62.4] (asType<double>(static_cast<real>(([this.$r == this.$r]:
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(\mathbf{heapIs} \ \$heap_{funcstart\_1032,1}, \ \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
\rho_{funcstart\_1032,1}.p1, 177).rem)._replace\rho_{funcstart\_1032,1}.p1, 177).rem)._replace
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p2,
176).quot) + (172 * div(heapIs \rho_{funcstart\_1032,1}, this.r.value(heapIs)
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p3,
178).quot) + (170 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.}\text{\$r.value}(\text{heapIs}))
heap_{funcstart_1032,1}.p3, 178.rem), [!(this.$r == this.$r)]:
this.$r.value(heapIs \rho_{tuncstart\_1032.1}._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{tuncstart_{1032.1}}, this. r.value(heapIs \rho_{tuncstart_{1032.1}}).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.} \text{\$r.value}(\text{heapIs}))
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\theta_{funcstart=1032.1}.p1, 177).rem)))._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs $heap<sub>funcstart_1032,1</sub>, this.$r.value(heapIs
\rho_{funcstart\_1032,1}.p1, 177).rem))).\_replace(p2 \rightarrow (-35 * div(heapIs))).
$heap_funcstart_1032,1, this.$r.value(heapIs $heap_funcstart_1032,1).p2,
176).quot) + (172 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
heap_{funcstart_{1032,1}}.p2, 176).rem)))).p1)) /
asType < double > (static\_cast < real > (\$heap_{funcend\_1032,1}.M1))) == raux1
[62.11] (real((-2 * div(heapIs $heap_{funcstart\_1032,1}, this.$r.value(heapIs )]
\text{Sheap}_{funcstart\_1032.1}, p1, 177).quot) + (171 * div(heapIs \text{Sheap}_{funcstart\_1032.1},
this.r.value(heapIs $heap_{funcstart\_1032.1}).p1, 177).rem)) /
asType < double > (static\_cast < real > (\$heap_{funcend\_1032.1}.M1))) == raux1
\rightarrow [from term 61.35, $heap_{funcend\_1032,1}$ is equal to
\$heap_{funcstart\_1032,1}.\_\textbf{replace}(\textbf{this}.\$r \rightarrow \textbf{this}.\$r.\textbf{value}(\textbf{heapIs}
heap_{funcstart\_1032.1}._replace(p1 \rightarrow ((-2 * div(heapIs \$heap_{funcstart\_1032.1},
this.$r.value(heapIs $heap_{funcstart_1032.1}).p1, 177).quot) + (171 *
div(heapIs $heap_{tuncstart 1032.1}, this.$r.value(heapIs
\label{eq:continuous_function} $$ heap_{funcstart\_1032,1}.p1,\ 177).rem)))).$$ \_{\bf replace(this.\$r} \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
heap_{funcstart\_1032,1}, this.r.value(heapIs heap_{funcstart\_1032,1}).p1,
 177).quot) + (171 * div(heapIs heapIs = 1032,1, this.r.value(heapIs
\rho_{tuncstart\_1032,1}.p1, 177).rem))._replace\rho_{tuncstart\_1032,1}.p1, 177).rem))
$heap_funcstart_1032,1, this.$r.value(heapIs $heap_funcstart_1032,1).p2,
 (176).quot) + (172 * div(heapIs $heap_{funcstart\_1032,1}, this.$r.value(heapIs)]
heap_{funcstart\_1032,1}.p2, 176).rem)))).replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
heap_{funcstart\_1032,1}, this.r.value(heapIs heap_{funcstart\_1032,1}).p1,
 177).quot) + (171 * div(\mathbf{heapIs} \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}))
\rho_{funcstart\_1032,1}.p1, 177).rem))._replace(p2 \rightarrow ((-35 * div(\mathbf{heapIs})))._replace(p2 \rightarrow ((-35 * div(\mathbf{heapIs})))
heap_{funcstart\_1032,1}, this.r.value(heapIs heap_{funcstart\_1032,1}).p2,
 176).quot) + (172 * div(\textbf{heapIs } \$heap_{funcstart\_1032,1}, \textbf{this.}\$r.\textbf{value}(\textbf{heapIs}))
heap_{funcstart\_1032,1}.p2, 176).rem))).\_replace(p3 \rightarrow (-63 * div(heapIs))).
heap_{funcstart\_1032.1}, this.r.value(heapIs heap_{funcstart\_1032.1}).p3,
 178).quot) + (170 * div(heapIs $heap_{tuncstart\_1032.1}, this.$r.value(heapIs
heap_{funcstart_{-1032,1}}.p3, 178).rem)))]
\textit{[62.12]} \; (\textbf{real}((-2 \; * \; \text{div}(\textbf{heapIs} \; \$ \text{heap}_{funcstart\_1032,1}, \; \textbf{this}.\$ \textbf{r.value}(\textbf{heapIs} \;
\label{eq:heap_funcstart_1032,1} \$ \operatorname{heap}_{funcstart_1032,1}. \operatorname{pl}, \ 177).\operatorname{quot}) + (171 * \operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart_1032,1}, \\
\mathbf{this.\$r.value(heapIs}~\$ \mathrm{heap}_{funcstart\_1032,1}).\mathrm{p1},~177).\mathrm{rem}))~/
\mathbf{asType} < \mathbf{double} > (\mathbf{static\_cast} < \mathbf{real}) \\ (\$ \mathbf{heap}_{funcstart\_1032,1}. \_ \mathbf{replace} \\ (\mathbf{this}.\$ \mathbf{real}) \\ (\$ \mathbf{
\rightarrow this.$r.value(heapIs $heap_{tuncstart\_1032.1})._replace(p1 \rightarrow ((-2 *
div(\mathbf{heapIs} \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
\text{Sheap}_{funcstart\_1032.1}.p1, 177).quot) + (171 * div(heapIs \text{Sheap}_{funcstart\_1032.1},
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this.r.value(heapIs \heap_{funcstart\_1032,1}).p1, 177).rem)))._replace(this.r.value(heapIs \heap_{funcstart\_1032,1}).p1, 177).rem)))
\rightarrow this.$r.value(heap
Is \rho_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 *
div(\mathbf{heapIs} \$ heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
\text{Sheap}_{funcstart\_1032,1}.p1, 177).quot) + (171 * div(heapIs \text{Sheap}_{funcstart\_1032,1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177).rem))).\_replace(p2 \rightarrow
((-35 * div(\mathbf{heapIs} \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}))
\rho_{tuncstart_{1032.1}, p2, 176} = 176 \cdot 176 \cdot 172 \cdot 176 \cdot 172 \cdot 176 \cdot 
\mathbf{this.\$r.value(heapIs}\ \$heap_{funcstart\_1032,1}).p2,\ 176).rem)))). \_\mathbf{replace(this.\$r}
\rightarrow this.$r.value(heapIs $heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 *
div(\mathbf{heapIs} \$ heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
\text{Sheap}_{funcstart\_1032,1}.p1, 177).quot) + (171 * div(heapIs \text{Sheap}_{funcstart\_1032,1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177).rem))).\_replace(p2 \rightarrow
((-35 * div(\mathbf{heapIs} \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}))
\text{Sheap}_{funcstart\_1032,1}.p2, 176).quot) + (172 * div(heapIs \text{Sheap}_{funcstart\_1032,1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p2, 176).rem))).\_replace(p3 \rightarrow
((-63 * div(\mathbf{heapIs} \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}))
\text{Sheap}_{funcstart\_1032.1}.p3, 178).quot) + (170 * div(heapIs \text{Sheap}_{funcstart\_1032.1},
this.r.value(heapIs \ heap_{funcstart\_1032.1}).p3, 178).rem))).M1))) == raux1
\rightarrow [const member of object with modified fields]
\textit{[62.15]} \; (\textbf{real}((-2 \; * \; \text{div}(\textbf{heapIs} \; \$ \text{heap}_{funcstart\_1032,1}, \; \textbf{this}.\$ \textbf{r.value}(\textbf{heapIs} \;
\text{Sheap}_{funcstart\_1032.1}.p1, 177).quot) + (171 * div(heapIs \text{Sheap}_{funcstart\_1032.1},
this.r.value(heapIs \ heap_{funcstart\_1032.1}).p1, 177).rem)) /
asType < double > (static\_cast < real > (\$heap_{funcstart\_1032.1}.M1))) == raux1
\rightarrow [const static or extern object]
\textit{[62.16]} \; (\textbf{real}((-2 \; * \; \text{div}(\textbf{heapIs} \; \$ \text{heap}_{funcstart\_1032,1}, \; \textbf{this}.\$ \textbf{r.value}(\textbf{heapIs} \;
\rho_{funcstart\_1032,1}.p1, 177).quot + (171 * div(heapIs $heap_{funcstart\_1032,1})
this.r.value(heapIs \ heap_{funcstart\_1032.1}).p1, 177).rem)) /
asType < double > (static\_cast < real > (\$heap_{init}.M1))) == raux1
\rightarrow [expand definition of constant 'M1' at prang.cpp (28,26)]
[62.17] (real((-2 * div(heapIs $heap_{funcstart\_1032,1}, this.$r.value(heapIs
\theta_{tuncstart_1032.1}, p1, 177).quot) + (171 * div(heapIs \theta_{tuncstart_1032.1},
this.r.value(heapIs \heap_{funcstart\_1032.1}).p1, 177).rem)) /
asType<double>(static_cast<real>((int)30269))) == raux1
\rightarrow [simplify]
[62.22] \ 0.0 == (-\text{raux}1 + (\text{real}((-2 * \text{div}(\text{heapIs } \$\text{heap}_{funcstart\_1032,1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177).quot) + (171 *
\label{eq:div_heapIs} $ \text{heap}_{funcstart\_1032,1}, \ \textbf{this}.\$r. \textbf{value} (\textbf{heapIs} \\
heap_{funcstart\_1032,1}.p1, 177).rem) / 30269.0)
[Take given term]
[63.0] (asType<double>(static_cast<real>(operator*(heapIs
heap_{funcend\_1032,1}, this).p2)) /
```

```
\rightarrow [from term 61.35, $heap<sub>funcend_1032,1</sub> is equal to
\$heap_{funcstart\_1032,1}.\_\textbf{replace}(\textbf{this}.\$r \rightarrow \textbf{this}.\$r.\textbf{value}(\textbf{heapIs}
heap_{funcstart\_1032.1}._replace(p1 \rightarrow ((-2 * div(heapIs $heap_{funcstart\_1032.1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177).quot) + (171 *
div(\mathbf{heapIs} \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
\theta_{funcstart\_1032,1}.p1, 177).rem)))).\_replace(this.\$r \rightarrow 0
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
heap_{funcstart\_1032,1}, this.r.value(heapIs heap_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(\mathbf{heapIs} \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}))
heap_{funcstart\_1032,1}.p1, 177).rem))._replace(p2 \rightarrow ((-35 * div(heapIs)))._replace
heap_{funcstart\_1032.1}, this.r.value(heapIs heap_{funcstart\_1032.1}).p2,
176).quot) + (172 * div(heapIs $heap_{tuncstart\_1032.1}, this.$r.value(heapIs
\theta_{tuncstart\_1032.1}.p2, 176).rem)))).\_replace(this.\$r \rightarrow 0
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
$heap_funcstart_1032,1, this.$r.value(heapIs $heap_funcstart_1032,1).p1,
177).quot) + (171 * div(\mathbf{heapIs} \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}))
\rho_{funcstart\_1032,1}.p1, 177).rem))._replace\rho_{funcstart\_1032,1}.p1, 177).rem))
heap_{funcstart\_1032,1}, this.r.value(heapIs heap_{funcstart\_1032,1}).p2,
176).quot) + (172 * div(heapIs $heap_{funcstart\_1032,1}, this.$r.value(heapIs
\$heap_{funcstart\_1032,1},\ \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}\ \$heap_{funcstart\_1032,1}).p3,
178).quot) + (170 * div(heapIs $heap_{tuncstart\_1032.1}, this.$r.value(heapIs
heap_{funcstart\_1032,1}.p3, 178).rem)))
[63.1] (asType<double>(static_cast<real>(operator*(heapIs
\$heap_{funcstart\_1032,1}.\_\textbf{replace}(\textbf{this}.\$\textbf{r} \rightarrow \textbf{this}.\$\textbf{r}.\textbf{value}(\textbf{heapIs}
heap_{funcstart\_1032,1}._replace(p1 \rightarrow ((-2 * div(heapIs heap_{funcstart\_1032,1}),
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177).quot) + (171 *
div(\mathbf{heapIs} \$ heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
\theta_{funcstart\_1032,1}.p1, 177).rem)))).\_replace(this.\$r \rightarrow 0
\textbf{this.}\$r.\textbf{value}(\textbf{heapIs}~\$heap_{funcstart\_1032,1}).\_\textbf{replace}(p1 \rightarrow ((-2~*div(\textbf{heapIs})))))
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{heap}_{funcstart\_1032,1}, \text{this.} \text{$r.value}(\text{heapIs}))
\rho_{funcstart\_1032,1}.p1, 177).rem))).\_replace(p2 \rightarrow ((-35 * div(heapIs)))._replace(p2 \rightarrow ((-35 * div(heapIs))))._replace(p3 + div(heapIs)))
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p2,
176).quot) + (172 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
\theta_{funcstart\_1032,1}.p2, 176).rem))))._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.\r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs $heap<sub>funcstart_1032.1</sub>, this.$r.value(heapIs
\$heap_{funcstart\_1032,1}).p1,\ 177).rem))).\_replace(p2 \rightarrow ((-35 * div(heapIs
\rho_{funcstart\_1032,1}, this.\r.value(heapIs \rho_{funcstart\_1032,1}).p2,
176).quot) + (172 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
\rho_{funcstart\_1032,1}.p2, 176).rem))._replace(p3 \rightarrow (-63 * div(heapIs)
\rho_{tuncstart\_1032,1}, this.r.value(heapIs \rho_{tuncstart\_1032,1}).p3,
```

 $asType < double > (static_cast < real > ($heap_{funcend_1032.1}.M2))) == raux2$

```
178).quot) + (170 * \text{div}(\text{heapIs } \text{heap}_{funcstart\_1032,1}, \text{this.} \text{$r.value}(\text{heapIs}))
\text{Sheap}_{funcstart\_1032,1}.p3, 178).rem)), this).p2)) /
\mathbf{asType} < \mathbf{double} > (\mathbf{static\_cast} < \mathbf{real} > (\$ \operatorname{heap}_{funcend\_1032,1}.\operatorname{M2}))) == \operatorname{raux2}
→ [expand definition of operator '*' in class 'pointer' at built in declaration]
[63.2] (asType<double>(static_cast<real>(this.$r.value(heapIs
\rho_{tuncstart\_1032.1}.-replace(this.r \to this.r.value(heapIs
\rho_{tuncstart\_1032,1}._replace(p1 \rightarrow ((-2 * div(heapIs \rho_{tuncstart\_1032,1}).
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177).quot) + (171 *
div(\mathbf{heapIs} \$ heap_{funcstart\_1032.1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
\theta_{funcstart, 1032.1}, p1, 177).rem))))._replace(this.r \rightarrow \theta_{funcstart, 1032.1}
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.} \text{\$r.value}(\text{heapIs}))
\rho_{funcstart\_1032,1}.p1, 177).rem))._replace(p2 \rightarrow ((-35 * div(heapIs
\$heap_{funcstart\_1032,1},\ \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}\ \$heap_{funcstart\_1032,1}).p2,
176).quot) + (172 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
\theta_{funcstart\_1032,1}.p2, 176).rem))))._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.\r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
\theta_{funcstart\_1032,1}.p1, 177).rem))._replace(p2 \rightarrow ((-35 * div(heapIs
\rho_{tuncstart\_1032.1}, this.r.value(heapIs \rho_{tuncstart\_1032.1}).p2,
176).quot) + (172 * div(\mathbf{heapIs} \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}))
\rho_{uncstart\_1032,1}.p2, 176).rem))._replace(p3 \rightarrow ((-63 * div(heapIs
\rho_{funcstart_1032,1}, this. r.value(heapIs \rho_{funcstart_1032,1}).p3,
178).quot) + (170 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.} \text{\$r.value}(\text{heapIs}))
heap_{funcstart\_1032,1}.p3, 178).rem)))).p2)) /
\mathbf{asType} < \mathbf{double} > (\mathbf{static\_cast} < \mathbf{real} > (\$ \operatorname{heap}_{funcend\_1032,1}.\operatorname{M2}))) == \operatorname{raux2}
→ [evaluate dereferenced pointer into modified heap]
[63.3] (asType<double>(static_cast<real>(([this.$r == this.$r]:
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(\mathbf{heapIs} \ \$heap_{funcstart\_1032,1}, \ \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
\rho_{funcstart\_1032,1}.p1, 177).rem)._replace\rho_{funcstart\_1032,1}.p1, 177).rem)._replace
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p2,
176).quot) + (172 * div(heapIs \rho_{funcstart\_1032,1}, this.r.value(heapIs)
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p3,
178).quot) + (170 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.}\text{\$r.value}(\text{heapIs}))
\theta_{funcstart_1032,1}.p3, 178).rem)), []: this.$r.value(heapIs)
\rho_{tuncstart\_1032.1}._replace(this.r \to this.r.value(heapIs)
\text{Sheap}_{funcstart\_1032.1})._replace(p1 \rightarrow ((-2 * div(heapIs \text{Sheap}_{funcstart\_1032.1}),
this.$r.value(heapIs heap_{funcstart\_1032,1}).p1, 177).quot) + (171 *
div(\mathbf{heapIs} \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
```

```
\theta_{funcstart=1032.1}.p1, 177).rem)))._replace(this.$r \rightarrow
this.$r.value(heapIs \frac{1}{2} heap\frac{1}{2} heap\frac{1}{2}
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs $heap<sub>funcstart_1032,1</sub>, this.$r.value(heapIs
\rho_{funcstart\_1032,1}.p1, 177).rem))._replace(p2 \rightarrow (-35 * div(heapIs
$heap_funcstart_1032,1, this.$r.value(heapIs $heap_funcstart_1032,1).p2,
176).quot) + (172 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
heap_{funcstart_{1032,1}}.p2, 176).rem)))).p2)) /
asType < double > (static\_cast < real > ($heap_{funcend\_1032.1}.M2))) == raux2
→ [explicitly assert falsehood of skipped guards in subsequent guards]
[63.4] (asType<double>(static_cast<real>(([this.$r == this.$r]:
\textbf{this.\$r.value}(\textbf{heapIs}~\$ heap_{funcstart\_1032,1}).\_\textbf{replace}(p1 \rightarrow ((-2~*div(\textbf{heapIs})))))
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
\rho_{uncstart\_1032,1}.p1, 177).rem))).\_replace(p2 \rightarrow ((-35 * div(heapIs)))._replace(p2 \rightarrow ((-35 * div(heapIs))))._replace(p3 + div(heapIs)))
\rho_{funcstart_1032,1}, this.r.value(heapIs \rho_{funcstart_1032,1}).p2,
176).quot) + (172 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.} \text{\$r.value}(\text{heapIs}))
\rho_{uncstart\_1032,1}.p2, 176).rem))._replace(p3 \rightarrow (-63 * div(heapIs
\label{eq:heapIs} \$ heap_{funcstart\_1032,1}, \ \mathbf{this}.\$ r. \mathbf{value} (\mathbf{heapIs} \ \$ heap_{funcstart\_1032,1}).p3,
178).quot) + (170 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.}\text{\$r.value}(\text{heapIs}))
\theta_{funcstart_{1032,1}}.p3, 178).rem), [!(this.$r == this.$r)]:
this.r.value(heapIs \ heap_{funcstart\_1032,1}.\_replace(this.\rdotsr) \rightarrow
this.$r.value(heapIs $heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs))._replace(p1 \rightarrow (-2 * div(heapIs))._r
\rho_{funcstart\_1032,1}, this.\r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.} \text{\$r.value}(\text{heapIs}))
\theta_{funcstart\_1032,1}.p1, 177).rem)))._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
\rho_{funcstart\_1032.1}.p1, 177).rem))._replace(p2 \rightarrow (-35 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p2,
176).quot) + (172 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.} \text{\$r.value}(\text{heapIs}))
\theta_{funcstart_{1032,1}}.p2, 176).rem)))).p2)) /
\mathbf{asType} < \mathbf{double} > (\mathbf{static\_cast} < \mathbf{real} > (\$ \operatorname{heap}_{funcend\_1032,1}.\operatorname{M2}))) == \operatorname{raux2}
[63.10] \; (\mathbf{real}((-35 \; * \; \mathrm{div}(\mathbf{heapIs} \; \$ \mathrm{heap}_{funcstart\_1032,1}, \; \mathbf{this}.\$ r. \mathbf{value}(\mathbf{heapIs} \; \mathsf{heapIs})))) \\
\text{Sheap}_{funcstart\_1032,1}.p2, 176).quot) + (172 * div(heapIs \text{Sheap}_{funcstart\_1032,1},
this.r.value(heapIs $heap_{funcstart\_1032,1}).p2, 176).rem)) /
asType < double > (static\_cast < real > (\$heap_{funcend\_1032,1}.M2))) == raux2
\rightarrow [from term 61.35, $heap<sub>funcend_1032,1</sub> is equal to
\$heap_{funcstart\_1032,1}.\_\textbf{replace}(\textbf{this.}\$r \rightarrow \textbf{this.}\$r.\textbf{value}(\textbf{heapIs}
heap_{funcstart\_1032,1}._replace(p1 \rightarrow ((-2 * div(heapIs $heap_{funcstart\_1032,1},
this.r.value(heapIs \ heap_{funcstart=1032.1}).p1, 177).quot) + (171 \ *
```

```
div(\mathbf{heapIs} \ \$heap_{funcstart\_1032,1}, \ \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
\theta_{funcstart\_1032,1}.p1, 177).rem)))._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
heap_{funcstart\_1032,1}, this.r.value(heapIs heap_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(\mathbf{heapIs} \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}))
\rho_{tuncstart\_1032,1}.p1, 177).rem))._replace\rho_{tuncstart\_1032,1}.p1, 177).rem))
$heap_funcstart_1032,1, this.$r.value(heapIs $heap_funcstart_1032,1).p2,
176).quot) + (172 * div(heapIs $heap_{funcstart_1032,1}, this.$r.value(heapIs)
heap_{funcstart_1032,1}.p2, 176).rem))))._replace(this.r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
heap_{funcstart\_1032,1}, this.r.value(heapIs heap_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(\mathbf{heapIs} * heap_{funcstart\_1032,1}, \mathbf{this}. * r.value(\mathbf{heapIs} 
heap_{funcstart\_1032,1}.p1, 177).rem))._replace(p2 \rightarrow ((-35 * div(heapIs)))._replace
$heap_{funcstart\_1032,1}$, this. $r.value(heapIs $heap_{funcstart\_1032,1}).p2$,
(176).\text{quot}) + (172 * \text{div}(\textbf{heapIs} \$ \text{heap}_{funcstart\_1032,1}, \textbf{this}.\$ \text{r.value}(\textbf{heapIs}))
heap_{funcstart\_1032,1}.p2, 176).rem))).\_replace(p3 \rightarrow (-63 * div(heapIs)))
heap_{funcstart\_1032.1}, this.r.value(heapIs heap_{funcstart\_1032.1}).p3,
178).quot) + (170 * div(\mathbf{heapIs} \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}
heap_{funcstart_{-1032,1}}.p3, 178).rem)))]
[63.11] (real((-35 * div(heapIs $heap_{funcstart\_1032,1}, this.$r.value(heapIs funcstart_1032,1)]
\text{Sheap}_{funcstart\_1032,1}.p2, 176).quot) + (172 * div(heapIs \text{Sheap}_{funcstart\_1032,1},
\mathbf{this.\$r.value}(\mathbf{heapIs}~\$\mathbf{heap}_{funcstart\_1032,1}).\mathbf{p2},~176).\mathbf{rem}))~/
\mathbf{asType} < \mathbf{double} > (\mathbf{static\_cast} < \mathbf{real} > (\$ \mathbf{heap}_{funcstart\_1032,1}. \_ \mathbf{replace}(\mathbf{this}.\$ \mathbf{real}))
\rightarrow this.$r.value(heapIs $heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 *
div(\mathbf{heapIs} \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
\text{Sheap}_{funcstart\_1032.1}.p1, 177).quot) + (171 * div(heapIs \text{Sheap}_{funcstart\_1032.1},
\mathbf{this.\$r.value(heapIs}~\$ heap_{funcstart\_1032,1}).p1,~177).rem)))).\_\mathbf{replace(this.\$r.}
\rightarrow this.$r.value(heapIs $heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 *
div(\mathbf{heapIs} \$ heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
\text{Sheap}_{funcstart\_1032,1}.p1, 177).quot) + (171 * div(heapIs \text{Sheap}_{funcstart\_1032,1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177).rem))).\_replace(p2 \rightarrow
((-35 * div(\mathbf{heapIs} \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}))
\text{Sheap}_{funcstart\_1032,1}.\text{p2}, 176).\text{quot} + (172 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_1032,1},
\mathbf{this.\$r.value(heapIs\ \$heap}_{funcstart\_1032,1}).p2,\ 176).rem)))).\_\mathbf{replace(this.\$r}
\rightarrow this.$r.value(heap
Is \rho_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 *
div(\mathbf{heapIs} \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
\text{Sheap}_{funcstart\_1032,1}.p1, 177).quot) + (171 * div(heapIs \text{Sheap}_{funcstart\_1032,1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177).rem))).\_replace(p2 \rightarrow
((-35 * div(\mathbf{heapIs} \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}))
\text{Sheap}_{funcstart\_1032,1}.p2, 176).quot) + (172 * div(heapIs \text{Sheap}_{funcstart\_1032,1},
\textbf{this.\$r.value}(\textbf{heapIs}~\$\text{heap}_{funcstart\_1032,1}).\text{p2},~176).\text{rem}))).\_\textbf{replace}(\text{p3}\rightarrow
((-63 * div(heapIs \$heap_{funcstart\_1032,1}, this.\$r.value(heapIs
\text{Sheap}_{funcstart\_1032,1}.p3, 178).quot) + (170 * div(heapIs \text{Sheap}_{funcstart\_1032,1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p3, 178).rem)))).M2))) == raux2
\rightarrow [const member of object with modified fields]
```

```
[63.14] (real((-35 * div(heapIs $heap<sub>funcstart-1032,1</sub>, this.$r.value(heapIs
\text{Sheap}_{funcstart\_1032,1}.p2, 176).quot) + (172 * div(heapIs \text{Sheap}_{funcstart\_1032,1},
this.r.value(heapIs $heap_{funcstart\_1032,1}).p2, 176).rem)) /
asType < double > (static\_cast < real > (\$heap_{funcstart\_1032,1}.M2))) = = raux2
\rightarrow [const static or extern object]
[63.15] (real((-35 * div(heapIs $heap<sub>funcstart_1032,1</sub>, this.$r.value(heapIs)
\rho_{funcstart\_1032,1}.p2, 176.quot) + \rho_{funcstart\_1032,1} + \rho_{funcstart\_1032,1}
this.r.value(heapIs $heap_{funcstart\_1032,1}).p2, 176).rem)) /
asType<double>(static_cast<real>($heap_{init}.M2))) == raux2
\rightarrow [expand definition of constant 'M2' at prang.cpp (33,26)]
[63.16] (real((-35 * div(heapIs $heap_{tuncstart\_1032.1}, this.$r.value(heapIs
\text{Sheap}_{funcstart\_1032.1}.p2, 176).quot) + (172 * div(heapIs \text{Sheap}_{funcstart\_1032.1},
this.r.value(heapIs $heap_{funcstart\_1032,1}).p2, 176).rem)) /
asType<double>(static_cast<real>((int)30307))) == raux2
\rightarrow [simplify]
[63.21] \ 0.0 == (-\text{raux}2 + (\text{real}((-35 * \text{div}(\text{heapIs} \$\text{heap}_{funcstart}))))))
this.$r.value(heapIs heap_{funcstart_{-1032,1}}).p2, 176).quot) + (172 *
div(\mathbf{heapIs} \$ heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
heap_{funcstart\_1032,1}.p2, 176).rem) / 30307.0)
[Take given term]
[64.0] (asType<double>(static_cast<real>(operator*(heapIs
heap_{funcend\_1032.1}, this).p3)) /
asType<double>(static_cast<real>($heap_{funcend_1032.1}.M3))) == raux3
\rightarrow [from term 61.35, $heap<sub>funcend_1032,1</sub> is equal to
\$heap_{funcstart\_1032,1}.\_\textbf{replace}(\textbf{this}.\$r \rightarrow \textbf{this}.\$r.\textbf{value}(\textbf{heapIs}
heap_{funcstart\_1032,1}._replace(p1 \rightarrow ((-2 * div(heapIs $heap_{funcstart\_1032,1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, \ 177).quot) + (171 *
div(\mathbf{heapIs} \ \$heap_{funcstart\_1032,1}, \ \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
\$heap_{funcstart\_1032,1}).p1,\ 177).rem)))).\_\mathbf{replace(this.\$r} \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
heap_{funcstart\_1032,1}, this.r.value(heapIs heap_{funcstart\_1032,1}).p1,
(177).quot + (171 * div(heapIs $heap_{funcstart\_1032,1}, this.$r.value(heapIs)
\rho_{funcstart\_1032,1}.p1, 177).rem))._replace(p2 \rightarrow ((-35 * div(\mathbf{heapIs})))._replace(p2 \rightarrow ((-35 * div(\mathbf{heapIs})))
heap_{funcstart\_1032,1}, this.r.value(heapIs heap_{funcstart\_1032,1}).p2,
176).quot) + (172 * div(heapIs $heap_{tuncstart\_1032.1}, this.$r.value(heapIs
\theta_{funcstart\_1032,1}.p2, 176).rem))))._replace(this.\$r \rightarrow 0
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
$heap_funcstart_1032,1, this.$r.value(heapIs $heap_funcstart_1032,1).p1,
177).quot) + (171 * div(heapIs $heap_{tuncstart = 1032.1}, this.$r.value(heapIs
\rho_{funcstart\_1032,1}.p1, 177).rem))._replace\rho_{funcstart\_1032,1}.p1, 177).rem))
heap_{funcstart\_1032,1}, this.r.value(heapIs heap_{funcstart\_1032,1}).p2,
(176).quot) + (172 * div(heapIs $heap_{funcstart\_1032,1}, this.$r.value(heapIs)]
```

```
heap_{funcstart\_1032,1}, this.r.value(heapIs heap_{funcstart\_1032,1}).p3,
178).quot) + (170 * div(heapIs heapIs = 1032,1, this.r.value(heapIs)
heap_{funcstart\_1032,1}.p3, 178.rem)))
[64.1] (asType<double>(static_cast<real>(operator*(heapIs
\theta_{funcstart\_1032,1}._replace(this.r \to this.r.value(heapIs)
\rho_{tuncstart\_1032,1}._replace(p1 \rightarrow ((-2 * div(heapIs \rho_{tuncstart\_1032,1}).
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177).quot) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_1032,1}, \ \mathbf{this}.\$ r. \mathbf{value}(\mathbf{heapIs}
\theta_{funcstart\_1032,1}.p1, 177).rem)))).\_replace(this.\$r \rightarrow 0
\textbf{this.}\$r.\textbf{value}(\textbf{heapIs}~\$heap_{funcstart\_1032,1}).\_\textbf{replace}(p1 \rightarrow ((-2~*div(\textbf{heapIs})))))
\rho_{tuncstart_1032.1}, this.r.value(heapIs \rho_{tuncstart_1032.1}).p1,
177).quot) + (171 * div(heapIs $heap<sub>funcstart_1032.1</sub>, this.$r.value(heapIs
\rho_{funcstart\_1032,1}.p1, 177).rem))._replace(p2 \rightarrow ((-35 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p2,
176).quot) + (172 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.} \text{\$r.value}(\text{heapIs}))
\theta_{tuncstart\ 1032.1}.p2,\ 176).rem)))._replace(this.$r \to
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
\rho_{uncstart\_1032,1}.p1, 177).rem))._replace(p2 \rightarrow ((-35 * div(heapIs
\$heap_{funcstart\_1032,1},\ \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}\ \$heap_{funcstart\_1032,1}).p2,
176).quot) + (172 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
\rho_{tuncstart\_1032.1}.p2, 176).rem)._replace(p3 \rightarrow (-63 * div(heapIs
\rho_{tuncstart\_1032.1}, this.r.value(heapIs \rho_{tuncstart\_1032.1}).p3,
178).quot) + (170 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
heap_{funcstart_{1032,1}}.p3, 178).rem)), this).p3)) /
\mathbf{asType} \small{<} \mathbf{double} \small{>} (\mathbf{static\_cast} \small{<} \mathbf{real} \small{>} (\$ \mathbf{heap}_{funcend\_1032,1}.\mathbf{M3}))) == \mathbf{raux3}
→ [expand definition of operator '*' in class 'pointer' at built in declaration]
{\it [64.2]}~(as Type < double > (static\_cast < real > (this.\$r.value (heap Is)) = (static\_cast < real > (this.\$r.value (heap Is))) = (static\_cast < real > (this.\$r.value (he
\rho_{funcstart\_1032,1}.\_replace(this.\rdots r 	o this.\rdots r.value(heapIs)
\text{Sheap}_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs \text{Sheap}_{funcstart\_1032,1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177).quot) + (171 *
div(\mathbf{heapIs} \$ heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
\theta_{funcstart\_1032,1}.p1, 177).rem)))).\_replace(this.\$r \rightarrow 0
\textbf{this.}\$r.\textbf{value}(\textbf{heapIs}~\$heap_{funcstart\_1032,1}).\_\textbf{replace}(p1 \rightarrow ((-2~*div(\textbf{heapIs})))))
\$heap_{funcstart\_1032,1},\, \textbf{this.}\$r.\textbf{value}(\textbf{heapIs}\,\,\$heap_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
\$heap_{funcstart\_1032,1}).p1,\ 177).rem))).\_\mathbf{replace}(p2 \to ((-35\ *\ div(\mathbf{heapIs})))).
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p2,
176).quot) + (172 * \text{div}(\text{heapIs } \text{heap}_{funcstart\_1032,1}, \text{this.} \text{$r.value}(\text{heapIs}))
\theta_{funcstart\_1032,1}.p2, 176).rem)))).\_replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
```

```
177).quot) + (171 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
\rho_{funcstart\_1032,1}.p1, 177).rem)._replace\rho_{funcstart\_1032,1}.p1, 177).rem)._replace
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p2,
176).quot) + (172 * div(heapIs $heap<sub>funcstart_1032,1</sub>, this.$r.value(heapIs
\rho_{uncstart\_1032,1}.p2, 176).rem))._replace(p3 \rightarrow ((-63 * div(heapIs
\rho_{funcstart\_1032,1}, this. r.value(heapIs \rho_{funcstart\_1032,1}).p3,
178).quot) + (170 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
heap_{funcstart_{1032,1}}.p3, 178).rem)))).p3)) /
asType < double > (static\_cast < real > (\$heap_{funcend\_1032,1}.M3))) == raux3
→ [evaluate dereferenced pointer into modified heap]
[64.3] (asType<double>(static_cast<real>(([this.$r == this.$r]:
\textbf{this.\$r.value}(\textbf{heapIs}~\$ heap_{funcstart\_1032,1}).\_\textbf{replace}(p1 \rightarrow ((-2~*div(\textbf{heapIs})))))
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs heap_{funcstart\_1032,1}, this.r.value(heapIs)
\rho_{uncstart\_1032,1}.p1, 177).rem))).\_replace(p2 \rightarrow ((-35 * div(heapIs)))._replace(p2 \rightarrow ((-35 * div(heapIs))))._replace(p3 + div(heapIs)))
\rho_{funcstart_1032,1}, this.r.value(heapIs \rho_{funcstart_1032,1}).p2,
176).quot) + (172 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.} \text{\$r.value}(\text{heapIs}))
heap_{funcstart\_1032,1}.p2, 176).rem))._replace(p3 \rightarrow (-63 * div(heapIs)
\label{eq:heapIs} \$ heap_{funcstart\_1032,1}, \ \mathbf{this}.\$ r. \mathbf{value} (\mathbf{heapIs} \ \$ heap_{funcstart\_1032,1}).p3,
178).quot) + (170 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
$heap_{tuncstart_1032.1}).p3, 178).rem)), []: this.$r.value(heapIs
\theta_{funcstart\_1032,1}._replace(this.r \to this.r.value(heapIs)
\text{Sheap}_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs \text{Sheap}_{funcstart\_1032,1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177).quot) + (171 *
div(heapIs $heap<sub>funcstart_1032.1</sub>, this.$r.value(heapIs
\theta_{funcstart\_1032,1}.p1, 177).rem)))._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
\rho_{funcstart\_1032.1}.p1, 177).rem))._replace(p2 \rightarrow (-35 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p2,
176).quot) + (172 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.} \text{\$r.value}(\text{heapIs}))
heap_{funcstart_{1032,1}}.p2, 176).rem)))).p3)) /
asType < double > (static\_cast < real > (\$heap_{funcend\_1032,1}.M3))) == raux3
→ [explicitly assert falsehood of skipped guards in subsequent guards]
[64.4] (asType<double>(static_cast<real>(([this.$r == this.$r]:
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(\mathbf{heapIs} \$ heap_{funcstart\_1032,1}, \mathbf{this}.\$ r. \mathbf{value}(\mathbf{heapIs})
\rho_{tuncstart_{-1032,1}}.p1, 177).rem))._replace(p2 \rightarrow ((-35 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p2,
176).quot) + (172 * div(heapIs $heap<sub>funcstart_1032.1</sub>, this.$r.value(heapIs
\rho_{uncstart\_1032,1}.p2, 176).rem))._replace(p3 \rightarrow (-63 * div(heapIs)
\rho_{tuncstart\_1032.1}, this.r.value(heapIs \rho_{tuncstart\_1032.1}).p3,
```

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178).quot) + (170 * \text{div}(\text{heapIs } \text{heap}_{funcstart\_1032,1}, \text{this.} \text{$r.value}(\text{heapIs}))
\text{heap}_{funcstart\_1032,1}.p3, 178).rem)), [!(this.$r == this.$r)]:
this.r.value(heapIs \ heap_{funcstart\_1032,1}.\_replace(this.\rdotsr) \rightarrow
this.$r.value(heapIs \rho_{uncstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs)
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs $heap<sub>funcstart_1032,1</sub>, this.$r.value(heapIs
\theta_{funcstart\_1032,1}.p1, 177).rem)))).replace(this.$r \rightarrow
this.$r.value(heapIs heap_{tuncstart\_1032.1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.}\text{\$r.value}(\text{heapIs}))
\$heap_{funcstart\_1032,1}).p1,\ 177).rem))).\_\mathbf{replace}(p2 \to (-35\ *\ div(\mathbf{heapIs}
\rho_{funcstart\_1032,1}, this. r.value(heapIs \rho_{funcstart\_1032,1}).p2,
176).quot) + (172^{*} \text{ div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.} \text{\$r.value}(\text{heapIs}))
\theta_{funcstart_{1032,1}}.p2, 176).rem)))).p3)) /
asType < double > (static\_cast < real > (\$heap_{funcend\_1032,1}.M3))) == raux3
\rightarrow [simplify]
[64.9] (real((-63 * div(heapIs $heap_{funcstart\_1032,1}, this.$r.value(heapIs)]
\text{Sheap}_{funcstart\_1032.1}).p3, 178).quot) + (170 * div(heapIs \text{Sheap}_{funcstart\_1032.1},
this.r.value(heapIs $heap_{funcstart\_1032,1}).p3, 178).rem)) /
asType<double>(static_cast<real>($heap_{tuncend\_1032.1}.M3))) == raux3
\rightarrow [from term 61.35, $heap<sub>funcend_1032,1</sub> is equal to
\$heap_{funcstart\_1032,1}.\_\textbf{replace}(\textbf{this}.\$r \rightarrow \textbf{this}.\$r.\textbf{value}(\textbf{heapIs}
heap_{funcstart\_1032,1}._replace(p1 \rightarrow ((-2 * div(heapIs heap_{funcstart\_1032,1}),
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177).quot) + (171 *
div(heapIs $heap_funcstart_1032.1, this.$r.value(heapIs
heap_{funcstart_1032,1}.p1, 177).rem)))._replace(this.$r \rightarrow
this.$r.value(heapIs $heap_{funcstart\_1032,1}).\_replace(p1 \rightarrow ((-2 * div(heapIs
heap_{funcstart\_1032,1}, this.r.value(heapIs heap_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs $heap_{funcstart\_1032,1}, this.$r.value(heapIs)
\rho_{funcstart\_1032,1}.p1, 177).rem))._replace\rho_{funcstart\_1032,1}.p1, 177).rem))
heap_{funcstart\_1032,1}, this.r.value(heapIs heap_{funcstart\_1032,1}).p2,
176).quot) + (172 * div(\textbf{heapIs } \$heap_{funcstart\_1032,1}, \textbf{this.}\$r.\textbf{value}(\textbf{heapIs}
heap_{funcstart\_1032,1}.p2, 176).rem)))._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
$heap_{tuncstart_1032.1}$, this.$r.value(heapIs $heap_{tuncstart_1032.1}).p1,
177).quot) + (171 * div(\mathbf{heapIs} \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}))
\rho_{funcstart\_1032.1}.p1, 177).rem))._replace\rho_{funcstart\_1032.1}.p1, 177).rem))
heap_{funcstart\_1032,1}, this.r.value(heapIs heap_{funcstart\_1032,1}).p2,
(176).quot) + (172 * div(\mathbf{heapIs} \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}))
heap_{funcstart\_1032,1}.p2, 176).rem)))._replace(p3 \rightarrow (-63 * div(heapIs)))
heap_{funcstart\_1032,1}, this.r.value(heapIs heap_{funcstart\_1032,1}).p3,
178).quot) + (170 * div(\textbf{heapIs } \$heap_{funcstart\_1032,1}, \textbf{this.}\$r.\textbf{value(heapIs}))
heap_{funcstart\_1032,1}.p3, 178).rem)))]
[64.10] (real((-63 * div(heapIs $heap_{tuncstart\_1032.1}, this.$r.value(heapIs
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\text{Sheap}_{funcstart\_1032.1}.p3, 178).quot) + (170 * div(heapIs \text{Sheap}_{funcstart\_1032.1},
this.r.value(heapIs $heap_{funcstart\_1032,1}).p3, 178).rem)) /
\mathbf{asType} < \mathbf{double} > (\mathbf{static\_cast} < \mathbf{real} > (\$ \mathbf{heap}_{funcstart\_1032,1}. \_ \mathbf{replace} (\mathbf{this}.\$ \mathbf{replace}))
\rightarrow this.$r.value(heapIs $heap_{tuncstart\_1032,1})._replace(p1 \rightarrow ((-2 *
div(\mathbf{heapIs} \$ heap_{funcstart\_1032.1}, \mathbf{this.}\$r.\mathbf{value}(\mathbf{heapIs})
\text{Sheap}_{funcstart\_1032.1}.p1, 177).quot) + (171 * div(heapIs \text{Sheap}_{funcstart\_1032.1},
\textbf{this.} \$r. \textbf{value}(\textbf{heapIs} \$ heap_{funcstart\_1032,1}).p1,\ 177).rem)))).\_\textbf{replace}(\textbf{this.} \$r. \texttt{value}(\textbf{heapIs} \$ heap_{funcstart\_1032,1}).p1,\ 177).rem))))
\rightarrow this.$r.value(heapIs $heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 *
div(\mathbf{heapIs} \$ heap_{funcstart\_1032.1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
\text{Sheap}_{funcstart\_1032.1}.p1, 177).quot) + (171 * div(heapIs \text{Sheap}_{funcstart\_1032.1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177).rem))).\_replace(p2 \rightarrow
((-35 * div(heapIs \$heap_{funcstart\_1032,1}, this.\$r.value(heapIs
\text{Sheap}_{funcstart\_1032,1}.p2, 176).quot) + (172 * div(heapIs \text{Sheap}_{funcstart\_1032,1},
\mathbf{this.\$r.value(heapIs}\ \$heap_{funcstart\_1032,1}).p2,\ 176).rem)))).\_\mathbf{replace(this.\$r}
\rightarrow this.$r.value(heapIs $heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 *
div(\mathbf{heapIs} \$ heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
\text{Sheap}_{funcstart\_1032.1}.p1, 177).quot) + (171 * div(heapIs \text{Sheap}_{funcstart\_1032.1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177).rem))).\_replace(p2 \rightarrow
((-35 * div(\mathbf{heapIs} \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}))
\text{Sheap}_{funcstart\_1032,1}.p2, 176).quot) + (172 * div(heapIs \text{Sheap}_{funcstart\_1032,1},
this.$r.value(heapIs \theta_{funcstart\_1032.1}).p2, 176).rem)))._replace(p3 \rightarrow
((-63 * div(\mathbf{heapIs} \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}))
\text{Sheap}_{funcstart\_1032.1}).p3, 178).quot) + (170 * div(heapIs \text{Sheap}_{funcstart\_1032.1},
\mathbf{this.\$r.value(heapIs}\ \$\mathrm{heap}_{funcstart\_1032,1}).\mathrm{p3},\ 178).\mathrm{rem})))).\mathrm{M3}))) == \mathrm{raux3}
→ [const member of object with modified fields]
[64.13] (real((-63 * div(heapIs $heap<sub>funcstart_1032,1</sub>, this.$r.value(heapIs funcstart_1032,1)]
\text{Sheap}_{funcstart\_1032,1}.p3, 178).quot) + (170 * div(heapIs \text{Sheap}_{funcstart\_1032,1},
this.r.value(heapIs $heap_{funcstart\_1032,1}).p3, 178).rem)) /
\mathbf{asType} < \mathbf{double} > (\mathbf{static\_cast} < \mathbf{real} > (\$ \operatorname{heap}_{funcstart\_1032,1}.\operatorname{M3}))) == \operatorname{raux3}
\rightarrow [const static or extern object]
[64.14] (real((-63 * div(heapIs $heap_{funcstart\_1032,1}, this.$r.value(heapIs)]
\text{Sheap}_{funcstart\_1032,1}.p3, 178).quot) + (170 * div(heapIs \text{Sheap}_{funcstart\_1032,1},
this.r.value(heapIs $heap_{funcstart\_1032,1}).p3, 178).rem)) /
asType<double>(static_cast<real>($heap_{init}.M3))) == raux3
\rightarrow [expand definition of constant 'M3' at prang.cpp (38,26)]
[64.15] \ (\mathbf{real}((-63\ ^*\ \mathrm{div}(\mathbf{heapIs}\ \$\mathbf{heap}_{funcstart\_1032,1},\ \mathbf{this}.\$\mathbf{r.value}(\mathbf{heapIs}\ \mathbf{s})))
\text{Sheap}_{funcstart\_1032.1}.p3, 178).quot) + (170 * div(heapIs \text{Sheap}_{funcstart\_1032.1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p3, 178).rem)) /
asType<double>(static_cast<real>((int)30323))) == raux3
\rightarrow [simplify]
[64.20] \ 0.0 == (-\text{raux}3 + (\text{real}((-63 * \text{div}(\text{heapIs }\$\text{heap}_{funcstart\_1032,1},
this.$r.value(heapIs heap_{funcstart\_1032,1}).p3, 178).quot) + (170 *
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div(\mathbf{heapIs} \$ heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
heap_{funcstart\_1032,1}.p3, 178.rem) / 30323.0)
[Take goal term]
[1.0] asType<real>((double)0.0) < ((asType<real>(raux2) +
asType<real>(raux1)) + asType<real>(raux3))
\rightarrow [simplify]
[1.2] 0.0 < ((asType < real > (raux2) + asType < real > (raux1)) +
asType<real>(raux3))
\rightarrow [from term 63.21, raux2 is equal to real((-35 * div(heapIs
heap_{funcstart\_1032,1}, this.r.value(heapIs heap_{funcstart\_1032,1}).p2,
(176).quot) + (172*div(\mathbf{heapIs} \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}))
heap_{funcstart\_1032,1}.p2, 176).rem)) / 30307.0]
[1.3] 0.0 < ((asType < real > (real((-35 * div(heapIs $heap_{tuncstart\_1032.1},
this.$r.value(heapIs heap_{funcstart\_1032.1}).p2, 176).quot) + (172 *
div(\mathbf{heapIs} \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
\frac{\text{sheap}_{funcstart\_1032.1}.p2, 176.rem)}{30307.0} + asType < real > (raux1)) +
asType<real>(raux3))
\rightarrow [simplify]
[1.4] \ 0.0 < (((real((-35 * div(heapIs $heap_{funcstart\_1032,1},
this.r.value(heapIs \ensuremath{\$}heap_{funcstart\_1032,1}).p2, 176).quot) + (172 *
div(\mathbf{heapIs} \$ heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
\frac{\text{sheap}_{funcstart\_1032,1}.p2, 176).rem}{) / 30307.0} + asType < real > (raux1)) +
asType<real>(raux3))
\rightarrow [from term 62.22, raux1 is equal to real((-2 * div(heapIs
heap_{funcstart\_1032,1}, this.r.value(heapIs heap_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(\mathbf{heapIs} \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}))
heap_{funcstart\_1032,1}.p1, 177).rem)) / 30269.0
[1.5] 0.0 < (((real((-35 * div(heapIs $heap_{funcstart\_1032.1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p2, 176).quot) + (172 *
div(\mathbf{heapIs} \$ heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
\frac{\text{sheap}_{funcstart\_1032,1}.p2, 176.rem)}{30307.0} + asType < real > (real((-2 * 
div(\mathbf{heapIs} \$ heap_{funcstart\_1032.1}, \mathbf{this.}\$r.\mathbf{value}(\mathbf{heapIs})
\text{Sheap}_{funcstart\_1032,1}.\text{p1}, 177).\text{quot} + (171 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_1032,1},
this.$r.value(heapIs heap_{funcstart\_1032,1}).p1, 177).rem)) / 30269.0)) +
asType<real>(raux3))
\rightarrow [simplify]
[1.6] 0.0 < (((real((-35 * div(heapIs $heap_{funcstart\_1032,1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p2, 176).quot) + (172 *
div(\mathbf{heapIs} \$ heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
\text{heap}_{funcstart\_1032,1}.p2, 176).rem)) / 30307.0) + (real((-2 * div(heapIs)
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
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177).quot) + (171 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.} \text{\$r.value}(\text{heapIs}))
\frac{\text{sheap}_{funcstart\_1032,1}.p1, 177).rem}{)} / 30269.0)) + asType < real > (raux3))
\rightarrow [from term 64.20, raux3 is equal to real((-63 * div(heapIs
heap_{funcstart\_1032.1}, this.r.value(heapIs heap_{funcstart\_1032.1}).p3,
178).quot) + (170 * div(heapIs $heap_{tuncstart\_1032.1}, this.$r.value(heapIs
heap_{funcstart\_1032,1}.p3, 178).rem)) / 30323.0]
[1.7] 0.0 < (((real((-2 * div(heapIs $heap_{funcstart\_1032,1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177).quot) + (171 *
div(\mathbf{heapIs} \$ heap_{funcstart\_1032.1}, \mathbf{this.}\$r.\mathbf{value}(\mathbf{heapIs})
\text{heap}_{funcstart\ 1032.1}.p1, 177).rem)) / 30269.0) + (real((-35 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p2,
176).quot) + (172 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.}\text{\$r.value}(\text{heapIs}))
\rho_{tuncstart\_1032.1}.p2, 176).rem) / 30307.0) + asType < real > (real((-63)) / 30307.0)) + asType < real((-63)) + asType < 
* \operatorname{div}(\mathbf{heapIs} \ \text{$heap}_{funcstart\_1032,1}, \ \mathbf{this}.\text{$r.value}(\mathbf{heapIs})
\text{Sheap}_{funcstart\_1032,1}.p3, 178).quot) + (170 * div(heapIs \text{Sheap}_{funcstart\_1032,1},
this.r.value(heapIs $heap_{funcstart\_1032,1}).p3, 178).rem)) / 30323.0))
\rightarrow [simplify]
[1.9] 0.0 < ((real((-63 * div(heapIs $heap_{funcstart\_1032,1},
this.r.value(heapIs \ensuremath{\$}heap_{funcstart\_1032,1}).p3, 178).quot) + (170 *
div(\mathbf{heapIs} \$ heap_{funcstart\_1032.1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
\text{heap}_{funcstart\_1032,1}.p3, 178).rem)) / 30323.0) + (real((-2 * div(heapIs)
\rho_{funcstart\_1032,1}, this. r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs $heap<sub>funcstart_1032.1</sub>, this.$r.value(heapIs
\rho_{uncstart_{1032,1},177,rem} / 30269.0) + (real((-35 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p2,
176).quot) + (172 * div(\mathbf{heapIs} \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}))
heap_{funcstart\_1032,1}.p2, 176).rem) / 30307.0)
\rightarrow [negate goal and search for contradiction]
[1.10]!(0.0 < ((real((-63 * div(heapIs $heap_{tuncstart\_1032.1},
this.r.value(heapIs \ensuremath{\$}heap_{funcstart\_1032,1}).p3, 178).quot) + (170 *
{\rm div}(\mathbf{heapIs}\ \$ \mathrm{heap}_{funcstart\_1032,1},\ \mathbf{this}.\$ \mathrm{r.value}(\mathbf{heapIs}
\text{heap}_{funcstart\_1032.1}.p3, 178).rem)) / 30323.0) + (real((-2 * div(heapIs)
\rho_{tuncstart\_1032.1}, this.r.value(heapIs \rho_{tuncstart\_1032.1}).p1,
177).quot) + (171 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
heap_{funcstart\_1032,1}.p1, 177).rem) / 30269.0) + (real((-35 * div(heapIs)) / 30269.0) + (real((-35 * div(heapIs))) / 30269.0) + (real((-35 * div(heapIs)))) / 30269.0) + (real((-35 * div(heapIs))) + (real((-35 * div(heapIs))
\rho_{tuncstart_{-1032.1}}, this.r.value(heapIs \rho_{tuncstart_{-1032.1}}).p2,
176).quot) + (172 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.} \text{\$r.value}(\text{heapIs}))
heap_{funcstart\_1032,1}.p2, 176).rem) / 30307.0)))
\rightarrow [simplify]
[1.17] \ 0.0 \le (-(\text{real}((-63 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1},
this.r.value(heapIs \ensuremath{\$}heap_{funcstart\_1032,1}).p3, 178).quot) + (170 *
div(\mathbf{heapIs} \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
```

```
\rho_{funcstart_1032,1}.p3, 178).rem) / 30323.0) + -(real((-35 * div(heapIs)) / 30323.0) + (real((-35 * div(heapIs))) / 30323.0
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p2,
176).quot) + (172 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.}\text{\$r.value}(\text{heapIs}))
\frac{\text{heap}_{funcstart\_1032,1}.p2, 176).rem}{} / 30307.0} + -(\text{real}((-2 * div(\text{heapIs}))) / 30307.0) + -(\text{real}((-2 * div(\text{heapIs})))) / 30307.0) + -(\text{real}((-2 * div(\text{heapIs}))) / 30307.0) + -(\text{real}((-2 * div(\text{heapIs})))) / 30307.0) + -(\text{real}((-2 * div(\text{heapIs})))) / 30307.0) + -(\text{real}((-2 * div(\text{heapIs})))) / 30307.0) + -(\text{real}((-2 * div(\text{heapIs}))) / 30307.0) + -(\text{real}((-2 * div(\text{heapIs})))) / 30307.0) + -(\text{real}((-2 * div(\text{heapIs}))) / 30307.0) + -(\text{real}((-2 * div(\text{heapIs})))) / 30307.0) + -(\text{real}((-2 * div(\text{heapIs}))) / 30307.0) + -(\text{real}((-2 * div(\text{heapI
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs $heap<sub>funcstart_1032,1</sub>, this.$r.value(heapIs
\theta_{funcstart\_1032,1}.p1, 177).rem) / 30269.0)
[Take given term]
[65.0] asType<real>((double)0.0) < asType<real>(raux1)
\rightarrow [simplify]
[65.2] 0.0 < asType < real > (raux1)
\rightarrow [from term 62.22, raux1 is equal to real((-2 * div(heapIs
heap_{funcstart\_1032,1}, this.r.value(heapIs heap_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(\mathbf{heapIs} \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}))
heap_{funcstart\_1032.1}.p1, 177).rem) / 30269.0
[65.3] 0.0 < asType < real > (real((-2 * div(heapIs $heap_{tuncstart\_1032.1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177).quot) + (171 *
div(\mathbf{heapIs} \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
heap_{funcstart\_1032,1}.p1, 177).rem) / 30269.0
\rightarrow [simplify]
[65.4] 0.0 < (real((-2 * div(heapIs $heap_{funcstart\_1032,1}, this.$r.value(heapIs 
\theta_{tuncstart_1032.1}, p1, 177).quot) + (171 * div(heapIs \theta_{tuncstart_1032.1},
this.$r.value(heapIs $heap_{funcstart\_1032,1}).p1, 177).rem)) / 30269.0)
[Take given term]
[66.0] asType<real>((double)0.0) < asType<real>(raux2)
\rightarrow [simplify]
[66.2] 0.0 < asType < real > (raux2)
\rightarrow [from term 63.21, raux2 is equal to real((-35 * div(heapIs
$heap_funcstart_1032,1, this.$r.value(heapIs $heap_funcstart_1032,1).p2,
(176).quot) + (172 * div(heapIs $heap_{funcstart\_1032,1}, this.$r.value(heapIs)]
heap_{funcstart\_1032,1}.p2, 176).rem)) / 30307.0]
[66.3] 0.0 < asType < real > (real((-35 * div(heapIs $heap_{funcstart\_1032,1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p2, 176).quot) + (172 *
div(\mathbf{heapIs} \$ heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
heap_{funcstart_1032.1}.p2, 176).rem)) / 30307.0)
\rightarrow [simplify]
[66.4] \ 0.0 < (real((-35 * div(heapIs $heap_{funcstart\_1032,1},
this.r.value(heapIs \ensuremath{\$}heap_{funcstart\_1032,1}).p2, 176).quot) + (172 *
div(\mathbf{heapIs} \$ heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
```

```
heap_{funcstart_{1032,1}}.p2, 176).rem) / 30307.0
[Take given term]
[67.0] asType<real>((double)0.0) < asType<real>(raux3)
\rightarrow [simplify]
[67.2] 0.0 < asType < real > (raux3)
\rightarrow [from term 64.20, raux3 is equal to real((-63 * div(heapIs
heap_{funcstart\_1032,1}, this.r.value(heapIs heap_{funcstart\_1032,1}).p3,
178).quot) + (170 * div(\textbf{heapIs} \$heap_{funcstart\_1032,1}, \textbf{this}.\$r.\textbf{value}(\textbf{heapIs}))
heap_{funcstart\_1032,1}.p3, 178).rem) / 30323.0
[67.3] 0.0 < asType < real > (real((-63 * div(heapIs $heap_{funcstart\_1032,1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p3, 178).quot) + (170 *
\label{eq:continuous} \text{div}(\textbf{heapIs} \ \$ \text{heap}_{funcstart\_1032,1}, \ \textbf{this}.\$ \text{r.value}(\textbf{heapIs}
heap_{funcstart_1032.1}.p3, 178).rem)) / 30323.0)
\rightarrow [simplify]
[67.4] \ 0.0 < (real((-63 * div(heapIs $heap_{funcstart\_1032,1},
this.$r.value(heapIs heap_{funcstart\_1032,1}).p3, 178).quot) + (170 *
div(\mathbf{heapIs} \$ heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
\theta_{funcstart\_1032,1}.p3, 178).rem)) / 30323.0)
[Create new term from terms 1.17, 67.4 using rule: transitivity 2b]
[110.0] (0.0 + 0.0) < (-(\text{real}((-35 * \text{div}(\text{heapIs } \text{$heap}_{funcstart\_1032,1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p2, 176).quot) + (172 *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_1032,1}, \ \mathbf{this}.\$ r. \mathbf{value}(\mathbf{heapIs}
\rho_{uncstart\_1032.1}, p2, 176).rem)) / 30307.0) + -(real((-2 * div(heapIs)
\rho_{tuncstart\_1032.1}, this.r.value(heapIs \rho_{tuncstart\_1032.1}).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.} \text{\$r.value}(\text{heapIs}))
heap_{funcstart\_1032,1}.p1, 177).rem) / 30269.0)
\rightarrow [simplify]
[110.1] 0.0 < (-(real((-35 * div(heapIs $heap_{funcstart\_1032,1},
this.$r.value(heapIs heap_{funcstart\_1032,1}).p2, 176).quot) + (172 *
\operatorname{div}(\mathbf{heapIs} \ \text{$heap}_{funcstart\_1032.1}, \ \mathbf{this}. \ \text{$r.value}(\mathbf{heapIs})
\text{Sheap}_{funcstart\_1032,1}.p2, 176).rem)) / 30307.0) + -(\text{real}((-2 * \text{div}(\text{heapIs}))))
\rho_{funcstart\_1032,1}, this. r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(\mathbf{heapIs} \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}))
heap_{funcstart\_1032,1}.p1, 177).rem) / 30269.0)
[Create new term from terms 110.1, 66.4 using rule: transitivity 2a]
[125.0] (0.0 + 0.0) < -(\text{real}((-2 * \text{div}(\text{heapIs } \$\text{heap}_{funcstart\_1032,1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177).quot) + (171 *
div(\mathbf{heapIs} \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
heap_{funcstart=1032.1}.p1, 177).rem)) / 30269.0)
```

```
\rightarrow [simplify]
[125.1] 0.0 < -(\text{real}((-2 * \text{div}(\text{heapIs } \text{$\text{sheap}_{funcstart}$}_{1032,1}),
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177).quot) + (171 *
{\rm div}(\textbf{heapIs}~\$ heap_{funcstart\_1032,1},~\textbf{this}.\$ r. \textbf{value}(\textbf{heapIs}
\theta_{funcstart\_1032,1}.p1, 177).rem)) / 30269.0)
\rightarrow [from term 65.4, literala < -(\text{real}((-2 * \text{div}(\text{heapIs } \$\text{heap}_{funcstart\_1032,1},
this.r.value(heapIs \ heap_{funcstart\_1032.1}).p1, 177).quot) + (171)
div(heapIs $heap_{tuncstart\_1032.1}, this.$r.value(heapIs
$heap_{funcstart\_1032,1}.p1, 177).rem)) / 30269.0) is false whenever -0.0 \leq
literala]
   Proof of rule precondition:
   [125.1.0] -0.0 \le 0.0
   \rightarrow [simplify]
   [125.1.1] true
[125.2] false
Proof of verification condition: Precondition of 'fmod' satisfied
In the context of class: WHPrang, declared at:
C:\Escher\Customers\prang-cpp\prang.cpp (18,1)
Condition generated at: C:\Escher\Customers\prang-cpp\prang.cpp
(95,21)
Condition defined at: C:\Escher\ecv\standard\math.h (84,16)
To prove: !(asType<real>((double)1.0) ==
asType < real > ((double)0.0))
Given:
heap_{init}.LIMIT == (int)80
heap_{init}.class WHPrang \in M1 == (int)30269
heap_{init}.class WHPrang \in r1 == (int)171
heap_{init}.class WHPrang \in a1 == (int)177
heap_{init}.class WHPrang \in b1 == (int)2
heap_{init}.class WHPrang \in M2 == (int)30307
heap_{init}.class WHPrang \in r2 == (int)172
heap_{init}.class WHPrang \in a2 == (int)176
heap_{init}.class WHPrang \in b2 == (int)35
heap_{init}.class WHPrang \in M3 == (int)30323
heap_{init}.class WHPrang \in r3 == (int)170
```

```
heap_{init}.class WHPrang \in a3 == (int)178
heap_{init}.class WHPrang \in b3 == (int)63
\mathrm{div1} == \mathrm{div}(\mathbf{heapIs} \ \$ \mathrm{heap}_{funcstart\_1032,1},
static\_cast < int > (operator^*(heapIs \$heap_{funcstart\_1032,1}, this).p1),
\mathbf{static\_cast}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_1032,1}.\mathrm{a1}))
(asType<integer>(static_cast<int>(operator*(heapIs
heap_{funcstart\_1032,1}, this).p1) /
\mathbf{asType}{<}\mathbf{integer}{>}(\mathbf{static\_cast}{<}\mathbf{int}{>}(\$\mathbf{heap}_{funcstart\_1032,1}.\mathbf{a1}))) = =
asType<integer>(div1.quot)
(asType < integer > (static\_cast < int > (operator*(heapIs)))
heap_{funcstart_1032.1}, this).p1)
asType < integer > (static\_cast < int > (\$heap_{funcstart\_1032.1}.a1))) = =
asType<integer>(div1.rem)
(asType<integer>(operator*(heapIs $heap_{funcstart\_1032,1}, this).p1) <
asType < integer > (\$heap_{funcstart\_1032,1}.a1)) = >
(asType<integer>(div1.rem) == asType<integer>(operator*(heapIs
heap_{funcstart\_1032,1}, this).p1)
(asType < integer > (\$heap_{funcstart\_1032,1}.a1) \le
\mathbf{asType} < \mathbf{integer} > (\mathbf{operator}^*(\mathbf{heapIs} \ \$ \mathbf{heap}_{funcstart\_1032,1}, \ \mathbf{this}).\mathtt{p1})) = >
!(0 == asType < integer > (div1.quot))
!(0 == asType < integer > (div1.rem)) || !(0 ==
asType<integer>(div1.quot))
div2 == div(\mathbf{heapIs} \$ heap_{funcstart\_1032,1},
\mathbf{static\_cast} < \mathbf{int} > (\mathbf{operator}^*(\mathbf{heapIs}\ \$ \mathbf{heap}_{funcstart\_1032,1},\ \mathbf{this}).\mathbf{p2}),
\mathbf{static\_cast}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_1032,1}.\mathrm{a2}))
(asType < integer > (static\_cast < int > (operator*(heapIs
heap_{funcstart\_1032.1}, this).p2)
asType < integer > (static\_cast < int > (\$heap_{funcstart\_1032,1}.a2))) = =
asType<integer>(div2.quot)
(asType < integer > (static\_cast < int > (operator*(heapIs)))
\theta_{funcstart\_1032,1}, this).p2)) \%
asType < integer > (static\_cast < int > (\$heap_{funcstart\_1032.1}.a2))) = =
asType<integer>(div2.rem)
(\mathbf{asType}{<}\mathbf{integer}{>}(\mathbf{operator}^*(\mathbf{heapIs}\ \$\mathbf{heap}_{funcstart\_1032,1},\ \mathbf{this}).\mathtt{p2})<
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathrm{heap}_{funcstart\_1032,1}.\mathrm{a2})) =>
(asType<integer>(div2.rem) == asType<integer>(operator*(heapIs
heap_{funcstart\_1032,1}, this).p2)
(\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathsf{heap}_{funcstart\_1032,1}.\mathsf{a2}) \leq
\mathbf{asType} < \mathbf{integer} > (\mathbf{operator}^*(\mathbf{heapIs} \ \$ \mathbf{heap}_{funcstart\_1032,1}, \ \mathbf{this}).\mathtt{p2})) = >
!(0 == asType < integer > (div2.quot))
```

```
!(0 == asType < integer > (div2.rem)) || !(0 ==
asType<integer>(div2.quot))
div3 == div(\mathbf{heapIs} \$heap_{funcstart\_1032,1},
static_cast<int>(operator*(heapIs $heap_{tuncstart\_1032.1}, this).p3),
static\_cast < int > (\$heap_{funcstart\_1032,1}.a3))
(asType < integer > (static\_cast < int > (operator*(heapIs)))
heap_{funcstart\_1032,1}, this).p3) /
\mathbf{asType} < \mathbf{integer} > (\mathbf{static\_cast} < \mathbf{int} > (\$ \mathbf{heap}_{funcstart\_1032,1}.\mathbf{a3}))) = =
asType<integer>(div3.quot)
(\mathbf{asType} {<} \mathbf{integer} {>} (\mathbf{static\_cast} {<} \mathbf{int} {>} (\mathbf{operator}^* (\mathbf{heapIs}
heap_{funcstart\_1032.1}, this).p3)
asType < integer > (static\_cast < int > (\$heap_{funcstart\_1032.1}.a3))) = =
asType<integer>(div3.rem)
(asType<integer>(operator*(heapIs $heap_{funcstart\_1032,1}, this).p3) <
asType < integer > (\$heap_{funcstart\_1032,1}.a3)) = >
(asType<integer>(div3.rem) == asType<integer>(operator*(heapIs
heap_{funcstart\_1032,1}, this).p3)
(\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathsf{heap}_{funcstart\_1032,1}.a3) \leq
\mathbf{asType} < \mathbf{integer} > (\mathbf{operator}^*(\mathbf{heapIs} \ \$ \mathbf{heap}_{funcstart\_1032,1}, \ \mathbf{this}).\mathrm{p3})) = >
!(0 == asType < integer > (div3.quot))
!(0 == asType < integer > (div3.rem)) || !(0 ==
asType<integer>(div3.quot))
temp1 == (\text{heap}_{funcstart\_1032,1}.r1 * static\_cast < signed int > (div1.rem)) -
(\text{sheap}_{funcstart\_1032,1}.\text{b1} * \text{static\_cast} < \text{signed int} > (\text{div1.quot}))
minof(signed int) \le temp1
temp1 \le maxof(signed int)
heap_{1032,1;1051,8} == heap_{funcstart\_1032,1}._replace(this.$r \rightarrow
operator*(heapIs heap_{funcstart\_1032,1}, this)._replace(p1 \rightarrow
asType<P1Type>(($heap_tuncstart_1032.1.M1 *
as Type < int > (static\_cast < integer > (static\_cast < signed
int>(operator^*(heapIs \$heap_{funcstart\_1032,1}, this).p1) < (int)0))) +
temp1)))
temp2 == (\$heap_{1032.1:1051.8}.r2 * static\_cast < signed int > (div2.rem)) -
(\text{sheap}_{1032.1:1051.8}.\text{b2} * \text{static\_cast} < \text{signed int} > (\text{div2.quot}))
minof(signed int) < temp2
temp2 \le maxof(signed int)
heap_{1032,1;1054,8} == heap_{1032,1;1051,8}._replace(this.$r \rightarrow
operator*(heapIs heap_{1032,1;1051,8}, this)._replace(p2 \rightarrow
asType<P2Type>(($heap<sub>1032.1:1051.8</sub>.M2 *
asType<int>(static_cast<integer>(static_cast<signed
```

```
int>(operator^*(heapIs \$heap_{1032,1;1051,8}, this).p2) < (int)(0))) + temp(2)))
temp3 == (\$heap_{1032,1;1054,8}.r3 * \textbf{static\_cast} < \textbf{signed int} > (div3.rem)) - \\
(\text{sheap}_{1032.1:1054.8}.\text{b3} * \text{static\_cast} < \text{signed int} > (\text{div}3.\text{quot}))
minof(signed\ int) \le temp3
temp3 \le maxof(signed int)
\theta_{1032,1;1054,8} = \theta_{1032,1;1054,8} - \theta_{1032,1;1054,8}
\mathbf{operator^*(heapIs} \ \$heap_{1032,1;1054,8}, \ \mathbf{this}).\_\mathbf{replace}(p3 \rightarrow
asType<P3Type>(($heap<sub>1032.1:1054.8</sub>.M3 *
asType < int > (static\_cast < integer > (static\_cast < signed)
int>(operator^*(heapIs $heap_{1032.1:1054.8}, this).p3) < (int)0))) + temp3)))
raux1 == asType<double>(static_cast<real>(operator*(heapIs
heap_{funcend\_1032,1}, this).p1) /
asType<double>(static_cast<real>($heap_{funcend\_1032,1}.M1))
raux2 == asType<double>(static_cast<real>(operator*(heapIs
\theta_{funcend\_1032,1}, this).p2)) /
asType<double>(static_cast<real>($heap_{funcend\_1032.1}.M2))
raux3 == \mathbf{asType} < \mathbf{double} > (\mathbf{static\_cast} < \mathbf{real} > (\mathbf{operator}^*(\mathbf{heapIs})) + (\mathbf{operator
heap_{funcend=1032.1}, this).p3)
\mathbf{asType} \small{<} \mathbf{double} \small{>} (\mathbf{static\_cast} \small{<} \mathbf{real} \small{>} (\$ \mathbf{heap}_{funcend\_1032,1}.\mathbf{M3}))
asType<real>((double)0.0) < asType<real>(raux1)
asType<real>((double)0.0) < asType<real>(raux2)
asType<real>((double)0.0) < asType<real>(raux3)
asType<real>((double)0.0) < ((asType<real>(raux2) +
asType < real > (raux1)) + asType < real > (raux3))
Proof:
[Take goal term]
[1.0]!(asType<real>((double)1.0) == asType<real>((double)0.0))
\rightarrow [simplify]
[1.6] true
Proof of verification condition: Postcondition satisfied when function
'GetRandom' returns
In the context of class: WHPrang, declared at:
C:\Escher\Customers\prang-cpp\prang.cpp (18,1)
Condition generated at: C:\Escher\Customers\prang-cpp\prang.cpp (97,5)
Condition defined at: C:\Escher\Customers\prang-cpp\prang.cpp (25,33)
To prove: asType<real>(result) < asType<real>((double)1.0)
```

Given:

```
heap_{init}.LIMIT == (int)80
heap_{init}.class WHPrang \in M1 == (int)30269
heap_{init}.class WHPrang \in r1 == (int)171
heap_{init}.class WHPrang \in a1 == (int)177
heap_{init}.class WHPrang \in b1 == (int)2
heap_{init}.class WHPrang \in M2 == (int)30307
heap_{init}.class WHPrang \in r2 == (int)172
heap_{init}.class WHPrang \in a2 == (int)176
heap_{init}.class WHPrang \in b2 == (int)35
\$ heap_{init}.\mathbf{class} \ WHPrang \in M3 == (\mathbf{int})30323
heap_{init}.class WHPrang \in r3 == (int)170
heap_{init}.class WHPrang \in a3 == (int)178
heap_{init}.class WHPrang \in b3 == (int)63
\operatorname{div1} == \operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_1032,1},
\mathbf{static\_cast} {<} \mathbf{int} {>} (\mathbf{operator^*(heapIs}\ \$heap_{funcstart\_1032,1},\ \mathbf{this}).p1),
\mathbf{static\_cast}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_1032,1}.\mathrm{a1}))
(asType<integer>(static_cast<int>(operator*(heapIs
heap_{funcstart\_1032,1}, this).p1) /
\mathbf{asType} < \mathbf{integer} > (\mathbf{static\_cast} < \mathbf{int} > (\$ \operatorname{heap}_{funcstart\_1032,1}.a1))) = =
asType<integer>(div1.quot)
(asType<integer>(static_cast<int>(operator*(heapIs
heap_{funcstart\_1032.1}, this).p1) %
\mathbf{asType} < \mathbf{integer} > (\mathbf{static\_cast} < \mathbf{int} > (\$ \operatorname{heap}_{funcstart\_1032,1}.a1))) = =
asType<integer>(div1.rem)
(asType<integer>(operator*(heapIs $heap_{funcstart\_1032,1}, this).p1) <
\mathbf{asType} < \mathbf{integer} > (\$ \mathrm{heap}_{funcstart\_1032,1}.\mathrm{a1})) = >
(asType<integer>(div1.rem) == asType<integer>(operator*(heapIs
heap_{funcstart\_1032,1}, this).p1)
(\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathsf{heap}_{funcstart\_1032,1}.\mathtt{a1}) \leq
asType < integer > (operator*(heapIs $heap_{funcstart\_1032.1}, this).p1)) = >
!(0 == asType < integer > (div1.quot))
!(0 == asType < integer > (div1.rem)) || !(0 ==
asType<integer>(div1.quot))
\label{eq:div2} \text{div2} == \text{div}(\mathbf{heapIs} \ \$ \text{heap}_{funcstart\_1032,1},
static\_cast < int > (operator^*(heapIs \$heap_{funcstart\_1032,1}, this).p2),
\mathbf{static\_cast} < \mathbf{int} > (\$ \mathbf{heap}_{funcstart\_1032,1}.\mathbf{a2}))
```

```
(asType<integer>(static_cast<int>(operator*(heapIs
heap_{funcstart\_1032,1}, this).p2) /
asType < integer > (static\_cast < int > (\$heap_{funcstart\_1032.1}.a2))) = =
asType<integer>(div2.quot)
(asType<integer>(static_cast<int>(operator*(heapIs
\theta_{funcstart\_1032,1}, this).p2))
asType < integer > (static\_cast < int > (\$heap_{funcstart\_1032.1}.a2))) = =
asType<integer>(div2.rem)
(\mathbf{asType}{<}\mathbf{integer}{>}(\mathbf{operator}^*(\mathbf{heapIs}\ \$\mathbf{heap}_{funcstart\_1032,1},\ \mathbf{this}).\mathtt{p2}) <
asType < integer > (\$heap_{tuncstart=1032.1}.a2)) = >
(asType<integer>(div2.rem) == asType<integer>(operator*(heapIs
heap_{funcstart\_1032,1}, this).p2)
(\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathbf{heap}_{funcstart\_1032,1}.\mathbf{a2}) \leq
asType<integer>(operator*(heapIs $heap_{tuncstart\_1032.1}, this).p2)) =>
!(0 == asType < integer > (div2.quot))
!(0 == asType < integer > (div2.rem)) || !(0 ==
asType<integer>(div2.quot))
div3 == div(\mathbf{heapIs} \$heap_{funcstart\_1032,1},
\mathbf{static\_cast} < \mathbf{int} > (\mathbf{operator}^*(\mathbf{heapIs}\ \$ \mathbf{heap}_{funcstart\_1032,1},\ \mathbf{this}).\mathbf{p3}),
static\_cast < int > (\$heap_{funcstart\_1032.1}.a3))
(asType<integer>(static_cast<int>(operator*(heapIs
heap_{funcstart\_1032,1}, this).p3)
asType < integer > (static\_cast < int > (\$heap_{funcstart\_1032.1}.a3))) = =
asType<integer>(div3.quot)
(asType < integer > (static\_cast < int > (operator*(heapIs)))
heap_{funcstart\_1032.1}, this).p3)
\mathbf{asType} < \mathbf{integer} > (\mathbf{static\_cast} < \mathbf{int} > (\$ \mathbf{heap}_{funcstart\_1032,1}.\mathbf{a3}))) = =
asType<integer>(div3.rem)
(\mathbf{asType}{<}\mathbf{integer}{>}(\mathbf{operator}^*(\mathbf{heapIs}\ \$\mathbf{heap}_{funcstart\_1032,1},\ \mathbf{this}).\mathrm{p3}) <
asType < integer > (\$heap_{funcstart\_1032,1}.a3)) = >
(asType<integer>(div3.rem) == asType<integer>(operator*(heapIs
heap_{funcstart\_1032,1}, this).p3)
(asType < integer > (\$heap_{funcstart\_1032,1}.a3) \le
\mathbf{asType} < \mathbf{integer} > (\mathbf{operator}^*(\mathbf{heapIs} \ \$ \mathbf{heap}_{funcstart\_1032,1}, \ \mathbf{this}).\mathtt{p3})) = >
!(0 == asType < integer > (div3.quot))
!(0 == asType < integer > (div3.rem)) || !(0 ==
asType<integer>(div3.quot))
temp1 == (\$heap_{funcstart\_1032,1}.r1 * static\_cast < signed int > (div1.rem)) -
($heap_tuncstart_1032.1.b1 * static_cast<signed int>(div1.quot))
minof(signed\ int) \le temp1
```

```
temp1 < maxof(signed int)
\theta_{1032,1;1051,8} == \theta_{1032
operator*(heapIs heap_{funcstart\_1032,1}, this)._replace(p1 \rightarrow
asType<P1Type>(($heap_{funcstart\_1032,1}.M1 *
asType<int>(static_cast<integer>(static_cast<signed
int>(operator^*(heapIs $heap_{funcstart\_1032.1}, this).p1) < (int)0))) +
temp1)))
temp2 == (\$heap_{1032,1:1051,8}.r2 * static\_cast < signed int > (div2.rem)) -
(\text{sheap}_{1032,1:1051.8}.\text{b2} * \text{static\_cast} < \text{signed int} > (\text{div}2.\text{quot}))
minof(signed\ int) \le temp2
temp2 < maxof(signed int)
heap_{1032,1;1054,8} == heap_{1032,1;1051,8}._replace(this.$r \rightarrow
operator*(heapIs \theta_{1032,1;1051,8}, this)._replace(p2 \rightarrow
asType<P2Type>(($heap<sub>1032,1:1051,8</sub>.M2 *
asType < int > (static\_cast < integer > (static\_cast < signed)
int>(operator^*(heapIs $heap_{1032,1;1051,8}, this).p2) < (int)0))) + temp2)))
temp3 == (\$heap_{1032,1;1054,8}.r3 * \mathbf{static\_cast} < \mathbf{signed\ int} > (div3.rem)) -
(\text{sheap}_{1032,1;1054,8}.\text{b3} * \text{static\_cast} < \text{signed int} > (\text{div}3.\text{quot}))
minof(signed\ int) \le temp3
temp3 \le maxof(signed int)
\$ heap_{funcend\_1032,1} == \$ heap_{1032,1;1054,8}.\_\textbf{replace}(\textbf{this}.\$r \rightarrow
operator*(heapIs \theta_{1032,1;1054,8}, this)._replace(p3 \rightarrow
asType<P3Type>(($heap<sub>1032,1;1054,8</sub>.M3 *
asType<int>(static_cast<integer>(static_cast<signed
int > (operator^*(heapIs \$heap_{1032,1;1054,8}, this).p3) < (int)0))) + temp3)))
raux1 == asType<double>(static_cast<real>(operator*(heapIs
\theta_{funcend\_1032,1}, this).p1)) /
asType < double > (static\_cast < real > ($heap_{funcend\_1032.1}.M1))
raux2 == asType<double>(static_cast<real>(operator*(heapIs
\theta_{funcend\_1032,1}, this).p2)) /
\mathbf{asType} < \mathbf{double} > (\mathbf{static\_cast} < \mathbf{real} > (\$ \mathbf{heap}_{funcend\_1032,1}.\mathbf{M2}))
raux3 == asType<double>(static_cast<real>(operator*(heapIs
\theta_{1032,1}, \theta_{1032,1}, \theta_{1032,1}
asType<double>(static_cast<real>($heap_{funcend_1032,1}.M3))
asType<real>((double)0.0) < asType<real>(raux1)
asType<real>((double)0.0) < asType<real>(raux2)
asType<real>((double)0.0) < asType<real>(raux3)
asType < real > ((double)0.0) < ((asType < real > (raux2) + real > (raux
asType<real>(raux1)) + asType<real>(raux3))
```

```
result == \operatorname{fmod}(\mathbf{heapIs} \ \operatorname{heap}_{funcend\_1032,1}, (\operatorname{raux}1 + \operatorname{raux}2) + \operatorname{raux}3,
(double)1.0)
((asType < real > ((double)0.0) \le asType < real > ((raux1 + raux2) + raux2))
raux3)) && (asType<real>((double)0.0) \leq asType<real>((double)1.0)))
=> ((asType < real > ((double)0.0) \le asType < real > (result)) \&\&
(asType<real>(result) < asType<real>((double)1.0)))
Proof:
[Take given term]
[2.0] \text{ div1} == \text{div}(\mathbf{heapIs} \$ heap_{funcstart\_1032,1},
static\_cast < int > (operator*(heapIs $heap_{funcstart\_1032,1}, this).p1),
static_cast<int>($heap_{tuncstart_1032.1}.a1))
→ [expand definition of operator '*' in class 'pointer' at built in declaration]
[2.1] \operatorname{div1} == \operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_1032,1},
static_cast<int>(this.$r.value(heapIs $heap_{tuncstart\_1032.1}).p1),
static\_cast < int > (\$heap_{funcstart\_1032,1}.a1))
\rightarrow [simplify]
[2.2] \text{ div1} == \text{div(heapIs } \text{$heap}_{funcstart\_1032,1}, \text{this.} \text{$r.value(heapIs)}
\theta_{funcstart\_1032,1}.p1, \theta_{funcstart\_1032,1}.p1, \theta_{funcstart\_1032,1}.a1))
\rightarrow [const static or extern object]
[2.3] div1 == div(heapIs heap_{funcstart\_1032,1}, this.r.value(heapIs)
\theta_{uncstart\_1032,1}.p1, \theta_{uncstart\_1032,1}.p2, \theta_{uncstart\_1032,1}.p3, \theta_{uncstart\_1032,1}.p4, \theta_{uncstart\_1032,1}.p4, \theta_{uncstart\_1032,1}.p4, \theta_{uncstart\_1032
\rightarrow [expand definition of constant 'a1' at prang.cpp (30,26)]
[2.4] \text{ div1} == \text{div}(\text{heapIs } \text{heap}_{funcstart\_1032,1}, \text{this.}\text{\$r.value}(\text{heapIs})
\$ heap_{funcstart\_1032,1}).p1, \ \mathbf{static\_cast} < \mathbf{int} > ((\mathbf{int})177))
\rightarrow [simplify]
[2.6] \operatorname{div1} == \operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_1032,1}, \mathbf{this}.\$ r. \mathbf{value}(\mathbf{heapIs})
heap_{funcstart\_1032,1}.p1, 177)
[Assume known post-assertion, class invariant or type constraint for term 2.6]
[7.0] (0 < asType<integer>(this.$r.value(heapIs
\theta_{funcstart\_1032,1}.p1) && (asType<integer>(this.$r.value(heapIs)
\verb§heap$_{funcstart\_1032,1}).p1) < \mathbf{asType} < \mathbf{integer} > (\$ heap.\mathbf{class} \ WHPrang \in \texttt{Prance})
M1))
\rightarrow [simplify]
[7.2] (0 < this.$r.value(heapIs \rho_{funcstart\_1032,1}).p1) &&
(this.r.value(heapIs $heap_{funcstart\_1032,1}).p1 <
asType < integer > (\$heap.class WHPrang \in M1))
\rightarrow [const static or extern object]
```

```
[7.3] (0 < this.$r.value(heap
Is $heap_{funcstart\_1032,1}).p1) &&
(this.$r.value(heapIs heap_{funcstart\_1032,1}).p1 <
asType < integer > (\$heap_{init}.class WHPrang \in M1))
\rightarrow [expand definition of constant 'M1' at prang.cpp (28,26)]
[7.4] (0 < this.$r.value(heap
Is $heap_{funcstart\_1032,1}).p1) &&
(this.r.value(heapIs $heap_{funcstart\_1032,1}).p1 <
asType<integer>((int)30269))
\rightarrow [simplify]
[7.10] (-30269 < -this.$r.value(heapIs $heap_{tuncstart\_1032.1}).p1) \land (0 <
\textbf{this.\$r.value}(\textbf{heapIs}~\$\text{heap}_{funcstart\_1032,1}).\text{p1})
[Work on sub-term 2 of conjunction in term 7.10]
[8.0] 0 < this.$r.value(heapIs $heap_{tuncstart\_1032.1}).p1
[Take given term]
[18.0] div2 == div(heapIs heap_{funcstart\_1032,1},
static_cast<int>(operator*(heapIs $heap_{tuncstart\_1032.1}, this).p2),
\mathbf{static\_cast}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_1032,1}.\mathrm{a2}))
→ [expand definition of operator '*' in class 'pointer' at built in declaration]
[18.1] \operatorname{div2} == \operatorname{div}(\mathbf{heapIs} \ \operatorname{\$heap}_{funcstart\_1032,1},
static_cast<int>(this.$r.value(heapIs $heap_{funcstart\_1032,1}).p2),
static\_cast < int > (\$heap_{funcstart\_1032,1}.a2))
\rightarrow [simplify]
[18.2] \text{ div2} == \text{div}(\mathbf{heapIs} \$ \mathbf{heap}_{funcstart\_1032,1}, \mathbf{this}.\$ \mathbf{r}.\mathbf{value}(\mathbf{heapIs})
\rho_{tuncstart_{1032,1}}, p2, static_cast<int>(\rho_{tuncstart_{1032,1}})
\rightarrow [const static or extern object]
[18.3] div2 == div(\mathbf{heapIs} \ \hat{\mathbf{s}}_{heap} \mathbf{I}_{sat}, \mathbf{this.} \hat{\mathbf{s}}_{r.} \mathbf{value}(\mathbf{heapIs})
\theta_{tuncstart\_1032,1}.p2, \theta_{tuncstart\_1032,1}.p3, \theta_{tuncstart\_1032,1}.p2, \theta_{tuncstart\_1032,1}.p2, \theta_{tuncstart\_1032,1}.p2, \theta_{tuncstart\_1032,1}.p2, \theta_{tuncstart\_1032,1}.p3, \theta_{tuncstart\_1032,1}.p4, \theta_{tuncstart\_1032,1}.p4, \theta_{tuncstart\_1032,1
\rightarrow [expand definition of constant 'a2' at prang.cpp (35,26)]
[18.4] div2 == div(\mathbf{heapIs} \ \mathbf{sheap}_{funcstart\_1032,1}, \ \mathbf{this}.\mathbf{sr.value}(\mathbf{heapIs})
\theta_{funcstart\_1032,1}.p2, \theta_{funcstart} (int)176)
\rightarrow [simplify]
[18.6] div2 == div(heapIs $heap<sub>funcstart_1032,1</sub>, this.$r.value(heapIs)
heap_{funcstart\_1032,1}.p2, 176)
[Assume known post-assertion, class invariant or type constraint for term 18.6]
[23.0] (0 < asType<integer>(this.$r.value(heapIs
\theta_{funcstart\_1032,1}.p2) && (asType<integer>(this.$r.value(heapIs)
\label{eq:class} \$ heap_{funcstart\_1032,1}).p2) < \mathbf{asType} < \mathbf{integer} > (\$ heap.\mathbf{class} \ WHPrang \in \texttt{Constart} = \texttt{Consta
M2))
```

```
\rightarrow [simplify]
[23.2] (0 < this.$r.value(heapIs $heap_{funcstart\_1032,1}).p2) &&
(this.r.value(heapIs $heap_{funcstart\_1032,1}).p2 <
asType < integer > (\$heap.class WHPrang \in M2))
\rightarrow [const static or extern object]
[23.3] (0 < this.$r.value(heapIs $heap_{funcstart\_1032,1}).p2) &&
(this.$r.value(heapIs \rho_{funcstart\_1032,1}).p2 <
asType < integer > (\$heap_{init}.class WHPrang \in M2))
\rightarrow [expand definition of constant 'M2' at prang.cpp (33,26)]
[23.4] (0 < this.$r.value(heap
Is \rho_{uncstart\_1032,1}).p2) &&
(this.$r.value(heapIs heap_{funcstart\_1032,1}).p2 <
asType < integer > ((int)30307))
\rightarrow [simplify]
[23.10] (-30307 < -this.$r.value(heapIs $heap_{funcstart\_1032.1}).p2) \land (0 <
\mathbf{this.\$r.value}(\mathbf{heapIs}~\$\mathrm{heap}_{funcstart\_1032,1}).\mathrm{p2})
[Work on sub-term 2 of conjunction in term 23.10]
[24.0] 0 < this.$r.value(heapIs $heap_{funcstart\_1032.1}).p2
[Take given term]
[34.0] \text{ div3} == \text{div}(\mathbf{heapIs} \$ heap_{funcstart\_1032,1},
static\_cast < int > (operator*(heapIs $heap_{funcstart\_1032,1}, this).p3),
static\_cast < int > (\$heap_{funcstart\_1032,1}.a3))
→ [expand definition of operator '*' in class 'pointer' at built in declaration]
[34.1] \text{ div3} == \text{div}(\mathbf{heapIs} \$ heap_{funcstart\_1032,1},
static\_cast < int > (this. r.value(heapIs $heap_{funcstart\_1032,1}).p3),
static\_cast < int > (\$heap_{funcstart\_1032,1}.a3))
\rightarrow [simplify]
[34.2]~{\rm div3} == {\rm div}(\mathbf{heapIs}~\$\mathrm{heap}_{funcstart\_1032,1},~\mathbf{this}.\$\mathrm{r.value}(\mathbf{heapIs}
\theta_{funcstart\_1032,1}, p3, static_cast<int>(\theta_{funcstart\_1032,1})
\rightarrow [const static or extern object]
[34.3] div3 == div(heapIs heapIs heapIs _{funcstart\_1032,1}, this.r.value(heapIs)
\label{eq:cast_int} $$ \rho_{funcstart\_1032,1}.p3, \ \mathbf{static\_cast} < \mathbf{int} > (\$ \rho_{init}.a3)) $$
\rightarrow [expand definition of constant 'a3' at prang.cpp (40,26)]
[34.4] div3 == div(heapIs $heap_{tuncstart\_1032.1}, this.$r.value(heapIs)
\label{eq:cast_int} $$ \rho_{tuncstart\_1032,1}.p3, \ \mathbf{static\_cast} < \mathbf{int} > ((\mathbf{int})178)) $$
\rightarrow [simplify]
[34.6] div3 == div(heapIs $heap_{funcstart\_1032,1}, this.$r.value(heapIs)
heap_{funcstart_{-1032,1}}.p3, 178)
```

```
[Assume known post-assertion, class invariant or type constraint for term 34.6]
[39.0] (0 < asType<integer>(this.$r.value(heapIs
\verb§heap$_{funcstart\_1032,1}).p3)) \&\& (\mathbf{asType} < \mathbf{integer} > (\mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}))) \&\& (\mathbf{asType} < \mathbf{integer} > (\mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}))) \&\& (\mathbf{asType} < \mathbf{integer} > (\mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})))) \&\& (\mathbf{asType} < \mathbf{integer} > (\mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}))))) \&\& (\mathbf{asType} < \mathbf{integer} > (\mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}))))) \&\& (\mathbf{asType} < \mathbf{integer} > (\mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}))))))
\$heap_{funcstart\_1032,1}).p3) < \mathbf{asType} < \mathbf{integer} > (\$heap.\mathbf{class} \ \mathbf{WHPrang} \in \texttt{Particle})
M3))
\rightarrow [simplify]
[39.2] (0 < this.\$r.value(heapIs \$heap_{funcstart_{-1032,1}}).p3) &&
(this.$r.value(heapIs \theta_{funcstart\_1032,1}).p3 <
asType < integer > (\$heap.class WHPrang \in M3))
\rightarrow [const static or extern object]
[39.3] (0 < this.$r.value(heap
Is \rho_{uncstart\_1032,1}).p3) &&
(this.r.value(heapIs \ heap_{funcstart\_1032,1}).p3 <
asType < integer > (\$heap_{init}.class WHPrang \in M3))
→ [expand definition of constant 'M3' at prang.cpp (38,26)]
[39.4] (0 < this.$r.value(heap
Is $heap_{funcstart\_1032,1}).p3) &&
(this.r.value(heapIs $heap_{funcstart\_1032,1}).p3 <
asType < integer > ((int)30323))
\rightarrow [simplify]
[39.10] (-30323 < -this.$r.value(heapIs $heap_{funcstart\_1032.1}).p3) \land (0 <
this.r.value(heapIs $heap_{funcstart\_1032,1}).p3)
[Work on sub-term 2 of conjunction in term 39.10]
[40.0] 0 < this.$r.value(heapIs \theta_{funcstart\_1032,1}).p3
[Take given term]
[50.0] \; ((\$heap_{funcstart\_1032,1}.r1 \; * \; \textbf{static\_cast} < \textbf{signed int} > (\text{div1.rem})) \; - \\
(\text{sheap}_{funcstart\_1032,1}.\text{b1 * static\_cast} < \text{signed int} > (\text{div1.quot}))) == \text{temp1}
\rightarrow [const static or extern object]
[50.1] \; ((\$ heap_{init}.r1 \; * \; \textbf{static\_cast} < \textbf{signed int} > (\text{div1.rem})) \; - \\
(\text{sheap}_{funcstart\_1032,1}.\text{b1 * static\_cast} < \text{signed int} > (\text{div1.quot}))) == \text{temp1}
→ [expand definition of constant 'r1' at prang.cpp (29,26)]
[50.2] (((int)171 * static_cast<signed int>(div1.rem)) -
(\text{\$heap}_{funcstart\_1032,1}.\text{b1 * static\_cast} < \text{signed int} > (\text{div1.quot}))) == \text{temp1}
\rightarrow [simplify]
[50.3] ((171 * static_cast < signed int > (div1.rem)) - ($heap_{funcstart\_1032,1}.b1
* static_cast<signed int>(div1.quot))) == temp1
\rightarrow [from term 2.6, div1 is equal to div(heapIs $heap_{funcstart\_1032,1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177)]
[50.4] ((171 * static_cast<signed int>(div(heapIs $heap_{funcstart\_1032.1},
```

```
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177).rem)) -
(\text{sheap}_{funcstart\_1032,1}.\text{b1 * static\_cast} < \text{signed int} > (\text{div1.quot}))) == \text{temp1}
\rightarrow [simplify]
[50.5] ((171 * div(heapIs \$heap_{funcstart\_1032,1}, this.\$r.value(heapIs)
heap_{funcstart\_1032,1}.p1, 177).rem - (heap_{funcstart\_1032,1}.b1 *
static_cast<signed int>(div1.quot))) == temp1
\rightarrow [const static or extern object]
[50.6] ((171 * div(heapIs $heap<sub>funcstart_1032.1</sub>, this.$r.value(heapIs)
\rho_{funcstart\_1032,1}.p1, 177).rem – (\rho_{funcstart\_1032,1}.p1, 177).rem
int>(div1.quot))) == temp1
\rightarrow [expand definition of constant 'b1' at prang.cpp (31,26)]
[50.7] ((171 * div(heapIs \$heap_{funcstart\_1032,1}, this.\$r.value(heapIs
\theta_{funcstart\_1032.1}.p1, 177).rem) - ((int)2 * static_cast<signed)
int>(div1.quot)) = temp1
\rightarrow [simplify]
[50.8] ((171 * div(heapIs $heap_{funcstart\_1032,1}, this.$r.value(heapIs)
\theta_{funcstart\_1032,1}.p1, 177).rem - (2 * static\_cast < signed)
int>(div1.quot)) == temp1
\rightarrow [from term 2.6, div1 is equal to div(heapIs $heap_{funcstart\_1032,1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177)
[50.9] ((171 * div(heapIs $heap<sub>funcstart_1032,1</sub>, this.$r.value(heapIs)
\theta_{funcstart\_1032.1}.p1, 177).rem) - (2 * static_cast<signed)
int>(div(heapIs \$heap_{funcstart\_1032,1}, this.\$r.value(heapIs
\text{Sheap}_{funcstart\_1032,1}).p1, 177).quot))) == temp1
\rightarrow [simplify]
[50.14] 0 == (-\text{temp1} + (-2 * \text{div}(\text{heapIs } \text{$heap}_{funcstart\_1032.1},
this.$r.value(heapIs heap_{funcstart\_1032,1}).p1, 177).quot) + (171 *
div(\mathbf{heapIs} \$ heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
heap_{funcstart\_1032,1}.p1, 177).rem)
[Take given term]
[53.0] heap_{1032,1;1051,8} == heap_{funcstart\_1032,1}._replace(this.$r \rightarrow
operator*(heapIs heap_{funcstart\_1032,1}, this)._replace(p1 \rightarrow
asType<P1Type>(($heap_funcstart_1032,1.M1 *
asType{<}int{>}(static\_cast{<}integer{>}(static\_cast{<}signed
int>(operator*(heapIs $heap_{funcstart\_1032,1}, this).p1) < (int)0))) +
→ [expand definition of operator '*' in class 'pointer' at built in declaration]
[53.1] heap_{1032,1;1051,8} == heap_{funcstart\_1032,1}._replace(this.r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow
```

```
asType < P1Type > ((\$heap_{funcstart\_1032,1}.M1 *
asType<int>(static_cast<integer>(static_cast<signed
\mathbf{int}{>}(\mathbf{operator}^*(\mathbf{heapIs}\ \$\mathbf{heap}_{funcstart\_1032,1},\ \mathbf{this}).\mathrm{p1})<(\mathbf{int})0)))+\\
temp1)))
\rightarrow [const static or extern object]
[53.2] heap_{1032,1;1051,8} == heap_{funcstart\_1032,1}._replace(this.r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow
asType<P1Type>(($heap<sub>init</sub>.M1 *
asType<int>(static_cast<integer>(static_cast<signed
int>(operator^*(heapIs \$heap_{tuncstart 1032.1}, this).p1) < (int)0))) +
temp1)))
\rightarrow [expand definition of constant 'M1' at prang.cpp (28,26)]
[53.3] heap_{1032,1;1051,8} == heap_{funcstart\_1032,1}._replace(this.$r \rightarrow
\textbf{this.}\$r.\textbf{value}(\textbf{heapIs}~\$heap_{funcstart\_1032,1}).\_\textbf{replace}(p1 \rightarrow
asType < P1Type > (((int)30269 *
asType<int>(static_cast<integer>(static_cast<signed
int>(operator*(heapIs $heap_{funcstart\_1032,1}, this).p1) < (int)0))) +
temp1)))
\rightarrow [simplify]
[53.4] heap_{1032,1;1051,8} == heap_{funcstart\_1032,1}._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow
asType<P1Type>((30269 *
as Type < int > (static\_cast < integer > (static\_cast < signed))
int>(operator^*(heapIs $heap_{funcstart\_1032,1}, this).p1) < (int)0))) +
temp1)))
→ [expand definition of operator '*' in class 'pointer' at built in declaration]
[53.5] $heap<sub>1032,1;1051,8</sub> == $heap<sub>funcstart_1032,1</sub>._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow
asType<P1Type>((30269 *
as Type < int > (static\_cast < integer > (static\_cast < signed))
int>(this.\$r.value(heapIs \$heap_{funcstart\_1032,1}).p1) < (int)0))) + temp1)))
\rightarrow [simplify]
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow
{\bf asType}{<} P1Type{>} ((30269 * {\bf asType}{<} {\bf int}{>} ({\bf static\_cast}{<} {\bf integer}{>} (0 <
-this.r.value(heapIs heap_{funcstart\_1032,1}.p1)) + temp1)))
\rightarrow [from term 8.0, literala < -this.$r.value(heapIs $heap_{funcstart\_1032,1}).p1
is false whenever -2 < (0 + literala)
   Proof of rule precondition:
   [53.9.0] - 2 < (0 + 0)
```

```
\rightarrow [simplify]
       [53.9.2] true
[53.10] $\text{heap}_{1032,1;1051,8} == $\text{heap}_{funcstart\_1032,1}._\text{replace}(\text{this}.\text{$\frac{1}{2}r$})
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow
\mathbf{asType} \small{<} P1Type \small{>} ((30269 * \mathbf{asType} \small{<} \mathbf{int} \small{>} (\mathbf{static\_cast} \small{<} \mathbf{integer} \small{>} (\mathbf{false})))
+ \text{temp1})))
\rightarrow [simplify]
[53.11] heap_{1032,1:1051,8} == heap_{funcstart\_1032,1}._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow
asType < P1Type > ((30269 * asType < int > (([false]: 1, []: 0))) + temp1)))
\rightarrow [explicitly assert falsehood of skipped guards in subsequent guards]
[53.12] \theta_{1032,1;1051,8} == \theta_{1032,1;1051,8} == \theta_{1032,1}.replace(this.$r \to
this.$r.value(heapIs heap_{funcstart\_1032.1})._replace(p1 \rightarrow
asType<P1Type>((30269 * asType<int>(([false]: 1, [true]: 0))) +
temp1)))
\rightarrow [simplify]
[53.15] $heap<sub>1032,1;1051,8</sub> == $heap<sub>funcstart_1032,1</sub>._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow
asType < P1Type > (0 + temp1))
\rightarrow [from term 50.14, temp1 is equal to (-2 * div(heapIs $heap_{tuncstart\_1032.1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177).quot) + (171 \ function for the first substitution of the first 
div(\textbf{heapIs}~\$heap_{funcstart\_1032,1},~\textbf{this.\$r.value}(\textbf{heapIs}
heap_{funcstart\_1032,1}.p1, 177).rem
[53.16] $heap<sub>1032.1:1051.8</sub> == $heap<sub>funcstart_1032.1</sub>._replace(this.$r \rightarrow
this.r.value(heapIs \ heap_{funcstart\_1032,1}).\_replace(p1 \rightarrow
asType < P1Type > (0 + ((-2 * div(heapIs $heap_{funcstart\_1032,1},
this.$r.value(heapIs heap_{funcstart_{-1032,1}}).p1, 177).quot) + (171 *
div(\mathbf{heapIs} \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
heap_{funcstart_{1032,1}}.p1, 177).rem))))
\rightarrow [simplify]
[53.19] $heap<sub>1032,1;1051,8</sub> == $heap<sub>funcstart_1032,1</sub>._replace(this.$r \rightarrow
this.$r.value(heapIs $heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{tuncstart_{-1032.1}}, this.r.value(heapIs \rho_{tuncstart_{-1032.1}}).p1,
177).quot) + (171 * div(\mathbf{heapIs} \ \$heap_{funcstart\_1032,1}, \ \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
\operatorname{\$heap}_{funcstart\_1032,1}).\operatorname{p1},\ 177).\operatorname{rem}))))
[Take given term]
[54.0] (($heap<sub>1032.1:1051.8</sub>.r2 * static_cast<signed int>(div2.rem)) -
(\text{sheap}_{1032,1:1051.8}.\text{b2} * \text{static\_cast} < \text{signed int} > (\text{div2.quot}))) == \text{temp2}
\rightarrow [from term 53.19, $heap<sub>1032,1;1051,8</sub> is equal to
```

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$heap_{funcstart\_1032,1}.$-replace(this.$r \rightarrow this.$r.value(heapIs)
heap_{funcstart\_1032,1}._replace(p1 \rightarrow (-2 * div(heapIs $heap_{funcstart\_1032,1}).
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177).quot) + (171 *
div(heapIs $heap_{funcstart\_1032,1}, this.$r.value(heapIs)
heap_{funcstart_{1032,1}}.p1, 177).rem)))
[54.1] \; ((\$ heap_{funcstart\_1032,1}. \verb"replace" (this.\$r) \to this.\$r. value (heapIs)) \\
\text{Sheap}_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs \text{Sheap}_{funcstart\_1032,1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177).quot) + (171 * 
div(\mathbf{heapIs} \$ heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
\theta_{funcstart\_1032,1}.p1, 177).rem))).r2 * static_cast < signed
\mathbf{int}{>}(\mathrm{div2.rem})) - (\$\mathrm{heap}_{1032,1;1051,8}.\mathrm{b2} * \mathbf{static\_cast}{<} \mathbf{signed}
int > (div2.quot))) == temp2
\rightarrow [const member of object with modified fields]
[54.2] (($heap_tuncstart_1032.1.r2 * static_cast<signed int>(div2.rem)) -
(\text{sheap}_{1032,1;1051,8}.\text{b2} * \text{static\_cast} < \text{signed int} > (\text{div2.quot}))) == \text{temp2}
\rightarrow [const static or extern object]
[54.3] (($heap<sub>init</sub>.r2 * static_cast<signed int>(div2.rem)) -
(\text{sheap}_{1032,1;1051,8}.\text{b2} * \text{static\_cast} < \text{signed int} > (\text{div2.quot}))) == \text{temp2}
\rightarrow [expand definition of constant 'r2' at prang.cpp (34,26)]
[54.4] (((int)172 * static_cast<signed int>(div2.rem)) -
(\text{sheap}_{1032,1:1051.8}.\text{b2} * \text{static\_cast} < \text{signed int} > (\text{div2.quot}))) == \text{temp2}
\rightarrow [simplify]
[54.5] ((172 * static_cast<signed int>(div2.rem)) - ($heap_{1032.1:1051.8}.b2 *
static_cast<signed int>(div2.quot))) == temp2
\rightarrow [from term 18.6, div2 is equal to div(heapIs $heap_{funcstart\_1032,1},
this.r.value(heapIs $heap_{funcstart\_1032,1}).p2, 176)]
[54.6] ((172 * static_cast < signed int > (div(heapIs heapIs funcstart_{1032,1}),
this.r.value(heapIs \ heap_{funcstart\_1032.1}).p2, 176).rem)) -
(\text{sheap}_{1032,1:1051,8}.\text{b2} * \text{static\_cast} < \text{signed int} > (\text{div2.quot}))) == \text{temp2}
\rightarrow [simplify]
[54.7] ((172 * div(heapIs \$heap_{funcstart\_1032,1}, this.\$r.value(heapIs
heap_{funcstart\_1032,1}.p2, 176).rem - (heap_{1032,1;1051.8}.b2 *
static_cast<signed int>(div2.quot))) == temp2
\rightarrow [from term 53.19, $heap<sub>1032,1;1051,8</sub> is equal to
\$heap_{funcstart\_1032,1}.\_\textbf{replace}(\textbf{this.}\$r \rightarrow \textbf{this.}\$r.\textbf{value}(\textbf{heapIs}
heap_{funcstart\_1032.1}._replace(p1 \rightarrow (-2 * div(heapIs heap_{funcstart\_1032.1}),
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177).quot) + (171 *
div(\mathbf{heapIs}\ \$heap_{funcstart\_1032,1},\ \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}
heap_{funcstart_{-1032.1}}.p1, 177).rem)))
```

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\rho_{funcstart\_1032,1}.p2, 176).rem – (\rho_{funcstart\_1032,1}.\_replace).
\rightarrow this.$r.value(heapIs $heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 *
div(\mathbf{heapIs} \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
\text{Sheap}_{funcstart\_1032,1}.p1, 177).quot) + (171 * div(heapIs \text{Sheap}_{funcstart\_1032,1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177).rem)))).b2 *
static_cast<signed int>(div2.quot))) == temp2
→ [const member of object with modified fields]
[54.9] ((172 * div(heapIs $heap<sub>funcstart_1032,1</sub>, this.$r.value(heapIs)
\text{Sheap}_{funcstart\ 1032.1}.p2, 176).rem) - (\text{Sheap}_{funcstart\ 1032.1}.b2 *
static_cast<signed int>(div2.quot))) == temp2
\rightarrow [const static or extern object]
[54.10]~((172~^*~{\rm div}({\bf heap Is}~\${\rm heap}_{funcstart\_1032,1},~{\bf this.\$r.value}({\bf heap Is}
\theta_{nit}.b2 * static_cast < signed
int>(div2.quot)) == temp2
\rightarrow [expand definition of constant 'b2' at prang.cpp (36,26)]
[54.11] ((172 * div(heapIs \$heap_{funcstart\_1032,1}, this.\$r.value(heapIs
\rho_{funcstart\_1032.1}.p2, 176).rem - ((int)35 * static\_cast < signed)
int>(div2.quot))) == temp2
\rightarrow [simplify]
[54.12] ((172 * \mathrm{div}(\mathbf{heapIs}\ \$\mathrm{heap}_{funcstart\_1032,1},\ \mathbf{this}.\$\mathrm{r.value}(\mathbf{heapIs}\ 
\rho_{funcstart\_1032.1}.p2, 176).rem) - (35 * static_cast<signed)
int>(div2.quot)) = temp2
\rightarrow [from term 18.6, div2 is equal to div(heapIs $heap_{funcstart\_1032,1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p2, 176)]
[54.13] ((172 * div(heapIs heap_{funcstart\_1032,1}, this.r.value(heapIs)
\rho_{tuncstart\_1032.1}.p2, 176).rem - (35 * static\_cast < signed)
int>(div(heapIs $heap_{tuncstart_1032.1}, this.$r.value(heapIs
\text{Sheap}_{funcstart\_1032,1}.p2, 176).quot))) == temp2
\rightarrow [simplify]
[54.18] 0 == (-\text{temp2} + (-35 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1},
this.r.value(heapIs \ensuremath{\$}heap_{funcstart\_1032,1}).p2, 176).quot) + (172 *
div(\mathbf{heapIs} \$ heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
heap_{funcstart\_1032,1}.p2, 176).rem
[Take given term]
[57.0] $\text{heap}_{1032,1;1054,8} == $\text{heap}_{1032,1;1051,8}._\text{replace}(\text{this}.$\text{$r} \to \text{
operator*(heapIs heap_{1032,1;1051,8}, this)._replace(p2 \rightarrow
asType<P2Type>(($heap<sub>1032,1:1051,8</sub>.M2 *
asType<int>(static_cast<integer>(static_cast<signed
int > (operator^*(heapIs $heap_{1032,1:1051.8}, this).p2) < (int)(0))) + temp(2)))
```

[54.8] ((172 * $\operatorname{div}(\mathbf{heapIs} \ \mathbf{sheap}_{funcstart_1032,1}, \ \mathbf{this}.\mathbf{sr.value}(\mathbf{heapIs})$

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\rightarrow [from term 53.19, $heap<sub>1032,1;1051,8</sub> is equal to
\$heap_{funcstart\_1032,1}.\_\textbf{replace}(\textbf{this}.\$r \rightarrow \textbf{this}.\$r.\textbf{value}(\textbf{heapIs}
heap_{funcstart\_1032,1}._replace(p1 \rightarrow (-2 * div(heapIs p_{funcstart\_1032,1}).
this. $r.value(heapIs heap_{funcstart\_1032,1}).p1, 177).quot) + (171 heapIs
div(heapIs $heap_funcstart_1032.1, this.$r.value(heapIs
heap_{funcstart\_1032,1}.p1, 177).rem)))
[57.2] heap_{1032,1;1054,8} == heap_{funcstart\_1032,1}._replace(this.r \rightarrow
\textbf{this.}\$r.\textbf{value}(\textbf{heapIs}~\$\text{heap}_{funcstart\_1032,1}).\_\textbf{replace}(\text{p1} \rightarrow ((-2~*\text{div}(\textbf{heapIs}
\rho_{funcstart\_1032,1}, this.\r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs \rho_{funcstart\_1032,1}, this.r.value(heapIs)
\hat{p}_{funcstart\_1032,1}.p1, 177).rem)))_replace(this.$r \rightarrow operator*(heapIs)
\rho_{tuncstart\_1032.1}._replace(this.r \to this.r.value(heapIs)
heap_{funcstart\_1032,1}._replace(p1 \rightarrow (-2 * div(heapIs p_{funcstart\_1032,1}).
this.r.value(heapIs \ heap_{funcstart\_1032.1}).p1, 177).quot) + (171)
{\rm div}(\mathbf{heapIs}~\$\mathrm{heap}_{funcstart\_1032,1},~\mathbf{this.\$r.value}(\mathbf{heapIs}
\theta_{tuncstart_{1032,1}}.p1, 177).rem)), this).replace(p2 \rightarrow
asType<P2Type>(($heap<sub>1032,1:1051,8</sub>.M2 *
as Type < int > (static\_cast < integer > (static\_cast < signed))
int > (operator^*(heapIs \$heap_{1032,1;1051,8}, this).p2) < (int)0))) + temp2)))
→ [expand definition of operator '*' in class 'pointer' at built in declaration]
[57.3] heap_{1032,1;1054,8} == heap_{funcstart\_1032,1}._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(\mathbf{heapIs} \$ heap_{funcstart\_1032,1}, \mathbf{this}.\$ r. \mathbf{value}(\mathbf{heapIs})
\theta_{tuncstart\_1032,1}.p1, 177).rem)))).\_replace(this.\$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1}._replace(this.$r \rightarrow
this.$r.value(heapIs \rho_{tuncstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart=1032,1}, this.r.value(heapIs \rho_{funcstart=1032,1}).p1,
177).quot) + (171 * div(heapIs \theta_{funcstart\_1032,1}, this.r.value(heapIs)
\theta_{funcstart\_1032.1}.p1, 177).rem))))._replace(p2 \rightarrow
asType<P2Type>(($heap<sub>1032,1:1051,8</sub>.M2 *
as Type < int > (static\_cast < integer > (static\_cast < signed
int>(operator^*(heapIs $heap_{1032,1;1051,8}, this).p2) < (int)0))) + temp2)))
→ [evaluate dereferenced pointer into modified heap]
[57.4] heap_{1032,1;1054,8} == heap_{funcstart\_1032,1}._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{tuncstart_{1032.1}}, this. r.value(heapIs \rho_{tuncstart_{1032.1}}).p1,
177).quot) + (171 * div(heapIs \theta_{funcstart\_1032,1}, this.r.value(heapIs)
\theta_{uncstart\_1032,1}.p1, 177).rem))))._replace(this.$r \rightarrow ([this.$r ===
this.$r]: this.$r.value(heap
Is $heap_{funcstart\_1032,1})._replace(p1 \rightarrow (-2 *
div(\mathbf{heapIs} \$ heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
\text{Sheap}_{funcstart\_1032,1}.p1, 177).quot) + (171 * div(heapIs \text{Sheap}_{funcstart\_1032,1},
this.$r.value(heapIs heap_{funcstart\_1032,1}).p1, 177).rem)), []:
```

```
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p2 \rightarrow
asType<P2Type>(($heap<sub>1032,1;1051,8</sub>.M2 *
as Type < int > (static\_cast < integer > (static\_cast < signed))
int>(operator*(heapIs $heap_{1032,1;1051,8}, this).p2) < (int)0))) + temp2)))
→ [explicitly assert falsehood of skipped guards in subsequent guards]
[57.5] heap_{1032,1;1054,8} == heap_{funcstart\_1032,1}._replace(this.$r \rightarrow
this.$r.value(heapIs \rho_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
\$heap_{funcstart\_1032,1}).p1,\,177).rem)))).\_\mathbf{replace}(\mathbf{this}.\$r \rightarrow ([\mathbf{this}.\$r ==
this.$r]: this.$r.value(heap
Is $heap_{funcstart\_1032,1}).$_replace(p1 \rightarrow (-2 *
div(\mathbf{heapIs} \$ heap_{funcstart\_1032.1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
\text{Sheap}_{funcstart\_1032,1}.p1, 177).quot) + (171 * div(heapIs \text{Sheap}_{funcstart\_1032,1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177).rem)), [!(this.<math>r = 
this.$r)]: this.$r.value(heapIs \rho_{funcstart\_1032,1})._replace(p2 \rightarrow
asType<P2Type>(($heap<sub>1032,1;1051,8</sub>.M2 *
asType < int > (static\_cast < integer > (static\_cast < signed)
int>(operator^*(heapIs $heap_{1032.1:1051.8}, this).p2) < (int)(0))) + temp(2)))
\rightarrow [simplify]
[57.7] heap_{1032,1;1054,8} == heap_{funcstart\_1032,1}._replace(this.$r \rightarrow
\textbf{this.\$r.value}(\textbf{heapIs}~\$ heap_{funcstart\_1032,1}).\_\textbf{replace}(p1 \rightarrow ((\text{-}2~*\text{div}(\textbf{heapIs}
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(\mathbf{heapIs} \ \$heap_{funcstart\_1032,1}, \ \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
\theta_{funcstart\_1032.1}.p1, 177).rem)))._replace(this.$r \rightarrow
\textbf{this.}\$r.\textbf{value}(\textbf{heapIs}~\$heap_{funcstart\_1032,1}).\_\textbf{replace}(p1 \rightarrow ((\text{-}2~*\text{div}(\textbf{heapIs}
\rho_{funcstart\_1032,1}, this.\r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(\mathbf{heapIs} \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}))
\theta_{funcstart\_1032,1}.p1, 177).rem))._replace(p2 \rightarrow
asType<P2Type>(($heap<sub>1032,1;1051,8</sub>.M2 *
asType<int>(static_cast<integer>(static_cast<signed
int > (operator^*(heapIs $heap_{1032,1:1051.8}, this).p2) < (int)(0))) + temp(2)))
\rightarrow [from term 53.19, $heap<sub>1032,1:1051,8</sub> is equal to
$heap_{funcstart\_1032,1}.$-replace(this.$r \rightarrow this.$r.value(heapIs)
heap_{funcstart\_1032,1}._replace(p1 \rightarrow (-2 * div(heapIs $heap_{funcstart\_1032,1},
this.r.value(heapIs \ \ heap_{funcstart\_1032,1}).p1, \ 177).quot) + (171 *
div(heapIs $heap_{funcstart_1032.1}, this.$r.value(heapIs
heap_{funcstart_{1032,1}}.p1, 177).rem)))
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs $heap<sub>funcstart_1032,1</sub>, this.$r.value(heapIs
\theta_{funcstart\_1032,1}.p1, 177).rem)))).replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
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\theta_{funcstart_1032,1}, this.\r.value(heapIs \theta_{funcstart_1032,1}).p1,
177).quot) + (171 * div(heapIs \theta_{funcstart\_1032,1}, this.r.value(heapIs)
\theta_{funcstart\_1032,1}.p1, 177).rem))).\_replace(p2 \rightarrow
asType < P2Type > ((\$heap_{tuncstart\_1032,1}.\_replace(this.\$r \rightarrow
this.$r.value(heapIs \rho_{tuncstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
$heap_tuncstart_1032.1).p1, 177).rem)))).M2 *
asType<int>(static_cast<integer>(static_cast<signed
int>(operator^*(heapIs $heap_{1032,1;1051,8}, this).p2) < (int)(0))) + temp(2)))
→ [const member of object with modified fields]
[57.9] heap_{1032,1;1054,8} == heap_{funcstart\_1032,1}._replace(this.$r \rightarrow
this.$r.value(heapIs p_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
heap_{funcstart\_1032,1}, this.r.value(heapIs heap_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
\theta_{funcstart\_1032,1}.p1, 177).rem)))).\_replace(this.\$r \rightarrow 0
this.$r.value(heapIs \rho_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\$heap_{funcstart\_1032,1},\, \textbf{this}.\$r.\textbf{value}(\textbf{heapIs}\,\,\$heap_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
\theta_{funcstart\_1032,1}.p1, 177).rem))).\_replace(p2 \rightarrow
asType<P2Type>(($heap<sub>funcstart_1032.1</sub>.M2 *
asType<int>(static_cast<integer>(static_cast<signed
\mathbf{int}{>}(\mathbf{operator}^*(\mathbf{heapIs}\ \$\mathrm{heap}_{1032,1;1051,8},\ \mathbf{this}).\mathrm{p2})<(\mathbf{int})0)))+\mathrm{temp2})))
\rightarrow [const static or extern object]
[57.10] $heap<sub>1032,1;1054,8</sub> == $heap<sub>funcstart_1032,1</sub>._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{tuncstart\_1032.1}, this.r.value(heapIs \rho_{tuncstart\_1032.1}).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{heap}_{funcstart\_1032,1}, \text{this.} \text{$r.value}(\text{heapIs}))
\theta_{funcstart\_1032,1}.p1, 177).rem)))).\_replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\theta_{funcstart\_1032,1}, this.r.value(heapIs \theta_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs \theta_{funcstart\_1032,1}, this.r.value(heapIs)
\theta_{funcstart\_1032,1}.p1, 177).rem)))._replace(p2 \rightarrow
asType<P2Type>(($heap<sub>init</sub>.M2 *
asType<int>(static_cast<integer>(static_cast<signed
\mathbf{int}{>}(\mathbf{operator}^*(\mathbf{heapIs}\ \$\mathrm{heap}_{1032,1;1051,8},\ \mathbf{this}).\mathrm{p2})<(\mathbf{int})0)))+\mathrm{temp2})))
\rightarrow [expand definition of constant 'M2' at prang.cpp (33,26)]
[57.11] $heap<sub>1032,1;1054,8</sub> == $heap<sub>funcstart_1032,1</sub>._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs $heap<sub>funcstart_1032,1</sub>, this.$r.value(heapIs
\theta_{funcstart\_1032,1}.p1, 177).rem)))).replace(this.$r \rightarrow
this.$r.value(heapIs \rho_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
```

```
\rho_{tuncstart=1032.1}, this.r.value(heapIs \rho_{tuncstart=1032.1}).p1,
177).quot) + (171 * div(heapIs \theta_{funcstart\_1032,1}, this.r.value(heapIs)
\theta_{funcstart\_1032,1}.p1, 177).rem))).\_replace(p2 \rightarrow
asType < P2Type > (((int)30307 *
asType<int>(static_cast<integer>(static_cast<signed
int > (operator^*(heapIs \$heap_{1032,1;1051,8}, this).p2) < (int)0))) + temp2)))
\rightarrow [simplify]
[57.12] $\text{heap}_{1032,1;1054,8} == $\text{heap}_{funcstart\_1032,1}._\text{replace}(\text{this}.$\text{$r} \to \text{$}
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\$heap_{funcstart\_1032,1},\, \textbf{this}.\$r.\textbf{value}(\textbf{heapIs}\,\,\$heap_{funcstart\_1032.1}).p1,
177).quot) + (171 * div(heapIs $heap<sub>funcstart_1032,1</sub>, this.$r.value(heapIs
\theta_{tuncstart\_1032,1}.p1, 177).rem)))).\_replace(this.\$r \rightarrow
this.$r.value(heapIs p_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs \theta_{funcstart\_1032,1}, this.r.value(heapIs)
\theta_{funcstart\_1032,1}.p1, 177).rem))).\_replace(p2 \rightarrow
asType<P2Type>((30307 *
asType < int > (static\_cast < integer > (static\_cast < signed)
int>(operator^*(heapIs $heap_{1032,1:1051,8}, this).p2) < (int)(0))) + temp(2)))
\rightarrow [from term 53.19, $heap<sub>1032,1;1051,8</sub> is equal to
$heap_{funcstart\_1032,1}.$-replace(this.$r \rightarrow this.$r.value(heapIs)
heap_{funcstart\_1032,1}._replace(p1 \rightarrow (-2 * div(heapIs $heap_{funcstart\_1032,1}, 
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177).quot) + (171 * leapIs \ heap_{funcstart\_1032,1}).p1, 177).quot)
div(\mathbf{heapIs} \ \$heap_{funcstart\_1032,1}, \ \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
$heap_tuncstart_1032.1).p1, 177).rem)))]
[57.13] $heap<sub>1032,1;1054,8</sub> == $heap<sub>funcstart_1032,1</sub>._replace(this.$r \rightarrow
this.$r.value(heapIs \rho_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\theta_{funcstart\_1032,1}, this.r.value(heapIs \theta_{funcstart\_1032,1}).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.} \text{\$r.value}(\text{heapIs}))
\theta_{funcstart_{1032,1}}.p1, 177).rem))))._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{tuncstart = 1032.1})._replace(p1 \rightarrow ((-2 * div(heapIs
\$heap_{funcstart\_1032,1},\, \textbf{this}.\$r.\textbf{value}(\textbf{heapIs}\,\,\$heap_{funcstart\_1032,1}).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032.1}, \text{this.} \text{\$r.value}(\text{heapIs}))
heap_{funcstart\_1032,1}.p1, 177).rem)))._replace(p2 \rightarrow
asType<P2Type>((30307 *
asType<int>(static_cast<integer>(static_cast<signed
\mathbf{int}{>}(\mathbf{operator}^*(\mathbf{heapIs}\ \$\mathbf{heap}_{funcstart\_1032,1}.\_\mathbf{replace}(\mathbf{this}.\$\mathbf{r}\rightarrow
this.$r.value(heapIs heapIs $heapfuncstart_1032,1)._replace(p1 \rightarrow (-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs $heap<sub>funcstart_1032,1</sub>, this.$r.value(heapIs
\text{Sheap}_{funcstart\_1032.1}.p1, 177).rem))), this).p2) < (int)0))) + temp2)))
→ [expand definition of operator '*' in class 'pointer' at built in declaration]
[57.14] $heap<sub>1032,1;1054,8</sub> == $heap<sub>funcstart_1032,1</sub>._replace(this.$r \rightarrow
```

```
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
\theta_{tuncstart\_1032,1}.p1, 177).rem)))).\_replace(this.\$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(\mathbf{heapIs} \ \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
heap_{funcstart=1032.1}, p1, 177).rem)))._replace(p2 \rightarrow
asType<P2Type>((30307 *
asType<int>(static_cast<integer>(static_cast<signed
\mathbf{int}{>}(\mathbf{this.\$r.value}(\mathbf{heapIs}\ \$\mathbf{heap}_{funcstart\_1032,1}.\mathbf{\_replace}(\mathbf{this.\$r} \to \mathbf{1032},1))
this.$r.value(heapIs \rho_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
\theta_{funcstart\_1032,1}.p1, 177).rem)))).p2) < (int)0))) + temp2)))
\rightarrow [evaluate dereferenced pointer into modified heap]
[57.15] heap_{1032,1;1054,8} == heap_{funcstart\_1032,1}.\_replace(this.$r \rightarrow funcstart\_1032,1]
\textbf{this.}\$r.\textbf{value}(\textbf{heapIs}~\$heap_{funcstart\_1032,1}).\_\textbf{replace}(p1 \rightarrow ((\text{-}2~*\text{div}(\textbf{heapIs}
\label{eq:heapIs} $ \text{heap}_{funcstart\_1032,1}, \, \textbf{this}. \\ \$r. \textbf{value}(\textbf{heapIs} \,\, \$ \text{heap}_{funcstart\_1032,1}). \\ \text{p1},
177).quot) + (171 * div(heapIs \$heap_{funcstart\_1032,1}, this.\$r.value(heapIs
\theta_{funcstart\_1032,1}.p1, 177).rem))))._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.\r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
\theta_{funcstart\_1032.1}.p1, 177).rem)))._replace(p2 \rightarrow
asType<P2Type>((30307 *
asType < int > (static\_cast < integer > (static\_cast < signed\ int > ((|this.\$r
== this.$r]: this.$r.value(heapIs \rho_{uncstart\_1032,1})._replace(p1 \rightarrow (-2 *
{\rm div}(\mathbf{heapIs}\ \$ \mathrm{heap}_{funcstart\_1032,1},\ \mathbf{this}.\$ \mathrm{r.value}(\mathbf{heapIs}
\text{Sheap}_{funcstart\_1032,1}.p1, 177).quot) + (171 * div(heapIs \text{Sheap}_{funcstart\_1032,1},
this.r.value(heapIs \ heap_{funcstart\_1032.1}).p1, 177).rem)), []:
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p2) < (int)0))) + temp2)))
→ [explicitly assert falsehood of skipped guards in subsequent guards]
[57.16] $heap<sub>1032,1;1054,8</sub> == $heap<sub>funcstart_1032,1</sub>._replace(this.$r \rightarrow
this.$r.value(heapIs heapIs = funcstart_{1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs)
\rho_{funcstart\_1032,1}, this. r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.}\text{\$r.value}(\text{heapIs}))
\theta_{tuncstart\_1032,1}.p1, 177).rem)))).\_replace(this.\$r \rightarrow 0
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart_1032,1}, this.r.value(heapIs \rho_{funcstart_1032,1}).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.} \text{\$r.value}(\text{heapIs}))
heap_{funcstart\_1032,1}.p1, 177).rem))).\_replace(p2 \rightarrow
asType<P2Type>((30307 *
asType<int>(static_cast<integer>(static_cast<signed int>(([this.$r
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== this.$r]: this.$r.value(heapIs \rho_{funcstart\_1032,1})._replace(p1 \rightarrow (-2 *
{\rm div}(\mathbf{heapIs}\ \$ \mathrm{heap}_{funcstart\_1032,1},\ \mathbf{this}.\$ \mathrm{r.value}(\mathbf{heapIs}
\text{Sheap}_{funcstart\_1032,1}.p1, 177).quot) + (171 * div(heapIs \text{Sheap}_{funcstart\_1032,1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177).rem)), [!(this.<math>r = 
this.$r)]: this.$r.value(heapIs \theta_{funcstart\_1032,1}).p2) < (int)0))) +
temp2)))
\rightarrow [simplify]
[57.23] heap_{1032,1;1054,8} == heap_{funcstart\_1032,1}._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs $heap<sub>funcstart_1032,1</sub>, this.$r.value(heapIs
\theta_{funcstart\_1032,1}.p1, 177).rem)))).\_replace(this.$r \rightarrow
this.$r.value(heapIs \frac{1}{2} heap\frac{1}{2} heap\frac{1}{2}
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(\mathbf{heapIs} \$ heap_{funcstart\_1032,1}, \mathbf{this}.\$ r. \mathbf{value}(\mathbf{heapIs})
heap_{funcstart\_1032,1}.p1, 177).rem))).\_replace(p2 \rightarrow
asType<P2Type>((30307 * asType<int>(static_cast<integer>(0 <
-this.$r.value(heapIs \frac{1}{2}heap_{funcstart\_1032.1}).p2))) + temp2)))
\rightarrow [from term 24.0, literala < -this.$r.value(heapIs $heap_{funcstart = 1032.1}).p2
is false whenever -2 < (0 + literala)
          Proof of rule precondition:
          [57.23.0] - 2 < (0 + 0)
          \rightarrow [simplify]
          [57.23.2] true
[57.24] $heap<sub>1032,1;1054,8</sub> == $heap<sub>funcstart_1032,1</sub>._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.}\text{\$r.value}(\text{heapIs}))
\theta_{funcstart\_1032,1}.p1, 177).rem)))).\_replace(this.\$r \rightarrow 0
this.$r.value(heapIs \frac{1}{2} heap\frac{1}{2} heap\frac{1}{2}
\rho_{funcstart_1032,1}, this.r.value(heapIs \rho_{funcstart_1032,1}).p1,
177).quot) + (171 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
\theta_{funcstart\_1032,1}.p1, 177).rem)))._replace(p2 \rightarrow
asType<P2Type>((30307 * asType<int>(static_cast<integer>(false)))
+ \text{temp2})))
\rightarrow [simplify]
[57.25] $heap<sub>1032,1;1054,8</sub> == $heap<sub>funcstart_1032,1</sub>._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs))
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs \rho_{funcstart\_1032,1}, this.r.value(heapIs)
\label{eq:continuous_function} $ \text{heap}_{funcstart\_1032,1}.\text{p1},\ 177).\text{rem})))).$ \_\textbf{replace}(\textbf{this}.\$r \rightarrow
```

```
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
\theta_{funcstart\_1032,1}.p1, 177).rem))).\_replace(p2 \rightarrow
asType < P2Type > ((30307 * asType < int > (([false]: 1, []: 0))) + temp2)))
→ [explicitly assert falsehood of skipped guards in subsequent guards]
[57.26] $heap<sub>1032,1;1054,8</sub> == $heap<sub>funcstart_1032,1</sub>._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs $heap<sub>funcstart 1032.1</sub>, this.$r.value(heapIs
\theta_{funcstart, 1032.1}.p1, 177.rem)))._replace(this.$r \rightarrow
\textbf{this.\$r.value}(\textbf{heapIs}~\$ heap_{funcstart\_1032,1}).\_\textbf{replace}(p1 \rightarrow ((-2~*div(\textbf{heapIs})))))
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
\theta_{funcstart\_1032,1}.p1, 177).rem))).\_replace(p2 \rightarrow
\mathbf{asType} \hspace{-0.5em} < \hspace{-0.5em} \text{P2Type} \hspace{-0.5em} > \hspace{-0.5em} ((30307 * \mathbf{asType} \hspace{-0.5em} < \hspace{-0.5em} \mathbf{int} \hspace{-0.5em} > \hspace{-0.5em} (([\mathbf{false}] : 1, \, [\mathbf{true}] : \, 0))) + \\
temp2)))
\rightarrow [simplify]
[57.29] $\text{heap}_{1032,1:1054.8} == $\text{heap}_{funcstart_1032,1}$._\text{replace}(\text{this}.\text{$\frac{1}{2}r$})
this.$r.value(heapIs p_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart=1032,1}, this.r.value(heapIs \rho_{funcstart=1032,1}).p1,
177).quot) + (171 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
\theta_{tuncstart\_1032.1}.p1, 177).rem)))).\_replace(this.\$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.\r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.} \text{\$r.value}(\text{heapIs}))
\frac{\text{sheap}_{funcstart\_1032.1}.p1, 177.rem)}{\text{ce}}._replace(p2 \rightarrow asType<P2Type>(0 +
temp2)))
\rightarrow [from term 54.18, temp2 is equal to (-35 * div(heapIs $heap_{funcstart\_1032,1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p2,\ 176).quot) + (172 \ respectively)
div(heapIs $heap_{funcstart\_1032.1}, this.$r.value(heapIs
heap_{funcstart\_1032,1}.p2, 176).rem
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart_1032,1}, this. r.value(heapIs \rho_{funcstart_1032,1}).p1,
177).quot) + (171 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
\theta_{funcstart\_1032,1}.p1, 177).rem))))._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs $heap<sub>funcstart_1032,1</sub>, this.$r.value(heapIs
\rho_{funcstart\_1032,1}.p1, 177).rem))._replace(p2 \rightarrow asType<P2Type>(0 +
((-35 * div(heapIs \$heap_{funcstart\_1032,1}, this.\$r.value(heapIs
\rho_{tuncstart_{1032.1}, p2, 176} = 176, quot \rho_{tuncstart_{1032.1}, p3} + 176
```

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this.r.value(heapIs \ heap_{funcstart\_1032.1}).p2, 176).rem))))
\rightarrow [simplify]
[57.33] $heap<sub>1032,1;1054,8</sub> == $heap<sub>funcstart_1032,1</sub>._replace(this.$r \rightarrow
this.$r.value(heapIs \rho_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(\mathbf{heapIs} \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}))
\theta_{funcstart\_1032,1}.p1, 177).rem)))).\_replace(this.\$r \rightarrow 0
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.} \text{\$r.value}(\text{heapIs}))
\$heap_{funcstart\_1032,1}).p1,\ 177).rem))).\_\mathbf{replace}(p2 \to ((-35\ *\ div(\mathbf{heapIs}
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p2,
176).quot) + (172 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.} \text{\$r.value}(\text{heapIs}))
heap_{funcstart\_1032,1}.p2, 176).rem)))
[Take given term]
[58.0] \; ((\$ heap_{1032,1;1054,8}.r3 * \textbf{static\_cast} < \textbf{signed int} > (div3.rem)) \; - \;
(\text{sheap}_{1032,1:1054,8}.\text{b3} * \text{static\_cast} < \text{signed int} > (\text{div3.quot}))) == \text{temp3}
\rightarrow [from term 57.33, $heap_{1032,1;1054,8}$ is equal to
\$heap_{funcstart\_1032,1}.\_\textbf{replace}(\textbf{this}.\$r \rightarrow \textbf{this}.\$r.\textbf{value}(\textbf{heapIs}
heap_{funcstart\_1032.1}._replace(p1 \rightarrow ((-2 * div(heapIs heap_{funcstart\_1032.1}),
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177).quot) + (171 *
div(\mathbf{heapIs} \ \$heap_{funcstart\_1032,1}, \ \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
\theta_{funcstart\_1032,1}.p1, 177).rem)))).\_replace(this.\$r \rightarrow 0
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
heap_{funcstart\_1032,1}, this.r.value(heapIs heap_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs heapIs = 1032,1, this.r.value(heapIs
\rho_{tuncstart\_1032,1}.p1, 177).rem))).\_replace(p2 \rightarrow (-35 * div(heapIs))).
heap_{funcstart\_1032,1}, this.r.value(heapIs heap_{funcstart\_1032,1}).p2,
176).quot) + (172 * div(heapIs $heap_{funcstart\_1032,1}, this.$r.value(heapIs)
heap_{funcstart_{1032,1}}.p2, 176).rem)))
[58.1] ((\theta_{tuncstart\_1032.1}._replace(this.r \to this.r.value(heapIs)
\rho_{tuncstart\_1032.1}._replace(p1 \rightarrow ((-2 * div(heapIs \rho_{tuncstart\_1032.1})
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177).quot) + (171 *
\operatorname{div}(\mathbf{heapIs}\ \$ \mathrm{heap}_{funcstart\_1032,1},\ \mathbf{this.\$r.value}(\mathbf{heapIs}
\label{eq:continuous_function} $ \text{heap}_{funcstart\_1032,1} . \text{p1}, 177).rem)))).\_\textbf{replace}(\textbf{this}.\$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs \rho_{funcstart\_1032,1}, this.r.value(heapIs)
\rho_{uncstart\_1032,1}.p1, 177).rem))._replace(p2 \rightarrow ((-35 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p2,
176).quot) + (172 * div(heapIs $heap<sub>funcstart_1032,1</sub>, this.$r.value(heapIs
\rho_{funcstart\_1032,1}.p2, 176).rem))).r3 * static_cast < signed
int>(div3.rem)) - (\$heap_{1032,1;1054,8}.b3 * static\_cast < signed
```

```
int>(div3.quot)) = temp3
\rightarrow [const member of object with modified fields]
[58.3]\;((\$heap_{funcstart\_1032,1}.r3\;*\;\textbf{static\_cast} < \textbf{signed int} > (\text{div3.rem}))\;-
(\text{sheap}_{1032,1:1054.8}.\text{b3} * \text{static\_cast} < \text{signed int} > (\text{div3.quot}))) == \text{temp3}
\rightarrow [const static or extern object]
[58.4]\;((\mathrm{\$heap}_{init}.\mathrm{r3}\; *\; \mathbf{static\_cast} {<} \mathbf{signed}\; \mathbf{int} {>} (\mathrm{div3.rem}))\; -
(\text{sheap}_{1032,1;1054,8}.\text{b3} * \text{static\_cast} < \text{signed int} > (\text{div3.quot}))) == \text{temp3}
\rightarrow [expand definition of constant 'r3' at prang.cpp (39,26)]
[58.5] (((int)170 * static_cast<signed int>(div3.rem)) -
(\text{sheap}_{1032,1;1054,8}.\text{b3} * \text{static\_cast} < \text{signed int} > (\text{div3.quot}))) == \text{temp3}
\rightarrow [simplify]
[58.6] ((170 * static_cast<signed int>(div3.rem)) - ($heap_{1032.1:1054.8}.b3 *
static_cast<signed int>(div3.quot))) == temp3
\rightarrow [from term 34.6, div3 is equal to div(heapIs $heap_{funcstart\_1032,1},
this.r.value(heapIs $heap_{funcstart\_1032,1}).p3, 178)]
[58.7] ((170 * static_cast<signed int>(div(heapIs $heap_{funcstart\_1032,1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p3, 178).rem)) -
(\text{sheap}_{1032,1:1054,8}.\text{b3} * \text{static\_cast} < \text{signed int} > (\text{div3.quot}))) == \text{temp3}
\rightarrow [simplify]
[58.8] ((170 * div(heapIs $heap_{funcstart\_1032,1}, this.$r.value(heapIs)]
\text{heap}_{funcstart\_1032,1}.p3, 178).rem) - (\text{heap}_{1032,1:1054,8}.b3 *
static_cast<signed int>(div3.quot))) == temp3
\rightarrow [from term 57.33, $heap<sub>1032.1:1054.8</sub> is equal to
$heap_{funcstart\_1032,1}.$_replace(this.$r \rightarrow this.$r.value(heapIs)
heap_{funcstart\_1032,1}._replace(p1 \rightarrow ((-2 * div(heapIs $heap_{funcstart\_1032,1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, \ 177).quot) + (171 * 
div(\mathbf{heapIs} \ \$heap_{funcstart\_1032,1}, \ \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
\theta_{funcstart\_1032,1}.p1, 177).rem)))._replace(this.$r \rightarrow
this.r.value(heapIs \ heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs))
$heap_funcstart_1032,1, this.$r.value(heapIs $heap_funcstart_1032,1).p1,
177).quot) + (171 * div(heapIs heap_{funcstart\_1032,1}, this.r.value(heapIs
\rho_{funcstart\_1032,1}.p1, 177).rem))).\_replace(p2 \rightarrow (-35 * div(heapIs))).
heap_{funcstart\_1032,1}, this.r.value(heapIs heap_{funcstart\_1032,1}).p2,
176).quot) + (172 * div(heapIs $heap_{funcstart\_1032,1}, this.$r.value(heapIs
heap_{funcstart_{-1032,1}}.p2, 176).rem)))]
[58.9] ((170 * div(heapIs $heap_{funcstart\_1032,1}, this.$r.value(heapIs
\theta_{funcstart\_1032,1}.p3, 178).rem) - (\theta_{funcstart\_1032,1}._replace(this.$r
\rightarrow this.$r.value(heapIs $heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{$heap}_{funcstart\_1032.1}, \ \mathbf{this}. \ \text{$r.value}(\mathbf{heapIs})
\text{Sheap}_{funcstart\_1032,1}.p1, 177).quot) + (171 * div(heapIs \text{Sheap}_{funcstart\_1032,1},
```

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this.r.value(heapIs \heap_{funcstart\_1032,1}).p1, 177).rem)))._replace(this.r.value(heapIs \heap_{funcstart\_1032,1}).p1, 177).rem)))
\rightarrow this.$r.value(heap
Is \rho_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs}\ \$ \mathrm{heap}_{funcstart\_1032,1},\ \mathbf{this}.\$ \mathrm{r.value}(\mathbf{heapIs}
\text{Sheap}_{funcstart\_1032,1}.p1, 177).quot) + (171 * div(heapIs \text{Sheap}_{funcstart\_1032,1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177).rem))).\_replace(p2 \rightarrow
((-35 * div(heapIs \$heap_{funcstart\_1032,1}, this.\$r.value(heapIs
\rho_{tuncstart\_1032,1}.p2, 176).quot + (172 * div(heapIs $heap_{funcstart\_1032,1})
this.$r.value(heapIs $heap_{tuncstart_1032.1}).p2, 176).rem)))).b3 *
static_cast<signed int>(div3.quot))) == temp3
\rightarrow [const member of object with modified fields]
[58.11] ((170 * div(\mathbf{heapIs} \ \$heap_{funcstart\_1032,1}, \ \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
\text{Sheap}_{funcstart\_1032,1}.p3, 178).rem) - (\text{Sheap}_{funcstart\_1032,1}.b3 *
static_cast<signed int>(div3.quot))) == temp3
\rightarrow [const static or extern object]
[58.12] ((170 * div(heapIs heapI_{tuncstart\_1032,1}, this.r.value(heapIs)
\rho_{uncstart\_1032,1}.p3, 178.rem – (\rho_{uncstart\_1032,1}.p3, 178.rem) – (\rho_{uncstart\_1032,1}.p3, 178.rem) – (\rho_{uncstart\_1032,1}.p3, 178.rem)
int>(div3.quot)) == temp3
\rightarrow [expand definition of constant 'b3' at prang.cpp (41,26)]
[58.13] ((170 * div(\mathbf{heapIs} \ \$heap_{funcstart\_1032,1}, \ \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
\theta_{100} = \theta_{1000} - ((int)63 * static_cast < signed
int>(div3.quot)) = temp3
\rightarrow [simplify]
[58.14] ((170 * div(heapIs $heap<sub>funcstart_1032,1</sub>, this.$r.value(heapIs)
\theta_{funcstart\_1032,1}.p3, 178).rem - (63 * static\_cast < signed)
int>(div3.quot)) == temp3
\rightarrow [from term 34.6, div3 is equal to div(heapIs $heap_{funcstart\_1032,1},
this.r.value(heapIs $heap_{funcstart\_1032,1}).p3, 178)]
[58.15] ((170 * div(heapIs $heap_{funcstart\_1032,1}, this.$r.value(heapIs
heap_{funcstart\_1032,1}.p3, 178).rem - (63 * static\_cast < signed
int>(div(heapIs \$heap_{funcstart\_1032,1}, this.\$r.value(heapIs
\$ \operatorname{heap}_{funcstart\_1032,1}).\operatorname{p3},\ 178).\operatorname{quot}))) == \operatorname{temp3}
\rightarrow [simplify]
[58.20] 0 == (-\text{temp3} + (-63 * \text{div}(\text{heapIs } \text{$heap}_{funcstart\_1032.1})]
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p3, 178).quot) + (170 *
div(\mathbf{heapIs} \$ heap_{funcstart\_1032.1}, \mathbf{this.}\$r.\mathbf{value}(\mathbf{heapIs})
heap_{funcstart_{1032,1}}.p3, 178).rem
[Take given term]
[61.0] $heap<sub>funcend_1032,1</sub> == $heap<sub>1032,1;1054,8</sub>._replace(this.$r \rightarrow
operator*(heapIs heap_{1032.1:1054.8}, this)._replace(p3 \rightarrow
asType<P3Type>(($heap<sub>1032,1:1054,8</sub>.M3 *
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asType<int>(static_cast<integer>(static_cast<signed
int>(operator^*(heapIs $heap_{1032,1;1054,8}, this).p3) < (int)(0))) + temp3)))
\rightarrow [from term 57.33, $heap<sub>1032,1;1054,8</sub> is equal to
\$heap_{funcstart\_1032,1}.\_\textbf{replace(this.}\$r \rightarrow \textbf{this.}\$r.\textbf{value(heapIs}
heap_{funcstart\_1032.1}._replace(p1 \rightarrow ((-2 * div(heapIs $heap_{funcstart\_1032.1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177).quot) + (171 * 
div(\mathbf{heapIs} \ \$heap_{funcstart\_1032,1}, \ \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
\theta_{funcstart\_1032,1}.p1, 177).rem)))).\_replace(this.\$r \rightarrow 0
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs) + div(heapIs)))
\$heap_{funcstart\_1032,1}, \ \textbf{this}.\$r. \textbf{value(heapIs} \ \$heap_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(\mathbf{heapIs} * heap_{funcstart\_1032,1}, \mathbf{this}. * r.value(\mathbf{heapIs} 
\rho_{funcstart\_1032.1}.p1, 177).rem))).\_replace(p2 \rightarrow (-35 * div(heapIs))).
heap_{funcstart\_1032.1}, this.r.value(heapIs heap_{funcstart\_1032.1}).p2,
(176).quot) + (172 * div(\mathbf{heapIs} \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}))
heap_{funcstart\_1032,1}.p2, 176).rem)))
[61.2] heap_{funcend\_1032,1} == heap_{funcstart\_1032,1}._replace(this.$r \rightarrow
this.$r.value(heapIs \theta_{funcstart\_1032,1})._replace(p1 \theta ((-2 * div(heapIs
\theta_{funcstart\_1032,1}, this.r.value(heapIs \theta_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(\mathbf{heapIs} \ \$heap_{funcstart\_1032,1}, \ \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
\theta_{funcstart\_1032,1}.p1, 177).rem)))).\_replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs \rho_{funcstart\_1032,1}, this.r.value(heapIs)
\theta_{funcstart\_1032,1}.p1, 177).rem))._replace(p2 \rightarrow ((-35 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p2,
(176).\text{quot} + (172 * \text{div}(\text{heapIs } \text{heap}_{funcstart\_1032,1}, \text{this.}\text{$r.value}(\text{heapIs}))
\rho_{funcstart\_1032,1}.p2, 176).rem)))._replace(this.$r \rightarrow operator*(heapIs)
\$heap_{funcstart\_1032,1}.\_\textbf{replace}(\textbf{this}.\$\textbf{r}\rightarrow\textbf{this}.\$\textbf{r}.\textbf{value}(\textbf{heapIs}
\rho_{tuncstart\_1032,1}._replace(p1 \rightarrow ((-2 * div(heapIs $heap_{tuncstart\_1032,1}), _replace(p1 \rightarrow (1.2 * div(heapIs $heap_{tuncstart\_1032,1}), _replace(p1 \rightarrow (1.3 * div(heapIs $heap_{tuncstart\_1032,1}), _replace(p1 \rightarrow (1.4 * div(heapIs $heap_{tuncstart\_1032,1}), _replace(
this.$r.value(heapIs heap_{funcstart\_1032,1}).p1, 177).quot) + (171 *
div(\mathbf{heapIs} \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
\theta_{tuncstart\_1032,1}.p1, 177).rem)))).\_replace(this.\$r \rightarrow
this.$r.value(heapIs $heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.} \text{\$r.value}(\text{heapIs}))
\rho_{funcstart\_1032,1}.p1, 177).rem))._replace(p2 \rightarrow (-35 * div(heapIs
\rho_{funcstart\_1032,1}, this. r.value(heapIs \rho_{funcstart\_1032,1}).p2,
176).quot) + (172 * div(heapIs \rho_{funcstart\_1032,1}, this.r.value(heapIs)
\theta_{funcstart\_1032,1}.p2, 176).rem)), this)._replace(p3 \rightarrow
asType<P3Type>(($heap<sub>1032.1:1054.8</sub>.M3 *
asType<int>(static_cast<integer>(static_cast<signed
int>(operator^*(heapIs $heap_{1032,1;1054,8}, this).p3) < (int)0))) + temp3)))
→ [expand definition of operator '*' in class 'pointer' at built in declaration]
[61.3] heap_{funcend\_1032,1} == heap_{funcstart\_1032,1}._replace(this.$r \rightarrow
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\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
\theta_{tuncstart\_1032,1}.p1, 177).rem)))).\_replace(this.\$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs $heap<sub>funcstart_1032,1</sub>, this.$r.value(heapIs
\rho_{uncstart\_1032,1}.p1, 177).rem))._replace(p2 \rightarrow ((-35 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p2,
176).quot) + (172 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.}\text{\$r.value}(\text{heapIs}))
\theta_{funcstart\_1032,1}.p2, 176).rem))))._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1}._replace(this.$r \rightarrow
\textbf{this.\$r.value}(\textbf{heapIs}~\$ heap_{funcstart\_1032,1}).\_\textbf{replace}(p1 \rightarrow ((-2 * div(\textbf{heapIs}) + (-2 * div(\textbf{heapI
\$heap_{funcstart\_1032,1},\, \textbf{this.}\$r.\textbf{value}(\textbf{heapIs}\,\,\$heap_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
\theta_{funcstart\_1032,1}.p1, 177).rem)))).\_replace(this.$r \rightarrow
this.$r.value(heapIs \rho_{tuncstart\_1032.1})._replace(p1 \rightarrow ((-2 * div(heapIs
\$heap_{funcstart\_1032,1},\, \textbf{this.}\$r.\textbf{value}(\textbf{heapIs}\,\,\$heap_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs $heap<sub>funcstart_1032.1</sub>, this.$r.value(heapIs
\rho_{uncstart\_1032,1}.p1, 177).rem))._replace(p2 \rightarrow ((-35 * div(heapIs
\$heap_{funcstart\_1032,1},\ \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}\ \$heap_{funcstart\_1032,1}).p2,
176).quot) + (172 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.}\text{\$r.value}(\text{heapIs}))
heap_{funcstart\_1032,1}.p2, 176).rem))))._replace(p3 \rightarrow
asType<P3Type>(($heap<sub>1032,1:1054,8</sub>.M3 *
asType{<}int{>}(static\_cast{<}integer{>}(static\_cast{<}signed
int>(operator^*(heapIs $heap_{1032,1;1054,8}, this).p3) < (int)0))) + temp3)))
→ [evaluate dereferenced pointer into modified heap]
[61.4] heap_{funcend\_1032,1} == heap_{funcstart\_1032,1}._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\ 1032.1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs \theta_{funcstart\_1032,1}, this.r.value(heapIs)
\theta_{funcstart\_1032,1}.p1, 177).rem)))).replace(this.r \rightarrow 0
this.$r.value(heapIs $heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.} \text{\$r.value}(\text{heapIs}))
\theta_{funcstart\_1032,1}.p1, 177).rem))._replace(p2 \rightarrow ((-35 * div(heapIs
\rho_{tuncstart\_1032.1}, this.r.value(heapIs \rho_{tuncstart\_1032.1}).p2,
176).quot) + (172 * div(heapIs \rho_{funcstart\_1032,1}, this.r.value(heapIs)
\rho_{funcstart\_1032,1}.p2, 176).rem)))).\_replace(this.\$r \rightarrow ([this.\$r ==
this.$r.value(heapIs \rho_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 *
div(heapIs $heap<sub>funcstart_1032.1</sub>, this.$r.value(heapIs
\text{Sheap}_{funcstart\_1032.1}.p1, 177).quot) + (171 * div(heapIs \text{Sheap}_{funcstart\_1032.1},
\textbf{this.\$r.value}(\textbf{heapIs}~\$\text{heap}_{funcstart\_1032,1}).\text{p1},~177).\text{rem}))).\_\textbf{replace}(\text{p2}\rightarrow
(-35 * div(heapIs $heap_{funcstart\_1032,1}, this.$r.value(heapIs)]
\text{Sheap}_{funcstart\_1032,1}.\text{p2}, 176).\text{quot} + (172 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_1032,1},
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this.\$r.value(heapIs $\rho_{funcstart_1032,1}$)._replace(p1 \rightarrow ((-2 * div(heapIs

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this.$r.value(heapIs heap_{funcstart\_1032,1}).p2, 176).rem)), []:
this.$r.value(heap
Is $heap_{funcstart\_1032,1}.\_replace(this.$r \rightarrow
this.$r.value(heapIs heapIs ._replace(p1 \rightarrow (-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.}\text{\$r.value}(\text{heapIs}))
heap_{funcstart\_1032,1}.p1, 177).rem)))))._replace(p3 \rightarrow
asType<P3Type>(($heap<sub>1032,1;1054,8</sub>.M3 *
asType<int>(static_cast<integer>(static_cast<signed
int>(operator^*(heapIs $heap_{1032,1:1054.8}, this).p3) < (int)0))) + temp3)))
→ [explicitly assert falsehood of skipped guards in subsequent guards]
[61.5] heap_{funcend\_1032,1} == heap_{funcstart\_1032,1}._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
\label{eq:continuous_function} $ \text{heap}_{funcstart\_1032,1} . \text{p1}, 177).rem)))).$ \textbf{replace(this.} \$r \rightarrow $ \text{the properties of the prop
this.$r.value(heapIs heap_{funcstart=1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs $heap_{funcstart\_1032,1}, this.$r.value(heapIs
\rho_{funcstart\_1032.1}.p1, 177).rem)._replace(p2 \rightarrow ((-35 * div(heapIs
\theta_{funcstart\_1032,1}, this.r.value(\theta_{funcstart\_1032,1}).p2,
176).quot) + (172 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.} \text{\$r.value}(\text{heapIs}))
\theta_{uncstart\_1032,1}.p2, 176).rem)))._replace(this.$r \to ([this.$r ===
this.$r.value(heapIs \rho_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs}\ \$ \mathrm{heap}_{funcstart\_1032,1},\ \mathbf{this}.\$ \mathbf{r.value}(\mathbf{heapIs}
\text{Sheap}_{funcstart\_1032.1}.p1, 177).quot) + (171 * div(heapIs \text{Sheap}_{funcstart\_1032.1},
this.$r.value(heapIs \rho_{tuncstart\_1032,1}).p1, 177).rem)))._replace(p2 \rightarrow
(-35 * div(\mathbf{heapIs} \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}))
\text{Sheap}_{funcstart\_1032,1}.\text{p2}, 176).\text{quot} + (172 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_1032,1},
\mathbf{this.\$r.value(heapIs}\ \$heap_{funcstart\_1032,1}).p2,\ 176).rem)),\ [!(\mathbf{this.\$r}==
this.r.value(heapIs $heap_{funcstart\_1032,1}.\_replace(this.$r \rightarrow funcstart\_1032,1})
\textbf{this.\$r.value}(\textbf{heapIs}~\$ heap_{funcstart\_1032,1}).\_\textbf{replace}(p1 \rightarrow (-2~*div(\textbf{heapIs}
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs \rho_{funcstart\_1032,1}, this.r.value(heapIs)
\label{eq:condition} $\operatorname{heap}_{funcstart\_1032,1}).p1,\ 177).rem))))).\_\mathbf{replace}(p3 \to
asType<P3Type>(($heap<sub>1032,1;1054,8</sub>.M3 *
asType < int > (static\_cast < integer > (static\_cast < signed
int > (operator^*(heapIs \$heap_{1032,1;1054,8}, this).p3) < (int)0))) + temp3)))
\rightarrow [simplify]
[61.7] heap_{funcend\_1032,1} == heap_{funcstart\_1032,1}._replace(this.$r \rightarrow
this.$r.value(heapIs \rho_{uncstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs)
\$heap_{funcstart\_1032,1},\, \textbf{this.}\$r.\textbf{value}(\textbf{heapIs}\,\,\$heap_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(\mathbf{heapIs} \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}))
\theta_{funcstart\_1032,1}.p1, 177).rem)))).\_replace(this.\$r \rightarrow 0
this.r.value(heapIs \ensuremath{\$}heap_{funcstart\_1032.1}).\_replace(p1 \rightarrow ((-2 * div(heapIs
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\rho_{funcstart_1032,1}, this.\r.value(heapIs \rho_{funcstart_1032,1}).p1,
177).quot) + (171 * div(heapIs \theta), this.$r.value(heapIs
\rho_{uncstart\_1032,1}.p1, 177).rem))).\_replace(p2 \rightarrow ((-35 * div(heapIs)))._replace(p2 \rightarrow ((-35 * div(heapIs))))._replace(p3 + div(heapIs)))
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p2,
176).quot) + (172 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.}\text{\$r.value}(\text{heapIs}))
\theta_{funcstart\_1032,1}.p2, 176).rem)))).\_replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, his.\r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.} \text{\$r.value}(\text{heapIs}))
\rho_{uncstart_1032,1}.p1, 177).rem))._replace(p2 \rightarrow ((-35 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p2,
176).quot) + (172^{*} \text{ div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.} \text{\$r.value}(\text{heapIs}))
\label{eq:continuous_function} $\operatorname{heap}_{funcstart\_1032,1}).p2,\ 176).rem))).\_\mathbf{replace}(p3 \to
asType<P3Type>(($heap<sub>1032,1;1054,8</sub>.M3 *
asType<int>(static_cast<integer>(static_cast<signed
int>(operator^*(heapIs $heap_{1032.1:1054.8}, this).p3) < (int)0))) + temp3)))
\rightarrow [from term 57.33, $heap<sub>1032.1:1054.8</sub> is equal to
\$heap_{funcstart\_1032,1}.\_\textbf{replace}(\textbf{this}.\$r \rightarrow \textbf{this}.\$r.\textbf{value}(\textbf{heapIs}
heap_{funcstart\_1032,1}._replace(p1 \rightarrow ((-2 * div(heapIs $heap_{funcstart\_1032,1},
div(\mathbf{heapIs} \ \$heap_{funcstart\_1032,1}, \ \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
heap_{funcstart\_1032,1}.p1, 177).rem)))).replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\$heap_{funcstart\_1032,1}, \ \textbf{this}.\$r. \textbf{value(heapIs} \ \$heap_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(\mathbf{heapIs} \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}))
heap_{funcstart\_1032,1}.p1, 177).rem))).\_replace(p2 \rightarrow (-35 * div(heapIs))).
heap_{funcstart\_1032,1}, this.r.value(heapIs heap_{funcstart\_1032,1}).p2,
176).quot) + (172 * div(heapIs $heap_{tuncstart\_1032.1}, this.$r.value(heapIs
heap_{funcstart_{1032,1}}.p2, 176).rem)))
[61.8] heap_{funcend\_1032,1} == heap_{funcstart\_1032,1}._replace(this.$r \rightarrow
\textbf{this.\$r.value}(\textbf{heapIs}~\$ heap_{funcstart\_1032,1}).\_\textbf{replace}(p1 \rightarrow ((-2~*div(\textbf{heapIs})))))
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{heap}_{funcstart\_1032,1}, \text{this.} \text{$r.value}(\text{heapIs}))
\theta_{funcstart\_1032,1}.p1, 177).rem)))).\_replace(this.\$r \rightarrow 0
this.$r.value(heapIs p_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.}\text{\$r.value}(\text{heapIs}))
\theta_{funcstart\_1032,1}.p1, 177).rem))._replace(p2 \rightarrow ((-35 * div(heapIs
\$heap_{funcstart\_1032,1},\, \textbf{this.}\$r.\textbf{value}(\textbf{heapIs}\,\,\$heap_{funcstart\_1032,1}).p2,
176).quot) + (172 * div(heapIs $heap<sub>funcstart_1032,1</sub>, this.$r.value(heapIs
\theta_{funcstart\_1032,1}.p2, 176).rem)))).\_replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs $heap<sub>funcstart_1032.1</sub>, this.$r.value(heapIs
\text{Sheap}_{funcstart\_1032,1}.\text{p1}, 177).\text{rem}))._replace(p2 \rightarrow ((-35 * div(heapIs)
```

```
\rho_{funcstart_1032,1}, this.\r.value(heapIs \rho_{funcstart_1032,1}).p2,
176).quot) + (172 * div(heapIs \theta), this.$r.value(heapIs
\theta_{funcstart\_1032,1}.p2, 176).rem))).\_replace(p3 \rightarrow
asType < P3Type > ((\$heap_{tuncstart\_1032,1}.\_replace(this.\$r \rightarrow
this.$r.value(heapIs \frac{1}{2} heap\frac{1}{2} line \frac{1}{2} heap\frac{1}{2} heap\frac{1}{2
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
\theta_{tuncstart_{1032,1}}.p1, 177.rem)))._replace(this.$r \rightarrow
this.$r.value(heapIs p_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart_1032,1}, this.r.value(heapIs \rho_{funcstart_1032,1}).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.} \text{\$r.value}(\text{heapIs}))
\rho_{uncstart\_1032,1}.p1, 177).rem))._replace(p2 \rightarrow ((-35 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p2,
176).quot) + (172 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
heap_{funcstart\_1032,1}.p2, 176).rem))).M3 *
asType < int > (static\_cast < integer > (static\_cast < signed
int>(operator^*(heapIs $heap_{1032.1:1054.8}, this).p3) < (int)0))) + temp3)))
\rightarrow [const member of object with modified fields]
[61.10] $heap<sub>funcend_1032,1</sub> == $heap<sub>funcstart_1032,1</sub>._replace(this.$r \rightarrow
this.$r.value(heapIs $heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
$heap_tuncstart_1032.1, this.$r.value(heapIs $heap_tuncstart_1032.1).p1,
177).quot) + (171 * div(heapIs $heap<sub>funcstart_1032.1</sub>, this.$r.value(heapIs
\label{eq:continuous_function} $ \text{heap}_{funcstart\_1032,1} . \text{p1}, 177).rem)))).$ \_\textbf{replace}(\textbf{this}.\$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\theta_{funcstart_{1032,1}}, this. r.value(heapIs \theta_{funcstart_{1032,1}}).p1,
(177).quot + (171 * div(heapIs $heap_{funcstart\_1032,1}, this.$r.value(heapIs)
\theta_{funcstart\_1032,1}.p1, 177).rem))._replace(p2 \rightarrow ((-35 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p2,
176).quot) + (172 * div(heapIs $heap<sub>funcstart 1032.1</sub>, this.$r.value(heapIs
\theta_{funcstart\_1032,1}.p2, 176).rem))))._replace(this.$r \rightarrow
\textbf{this.\$r.value}(\textbf{heapIs}~\$ heap_{funcstart\_1032,1}).\_\textbf{replace}(p1 \rightarrow ((\text{-}2~*\text{div}(\textbf{heapIs}
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.} \text{\$r.value}(\text{heapIs}))
\$heap_{funcstart\_1032,1}).p1,\ 177).rem))).\_\mathbf{replace}(p2 \to ((-35\ *\ div(\mathbf{heapIs})))).
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p2,
176).quot) + (172 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
\theta_{funcstart\_1032.1}, p2, 176).rem)))._replace(p3 \rightarrow
asType<P3Type>(($heap_funcstart_1032,1.M3 *
asType < int > (static\_cast < integer > (static\_cast < signed
int>(operator^*(heapIs $heap_{1032.1:1054.8}, this).p3) < (int)0))) + temp3)))
\rightarrow [const static or extern object]
[61.11] heap_{funcend\_1032.1} == heap_{funcstart\_1032.1}._replace(this.r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{tuncstart_{1032.1}}, this. r.value(heapIs \rho_{tuncstart_{1032.1}}).p1,
```

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177).quot) + (171 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.} \text{\$r.value}(\text{heapIs}))
\theta_{funcstart\_1032,1}.p1, 177).rem))))._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.} \text{\$r.value}(\text{heapIs}))
\rho_{tuncstart\_1032,1}.p1, 177).rem))._replace(p2 \rightarrow ((-35 * div(heapIs
$heap_funcstart_1032,1, this.$r.value(heapIs $heap_funcstart_1032,1).p2,
176).quot) + (172 * \text{div}(\text{heapIs} \$\text{heap}_{tuncstart\_1032.1}, \text{this}.\$\text{r.value}(\text{heapIs}))
\theta_{funcstart\_1032,1}.p2, 176).rem)))).\_replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs $heap_{funcstart\_1032,1}, this.$r.value(heapIs
\rho_{funcstart\_1032,1}.p1, 177).rem)._replace(p2 \rightarrow ((-35 * div(heapIs
\theta_{funcstart\_1032,1}, this.r.value(heapIs \theta_{funcstart\_1032,1}).p2,
176).quot) + (172 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
\theta_{funcstart\_1032,1}.p2, 176).rem))).\_replace(p3 \rightarrow
asType<P3Type>(($heap<sub>init</sub>.M3 *
asType < int > (static\_cast < integer > (static\_cast < signed
int>(operator^*(heapIs \$heap_{1032,1:1054.8}, this).p3) < (int)0))) + temp3)))
\rightarrow [expand definition of constant 'M3' at prang.cpp (38,26)]
[61.12] heap_{funcend\_1032.1} == heap_{funcstart\_1032.1}._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.\r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(\mathbf{heapIs} \ \$heap_{funcstart\_1032,1}, \ \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
\theta_{tuncstart_1032.1}.p1, 177.rem)))._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
\rho_{uncstart\_1032,1}.p1, 177).rem))._replace(p2 \rightarrow ((-35 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p2,
176).quot) + (172 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
\theta_{funcstart\_1032,1}.p2, 176).rem)))).replace(this.r \rightarrow 0
this.$r.value(heapIs $heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs \theta_{funcstart\_1032,1}, this.r.value(heapIs)
\rho_{funcstart\_1032,1}.p1, 177).rem))._replace(p2 \rightarrow ((-35 * div(heapIs
\rho_{tuncstart\_1032.1}, this.r.value(heapIs \rho_{tuncstart\_1032.1}).p2,
176).quot) + (172 * div(heapIs \rho_{funcstart\_1032,1}, this.r.value(heapIs)
\theta_{funcstart\_1032,1}.p2, 176).rem))._replace(p3 \rightarrow
asType < P3Type > (((int)30323 *
asType<int>(static_cast<integer>(static_cast<signed
int>(operator^*(heapIs \$heap_{1032,1:1054.8}, this).p3) < (int)0))) + temp3)))
\rightarrow [simplify]
[61.13] heap_{funcend\_1032,1} == heap_{funcstart\_1032,1}._replace(this.$r \rightarrow
```

```
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.}\text{\$r.value}(\text{heapIs}))
\theta_{tuncstart\_1032,1}.p1, 177).rem)))).\_replace(this.\$r \rightarrow
this.$r.value(heapIs \rho_{tuncstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{tuncstart\_1032,1}, this.r.value(heapIs \rho_{tuncstart\_1032,1}).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032.1}, \text{this.} \text{\$r.value}(\text{heapIs}))
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p2,
176).quot) + (172 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.}\text{\$r.value}(\text{heapIs}))
\theta_{funcstart\_1032,1}.p2, 176).rem))))._replace(this.$r \rightarrow
this.$r.value(heapIs \rho_{tuncstart\_1032.1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
\rho_{uncstart\_1032,1}.p1, 177).rem))._replace(p2 \rightarrow ((-35 * div(heapIs
\rho_{funcstart\_1032,1}, this.\r.value(heapIs \rho_{funcstart\_1032,1}).p2,
176).quot) + (172 * div(\mathbf{heapIs} \ \$heap_{funcstart\_1032,1}, \ \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
\theta_{funcstart\_1032.1}.p2, 176).rem))._replace(p3 \rightarrow
asType<P3Type>((30323 *
asType<int>(static_cast<integer>(static_cast<signed
int>(operator^*(heapIs $heap_{1032,1;1054,8}, this).p3) < (int)(0))) + temp3)))
\rightarrow [from term 57.33, $heap<sub>1032,1;1054,8</sub> is equal to
heap_{funcstart\_1032.1}._replace(this.r \rightarrow this.r.value(heapIs)
heap_{funcstart\_1032.1}._replace(p1 \rightarrow ((-2 * div(heapIs $heap_{funcstart\_1032.1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177).quot) + (171 *
div(\mathbf{heapIs} \ \$heap_{funcstart\_1032,1}, \ \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
\theta_{funcstart\_1032,1}.p1, 177).rem)))).\_replace(this.\$r \rightarrow 0
this.$r.value(heapIs heap_{funcstart\_1032.1})._replace(p1 \rightarrow ((-2 * div(heapIs) + (-2 * div(heapIs) + (
\$heap_{funcstart\_1032,1}, \ \textbf{this}.\$r. \textbf{value} (\textbf{heapIs} \ \$heap_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(\textbf{heapIs} \$heap_{funcstart\_1032,1}, \textbf{this}.\$r.\textbf{value}(\textbf{heapIs}))
heap_{funcstart\_1032,1}.p1, 177).rem))).\_replace(p2 \rightarrow (-35 * div(heapIs))).
heap_{funcstart\_1032,1}, this.r.value(heapIs heap_{funcstart\_1032,1}).p2,
176).quot) + (172 * div(\mathbf{heapIs} \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}))
heap_{funcstart\_1032,1}.p2, 176).rem)))
[61.14] \theta_{1.032,1} == \theta_{1.032,1}.\_replace(this.\$r \rightarrow 0.014)
this.$r.value(heapIs \theta_{funcstart\_1032,1})._replace(p1 \theta ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs \rho_{funcstart\_1032,1}, this.r.value(heapIs)
\theta_{funcstart\_1032,1}.p1, 177).rem)))).\_replace(this.$r \rightarrow
this.$r.value(heapIs \rho_{uncstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{tuncstart\_1032.1}, this.r.value(heapIs \rho_{tuncstart\_1032.1}).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.} \text{\$r.value}(\text{heapIs}))
\$heap_{funcstart\_1032,1}).p1,\ 177).rem))).\_\mathbf{replace}(p2 \to ((-35\ *\ div(\mathbf{heapIs}
\rho_{funcstart=1032,1}, this.r.value(heapIs \rho_{funcstart=1032,1}).p2,
176).quot) + (172 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.} \text{\$r.value}(\text{heapIs}))
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```
\theta_{funcstart=1032,1}.p2, 176).rem)))._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs $heap<sub>funcstart_1032,1</sub>, this.$r.value(heapIs
\theta_{funcstart\_1032,1}.p1, 177).rem))._replace(p2 \rightarrow ((-35 * div(heapIs
$heap_funcstart_1032,1, this.$r.value(heapIs $heap_funcstart_1032,1).p2,
176).quot) + (172 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.} \text{\$r.value}(\text{heapIs}))
heap_{funcstart=1032.1}, p2, 176).rem)))._replace(p3 \rightarrow
asType<P3Type>((30323 *
asType<int>(static_cast<integer>(static_cast<signed
\mathbf{int}{>}(\mathbf{operator^*}(\mathbf{heapIs}\ \$\mathbf{heap}_{funcstart\_1032,1}.\_\mathbf{replace}(\mathbf{this}.\$\mathbf{r}\rightarrow
this.$r.value(heapIs \rho_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this. r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
\theta_{funcstart\_1032,1}.p1, 177).rem)))).\_replace(this.\$r \rightarrow 0
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{uncstart\_1032,1}, this.r.value(heapIs \rho_{uncstart\_1032,1}).p1,
177).quot) + (171 * div(\mathbf{heapIs} \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}))
\rho_{funcstart\_1032.1}.p1, 177).rem)._replace(p2 \rightarrow (-35 * div(heapIs
$\text{heap}_{funcstart=1032.1}$, this.$\text{r.value}(\text{heapIs} $\text{heap}_{funcstart=1032.1}).p2,
176).quot) + (172 * \text{div}(\text{heapIs } \text{heap}_{funcstart\_1032,1}, \text{this.} \text{$r.value}(\text{heapIs}))
heap_{funcstart\_1032,1}.p2, 176).rem)), this).p3) < (int)0)) + temp3))
→ [expand definition of operator '*' in class 'pointer' at built in declaration]
[61.15] \theta_{1.15} == \theta_{1.15} == \theta_{1.15}._replace(this.$r \theta_{1.15}
this.$r.value(heapIs $heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
\label{eq:continuous_function} $ \text{heap}_{funcstart\_1032,1} . \text{p1}, 177).rem)))).\_\textbf{replace}(\textbf{this}.\$r \rightarrow
this.$r.value(heapIs heap_{funcstart\ 1032.1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs \theta_{funcstart\_1032,1}, this.r.value(heapIs)
\rho_{uncstart\_1032,1}.p1, 177).rem))._replace(p2 \rightarrow ((-35 * div(heapIs
\rho_{funcstart_1032,1}, this.r.value(heapIs \rho_{funcstart_1032,1}).p2,
176).quot) + (172 * div(heapIs \rho_{funcstart\_1032,1}, this.r.value(heapIs)
\theta_{uncstart\_1032,1}.p2, 176).rem)))._replace(this.$r \rightarrow
\textbf{this.}\$r.\textbf{value}(\textbf{heapIs}~\$heap_{funcstart\_1032,1}).\_\textbf{replace}(p1 \rightarrow ((\text{-}2~*\text{div}(\textbf{heapIs}
\rho_{funcstart\_1032,1}, this. r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs \rho_{funcstart\_1032,1}, this.r.value(heapIs)
\rho_{funcstart\_1032,1}.p1, 177).rem))._replace(p2 \rightarrow ((-35 * div(heapIs
$heap_tuncstart_1032.1, this.$r.value(heapIs $heap_tuncstart_1032.1).p2,
176).quot) + (172 * div(\mathbf{heapIs} \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}))
\theta_{funcstart\_1032,1}.p2, 176).rem))._replace(p3 \rightarrow
asType<P3Type>((30323 *
asType{<}int{>}(static\_cast{<}integer{>}(static\_cast{<}signed
int>(this.$r.value(heapIs \rho_{tuncstart 1032.1}._replace(this.$r \rightarrow
```

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this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
\theta_{tuncstart\_1032,1}.p1, 177).rem)))).\_replace(this.\$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs $heap<sub>funcstart_1032,1</sub>, this.$r.value(heapIs
\rho_{uncstart\_1032,1}.p1, 177).rem))._replace(p2 \rightarrow ((-35 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p2,
176).quot) + (172 * div(heapIs \theta_{funcstart\_1032,1}, this.r.value(heapIs)
\theta_{funcstart\_1032,1}.p2, 176).rem)))).p3) < (int)0))) + temp3))
→ [evaluate dereferenced pointer into modified heap]
[61.16] $heap<sub>funcend_1032,1</sub> == $heap<sub>funcstart_1032,1</sub>._replace(this.$r \rightarrow
this.$r.value(heapIs p_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(\mathbf{heapIs} \$ heap_{funcstart\_1032,1}, \mathbf{this}.\$ r. \mathbf{value}(\mathbf{heapIs})
\theta_{funcstart\_1032,1}.p1, 177).rem))))._replace(this.$r \rightarrow
\textbf{this.}\$r.\textbf{value}(\textbf{heapIs}~\$heap_{funcstart\_1032,1}).\_\textbf{replace}(p1 \rightarrow ((\text{-}2~*\text{div}(\textbf{heapIs}
\rho_{funcstart\_1032,1}, this.\r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
\rho_{funcstart\_1032.1}.p1, 177).rem))._replace(p2 \rightarrow ((-35 * div(heapIs
\rho_{tuncstart\_1032.1}, this.r.value(heapIs \rho_{tuncstart\_1032.1}).p2,
176).quot) + (172 * div(\mathbf{heapIs} \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}))
\label{eq:continuous_function} $ \text{heap}_{funcstart\_1032,1} . \text{p2}, \ 176).rem)))).$ \_\textbf{replace}(\textbf{this}.\$r \rightarrow
this.$r.value(heapIs \rho_{tuncstart\_1032.1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
\rho_{uncstart\_1032,1}.p1, 177).rem))).\_replace(p2 \rightarrow ((-35 * div(heapIs)))._replace(p2 \rightarrow ((-35 * div(heapIs))))._replace(p3 + div(heapIs)))
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p2,
176).quot) + (172 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.} \text{\$r.value}(\text{heapIs}))
\$heap_{funcstart\_1032,1}).p2,\ 176).rem))).\_\textbf{replace}(p3 \rightarrow
asType<P3Type>((30323 *
asType < int > (static\_cast < integer > (static\_cast < signed int > (([this.$r
== this.$r]: this.$r.value(heapIs \theta_{funcstart\_1032.1})._replace(p1 \theta ((-2)
* div(\mathbf{heapIs} \ \mathbf{sheap}_{funcstart\_1032,1}, \ \mathbf{this.sr.value}(\mathbf{heapIs})
\text{Sheap}_{funcstart\_1032,1}.p1, 177).quot) + (171 * div(heapIs \text{Sheap}_{funcstart\_1032,1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177).rem))).\_replace(p2 \rightarrow
(-35 * div(heapIs \$heap_{funcstart\_1032,1}, this.\$r.value(heapIs
\rho_{funcstart\_1032,1}.p2, 176).quot + (172 * div(heapIs $heap_{funcstart\_1032,1})
this.$r.value(heapIs heap_{funcstart\_1032.1}).p2, 176).rem)), []:
this.$r.value(heapIs heap_{funcstart\_1032.1}._replace(this.$r \rightarrow
this.$r.value(heapIs heapIs_{funcstart\_1032,1})._replace(p1 \rightarrow (-2 * div(heapIs
\rho_{tuncstart_{1032.1}}, this.r.value(heapIs \rho_{tuncstart_{1032.1}}).p1,
177).quot) + (171 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
\text{Sheap}_{funcstart\_1032,1}.\text{p1}, 177).\text{rem})))).\text{p3} < (int)0)) + \text{temp3}))
```

```
→ [explicitly assert falsehood of skipped guards in subsequent guards]
[61.17] heap_{funcend\_1032,1} == heap_{funcstart\_1032,1}._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.} \text{\$r.value}(\text{heapIs}))
\theta_{funcstart\_1032,1}.p1, 177).rem)))).\_replace(this.$r \rightarrow
\textbf{this.\$r.value}(\textbf{heapIs}~\$ heap_{funcstart\_1032,1}).\_\textbf{replace}(p1 \rightarrow ((-2 * div(\textbf{heapIs}) + (-2 * div(\textbf{heapI
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.} \text{\$r.value}(\text{heapIs}))
\rho_{funcstart\_1032,1}.p1, 177).rem)._replace\rho_{funcstart\_1032,1}.p1, 177).rem)._replace
\rho_{funcstart\_1032,1}, this.\r.value(heapIs \rho_{funcstart\_1032,1}).p2,
176).quot) + (172 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
\theta_{funcstart_{1032,1}}.p2, 176).rem))))._replace(this.$r \rightarrow
this.$r.value(heapIs \rho_{tuncstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\label{eq:heapIs} $\operatorname{heap}_{funcstart\_1032,1},\ \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}\ \$\operatorname{heap}_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs $heap<sub>funcstart_1032,1</sub>, this.$r.value(heapIs
\rho_{funcstart\_1032,1}.p1, 177).rem)._replace(p2 \rightarrow ((-35 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p2,
176).quot) + (172 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.}\text{\$r.value}(\text{heapIs}))
\theta_{funcstart\_1032,1}.p2, 176).rem)))._replace(p3 \rightarrow
asType<P3Type>((30323 *
asType<int>(static_cast<integer>(static_cast<signed int>(([this.$r
== this.$r]: this.$r.value(heapIs \theta_{funcstart\_1032,1})._replace(p1 \theta ((-2)
* div(heapIs heap_{funcstart\_1032,1}, this.r.value(heapIs)
\text{Sheap}_{funcstart\_1032,1}.\text{p1}, 177).\text{quot} + (171 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_1032,1},
\textbf{this.\$r.value}(\textbf{heapIs}~\$\text{heap}_{funcstart\_1032,1}).\text{p1},~177).\text{rem}))).\_\textbf{replace}(\text{p2}\rightarrow
(-35 * div(heapIs \$heap_{funcstart\_1032,1}, this.\$r.value(heapIs
\text{Sheap}_{funcstart\_1032.1}.p2, 176).quot) + (172 * div(heapIs \text{Sheap}_{funcstart\_1032.1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p2, 176).rem)), [!(this.<math>r = 
\textbf{this.\$r.value}(\textbf{heapIs}~\$ heap_{funcstart\_1032,1}.\_\textbf{replace}(\textbf{this.\$r} \rightarrow \texttt{a.s.}))
this.$r.value(heapIs heapIs_{funcstart\_1032,1})._replace(p1 \rightarrow (-2 * div(heapIs
\rho_{tuncstart=1032.1}, this.r.value(heapIs \rho_{tuncstart=1032.1}).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.}\text{\$r.value}(\text{heapIs}))
\rightarrow [simplify]
[61.25] heap_{funcend\_1032,1} == heap_{funcstart\_1032,1}._replace(this.$r \rightarrow
this.$r.value(heapIs $heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.} \text{\$r.value}(\text{heapIs}))
\label{eq:heap_funcstart_1032,1} $$ \text{heap}_{funcstart_1032,1}.\text{p1},\ 177).rem)))).$$ \_\textbf{replace}(\textbf{this}.\$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.} \text{\$r.value}(\text{heapIs}))
\rho_{funcstart\_1032,1}.p1, 177).rem))._replace(p2 \rightarrow ((-35 * div(heapIs
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\rho_{funcstart=1032,1}, this.r.value(heapIs \rho_{funcstart=1032,1}).p2,
176).quot) + (172 * div(heapIs \theta_{funcstart\_1032,1}, this.r.value(heapIs)
\theta_{funcstart\_1032,1}.p2, 176).rem))))._replace(this.$r \rightarrow
this.$r.value(heapIs \frac{1}{2} heap\frac{1}{2} heap\frac{1}{2}
\$heap_{funcstart\_1032,1},\, \textbf{this}.\$r.\textbf{value}(\textbf{heapIs}\,\,\$heap_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs $heap<sub>funcstart_1032,1</sub>, this.$r.value(heapIs
\rho_{uncstart\_1032,1}.p1, 177).rem))).\_replace(p2 \rightarrow ((-35 * div(heapIs)))._replace(p2 \rightarrow ((-35 * div(heapIs))))._replace(p3 + div(heapIs)))
$\text{heap}_{tuncstart_1032,1}$, this.$\text{r.value}(\text{heapIs} \text{$heap}_{tuncstart_1032,1}).p2,
176).quot) + (172 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032.1}, \text{this.} \text{\$r.value}(\text{heapIs}))
heap_{funcstart\_1032,1}.p2, 176).rem))).\_replace(p3 \rightarrow
asType<P3Type>((30323 * asType<int>(static_cast<integer>(0 <
-\mathbf{this.\$r.value}(\mathbf{heapIs}\ \$\mathbf{heap}_{funcstart\_1032,1}).\mathbf{p3}))) + \mathbf{temp3})))
\rightarrow [from term 40.0, literala < -this.$r.value(heapIs $heap_{funcstart = 1032.1}).p3
is false whenever -2 < (0 + literala)
       Proof of rule precondition:
       [61.25.0] - 2 < (0 + 0)
       \rightarrow [simplify]
       [61.25.2] true
[61.26] heap_{funcend\_1032,1} == heap_{funcstart\_1032,1}._replace(this.$r \rightarrow
this.$r.value(heapIs \theta_{funcstart\_1032,1})._replace(p1 \theta ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.}\text{\$r.value}(\text{heapIs}))
\theta_{tuncstart\_1032,1}.p1, 177).rem)))).\_replace(this.\$r \rightarrow
this.$r.value(heapIs p_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart_1032,1}, this. r.value(heapIs \rho_{funcstart_1032,1}).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.} \text{\$r.value}(\text{heapIs}))
\rho_{funcstart\_1032,1}.p1, 177).rem)._replace(p2 \rightarrow ((-35 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p2,
176).quot) + (172 * div(\mathbf{heapIs} \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}))
\theta_{funcstart\_1032,1}.p2, 176).rem))))._replace(this.$r \rightarrow
\textbf{this.}\$r.\textbf{value}(\textbf{heapIs}~\$heap_{funcstart\_1032,1}).\_\textbf{replace}(p1 \rightarrow ((-2~*div(\textbf{heapIs})))))
\rho_{tuncstart\_1032.1}, this.r.value(heapIs \rho_{tuncstart\_1032.1}).p1,
177).quot) + (171 * div(heapIs \theta_{funcstart\_1032,1}, this.r.value(heapIs)
\rho_{uncstart\_1032,1}.p1, 177).rem))).\_replace(p2 \rightarrow ((-35 * div(heapIs)))._replace(p2 \rightarrow ((-35 * div(heapIs))))._replace(p3 + div(heapIs)))
\rho_{funcstart_1032,1}, this.\r.value(heapIs \rho_{funcstart_1032,1}).p2,
176).quot) + (172 * div(heapIs $heap<sub>funcstart_1032.1</sub>, this.$r.value(heapIs
heap_{funcstart\_1032,1}.p2, 176).rem))._replace(p3 \rightarrow
asType<P3Type>((30323 * asType<int>(static_cast<integer>(false)))
+ \text{temp3})))
\rightarrow [simplify]
[61.27] heap_{funcend\_1032,1} == heap_{funcstart\_1032,1}._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
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\rho_{funcstart=1032,1}, this.r.value(heapIs \rho_{funcstart=1032,1}).p1,
177).quot) + (171 * div(heapIs \theta), this.$r.value(heapIs
\theta_{funcstart\_1032,1}.p1, 177).rem))))._replace(this.$r \rightarrow
this.$r.value(heapIs \frac{1}{2} heap\frac{1}{2} line \frac{1}{2} heap\frac{1}{2} heap\frac{1}{2
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs $heap<sub>funcstart_1032,1</sub>, this.$r.value(heapIs
\rho_{uncstart\_1032,1}.p1, 177).rem))).\_replace(p2 \rightarrow ((-35 * div(heapIs)))._replace(p2 \rightarrow ((-35 * div(heapIs))))._replace(p3 + div(heapIs)))
$\text{heap}_{tuncstart_1032,1}$, this.$\text{r.value}(\text{heapIs} \text{$heap}_{tuncstart_1032,1}).p2,
176).quot) + (172 * div(heapIs $heap<sub>funcstart_1032,1</sub>, this.$r.value(heapIs
\theta_{funcstart_1032,1}.p2, 176).rem)))).\_replace(this.\$r \rightarrow 0
\textbf{this.\$r.value}(\textbf{heapIs}~\$ heap_{funcstart\_1032,1}).\_\textbf{replace}(p1 \rightarrow ((-2~*div(\textbf{heapIs}
\theta_{funcstart\_1032,1}, this.r.value(heapIs \theta_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
\rho_{funcstart\_1032,1}.p1, 177).rem))._replace(p2 \rightarrow ((-35 * div(heapIs
\rho_{funcstart\_1032,1}, this. r.value(heapIs \rho_{funcstart\_1032,1}).p2,
176).quot) + (172 * \text{div}(\text{heapIs } \text{heap}_{funcstart\_1032,1}, \text{this.} \text{$r.value}(\text{heapIs}))
\theta_{funcstart\_1032,1}.p2, 176).rem))).\_replace(p3 \rightarrow
asType<P3Type>((30323 * asType<int>(([false]: 1, []: 0))) + temp3)))
→ [explicitly assert falsehood of skipped guards in subsequent guards]
[61.28] heap_{funcend\_1032,1} == heap_{funcstart\_1032,1}._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.} \text{\$r.value}(\text{heapIs}))
\label{eq:continuous_function} $ \text{heap}_{funcstart\_1032,1} . \text{p1}, 177).rem)))).\_\textbf{replace}(\textbf{this}.\$r \rightarrow
this.$r.value(heapIs \rho_{tuncstart\_1032.1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs \theta_{funcstart\_1032,1}, this.r.value(heapIs)
\rho_{uncstart\_1032,1}.p1, 177).rem))).\_replace(p2 \rightarrow ((-35 * div(heapIs)))._replace(p2 \rightarrow ((-35 * div(heapIs))))._replace(p3 + div(heapIs)))
$\text{heap}_{tuncstart=1032.1}$, this.$\text{r.value}(\text{heapIs} \text{$heap}_{tuncstart=1032.1}).p2,
176).quot) + (172 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
\theta_{funcstart\_1032,1}.p2, 176).rem)))).replace(this.$r \rightarrow
this.$r.value(heapIs heapIs_{tuncstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.} \text{\$r.value}(\text{heapIs}))
\rho_{funcstart\_1032,1}.p1, 177).rem)._replace(p2 \rightarrow ((-35 * div(heapIs
\rho_{funcstart\_1032,1}, this. r.value(heapIs \rho_{funcstart\_1032,1}).p2,
176).quot) + (172 * \text{div}(\text{heapIs } \text{heap}_{funcstart\_1032.1}, \text{this.}\text{$\text{r.value}(\text{heapIs})$})
heap_{funcstart\_1032.1}.p2, 176).rem)).\_replace(p3 \rightarrow
asType<P3Type>((30323 * asType<int>(([false]: 1, [true]: 0))) +
temp3)))
\rightarrow [simplify]
[61.31] heap_{funcend\_1032.1} == heap_{funcstart\_1032.1}._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{tuncstart\_1032.1}, this.r.value(heapIs \rho_{tuncstart\_1032.1}).p1,
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177).quot) + (171 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.} \text{\$r.value}(\text{heapIs}))
\theta_{funcstart\_1032,1}.p1, 177).rem))))._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.}\text{\$r.value}(\text{heapIs}))
\rho_{tuncstart\_1032,1}.p1, 177).rem))._replace(p2 \rightarrow ((-35 * div(heapIs
$heap_funcstart_1032,1, this.$r.value(heapIs $heap_funcstart_1032,1).p2,
176).quot) + (172 * div(heapIs $heap<sub>funcstart_1032,1</sub>, this.$r.value(heapIs
\theta_{tuncstart\_1032,1}.p2, 176).rem)))._replace(this.$r \rightarrow
\textbf{this.\$r.value}(\textbf{heapIs}~\$ heap_{funcstart\_1032,1}).\_\textbf{replace}(p1 \rightarrow ((-2~*div(\textbf{heapIs})))))
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs \rho_{funcstart\_1032,1}, this.r.value(heapIs)
\rho_{uncstart\_1032,1}.p1, 177).rem))._replace(p2 \rightarrow ((-35 * div(heapIs
\rho_{uncstart\_1032,1}, this.r.value(heapIs \rho_{uncstart\_1032,1}).p2,
176).quot) + (172 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
\rho_{uncstart\_1032.1}.p2, 176).rem))._replace(p3 \rightarrow asType<P3Type>(0 +
temp3)))
\rightarrow [from term 58.20, temp3 is equal to (-63 * div(heapIs $heap_{funcstart\_1032,1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p3, 178).quot) + (170 *
div(heapIs $heap_{funcstart\_1032,1}, this.$r.value(heapIs)
heap_{funcstart_{1032,1}}.p3, 178).rem
[61.32] heap_{funcend\_1032,1} == heap_{funcstart\_1032,1}._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.\r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.} \text{\$r.value}(\text{heapIs}))
\theta_{funcstart\_1032,1}.p1, 177).rem)))._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
\rho_{funcstart\_1032,1}.p1, 177).rem))._replace(p2 \rightarrow ((-35 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p2,
176).quot) + (172 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.} \text{\$r.value}(\text{heapIs}))
\theta_{funcstart\_1032,1}.p2, 176).rem)))).replace(this.r \rightarrow 0
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
\rho_{uncstart\_1032,1}.p1, 177).rem))._replace(p2 \rightarrow ((-35 * div(heapIs
\rho_{funcstart\_1032,1}, this. r.value(heapIs \rho_{funcstart\_1032,1}).p2,
176).quot) + (172 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.}\text{\$r.value}(\text{heapIs}))
\rho_{tuncstart\_1032.1}.p2, 176).rem))._replace(p3 \rightarrow asType<P3Type>(0 +
((-63 * div(heapIs $heap<sub>funcstart 1032.1</sub>, this.$r.value(heapIs
\text{Sheap}_{funcstart\_1032.1}.p3, 178).quot) + (170 * div(heapIs \text{Sheap}_{funcstart\_1032.1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p3, 178).rem)))))
\rightarrow [simplify]
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[61.35] heap_{funcend\_1032,1} == heap_{funcstart\_1032,1}._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
\theta_{tuncstart\_1032,1}.p1, 177).rem)))).\_replace(this.\$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs heapIs f_{uncstart_1032,1}, this. r.value(heapIs)
\rho_{funcstart\_1032,1}.p1, 177).rem))._replace(p2 \rightarrow ((-35 * div(heapIs
$heap_funcstart_1032,1, this.$r.value(heapIs $heap_funcstart_1032,1).p2,
176).quot) + (172 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.} \text{\$r.value}(\text{heapIs}))
\theta_{funcstart\_1032,1}.p2, 176).rem))))._replace(this.$r \rightarrow
\textbf{this.}\$r.\textbf{value}(\textbf{heapIs}~\$heap_{funcstart\_1032,1}).\_\textbf{replace}(p1 \rightarrow ((-2~*div(\textbf{heapIs})))))
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(\mathbf{heapIs} \ \$heap_{funcstart\_1032,1}, \ \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
\rho_{uncstart\_1032,1}.p1, 177).rem))._replace(p2 \rightarrow ((-35 * div(heapIs
\rho_{tuncstart\_1032.1}, this.r.value(heapIs \rho_{tuncstart\_1032.1}).p2,
176).quot) + (172 * div(\mathbf{heapIs} \ \$heap_{funcstart\_1032,1}, \ \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
\rho_{funcstart\_1032.1}.p2, 176).rem))._replace(p3 \rightarrow ((-63 * div(heapIs
$\text{heap}_{funcstart=1032.1}$, this.$\text{r.value}(\text{heapIs} $\text{heap}_{funcstart=1032.1}).p3,
178).quot) + (170 * \text{div}(\text{heapIs } \text{heap}_{funcstart\_1032,1}, \text{this.} \text{$r.value}(\text{heapIs}))
heap_{funcstart\_1032,1}.p3, 178.rem)))
[Take given term]
[62.0] (asType<double>(static_cast<real>(operator*(heapIs
heap_{funcend\_1032.1}, this).p1) /
asType < double > (static\_cast < real > ($heap_{funcend\_1032,1}.M1))) == raux1
\$heap_{funcstart\_1032,1}.\_\textbf{replace}(\textbf{this}.\$r \rightarrow \textbf{this}.\$r.\textbf{value}(\textbf{heapIs}
heap_{funcstart\_1032,1}._replace(p1 \rightarrow ((-2 * div(heapIs heap_{funcstart\_1032,1}),
this. $r.value(heapIs heap_{funcstart\_1032.1}).p1, 177).quot) + (171 *
div(\mathbf{heapIs} \ \$heap_{funcstart\_1032,1}, \ \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
\theta_{funcstart\_1032,1}.p1, 177).rem)))).replace(this.$r \rightarrow
this.$r.value(heapIs $heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
heap_{funcstart\_1032,1}, this.r.value(heapIs heap_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs $heap_{tuncstart\_1032.1}, this.$r.value(heapIs
$heap_funcstart_1032.1, this.$r.value(heapIs $heap_funcstart_1032.1).p2,
(176).quot) + (172 * div(heapIs $heap_{funcstart\_1032,1}, this.$r.value(heapIs)
heap_{funcstart\_1032,1}.p2, 176).rem))).\_replace(this.$r \rightarrow
this.$r.value(heapIs $heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
heap_{funcstart\_1032,1}, this.r.value(heapIs heap_{funcstart\_1032,1}).p1,
(177).quot + (171 * div(\mathbf{heapIs} \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}))
\rho_{funcstart\_1032,1}.p1, 177).rem))).\_replace(p2 \rightarrow ((-35 * div(heapIs)))._replace(p2 \rightarrow ((-35 * div(heapIs))))._replace(p2 \rightarrow ((-35 * div(heapIs)))))._replace(p3 + div(heapIs)))
\rho_{tuncstart\_1032,1}, this.r.value(heapIs \rho_{tuncstart\_1032,1}).p2,
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176).quot) + (172 * div(\textbf{heapIs} \$heap_{funcstart\_1032,1}, \textbf{this}.\$r.\textbf{value}(\textbf{heapIs}))
heap_{funcstart\_1032,1}.p2, 176).rem))).\_replace(p3 \rightarrow (-63 * div(heapIs))).
heap_{funcstart\_1032,1}, this.r.value(heapIs heap_{funcstart\_1032,1}).p3,
178).quot) + (170 * div(heapIs $heap_{funcstart\_1032,1}, this.$r.value(heapIs
heap_{funcstart\_1032,1}.p3, 178.rem)))]
[62.1] (asType<double>(static_cast<real>(operator*(heapIs
\$ heap_{funcstart\_1032,1}.\_\textbf{replace}(\textbf{this}.\$r \rightarrow \textbf{this}.\$r.\textbf{value}(\textbf{heapIs}
\text{Sheap}_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs \text{Sheap}_{funcstart\_1032,1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177).quot) + (171 *
div(\mathbf{heapIs} \$ heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
\theta_{funcstart\_1032,1}.p1, 177).rem)))).\_replace(this.\$r \rightarrow 0
this.$r.value(heapIs \rho_{tuncstart\_1032.1})._replace(p1 \rightarrow ((-2 * div(heapIs
\theta_{funcstart\_1032,1}, this. r.value(heapIs \theta_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(\mathbf{heapIs} \ \$heap_{funcstart\_1032,1}, \ \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
\$heap_{funcstart\_1032,1}).p1,\ 177).rem))).\_\mathbf{replace}(p2 \to ((-35\ *\ div(\mathbf{heapIs})))).
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p2,
(176).\text{quot} + (172 * \text{div}(\text{heapIs } \text{heap}_{funcstart\_1032,1}, \text{this.}\text{$r.value}(\text{heapIs}))
\theta_{funcstart\_1032,1}.p2, 176).rem)))).\_replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs \theta_{funcstart\_1032,1}, this.r.value(heapIs)
\rho_{uncstart\_1032,1}.p1, 177).rem))._replace(p2 \rightarrow ((-35 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p2,
176).quot) + (172 * div(heapIs $heap<sub>funcstart_1032.1</sub>, this.$r.value(heapIs
heap_{funcstart\_1032,1}.p2, 176).rem))._replace(p3 \rightarrow (-63 * div(heapIs)
\rho_{funcstart\_1032,1}, this.\r.value(heapIs \rho_{funcstart\_1032,1}).p3,
178).quot) + (170 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
heap_{funcstart_{1032.1}}.p3, 178).rem)), this).p1)) /
asType < double > (static\_cast < real > (\$heap_{funcend\_1032,1}.M1))) == raux1
→ [expand definition of operator '*' in class 'pointer' at built in declaration]
[62.2] (asType<double>(static_cast<real>(this.$r.value(heapIs
\theta_{funcstart\_1032,1}.$$replace(this.\theta_{r}\to \theta_{r}.$$r.value(heapIs
\text{Sheap}_{funcstart\_1032,1}._replace(p1 \rightarrow ((-2 * div(heapIs \text{Sheap}_{funcstart\_1032,1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177).quot) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_1032,1}, \ \mathbf{this}.\$ r. \mathbf{value}(\mathbf{heapIs}
\theta_{tuncstart\_1032.1}.p1, 177).rem)))._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\$heap_{funcstart\_1032,1},\, \textbf{this}.\$r.\textbf{value}(\textbf{heapIs}\,\,\$heap_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
\rho_{funcstart\_1032,1}.p1, 177).rem))._replace(p2 \rightarrow ((-35 * div(heapIs))
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p2,
176).quot) + (172 * \text{div}(\text{heapIs } \text{heap}_{funcstart\_1032,1}, \text{this.} \text{r.value}(\text{heapIs}))
\theta_{funcstart\_1032,1}.p2, 176).rem)))._replace(this.$r \rightarrow
\textbf{this.}\$r.\textbf{value}(\textbf{heapIs}~\$heap_{funcstart\_1032,1}).\_\textbf{replace}(p1 \rightarrow ((-2~*div(\textbf{heapIs})))))
```

```
\rho_{funcstart_1032,1}, this.\r.value(heapIs \rho_{funcstart_1032,1}).p1,
177).quot) + (171 * div(heapIs \theta_{funcstart\_1032,1}, this.r.value(heapIs)
\rho_{uncstart\_1032,1}.p1, 177).rem))._replace(p2 \rightarrow ((-35 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p2,
176).quot) + (172 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.}\text{\$r.value}(\text{heapIs}))
\rho_{tuncstart\_1032,1}.p2, 176).rem))._replace(p3 \rightarrow ((-63 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p3,
178).quot) + (170 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.} \text{\$r.value}(\text{heapIs}))
\theta_{funcstart_{1032,1}}.p3, 178).rem)))).p1)) /
asType < double > (static\_cast < real > (\$heap_{funcend\_1032,1}.M1))) == raux1
→ [evaluate dereferenced pointer into modified heap]
[62.3] (asType<double>(static_cast<real>(([this.$r == this.$r]:
this.$r.value(heapIs \rho_{uncstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs)
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
\rho_{funcstart\_1032,1}.p1, 177).rem))._replace(p2 \rightarrow ((-35 * div(heapIs
\rho_{funcstart\_1032,1}, this. r.value(heapIs \rho_{funcstart\_1032,1}).p2,
176).quot) + (172 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.} \text{\$r.value}(\text{heapIs}))
heap_{funcstart\_1032,1}.p2, 176).rem))).\_replace(p3 \rightarrow (-63 * div(heapIs))).
\$heap_{funcstart\_1032,1}, \ \textbf{this.} \$r. \textbf{value} (\textbf{heapIs} \ \$heap_{funcstart\_1032,1}).p3,
178).quot) + (170 * div(heapIs $heap<sub>funcstart_1032.1</sub>, this.$r.value(heapIs
\theta_{funcstart\_1032,1}.p3, 178).rem), []: this.\$r.value(heapIs)
\rho_{tuncstart\_1032.1}._replace(this.r \to this.r.value(heapIs)
\text{Sheap}_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs \text{Sheap}_{funcstart\_1032,1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177).quot) + (171 *
div(\mathbf{heapIs} \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
\theta_{funcstart\_1032,1}.p1, 177).rem))))._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\$heap_{funcstart\_1032,1},\, \textbf{this}.\$r.\textbf{value}(\textbf{heapIs}\,\,\$heap_{funcstart\_1032.1}).p1,
177).quot) + (171 * div(\mathbf{heapIs} \$ heap_{funcstart\_1032,1}, \mathbf{this}.\$ r. \mathbf{value}(\mathbf{heapIs})
\rho_{funcstart\_1032.1}.p1, 177).rem))._replace(p2 \rightarrow (-35 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p2,
176).quot) + (172 * \text{div}(\text{heapIs } \text{heap}_{funcstart\_1032,1}, \text{this.} \text{$r.value}(\text{heapIs}))
{\tt \$heap}_{funcstart\_1032,1}).p2,\; 176).rem))))).p1))\;/
\mathbf{asType} < \mathbf{double} > (\mathbf{static\_cast} < \mathbf{real} > (\$ \operatorname{heap}_{funcend\_1032,1}.\operatorname{M1}))) == \operatorname{raux1}
→ [explicitly assert falsehood of skipped guards in subsequent guards]
[62.4] (asType<double>(static_cast<real>(([this.$r == this.$r]:
this.$r.value(heapIs \rho_{uncstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs)
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032.1}, \text{this.} \text{\$r.value}(\text{heapIs}))
\rho_{uncstart\_1032,1}.p1, 177).rem))).\_replace(p2 \rightarrow ((-35 * div(heapIs)))._replace(p2 \rightarrow ((-35 * div(heapIs))))._replace(p3 + div(heapIs)))
\rho_{tuncstart\_1032.1}, this.r.value(heapIs \rho_{tuncstart\_1032.1}).p2,
176).quot) + (172 * div(\mathbf{heapIs} \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}))
\rho_{uncstart\_1032,1}.p2, 176).rem))._replace(p3 \rightarrow (-63 * div(heapIs
```

```
\rho_{funcstart_1032,1}, this.\r.value(heapIs \rho_{funcstart_1032,1}).p3,
178).quot) + (170 * div(heapIs \theta_{funcstart\_1032,1}, this.r.value(heapIs)
\text{heap}_{funcstart\_1032.1}.p3, 178).rem)), [!(this.$r == this.$r)]:
this.$r.value(heapIs heap_{funcstart\_1032,1}._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs $heap<sub>funcstart_1032,1</sub>, this.$r.value(heapIs
\theta_{tuncstart_{1032,1}}.p1, 177.rem)))._replace(this.r \rightarrow
this.$r.value(heapIs p_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart=1032,1}, this.r.value(heapIs \rho_{funcstart=1032,1}).p1,
177).quot) + (171 * div(\mathbf{heapIs} \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}))
\rho_{funcstart\_1032,1}.p1, 177).rem))).\_replace(p2 \rightarrow (-35 * div(heapIs))).
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p2,
176).quot) + (172 * \text{div}(\text{heapIs } \text{heap}_{funcstart\_1032,1}, \text{this.} \text{$r.value}(\text{heapIs}))
heap_{funcstart\_1032,1}.p2, 176).rem)))).p1)) /
asType < double > (static\_cast < real > (\$heap_{funcend\_1032,1}.M1))) == raux1
\rightarrow [simplify]
[62.11] (real((-2 * div(heapIs \rho_{funcstart\_1032,1}, this.\r.value(heapIs)
\text{Sheap}_{funcstart\_1032.1}.p1, 177).quot) + (171 * div(heapIs \text{Sheap}_{funcstart\_1032.1},
this.r.value(heapIs $heap_{funcstart\_1032,1}).p1, 177).rem)) /
asType<double>(static_cast<real>($heap_{funcend\_1032.1}.M1))) == raux1
\rightarrow [from term 61.35, $heap<sub>funcend_1032,1</sub> is equal to
\$heap_{funcstart\_1032,1}.\_\textbf{replace}(\textbf{this}.\$r \rightarrow \textbf{this}.\$r.\textbf{value}(\textbf{heapIs}
heap_{funcstart\_1032,1}._replace(p1 \rightarrow ((-2 * div(heapIs \$heap_{funcstart\_1032,1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177).quot) + (171 * funcstart\_1032,1).p1
div(\mathbf{heapIs} \ \$heap_{funcstart\_1032,1}, \ \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
heap_{funcstart\_1032,1}.p1, 177).rem))).\_replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
heap_{funcstart\_1032,1}, this.r.value(heapIs heap_{funcstart\_1032,1}).p1,
(177).quot + (171 * div(heapIs $heap_{funcstart\_1032,1}, this.$r.value(heapIs)
\rho_{funcstart\_1032,1}.p1, 177).rem))).\_replace(p2 \rightarrow ((-35 * div(heapIs))).\_replace(p2 \rightarrow ((-35 * div(heapIs)))).\_replace(p2 \rightarrow ((-35 * div(heapIs)))))
heap_{funcstart\_1032,1}, this.r.value(heapIs heap_{funcstart\_1032,1}).p2,
176).quot) + (172 * div(\textbf{heapIs } \$heap_{funcstart\_1032,1}, \textbf{this.}\$r.\textbf{value}(\textbf{heapIs}))
heap_{funcstart\_1032,1}.p2, 176).rem)))).\_replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032.1})._replace(p1 \rightarrow ((-2 * div(heapIs) + (-2 * div(heapIs) + (
\$heap_{funcstart\_1032,1}, \ \mathbf{this}.\$r.\mathbf{value(heapIs}\ \$heap_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs $heap_{tuncstart\_1032.1}, this.$r.value(heapIs
\rho_{funcstart\_1032,1}.p1, 177).rem))._replace\rho_{funcstart\_1032,1}.p1, 177).rem))
heap_{funcstart\_1032,1}, this.r.value(heapIs heap_{funcstart\_1032,1}).p2,
176).quot) + (172 * div(\mathbf{heapIs} \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}))
heap_{funcstart\_1032,1}.p2, 176).rem))).\_replace(p3 \rightarrow (-63 * div(heapIs)))
$heap_{funcstart\_1032,1}$, this. $r.value(heapIs $heap_{funcstart\_1032,1}).p3,
178).quot) + (170 * div(\textbf{heapIs} \$heap_{funcstart\_1032,1}, \textbf{this}.\$r.\textbf{value}(\textbf{heapIs}))
heap_{funcstart\_1032,1}.p3, 178.rem)))]
```

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\textit{[62.12]} \; (\textbf{real}((-2 \; * \; \text{div}(\textbf{heapIs} \; \$ \text{heap}_{funcstart\_1032,1}, \; \textbf{this}.\$ \textbf{r.value}(\textbf{heapIs} \;
\text{Sheap}_{funcstart\_1032,1}.\text{p1}, 177).\text{quot} + (171 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_1032,1}),
this.r.value(heapIs $heap_{funcstart\_1032,1}).p1, 177).rem)) /
\mathbf{asType} \small{<} \mathbf{double} \small{>} (\mathbf{static\_cast} \small{<} \mathbf{real} \small{>} (\$ \mathbf{heap}_{funcstart\_1032,1}. \mathbf{\_replace} (\mathbf{this}.\$ \mathbf{replace}))

ightarrow this.$r.value(heap
Is $heap_{funcstart\_1032,1})._replace(p1 
ightarrow ((-2 *
div(\mathbf{heapIs} \$ heap_{funcstart\_1032.1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
\text{Sheap}_{funcstart\_1032.1}.p1, 177).quot) + (171 * div(heapIs \text{Sheap}_{funcstart\_1032.1},
this.$r.value(heapIs $heap_funcstart_1032,1).p1, 177).rem))))._replace(this.$r
\rightarrow this.$r.value(heapIs $heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 *
div(\mathbf{heapIs} \$ heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
\text{Sheap}_{funcstart\_1032.1}.p1, 177).quot) + (171 * div(heapIs \text{Sheap}_{funcstart\_1032.1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177).rem))).\_replace(p2 \rightarrow
((-35 * div(heapIs \$heap_{funcstart\_1032,1}, this.\$r.value(heapIs
\text{Sheap}_{funcstart\_1032,1}.p2, 176).quot) + (172 * div(heapIs \text{Sheap}_{funcstart\_1032,1},
\textbf{this.} \$r. \textbf{value}(\textbf{heapIs} \ \$ heap_{funcstart\_1032,1}). p2, \ 176). rem)))). \_\textbf{replace}(\textbf{this.} \$r. \textbf{value}(\textbf{heapIs} \ \$ heap_{funcstart\_1032,1}). p2, \ 176). rem))))
\rightarrow this.$r.value(heapIs $heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 *
div(\mathbf{heapIs} \$heap_{funcstart\_1032.1}, \mathbf{this.}\$r.\mathbf{value}(\mathbf{heapIs})
\text{Sheap}_{funcstart\_1032.1}.p1, 177).quot) + (171 * div(heapIs \text{Sheap}_{funcstart\_1032.1},
this.r.value(heapIs \ heap_{funcstart\_1032.1}).p1, 177).rem))).\_replace(p2 \rightarrow
((-35 * div(heapIs $heap_{tuncstart_1032.1}, this.$r.value(heapIs
\text{Sheap}_{funcstart\_1032,1}.p2, 176).quot) + (172 * div(heapIs \text{Sheap}_{funcstart\_1032,1},
this.$r.value(heapIs \theta_{funcstart\_1032.1}).p2, 176).rem)))._replace(p3 \rightarrow
((-63 * div(heapIs \$heap_{funcstart\_1032,1}, this.\$r.value(heapIs
\text{Sheap}_{funcstart\_1032.1}).p3, 178).quot) + (170 * div(heapIs \text{Sheap}_{funcstart\_1032.1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p3, 178).rem))).M1))) == raux1
\rightarrow [const member of object with modified fields]
[62.15] (real((-2 * div(heapIs \rho_{funcstart\_1032,1}, this.\r.value(heapIs)
\text{Sheap}_{funcstart\_1032.1}, p1, 177).quot) + (171 * div(heapIs \text{Sheap}_{funcstart\_1032.1},
this.$r.value(heapIs $heap_tuncstart_1032.1).p1, 177).rem)) /
asType<double>(static_cast<real>($heap_{tuncstart_1032,1}.M1))) == raux1
\rightarrow [const static or extern object]
[62.16] \; (\mathbf{real}((-2 \; * \; \mathrm{div}(\mathbf{heapIs} \; \$ \mathrm{heap}_{funcstart\_1032,1}, \; \mathbf{this}.\$ r. \mathbf{value}(\mathbf{heapIs} \;
\text{Sheap}_{funcstart\_1032.1}, p1, 177).quot) + (171 * div(heapIs \text{Sheap}_{funcstart\_1032.1},
this.r.value(heapIs $heap_{funcstart\_1032,1}).p1, 177).rem)) /
asType < double > (static\_cast < real > (\$heap_{init}.M1))) == raux1
\rightarrow [expand definition of constant 'M1' at prang.cpp (28,26)]
[62.17] (real((-2 * div(heap
Is \rho_{funcstart\_1032,1}, this.\r.value(heap
Is
\text{Sheap}_{funcstart\_1032,1}.\text{p1}, 177).\text{quot} + (171 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_1032,1}),
\mathbf{this.\$r.value}(\mathbf{heapIs}~\$\mathbf{heap}_{funcstart\_1032,1}).\mathbf{p1},~177).\mathbf{rem}))~/
asType < double > (static\_cast < real > ((int)30269))) == raux1
\rightarrow [simplify]
[62.22] \ 0.0 == (-\text{raux}1 + (\text{real}((-2 * \text{div}(\text{heapIs } \text{$heap}_{funcstart\_1032.1},
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this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177).quot) + (171 *
{\rm div}(\mathbf{heapIs}~\$\mathrm{heap}_{funcstart\_1032,1},~\mathbf{this.\$r.value}(\mathbf{heapIs}
\mathrm{\$heap}_{funcstart\_1032,1}).\mathrm{p1},\,177).\mathrm{rem}))~/~30269.0))
[Take given term]
[63.0] (asType<double>(static_cast<real>(operator*(heapIs
heap_{funcend\_1032.1}, this).p2)) /
asType < double > (static\_cast < real > (\$heap_{funcend\_1032,1}.M2))) == raux2
$heap_{funcstart\_1032,1}.$-replace(this.$r \rightarrow this.$r.value(heapIs)
heap_{funcstart\_1032,1}._replace(p1 \rightarrow ((-2 * div(heapIs $heap_{funcstart\_1032,1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177).quot) + (171 *
div(\mathbf{heapIs}\ \$heap_{funcstart\_1032,1},\ \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}
\theta_{tuncstart\_1032.1}.p1, 177).rem)))._replace(this.$r \rightarrow
this.$r.value(heapIs $heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
$heap_{funcstart\_1032,1}$, this. $r.value(heapIs $heap_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(\mathbf{heapIs} \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}))
\rho_{funcstart\_1032,1}.p1, 177).rem))).\_replace(p2 \rightarrow ((-35 * div(heapIs)))._replace(p2 \rightarrow ((-35 * div(heapIs))))._replace(p2 \rightarrow ((-35 * div(heapIs))))._replace(p3 \rightarrow ((-35 * div(heapIs)))))._replace(p3 \rightarrow ((-35 * div(heapIs))))._replace(p3 \rightarrow ((-35 * div(heapIs)))))._replace(p3 \rightarrow ((-35 * div(heapIs)))))._replace(p3 \rightarrow ((-35 * div(heapIs))))._replace(p3 \rightarrow ((-35 * div(heapIs)))))._replace(p3 \rightarrow ((-35 * div(heapIs))))))._replace(p3 \rightarrow ((-35 * div(heapIs)))))))._replace(p3 \rightarrow ((-35 * div(heapIs))))))._replace(p3 \rightarrow ((-35 * div(heapIs)))))))
heap_{funcstart\_1032.1}, this.r.value(heapIs heap_{funcstart\_1032.1}).p2,
(176).quot + (172 * div(heapIs \$heap_{funcstart\_1032,1}, this.\$r.value(heapIs))
heap_{funcstart\_1032,1}.p2, 176).rem))).\_replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
heap_{funcstart\_1032,1}, this.r.value(heapIs heap_{funcstart\_1032,1}).p1,
(177).\text{quot} + (171 * \text{div}(\textbf{heapIs} \$ \text{heap}_{funcstart\_1032,1}, \textbf{this}.\$ \text{r.value}(\textbf{heapIs}))
\rho_{tuncstart\_1032,1}.p1, 177).rem))._replace\rho_{tuncstart\_1032,1}.p1, 177).rem))
$heap_funcstart_1032,1, this.$r.value(heapIs $heap_funcstart_1032,1).p2,
176).quot) + (172 * div(\textbf{heapIs} \$heap_{funcstart\_1032,1}, \textbf{this}.\$r.\textbf{value}(\textbf{heapIs}))
heap_{funcstart\_1032,1}.p2, 176).rem)))_replace(p3 \rightarrow (-63 * div(heapIs
$heap_funcstart_1032,1, this.$r.value(heapIs $heap_funcstart_1032,1).p3,
(178).quot) + (170 * div(heapIs $heap_{funcstart\_1032,1}, this.$r.value(heapIs)]
heap_{funcstart\_1032,1}.p3, 178).rem)))
[63.1] (asType<double>(static_cast<real>(operator*(heapIs
\rho_{funcstart\_1032,1}._replace(this.$r \rightarrow this.$r.value(heapIs)
heap_{funcstart\_1032,1}._replace(p1 \rightarrow ((-2 * div(heapIs p_{funcstart\_1032,1}),
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177).quot) + (171 *
div(\mathbf{heapIs} \$ heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
\theta_{funcstart\_1032,1}.p1, 177).rem)))._replace(this.$r \rightarrow
\textbf{this.\$r.value}(\textbf{heapIs}~\$ heap_{funcstart\_1032,1}).\_\textbf{replace}(p1 \rightarrow ((-2~*div(\textbf{heapIs})))))
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.} \text{\$r.value}(\text{heapIs}))
\theta_{funcstart=1032,1}.p1, 177).rem))._replace(p2 \rightarrow ((-35 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p2,
176).quot) + (172 * div(\mathbf{heapIs} \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}))
\theta_{funcstart\_1032,1}.p2, 176).rem))))._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
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\rho_{tuncstart=1032.1}, this.$r.value(heapIs \rho_{tuncstart=1032.1}).p1,
177).quot) + (171 * div(heapIs \theta_{funcstart\_1032,1}, this.r.value(heapIs)
\rho_{uncstart\_1032,1}.p1, 177).rem))._replace(p2 \rightarrow ((-35 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p2,
176).quot) + (172 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.}\text{\$r.value}(\text{heapIs}))
\rho_{funcstart\_1032,1}.p2, 176).rem))).\_replace(p3 \rightarrow (-63 * div(heapIs))).
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p3,
178).quot) + (170 * \text{div}(\text{heapIs } \text{heap}_{funcstart\_1032.1}, \text{this.}\text{\$r.value}(\text{heapIs}))
heap_{funcstart_{1032,1}}.p3, 178).rem)), this).p2)) /
asType < double > (static\_cast < real > (\$heap_{funcend\_1032,1}.M2))) == raux2
→ [expand definition of operator '*' in class 'pointer' at built in declaration]
{\it [63.2] (as Type < double > (static\_cast < real > (this.\$r.value(heap Is))}
\$heap_{funcstart\_1032,1}.\_\textbf{replace}(\textbf{this}.\$r \rightarrow \textbf{this}.\$r.\textbf{value}(\textbf{heapIs}
\rho_{tuncstart_1032,1}._replace(p1 \rightarrow ((-2 * div(heapIs $heap_{tuncstart_1032,1}), _replace(p1 \rightarrow (1.2 * div(heapIs $heap_{tuncstart_1032,1}), _replace(p1 \rightarrow (1.3 * div(heapIs $heap_{tuncstart_1032,1}), _replace(p1 \rightarrow (1.4 * div(heapIs $heap_{tuncstart_1032,1}), _replace(
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177).quot) + (171 *
div(\mathbf{heapIs} \$ heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
\theta_{funcstart\_1032,1}.p1, 177).rem))))._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\label{eq:heapIs} $ \text{heap}_{funcstart\_1032,1}, \, \textbf{this}. \\ \$r. \textbf{value}(\textbf{heapIs} \,\, \$ \text{heap}_{funcstart\_1032,1}). \\ \text{p1},
177).quot) + (171 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
\rho_{funcstart\_1032.1}.p1, 177).rem))._replace(p2 \rightarrow ((-35 * div(heapIs
\rho_{tuncstart\_1032.1}, this.r.value(heapIs \rho_{tuncstart\_1032.1}).p2,
176).quot) + (172 * div(\mathbf{heapIs} \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}))
\label{eq:continuous_function} $ \text{heap}_{funcstart\_1032,1} . \text{p2}, \ 176).rem)))).$ \_\textbf{replace}(\textbf{this}.\$r \rightarrow
this.$r.value(heapIs \rho_{tuncstart\_1032.1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(\mathbf{heapIs} \ \$heap_{funcstart\_1032,1}, \ \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
\rho_{uncstart\_1032,1}.p1, 177).rem))).\_replace(p2 \rightarrow ((-35 * div(heapIs)))._replace(p2 \rightarrow ((-35 * div(heapIs))))._replace(p3 + div(heapIs)))
$heap_funcstart_1032,1, this.$r.value(heapIs $heap_funcstart_1032,1).p2,
176).quot) + (172 * div(heapIs \rho_{funcstart\_1032,1}, this.r.value(heapIs)
\rho_{tuncstart\_1032,1}.p2, 176).rem))._replace(p3 \rightarrow ((-63 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p3,
178).quot) + (170 * \text{div}(\text{heapIs } \text{heap}_{funcstart\_1032,1}, \text{this.} \text{$r.value}(\text{heapIs}))
{\tt \$heap}_{funcstart\_1032,1}).p3,\ 178).rem))))).p2))\ /
\mathbf{asType} < \mathbf{double} > (\mathbf{static\_cast} < \mathbf{real} > (\$ \operatorname{heap}_{funcend\_1032,1}.\operatorname{M2}))) == \operatorname{raux2}
→ [evaluate dereferenced pointer into modified heap]
[63.3] (asType<double>(static_cast<real>(([this.$r == this.$r]:
this.$r.value(heapIs p_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032.1}, \text{this.} \text{\$r.value}(\text{heapIs}))
\rho_{funcstart\_1032.1}.p1, 177).rem)._replace(p2 \rightarrow ((-35 * div(heapIs
$heap_tuncstart_1032.1, this.$r.value(heapIs $heap_tuncstart_1032.1).p2,
176).quot) + (172 * div(heapIs $heap<sub>funcstart_1032.1</sub>, this.$r.value(heapIs
\rho_{uncstart\_1032,1}.p2, 176).rem))._replace(p3 \rightarrow (-63 * div(heapIs
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\rho_{funcstart_{-1032,1}}, this. r.value(heapIs \rho_{funcstart_{-1032,1}}).p3,
178).quot) + (170 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.} \text{\$r.value}(\text{heapIs}))
\theta_{funcstart\_1032,1}.p3, 178).rem), [: this.$r.value(heapIs)
\theta_{funcstart\_1032,1}._replace(this.r \to this.r.value(heapIs)
\text{Sheap}_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs \text{Sheap}_{funcstart\_1032,1},
this.r.value(heapIs \ heap_{funcstart\_1032.1}).p1, 177).quot) + (171)
{\rm div}(\textbf{heapIs}~\$ heap_{funcstart\_1032,1},~\textbf{this}.\$ r. \textbf{value}(\textbf{heapIs}
\theta_{funcstart_1032.1},p1, 177).rem))))._replace(this.r \rightarrow
this.$r.value(heapIs \frac{1}{2} heap\frac{1}{2} heap\frac{1}{2}
\rho_{funcstart_1032,1}, this.r.value(heapIs \rho_{funcstart_1032,1}).p1,
177).quot) + (171 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
\rho_{uncstart\_1032,1}.p1, 177).rem))).\_replace(p2 \rightarrow (-35 * div(heapIs))).
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p2,
176).quot) + (172 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.} \text{\$r.value}(\text{heapIs}))
heap_{funcstart\_1032,1}.p2, 176).rem)))).p2)) /
asType < double > (static\_cast < real > ($heap_{funcend\_1032,1}.M2))) == raux2
→ [explicitly assert falsehood of skipped guards in subsequent guards]
[63.4] (asType<double>(static_cast<real>(([this.$r == this.$r]:
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\$heap_{funcstart\_1032,1},\, \textbf{this.}\$r.\textbf{value}(\textbf{heapIs}\,\,\$heap_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs $heap<sub>funcstart_1032,1</sub>, this.$r.value(heapIs
\$heap_{funcstart\_1032,1}).p1,\ 177).rem))).\_\mathbf{replace}(p2 \to ((-35\ *\ div(\mathbf{heapIs}
\rho_{funcstart\_1032,1}, this. r.value(heapIs \rho_{funcstart\_1032,1}).p2,
176).quot) + (172 * div(\mathbf{heapIs} \ \$heap_{funcstart\_1032,1}, \ \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
\theta_{uncstart_1032,1}.p2, 176).rem))._replace(p3 \rightarrow (-63 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p3,
178).quot) + (170 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
heap_{funcstart\_1032,1}.p3, 178.rem), [!(this.$r == this.$r)]:
this.$r.value(heapIs \rho_{tuncstart\ 1032.1}._replace(this.$r \rightarrow
\textbf{this.}\$r.\textbf{value}(\textbf{heapIs}~\$heap_{funcstart\_1032,1}).\_\textbf{replace}(p1 \rightarrow ((-2~*div(\textbf{heapIs})))))
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs $heap<sub>funcstart_1032,1</sub>, this.$r.value(heapIs
\theta_{funcstart\_1032,1}.p1, 177).rem)))).replace(this.r \rightarrow 0
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs \theta), this.$r.value(heapIs
\rho_{funcstart\_1032,1}, this. r.value(heapIs \rho_{funcstart\_1032,1}).p2,
176).quot) + (172 * div(\mathbf{heapIs} \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}))
heap_{funcstart\_1032,1}.p2, 176).rem)))).p2)) /
asType < double > (static\_cast < real > ($heap_{funcend\_1032.1}.M2))) == raux2
\rightarrow [simplify]
[63.10] (real((-35 * div(heapIs $heap<sub>funcstart_1032,1</sub>, this.$r.value(heapIs)
\text{Sheap}_{funcstart\_1032.1}.p2, 176).quot) + (172 * div(heapIs \text{Sheap}_{funcstart\_1032.1},
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this.r.value(heapIs \ heap_{funcstart\_1032,1}).p2, 176).rem)) /
\mathbf{asType} < \mathbf{double} > (\mathbf{static\_cast} < \mathbf{real} > (\$ \operatorname{heap}_{funcend\_1032,1}.\operatorname{M2}))) == \operatorname{raux2}
\rightarrow [from term 61.35, $heap<sub>funcend_1032,1</sub> is equal to
\$heap_{funcstart\_1032,1}.\_\textbf{replace}(\textbf{this}.\$r \rightarrow \textbf{this}.\$r.\textbf{value}(\textbf{heapIs}
heap_{funcstart\_1032.1}._replace(p1 \rightarrow ((-2 * div(heapIs $heap_{funcstart\_1032.1},
this.r.value(heapIs \ \$heap_{funcstart\_1032,1}).p1, \ 177).quot) + (171 * 
div(\mathbf{heapIs} \ \$heap_{funcstart\_1032,1}, \ \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
\theta_{funcstart\_1032,1}.p1, 177).rem)))).\_replace(this.\$r \rightarrow 0
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs))
\$heap_{funcstart\_1032,1}, \ \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs} \ \$heap_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(\mathbf{heapIs} * heap_{funcstart\_1032,1}, \mathbf{this}. * r.value(\mathbf{heapIs} 
\rho_{funcstart\_1032.1}.p1, 177).rem))._replace\rho_{funcstart\_1032.1}.p1, 177).rem))
$heap_{tuncstart_1032.1}$, this.$r.value(heapIs $heap_{tuncstart_1032.1}).p2$,
176).quot) + (172 * div(\mathbf{heapIs} \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}))
heap_{funcstart\_1032,1}.p2, 176).rem))))._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
heap_{funcstart\_1032,1}, this.r.value(heapIs heap_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(\mathbf{heapIs} \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}))
\rho_{funcstart\_1032,1}.p1, 177).rem))._replace\rho_{funcstart\_1032,1}.p1, 177).rem))
heap_{funcstart\_1032,1}, this.r.value(heapIs heap_{funcstart\_1032,1}).p2,
(176).\text{quot}) + (172 * \text{div}(\textbf{heapIs} \$ \text{heap}_{funcstart\_1032,1}, \textbf{this}.\$ \text{r.value}(\textbf{heapIs}))
heap_{funcstart\_1032,1}.p2, 176).rem)))_replace(p3 \rightarrow (-63 * div(heapIs
heap_{funcstart\_1032,1}, this.r.value(heapIs heap_{funcstart\_1032,1}).p3,
(178).quot) + (170 * div(\mathbf{heapIs} \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}))
heap_{funcstart\_1032,1}.p3, 178.rem)))
[63.11] (real((-35 * div(heapIs $heap<sub>funcstart_1032,1</sub>, this.$r.value(heapIs)
\text{Sheap}_{funcstart\_1032,1}.p2, 176).quot) + (172 * div(heapIs \text{Sheap}_{funcstart\_1032,1},
\mathbf{this.\$r.value(heapIs}~\$heap_{funcstart\_1032,1}).p2,~176).rem))~/
\mathbf{asType} \small{<} \mathbf{double} \small{>} (\mathbf{static\_cast} \small{<} \mathbf{real} \small{>} (\$ \mathbf{heap}_{funcstart\_1032,1}. \mathbf{\_replace} (\mathbf{this}.\$ \mathbf{replace}))
\rightarrow this.$r.value(heapIs $heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 *
div(\mathbf{heapIs} \$ heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
\text{Sheap}_{funcstart\_1032,1}.p1, 177).quot) + (171 * div(heapIs \text{Sheap}_{funcstart\_1032,1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177).rem)))).\_replace(this.<math>r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177).rem))))
div(\mathbf{heapIs} \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
\text{Sheap}_{funcstart\_1032,1}.p1, 177).quot) + (171 * div(heapIs \text{Sheap}_{funcstart\_1032,1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177).rem))).\_replace(p2 \rightarrow
((-35 * div(\mathbf{heapIs} \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}))
\text{Sheap}_{funcstart\_1032,1}.p2, 176).quot) + (172 * div(heapIs \text{Sheap}_{funcstart\_1032,1},
this.$r.value(heapIs $heap_funcstart_1032.1).p2, 176).rem))))._replace(this.$r
\rightarrow this.$r.value(heapIs $heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_1032,1}, \ \mathbf{this}.\$ r. \mathbf{value}(\mathbf{heapIs}
\rho_{funcstart_{1032,1}}.p1, 177).quot + (171 * div(heapIs $heap_{funcstart_{1032,1}})
this.$r.value(heapIs \rho_{tuncstart_1032.1}).p1, 177).rem)))._replace(p2 \rightarrow
((-35 * div(heapIs \$heap_{funcstart\_1032,1}, this.\$r.value(heapIs
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\text{Sheap}_{funcstart\_1032,1}.p2, 176).quot) + (172 * div(heapIs \text{Sheap}_{funcstart\_1032,1},
\textbf{this.\$r.value}(\textbf{heapIs}~\$\text{heap}_{funcstart\_1032,1}).\text{p2},~176).\text{rem}))).\_\textbf{replace}(\text{p3}\rightarrow
((-63 * div(heapIs \$heap_{funcstart\_1032,1}, this.\$r.value(heapIs
\text{Sheap}_{funcstart\_1032.1}).p3, 178).quot) + (170 * div(heapIs \text{Sheap}_{funcstart\_1032.1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p3, 178).rem)))).M2))) == raux2
→ [const member of object with modified fields]
[63.14] \; (\mathbf{real}((-35 \; * \; \mathrm{div}(\mathbf{heapIs} \; \$ \mathrm{heap}_{funcstart\_1032,1}, \; \mathbf{this}.\$ r. \mathbf{value}(\mathbf{heapIs} \; \mathsf{heapIs})))))
\rho_{tuncstart_1032.1}, p2, 176).quot) + (172 * div(heapIs \rho_{tuncstart_1032.1},
this.r.value(heapIs $heap_{funcstart\_1032,1}).p2, 176).rem)) /
asType<double>(static_cast<real>($heap_{tuncstart_1032,1}.M2))) == raux2
\rightarrow [const static or extern object]
\textit{[63.15]} \; (\mathbf{real}((-35\; *\; \mathrm{div}(\mathbf{heapIs}\; \$ \mathrm{heap}_{funcstart\_1032,1}, \, \mathbf{this}.\$ r. \mathbf{value}(\mathbf{heapIs}\; \$))
\text{Sheap}_{funcstart\_1032,1}.p2, 176).quot) + (172 * div(heapIs \text{Sheap}_{funcstart\_1032,1},
this.r.value(heapIs $heap_{funcstart\_1032,1}).p2, 176).rem)) /
asType < double > (static\_cast < real > (\$heap_{init}.M2))) == raux2
\rightarrow [expand definition of constant 'M2' at prang.cpp (33,26)]
[63.16] (real((-35 * div(heapIs $heap<sub>funcstart=1032,1</sub>, this.$r.value(heapIs)
\text{Sheap}_{funcstart\_1032,1}.p2, 176).quot) + (172 * div(heapIs \text{Sheap}_{funcstart\_1032,1},
this.r.value(heapIs $heap_{funcstart\_1032,1}).p2, 176).rem)) /
asType < double > (static\_cast < real > ((int)30307))) == raux2
\rightarrow [simplify]
[63.21] \ 0.0 == (-\text{raux}2 + (\text{real}((-35 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1},
this.r.value(heapIs $heap_{funcstart\_1032,1}).p2, 176).quot) + (172 *
div(\mathbf{heapIs} \$ heap_{funcstart\_1032.1}, \mathbf{this.}\$r.\mathbf{value}(\mathbf{heapIs})
heap_{funcstart\_1032.1}.p2, 176).rem)) / 30307.0))
[Take given term]
[64.0] (asType<double>(static_cast<real>(operator*(heapIs
heap_{funcend\_1032.1}, this).p3)) /
asType < double > (static\_cast < real > (\$heap_{funcend\_1032,1}.M3))) == raux3
heap_{funcstart\_1032,1}._replace(this.r \rightarrow this.r.value(heapIs)
heap_{funcstart\_1032,1}._replace(p1 \rightarrow ((-2 * div(heapIs $heap_{funcstart\_1032,1},
this.r.value(heapIs \ \ heap_{funcstart\_1032.1}).p1, 177).quot) + (171 *
div(\mathbf{heapIs} \ \$heap_{funcstart\_1032,1}, \ \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
\theta_{funcstart\_1032,1}.p1, 177).rem)))).\_replace(this.\$r \rightarrow 0
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs) + (-2 * div(heapIs) + (
heap_{funcstart\_1032,1}, this.r.value(heapIs heap_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(\mathbf{heapIs} \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}))
\rho_{funcstart\_1032.1}.p1, 177).rem))._replace(p2 \rightarrow ((-35 * div(heapIs)))._replace(p2 \rightarrow ((-35 * div(heap
heap_{funcstart\_1032.1}, this.r.value(heapIs heap_{funcstart\_1032.1}).p2,
176).quot) + (172 * div(heapIs $heap_{funcstart=1032.1}, this.$r.value(heapIs
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heap_{funcstart\_1032,1}.p2, 176).rem))).\_replace(this.$r \rightarrow
this.r.value(heapIs \ heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
heap_{funcstart\_1032,1}, this.r.value(heapIs heap_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs \$heap_{funcstart\_1032,1}, this.\$r.value(heapIs))
\rho_{funcstart\_1032,1}.p1, 177).rem))).\_replace(p2 \rightarrow ((-35 * div(heapIs))).\_replace(p2 \rightarrow ((-35 * div(heapIs)))).\_replace(p2 \rightarrow ((-35 * div(heapIs)))))
$heap_funcstart_1032,1, this.$r.value(heapIs $heap_funcstart_1032,1).p2,
(176).quot) + (172 * div(heapIs $heap_{funcstart\_1032.1}, this.$r.value(heapIs)
heap_{funcstart\_1032,1}.p2, 176).rem))).\_replace(p3 \rightarrow (-63 * div(heapIs))).
$heap_funcstart_1032,1, this.$r.value(heapIs $heap_funcstart_1032,1).p3,
(178).quot + (170)*div(heapIs heap_{funcstart\_1032,1}, this.r.value(heapIs
heap_{funcstart\_1032,1}.p3, 178).rem)))]
[64.1] (asType<double>(static_cast<real>(operator*(heapIs
\$heap_{funcstart\_1032,1}.\_\textbf{replace}(\textbf{this}.\$r. \bm{\$this}.\$r. \bm{\$r.value}(\textbf{heapIs}
\text{Sheap}_{funcstart\_1032,1}._replace(p1 \rightarrow ((-2 * div(heapIs \text{Sheap}_{funcstart\_1032,1},
this.r.value(heapIs \ensuremath{\$heap}_{funcstart\_1032,1}).p1, 177).quot) + (171)^3
\operatorname{div}(\mathbf{heapIs} \ \text{heap}_{funcstart\_1032,1}, \ \mathbf{this}.\text{sr.value}(\mathbf{heapIs})
\theta_{funcstart\_1032,1}.p1, 177).rem)))).\_replace(this.\$r \rightarrow 0
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
\rho_{uncstart\_1032,1}.p1, 177).rem))._replace(p2 \rightarrow ((-35 * div(heapIs
\$heap_{funcstart\_1032,1},\ \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}\ \$heap_{funcstart\_1032,1}).p2,
176).quot) + (172 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
\theta_{funcstart\_1032,1}.p2, 176).rem)))._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\label{eq:heapIs} $ \text{heap}_{funcstart\_1032,1}, \, \textbf{this}. \\ \$r. \textbf{value}(\textbf{heapIs} \,\, \$ \text{heap}_{funcstart\_1032,1}). \\ \text{p1},
177).quot) + (171 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.} \text{\$r.value}(\text{heapIs}))
\rho_{uncstart\_1032,1}.p1, 177).rem))).\_replace(p2 \rightarrow ((-35 * div(heapIs)))._replace(p2 \rightarrow ((-35 * div(heapIs))))._replace(p3 \rightarrow ((-35 * div(heapIs)))))
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p2,
176).quot) + (172 * div(\mathbf{heapIs} \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}))
\rho_{tuncstart_{-1032.1}}, this.r.value(heapIs \rho_{tuncstart_{-1032.1}}).p3,
178).quot) + (170 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.} \text{\$r.value}(\text{heapIs}))
\theta_{funcstart\_1032,1}.p3, 178).rem))), this).p3)) /
\mathbf{asType} < \mathbf{double} > (\mathbf{static\_cast} < \mathbf{real} > (\$ \operatorname{heap}_{funcend\_1032,1}.\operatorname{M3}))) == \operatorname{raux3}
→ [expand definition of operator '*' in class 'pointer' at built in declaration]
[64.2] (asType<double>(static_cast<real>(this.$r.value(heapIs
\theta_{funcstart\_1032,1}._replace(this.r \to this.r.value(heapIs)
heap_{funcstart\_1032,1}._replace(p1 \rightarrow ((-2 * div(heapIs p_{funcstart\_1032,1}),
this.r.value(heapIs \ensuremath{\$}heap_{funcstart\_1032,1}).p1, 177).quot) + (171 \ensuremath{\$}
div(\mathbf{heapIs} \$ heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
\theta_{funcstart\_1032,1}.p1, 177).rem)))._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
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\rho_{funcstart\_1032,1}.p1, 177).rem))._replace(p2 \rightarrow ((-35 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p2,
176).quot) + (172 * div(heapIs $heap<sub>funcstart_1032,1</sub>, this.$r.value(heapIs
\theta_{funcstart\_1032,1}.p2, 176).rem)))).\_replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs heapIs f_{uncstart_1032,1}, this. r.value(heapIs)
\rho_{funcstart\_1032,1}.p1, 177).rem))._replace(p2 \rightarrow ((-35 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p2,
176).quot) + (172 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.} \text{\$r.value}(\text{heapIs}))
\$heap_{funcstart\_1032,1}).p2,\ 176).rem))).\_\mathbf{replace}(p3 \rightarrow ((-63 * div(\mathbf{heapIs}
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p3,
178).quot) + (170 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.} \text{\$r.value}(\text{heapIs}))
heap_{funcstart\_1032,1}.p3, 178.rem)))).p3)) /
asType < double > (static\_cast < real > ($heap_{funcend\_1032,1}.M3))) == raux3
→ [evaluate dereferenced pointer into modified heap]
[64.3] (asType<double>(static_cast<real>(([this.$r == this.$r]:
\textbf{this.}\$r.\textbf{value}(\textbf{heapIs}~\$\text{heap}_{funcstart\_1032,1}).\_\textbf{replace}(\text{p1} \rightarrow ((-2~*\text{div}(\textbf{heapIs}
\$heap_{funcstart\_1032,1},\, \textbf{this.}\$r.\textbf{value}(\textbf{heapIs}\,\,\$heap_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs $heap<sub>funcstart_1032.1</sub>, this.$r.value(heapIs
\rho_{funcstart\_1032,1}.p1, 177).rem)._replace(p2 \rightarrow ((-35 * div(heapIs
\rho_{funcstart\_1032,1}, this. r.value(heapIs \rho_{funcstart\_1032,1}).p2,
176).quot) + (172 * div(\mathbf{heapIs} \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}))
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p3,
178).quot) + (170 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.}\text{\$r.value}(\text{heapIs}))
\theta_{funcstart\_1032,1}.p3, 178).rem), []: this.$r.value(heapIs)
\theta_{funcstart\_1032,1}._replace(this.r \to this.r.value(heapIs)
heap_{funcstart\_1032,1}._replace(p1 \rightarrow ((-2 * div(heapIs p_{funcstart\_1032,1}),
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177).quot) + (171 *
div(\mathbf{heapIs} \$ heap_{funcstart\_1032.1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
\theta_{funcstart\_1032,1}.p1, 177).rem)))._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs))
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(\mathbf{heapIs} \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}))
\rho_{funcstart\_1032,1}.p1, 177).rem))._replace(p2 \rightarrow (-35 * div(heapIs
\rho_{funcstart\_1032,1}, this. r.value(heapIs \rho_{funcstart\_1032,1}).p2,
176).quot) + (172 * div(\mathbf{heapIs} \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}))
heap_{funcstart_{1032.1}}.p2, 176).rem)))).p3)) /
asType<double>(static_cast<real>($heap_{funcend\_1032.1}.M3))) == raux3
→ [explicitly assert falsehood of skipped guards in subsequent guards]
[64.4] (asType<double>(static_cast<real>(([this.$r == this.$r]:
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs))
```

177).quot) + $(171 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart_1032,1}, \text{this.} \text{\$r.value}(\text{heapIs}))$

```
\rho_{funcstart_1032,1}, this.\r.value(heapIs \rho_{funcstart_1032,1}).p1,
177).quot) + (171 * div(heapIs \theta), this.$r.value(heapIs
\rho_{uncstart\_1032,1}.p1, 177).rem))._replace(p2 \rightarrow ((-35 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p2,
176).quot) + (172 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.}\text{\$r.value}(\text{heapIs}))
\rho_{tuncstart\_1032,1}.p2, 176).rem)._replace(p3 \rightarrow (-63 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p3,
178).quot) + (170 * \text{div}(\text{heapIs } \text{heap}_{funcstart\_1032.1}, \text{this.}\text{\$r.value}(\text{heapIs}))
heap_{funcstart_{1032,1}}.p3, 178).rem), [!(this.$r == this.$r)]:
this.$r.value(heapIs \theta_{funcstart\_1032,1}._replace(this.$r \to
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs heap_{funcstart\_1032,1}, this.r.value(heapIs)
\theta_{funcstart\_1032,1}.p1, 177).rem))))._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs \rho_{funcstart\_1032,1}, this.r.value(heapIs)
\rho_{funcstart\_1032.1}.p1, 177).rem))._replace(p2 \rightarrow (-35 * div(heapIs
\rho_{tuncstart_1032.1}, this.r.value(heapIs \rho_{tuncstart_1032.1}).p2,
176).quot) + (172 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
\theta_{funcstart_{1032,1}}.p2, 176).rem)))).p3)) /
asType < double > (static\_cast < real > (\$heap_{funcend\_1032,1}.M3))) == raux3
\rightarrow [simplify]
\it [64.9] (real
((-63 * div(heapIs $heap_{funcstart\_1032,1}, this.$r.value(heapIs  
\text{Sheap}_{funcstart=1032.1}).p3, 178).quot) + (170 * div(heapIs \text{Sheap}_{funcstart=1032.1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p3, 178).rem)) /
asType < double > (static\_cast < real > (\$heap_{funcend\_1032,1}.M3))) == raux3
$heap_{funcstart\_1032,1}.$_replace(this.$r \rightarrow this.$r.value(heapIs)
heap_{funcstart\_1032,1}._replace(p1 \rightarrow ((-2 * div(heapIs \$heap_{funcstart\_1032,1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177).quot) + (171)
div(\mathbf{heapIs} \ \$heap_{funcstart\_1032,1}, \ \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
\$heap_{funcstart\_1032,1}).p1,\ 177).rem)))).\_\mathbf{replace(this.\$r} \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
$heap_{tuncstart_1032.1}$, this.$r.value(heapIs $heap_{tuncstart_1032.1}).p1,
(177).quot) + (171*div(\mathbf{heapIs} \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}))
\rho_{funcstart\_1032.1}.p1, 177).rem))._replace\rho_{funcstart\_1032.1}.p1, 177).rem))
\$heap_{funcstart\_1032,1},\ \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}\ \$heap_{funcstart\_1032,1}).p2,
(176).quot) + (172 * div(\mathbf{heapIs} \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}))
\$heap_{funcstart\_1032,1}).p2,\ 176).rem)))).\_\mathbf{replace(this}.\$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs)))
heap_{funcstart\_1032,1}, this.r.value(heapIs heap_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(\mathbf{heapIs} \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}))
\rho_{funcstart\_1032,1}.p1, 177).rem))._replace\rho_{funcstart\_1032,1}.p1, 177).rem))
```

```
heap_{funcstart\_1032,1}, this.r.value(heapIs heap_{funcstart\_1032,1}).p2,
176).quot) + (172 * div(\textbf{heapIs } \$heap_{funcstart\_1032,1}, \textbf{this.}\$r.\textbf{value}(\textbf{heapIs}))
heap_{funcstart\_1032,1}.p2, 176).rem))).\_replace(p3 \rightarrow (-63 * div(heapIs))).
heap_{funcstart\_1032,1}, this.r.value(heapIs heap_{funcstart\_1032,1}).p3,
178).quot) + (170 * div(\mathbf{heapIs} \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}))
heap_{funcstart\_1032,1}.p3, 178.rem)))]
[64.10]~(\mathbf{real}((-63~^*\mathrm{div}(\mathbf{heapIs}~\$\mathrm{heap}_{funcstart\_1032,1},~\mathbf{this}.\$\mathrm{r.value}(\mathbf{heapIs}
\rho_{funcstart\_1032,1}.p3, 178).quot + (170 * div(heapIs $heap_{funcstart\_1032,1}), quot) + (170 * div(heapIs $heap_{funcstart\_1032,1}), q
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p3, 178).rem)) /
as Type < double > (static\_cast < real > (\$heap_{funcstart\_1032,1}.\_replace(this.\$r
div(\mathbf{heapIs} \$ heap_{funcstart\_1032.1}, \mathbf{this.}\$ r. \mathbf{value}(\mathbf{heapIs})
\text{Sheap}_{funcstart\_1032.1}.p1, 177).quot) + (171 * div(heapIs \text{Sheap}_{funcstart\_1032.1},
this.$r.value(heapIs $heap_funcstart_1032.1).p1, 177).rem))))._replace(this.$r
\rightarrow this.$r.value(heapIs $heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 *
div(\mathbf{heapIs} \$ heap_{funcstart\_1032.1}, \mathbf{this.}\$r.\mathbf{value}(\mathbf{heapIs})
\text{Sheap}_{funcstart\_1032.1}.p1, 177).quot) + (171 * div(heapIs \text{Sheap}_{funcstart\_1032.1},
this.r.value(heapIs \ensuremath{\$heap}_{funcstart\_1032,1}).p1, 177).rem))).\_replace(p2 \rightarrow
((-35 * div(\mathbf{heapIs} \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}))
\text{Sheap}_{funcstart\_1032,1}.p2, 176).quot) + (172 * div(heapIs \text{Sheap}_{funcstart\_1032,1},
\mathbf{this.\$r.value(heapIs\ \$heap}_{funcstart\_1032,1}).p2,\ 176).rem)))).\_\mathbf{replace(this.\$r}
div(\mathbf{heapIs} \$ heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
\text{Sheap}_{funcstart\_1032.1}.p1, 177).quot) + (171 * div(heapIs \text{Sheap}_{funcstart\_1032.1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177).rem))).\_replace(p2 \rightarrow
((-35 * div(\mathbf{heapIs} \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}))
\text{Sheap}_{funcstart\_1032,1}.p2, 176).quot) + (172 * div(heapIs \text{Sheap}_{funcstart\_1032,1},
this.$r.value(heapIs \rho_{tuncstart\_1032.1}).p2, 176).rem)))._replace(p3 \rightarrow
((-63 * div(heapIs \$heap_{funcstart\_1032.1}, this.\$r.value(heapIs))
\text{Sheap}_{funcstart\_1032,1}.p3, 178).quot) + (170 * div(heapIs \text{Sheap}_{funcstart\_1032,1},
this.r.value(heapIs \heap_{funcstart\_1032,1}).p3, 178).rem)))).M3))) == raux3
\rightarrow [const member of object with modified fields]
[64.13]~(\mathbf{real}((-63~^*\mathrm{div}(\mathbf{heapIs}~\$\mathrm{heap}_{funcstart\_1032,1},~\mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}
\rho_{tuncstart\_1032.1}, p3, 178).quot) + (170 * div(heapIs \rho_{tuncstart\_1032.1},
this.r.value(heapIs \ heap_{funcstart\_1032.1}).p3, 178).rem)) /
asType < double > (static\_cast < real > (\$heap_{funcstart\_1032.1}.M3))) == raux3
\rightarrow [const static or extern object]
[64.14] (real((-63 * div(heapIs $heap<sub>funcstart_1032,1</sub>, this.$r.value(heapIs)
\text{Sheap}_{funcstart\_1032.1}.p3, 178).quot) + (170 * div(heapIs \text{Sheap}_{funcstart\_1032.1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p3, 178).rem)) /
asType<double>(static_cast<real>($heap_{init}.M3))) == raux3
→ [expand definition of constant 'M3' at prang.cpp (38,26)]
[64.15] \ (\mathbf{real}((-63\ ^*\ \mathrm{div}(\mathbf{heapIs}\ \$\mathbf{heap}_{funcstart\_1032,1},\ \mathbf{this}.\$\mathbf{r}.\mathbf{value}(\mathbf{heapIs}\ \mathbf{s})))
```

```
\text{Sheap}_{funcstart\_1032,1}.p3, 178).quot) + (170 * div(heapIs \text{Sheap}_{funcstart\_1032,1},
this.r.value(heapIs $heap_{funcstart\_1032,1}).p3, 178).rem)) /
asType<double>(static_cast<real>((int)30323))) == raux3
\rightarrow [simplify]
[64.20] \ 0.0 == (-\text{raux}3 + (\text{real}((-63 * \text{div}(\text{heapIs }\$\text{heap}_{funcstart\_1032,1},
this.$r.value(heapIs heap_{funcstart_{-1032.1}}).p3, 178).quot) + (170 *
div(\mathbf{heapIs} \$ heap_{funcstart\_1032.1}, \mathbf{this.}\$r.\mathbf{value}(\mathbf{heapIs})
heap_{funcstart\_1032.1}.p3, 178).rem)) / 30323.0))
[Take given term]
[68.0] asType<real>((double)0.0) < ((asType<real>(raux2) +
asType<real>(raux1)) + asType<real>(raux3))
\rightarrow [simplify]
[68.2] 0.0 < ((asType < real > (raux2) + asType < real > (raux1)) +
asType<real>(raux3))
\rightarrow [from term 63.21, raux2 is equal to real((-35 * div(heapIs
$heap_funcstart_1032,1, this.$r.value(heapIs $heap_funcstart_1032,1).p2,
(176).quot) + (172 * div(heapIs $heap_{funcstart\_1032,1}, this.$r.value(heapIs)]
heap_{funcstart\_1032,1}.p2, 176).rem)) / 30307.0]
[68.3] 0.0 < ((asType < real > (real((-35 * div(heapIs $heap_{funcstart\_1032,1}, 
this.r.value(heapIs \heap_{funcstart\_1032,1}).p2, 176).quot) + (172)
div(\mathbf{heapIs} \$ heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
\frac{\text{sheap}_{funcstart\_1032.1}.p2, 176.rem)}{30307.0} + asType < real > (raux1)) +
asType<real>(raux3))
\rightarrow [simplify]
[68.4] \ 0.0 < (((real((-35 * div(heapIs $heap_{funcstart\_1032,1},
this.r.value(heapIs \ensuremath{\$}heap_{funcstart\_1032,1}).p2, 176).quot) + (172 *
{\rm div}(\mathbf{heapIs}~\$\mathrm{heap}_{funcstart\_1032,1},~\mathbf{this}.\$\mathrm{r.value}(\mathbf{heapIs}
\frac{\text{sheap}_{funcstart\_1032.1}.p2, 176).rem}{/ 30307.0} + asType < real > (raux1)) +
asType<real>(raux3))
\rightarrow [from term 62.22, raux1 is equal to real((-2 * div(heapIs
\$heap_{funcstart\_1032,1},\ \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}\ \$heap_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(\mathbf{heapIs} \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}))
heap_{funcstart\_1032.1}.p1, 177).rem)) / 30269.0
[68.5] \ 0.0 < (((real((-35 * div(heapIs $heap_{tuncstart 1032.1},
this.$r.value(heapIs heap_{funcstart\_1032,1}).p2, 176).quot) + (172 *
div(\mathbf{heapIs} \$ heap_{funcstart\_1032.1}, \mathbf{this.}\$r.\mathbf{value}(\mathbf{heapIs})
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_1032,1}, \ \mathbf{this}. \text{\$r.value}(\mathbf{heapIs})
\text{Sheap}_{funcstart\_1032,1}.p1, 177).quot) + (171 * div(heapIs \text{Sheap}_{funcstart\_1032,1},
this.$r.value(heap
Is \rho_{tuncstart\_1032,1}.p1,\ 177).rem)) / 30269.0)) +
asType<real>(raux3))
```

```
\rightarrow [simplify]
[68.6] \ 0.0 < (((real((-35 * div(heapIs $heap_{tuncstart\_1032.1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p2, 176).quot) + (172 *
div(\mathbf{heapIs} \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
heap_{funcstart\_1032,1}.p2, 176).rem) / 30307.0) + (real((-2 * div(heapIs) / 20307.0) + (real((-2 * div(heapIs) / 20307.
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
\frac{\text{sheap}_{funcstart\_1032,1}.p1, 177).rem}{/ 30269.0} + asType < real > (raux3)}
\rightarrow [from term 64.20, raux3 is equal to real((-63 * div(heapIs
$\text{$heap}_{tuncstart=1032.1}$, this.$\text{$r.value(heapIs $$heap}_{tuncstart=1032.1}$).p3,
178).quot) + (170 * div(heapIs $heap_{funcstart\_1032,1}, this.$r.value(heapIs
heap_{funcstart\_1032,1}.p3, 178.rem) / 30323.0
[68.7] \ 0.0 < (((\mathbf{real}((-2 * div(\mathbf{heapIs} \$heap_{funcstart\_1032,1},
this.r.value(heapIs \ensuremath{\$}heap_{funcstart\_1032,1}).p1, 177).quot) + (171 *
div(heapIs $heap<sub>funcstart_1032.1</sub>, this.$r.value(heapIs
\label{eq:funcstart_1032,1} \$ heap_{funcstart\_1032,1}).p1,\ 177).rem))\ /\ 30269.0)\ +\ (\mathbf{real}((-35\ *\ \mathrm{div}(\mathbf{heapIs}
\rho_{funcstart\_1032,1}, this.\r.value(heapIs \rho_{funcstart\_1032,1}).p2,
176).quot) + (172 * div(heapIs $heap<sub>funcstart_1032.1</sub>, this.$r.value(heapIs
\frac{\text{sheap}_{funcstart\_1032,1}.p2, 176).rem}{30307.0} + asType < real > (real((-63)) + asType < real) < real((-63)) + asType < real > (real((-63)) + asType < real) < real((-63)) + asType < real > (real((-63)) + asType < real) < real((-63)) + asType < real > (real((-63)) + asType < real) < real((-63)) + asType < real((-
* \operatorname{div}(\mathbf{heapIs} \ \text{$heap}_{funcstart\_1032,1}, \ \mathbf{this}.\text{$r.value}(\mathbf{heapIs})
\text{Sheap}_{funcstart\_1032,1}.p3, 178).quot) + (170 * div(heapIs \text{Sheap}_{funcstart\_1032,1},
this.$r.value(heapIs heap_{funcstart_{-1032,1}}).p3, 178).rem)) / 30323.0))
\rightarrow [simplify]
[68.9] \ 0.0 < ((real((-63 * div(heapIs $heap_{funcstart\_1032,1},
this.$r.value(heapIs heap_{funcstart\_1032,1}).p3, 178).quot) + (170 *
div(\mathbf{heapIs} \$ heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
\label{eq:funcstart_1032,1} \$ heap_{funcstart\_1032,1}).p3,\, 178).rem)) \,\,/\,\, 30323.0) \,+\, (\mathbf{real}((-2\,\,*\,\, div(\mathbf{heapIs})))) \,\,/\,\, 30323.0)) \,\,+\, (\mathbf{real}((-2\,\,*\,\, div(\mathbf{heapIs})))) \,\,/\,\, 30323.0)) \,\,+\, (\mathbf{real}((-2\,\,*\,\, div(\mathbf{heapIs}))))) \,\,/\,\, 30323.0)) \,\,+\, (\mathbf{real}((-2\,\,*\,\, div(\mathbf{heapIs})))) \,\,/\,\, 30323.0)) \,\,/\,\, 30323.0)
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs \theta_{funcstart\_1032,1}, this.r.value(heapIs)
heap_{funcstart_{-1032,1}}.p1, 177).rem) / 30269.0) + (real((-35 * div(heapIs)) / 30269.0) + (real((-35 * div(heapIs))) / 30269.0) + (real((-35 * div(heapIs)))) / 30269.0) + (real((-35 * div(heapIs))) + (real((-35 * div(heapIs))) + (real((-35 * div(heapIs))) + (real((-35 * div(heapIs))) + (real((-35 
$heap_funcstart_1032,1, this.$r.value(heapIs $heap_funcstart_1032,1).p2,
176).quot) + (172 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.}\text{\$r.value}(\text{heapIs}))
heap_{funcstart_{1032,1}}.p2, 176).rem) / 30307.0)
[Take given term]
[69.0] result == fmod(heapIs heapIs = fmod(heapIs + raux2) + raux3,
(double)1.0)
\rightarrow [from term 61.35, \theta_{1.35,1} is equal to
$heap_{funcstart\_1032,1}.$_replace(this.$r \rightarrow this.$r.value(heapIs)
heap_{funcstart\_1032,1}._replace(p1 \rightarrow ((-2 * div(heapIs $heap_{funcstart\_1032,1},
div(\mathbf{heapIs} \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
\theta_{funcstart\_1032,1}.p1, 177).rem)))._replace(this.r \rightarrow replace(this.
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this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs)))
heap_{funcstart\_1032,1}, this.r.value(heapIs heap_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs heapIs = 1032,1, this.r.value(heapIs)
\rho_{funcstart\_1032,1}.p1, 177).rem))._replace\rho_{funcstart\_1032,1}.p1, 177).rem))._replace
\rho_{tuncstart\_1032,1}, this.r.value(heapIs \rho_{tuncstart\_1032,1}).p2,
176).quot) + (172 * div(\textbf{heapIs } \$heap_{funcstart\_1032,1}, \textbf{this.}\$r.\textbf{value}(\textbf{heapIs}))
heap_{funcstart\_1032,1}.p2, 176).rem)))).replace(this.$r \rightarrow
this.$r.value(heapIs heap_{tuncstart\_1032.1})._replace(p1 \rightarrow ((-2 * div(heapIs
heap_{funcstart\_1032,1}, this.r.value(heapIs heap_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(\mathbf{heapIs} \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}))
heap_{funcstart\_1032,1}.p1, 177).rem))).\_replace(p2 \rightarrow ((-35 * div(heapIs)))._replace(p2 \rightarrow ((-35 * div(heapIs)))))._replace(p2 \rightarrow ((-35 * div(heapIs)))))
heap_{funcstart\_1032,1}, this.r.value(heapIs heap_{funcstart\_1032,1}).p2,
(176).quot) + (172 * div(\mathbf{heapIs} \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}))
heap_{funcstart\_1032,1}.p2, 176).rem))).\_replace(p3 \rightarrow (-63 * div(heapIs))).\_replace(p3 \rightarrow (-63 * div(heapIs))).\_replace(p3 \rightarrow (-63 * div(heapIs))).\_replace(p3 \rightarrow (-63 * div(heapIs)))).\_replace(p3 \rightarrow (-63 * div(heapIs)))).\_replace(p3 \rightarrow (-63 * div(heapIs)))).\_replace(p3 \rightarrow (-63 * div(heapIs))))
heap_{funcstart\_1032,1}, this.r.value(heapIs heap_{funcstart\_1032,1}).p3,
178).quot) + (170 * div(\textbf{heapIs} \$heap_{funcstart\_1032,1}, \textbf{this}.\$r.\textbf{value}(\textbf{heapIs}))
heap_{funcstart\_1032,1}.p3, 178).rem)))]
[69.1] result == fmod(heapIs heap_{funcstart\_1032,1}._replace(this.r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
\theta_{funcstart\_1032,1}.p1, 177).rem)))).replace(this.r \rightarrow 0
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\$heap_{funcstart\_1032,1},\, \textbf{this.}\$r.\textbf{value}(\textbf{heapIs}\,\,\$heap_{funcstart\_1032,1}).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{heap}_{funcstart\_1032,1}, \text{this.}\text{\$r.value}(\text{heapIs}))
\rho_{funcstart\_1032,1}.p1, 177).rem))._replace(p2 \rightarrow ((-35 * div(heapIs
\rho_{funcstart\_1032,1}, this. r.value(heapIs \rho_{funcstart\_1032,1}).p2,
176).quot) + (172 * div(\mathbf{heapIs} \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}))
\theta_{funcstart\_1032.1}.p2, 176).rem)))._replace(this.$r \rightarrow
\textbf{this.}\$r.\textbf{value}(\textbf{heapIs}~\$heap_{funcstart\_1032,1}).\_\textbf{replace}(p1 \rightarrow ((-2~*div(\textbf{heapIs})))))
\rho_{funcstart_1032,1}, this. r.value(heapIs \rho_{funcstart_1032,1}).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.} \text{\$r.value}(\text{heapIs}))
\rho_{funcstart\_1032,1}.p1, 177).rem))._replace(p2 \rightarrow ((-35 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p2,
176).quot) + (172 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
\$heap_{funcstart\_1032,1}).p2,\ 176).rem))).\_\mathbf{replace}(p3 \rightarrow (\text{-}63 * div(\mathbf{heapIs}
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p3,
178).quot) + (170 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
\frac{\text{sheap}_{funcstart_1032,1}.p3, 178.rem)}{\text{rem}}, (raux1 + raux2) + raux3, (double)1.0)
\rightarrow [from term 62.22, raux1 is equal to real((-2 * div(heapIs
heap_{funcstart\_1032.1}, this.r.value(heapIs \ heap_{funcstart\_1032.1}).p1,
177).quot) + (171 * div(\mathbf{heapIs} * \mathbf{heap}_{funcstart\_1032,1}, \mathbf{this}. \$r. \mathbf{value}(\mathbf{heapIs} * \mathbf{heap}_{funcstart\_1032,1}, \mathbf{this}))
heap_{funcstart_{-1032,1}}.p1, 177).rem)) / 30269.0
| 69.2| result == fmod(heap
Is $heap_{funcstart\_1032,1}._replace(this.$r \rightarrow
```

```
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
\theta_{tuncstart\_1032,1}.p1, 177).rem)))).\_replace(this.\$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032.1}, \text{this.} \text{\$r.value}(\text{heapIs}))
\rho_{uncstart\_1032,1}.p1, 177).rem))._replace(p2 \rightarrow ((-35 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p2,
176).quot) + (172 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.}\text{\$r.value}(\text{heapIs}))
\theta_{funcstart\_1032,1}.p2, 176).rem))))._replace(this.$r \rightarrow
this.$r.value(heapIs \rho_{tuncstart\_1032.1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
\rho_{funcstart\_1032,1}.p1, 177).rem))._replace(p2 \rightarrow ((-35 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p2,
176).quot) + (172 * div(\mathbf{heapIs} \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}))
\rho_{funcstart\_1032.1}.p2, 176).rem))._replace(p3 \rightarrow (-63 * div(heapIs
\rho_{tuncstart_1032.1}, this.r.value(heapIs \rho_{tuncstart_1032.1}).p3,
178).quot) + (170 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.}\text{\$r.value}(\text{heapIs}))
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.}\text{\$r.value}(\text{heapIs}))
heap_{funcstart\_1032,1}.p1, 177.rem) / 30269.0) + raux2) + raux3,
(double)1.0)
\rightarrow [from term 63.21, raux2 is equal to real((-35 * div(heapIs
heap_{funcstart\_1032,1}, this.r.value(heapIs heap_{funcstart\_1032,1}).p2,
176).quot) + (172 * div(\mathbf{heapIs} \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}))
heap_{funcstart\_1032,1}.p2, 176).rem)) / 30307.0]
[69.3] result == fmod(heapIs heap_{funcstart\_1032,1}._replace(this.r \rightarrow
\textbf{this.\$r.value}(\textbf{heapIs}~\$ heap_{funcstart\_1032,1}).\_\textbf{replace}(p1 \rightarrow ((-2~*div(\textbf{heapIs})))))
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.} \text{\$r.value}(\text{heapIs}))
\label{eq:continuous_function} $\operatorname{heap}_{funcstart\_1032,1}.p1,\ 177).rem)))).\_\mathbf{replace}(\mathbf{this}.\$r \to
this.$r.value(heapIs p_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(\mathbf{heapIs} \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}))
\theta_{funcstart\_1032,1}.p1, 177).rem))._replace(p2 \rightarrow ((-35 * div(heapIs
\$heap_{funcstart\_1032,1},\, \textbf{this.}\$r.\textbf{value}(\textbf{heapIs}\,\,\$heap_{funcstart\_1032,1}).p2,
176).quot) + (172 * div(heapIs $heap<sub>funcstart_1032.1</sub>, this.$r.value(heapIs
\theta_{funcstart\_1032,1}.p2, 176).rem)))).\_replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs $heap<sub>funcstart_1032.1</sub>, this.$r.value(heapIs
\rho_{funcstart\_1032,1}.p1, 177).rem)._replace\rho_{funcstart\_1032,1}.p1, 177).rem)._replace
```

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\rho_{tuncstart=1032.1}, this.r.value(heapIs \rho_{tuncstart=1032.1}).p2,
176).quot) + (172 * div(heapIs \theta), this.$r.value(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p3,
178).quot) + (170 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.}\text{\$r.value}(\text{heapIs}))
\theta_{funcstart\_1032,1}.p3, 178).rem))), ((real((-2 * div(heapIs)
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs heapIs f_{uncstart_1032,1}, this. r.value(heapIs)
heap_{funcstart_{-1032,1}}.p1, 177).rem) / 30269.0) + (real((-35 * div(heapIs)) / 30269.0) + (real((-35 * div(heapIs))) / 30269.0) + (real((-35 * div(heapIs)))) / 30269.0) + (real((-35 * div(heapIs))) + (real((-35 * div(heapIs))) + (real((-35 * div(heapIs))) + 
\label{eq:heapIs} \$ heap_{funcstart\_1032,1}, \ \mathbf{this}.\$ r. \mathbf{value} (\mathbf{heapIs} \ \$ heap_{funcstart\_1032,1}). p2,
176).quot) + (172 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.} \text{\$r.value}(\text{heapIs}))
\frac{\text{sheap}_{funcstart\_1032,1}.p2, 176).rem}{\text{rem}} / \frac{30307.0}{\text{rem}} + \frac{1}{1000} + \frac{1}{1
\rightarrow [from term 64.20, raux3 is equal to real((-63 * div(heapIs
heap_{funcstart\_1032,1}, this.r.value(heapIs heap_{funcstart\_1032,1}).p3,
178).quot) + (170 * div(heapIs $heap_{funcstart\_1032,1}, this.$r.value(heapIs
heap_{funcstart\_1032,1}.p3, 178).rem)) / 30323.0]
[69.4] result == fmod(heapIs \rho_{funcstart\_1032,1}._replace(this.$r \rightarrow
\textbf{this.}\$r.\textbf{value}(\textbf{heapIs}~\$heap_{funcstart\_1032,1}).\_\textbf{replace}(p1 \rightarrow ((\text{-}2~*\text{div}(\textbf{heapIs}
$\text{heap}_{funcstart_1032.1}$, this.$\text{r.value}(\text{heapIs} \text{$heap}_{funcstart_1032.1}).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.} \text{\$r.value}(\text{heapIs}))
\theta_{tuncstart\_1032.1}.p1, 177).rem)))._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.\r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.} \text{\$r.value}(\text{heapIs}))
\rho_{uncstart_1032,1}.p1, 177).rem))._replace(p2 \rightarrow ((-35 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p2,
176).quot) + (172 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
\theta_{funcstart\_1032,1}.p2, 176).rem)))).\_replace(this.\$r \rightarrow 0
this.$r.value(heapIs heap_{funcstart\ 1032.1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs \theta_{funcstart\_1032,1}, this.r.value(heapIs)
\rho_{uncstart\_1032,1}.p1, 177).rem))._replace(p2 \rightarrow ((-35 * div(heapIs
\rho_{funcstart_1032,1}, this.r.value(heapIs \rho_{funcstart_1032,1}).p2,
176).quot) + (172 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.}\text{\$r.value}(\text{heapIs}))
\rho_{funcstart\_1032,1}.p2, 176).rem)._replace(p3 \rightarrow (-63 * div(heapIs
\rho_{funcstart\_1032,1}, this. r.value(heapIs \rho_{funcstart\_1032,1}).p3,
178).quot) + (170 * \text{div}(\text{heapIs } \text{heap}_{funcstart\_1032.1}, \text{this.}\text{$\text{r.value}(\text{heapIs})$})
\theta_{funcstart\_1032,1}.p3, 178).rem))), ((real((-35 * div(heapIs)))))
\$heap_{funcstart\_1032,1},\, \textbf{this.}\$r.\textbf{value}(\textbf{heapIs}\,\,\$heap_{funcstart\_1032,1}).p2,
176).quot) + (172 * div(heapIs $heap<sub>funcstart_1032.1</sub>, this.$r.value(heapIs
\theta_{funcstart\_1032,1}.p2, 176).rem / 30307.0) + (real((-2 * div(heapIs)) / 30307.0)
\$heap_{funcstart\_1032,1},\, \textbf{this.} \$r. \textbf{value} (\textbf{heapIs} \,\,\$heap_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
\text{Sheap}_{funcstart_1032.1}.\text{p1}, 177).\text{rem}) / 30269.0)) + (\text{real}((-63 * div(\text{heapIs})))) + (\text{real}((-63 * div(\text{heapIs})))))
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p3,
```

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178).quot) + (170 * \text{div}(\text{heapIs } \text{heap}_{funcstart\_1032,1}, \text{this.} \text{$r.value}(\text{heapIs}))
heap_{funcstart\_1032,1}.p3, 178).rem) / 30323.0), (double)1.0)
\rightarrow [simplify]
[69.7] \ 0.0 == (-\text{fmod}(\text{heapIs} \$\text{heap}_{funcstart\_1032,1}.\text{-replace}(\text{this.}\$\text{r} \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{tuncstart_{-1032.1}}, this.r.value(heapIs \rho_{tuncstart_{-1032.1}}).p1,
177).quot) + (171 * div(heapIs $heap<sub>funcstart_1032,1</sub>, this.$r.value(heapIs
\theta_{funcstart\_1032,1}.p1, 177).rem))))._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.} \text{\$r.value}(\text{heapIs}))
\$heap_{funcstart\_1032,1}).p1,\ 177).rem))).\_replace(p2 \rightarrow ((-35 * div(\textbf{heapIs}) + (-35 * div(\textbf{heapI
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p2,
176).quot) + (172 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
\theta_{funcstart\_1032,1}.p2, 176).rem)))).replace(this.r \rightarrow 0
this.$r.value(heapIs \theta_{funcstart=1032,1})._replace(p1 \theta ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.} \text{\$r.value}(\text{heapIs}))
\rho_{funcstart\_1032,1}.p1, 177).rem))._replace(p2 \rightarrow ((-35 * div(heapIs
\theta_{funcstart\_1032,1}, this.r.value(\theta_{funcstart\_1032,1}).p2,
176).quot) + (172 * div(heapIs $heap<sub>funcstart_1032.1</sub>, this.$r.value(heapIs
\rho_{funcstart\_1032,1}, this.\r.value(heapIs \rho_{funcstart\_1032,1}).p3,
178).quot) + (170 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.}\text{\$r.value}(\text{heapIs}))
\text{heap}_{funcstart=1032.1}.p3, 178).rem))), (real((-63 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p3,
178).quot) + (170 * \text{div}(\text{heapIs} \$\text{heap}_{funcstart\_1032,1}, \text{this.}\$\text{r.value}(\text{heapIs}))
heap_{funcstart\_1032,1}.p3, 178).rem) / 30323.0) + (real((-35 * div(heapIs)) / 30323.0) + (real((-35 * div(heapIs))) / 30323
$heap_tuncstart_1032.1, this.$r.value(heapIs $heap_tuncstart_1032.1).p2,
176).quot) + (172 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.}\text{\$r.value}(\text{heapIs}))
\rho_{tuncstart\_1032,1}.p2, 176).rem / 30307.0) + (real((-2 * div(heapIs)) / 30307.0)
$heap_funcstart_1032,1, this.$r.value(heapIs $heap_funcstart_1032,1).p1,
177).quot) + (171 * div(\mathbf{heapIs} \ \$heap_{funcstart\_1032,1}, \ \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
heap_{funcstart_1032,1}.p1, 177).rem) / 30269.0, 1.0) + result
[Assume known post-assertion, class invariant or type constraint for term 69.7]
[72.0] ((asType<real>((double)0.0) \leq asType<real>((real((-63 *
div(\mathbf{heapIs} \$ heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
\text{Sheap}_{funcstart\_1032,1}.p3, 178).quot) + (170 * div(heapIs \text{Sheap}_{funcstart\_1032,1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p3, 178).rem)) / 30323.0) +
(\mathbf{real}((-35 * \operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_1032,1}, \, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs} + \mathbf{heap}_{funcstart\_1032,1}, \, \mathbf{this}))
\text{Sheap}_{funcstart\_1032.1}.p2, 176).quot) + (172 * div(heapIs \text{Sheap}_{funcstart\_1032.1},
this.$r.value(heapIs heap_{funcstart\_1032,1}).p2, 176).rem)) / 30307.0) +
(real((-2 * div(heapIs $heap_{tuncstart\_1032.1}, this.$r.value(heapIs
\text{Sheap}_{funcstart\_1032.1}.p1, 177).quot) + (171 * div(heapIs \text{Sheap}_{funcstart\_1032.1},
```

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this.$r.value(heapIs heap_{funcstart_{-1032,1}}).p1, 177).rem)) / 30269.0))) &&
(asType < real > ((double)0.0) \le asType < real > (1.0))) = >
((asType < real > ((double)0.0) \le asType < real > (fmod(heapIs)))
\$heap_{funcstart\_1032,1}.\_\textbf{replace}(\textbf{this}.\$\textbf{r} \rightarrow \textbf{this}.\$\textbf{r}.\textbf{value}(\textbf{heapIs}
\text{Sheap}_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs \text{Sheap}_{funcstart\_1032,1},
this.r.value(heapIs $heap_{funcstart\_1032,1}).p1, 177).quot) + (171)
div(\mathbf{heapIs} \$heap_{funcstart\_1032.1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
\theta_{funcstart_1032.1},p1, 177).rem))))._replace(this.r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\theta_{funcstart_{1032,1}}, this.r.value(\theta_{funcstart_{1032,1}}).p1,
177).quot) + (171 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
\$heap_{funcstart\_1032,1}).p1,\ 177).rem))).\_\mathbf{replace}(p2 \to ((-35\ *\ div(\mathbf{heapIs}
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p2,
176).quot) + (172 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
\theta_{funcstart\_1032,1}.p2, 176).rem))))._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{uncstart\_1032,1}, this.r.value(heapIs \rho_{uncstart\_1032,1}).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.} \text{\$r.value}(\text{heapIs}))
\rho_{funcstart\_1032.1}.p1, 177).rem))._replace(p2 \rightarrow ((-35 * div(heapIs
$\text{heap}_{funcstart=1032.1}$, this.$\text{r.value}(\text{heapIs} \text{$heap}_{funcstart=1032.1}).p2,
176).quot) + (172 * div(heapIs $heap<sub>funcstart_1032,1</sub>, this.$r.value(heapIs
\rho_{funcstart\_1032,1}.p2, 176).rem))._replace(p3 \rightarrow (-63 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p3,
178).quot) + (170 * \text{div}(\text{heapIs } \text{heap}_{funcstart\_1032,1}, \text{this.} \text{$r.value}(\text{heapIs}))
\theta_{funcstart\_1032,1}.p3, 178).rem))), (real((-63 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p3,
178).quot) + (170 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.} \text{\$r.value}(\text{heapIs}))
\text{Sheap}_{funcstart\_1032,1}.p3, 178).rem)) / 30323.0) + (real((-35 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p2,
176).quot) + (172 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.} \text{\$r.value}(\text{heapIs}))
\text{heap}_{funcstart\_1032.1}.p2, 176).rem)) / 30307.0) + (real((-2 * div(heapIs)
\theta_{funcstart\_1032,1}, this.r.value(heapIs \theta_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(\mathbf{heapIs} \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}))
heap_{funcstart_{1032,1}}.p1, 177).rem) / 30269.0, 1.0)) &&
(asType < real > (fmod(heapIs \$heap_{funcstart\_1032.1}.\_replace(this.\$r \rightarrow funcstart\_1032.1))
this.$r.value(heapIs heapIs = funcstart_{1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this. r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
\theta_{tuncstart 1032.1}, p1, 177).rem))))._replace(this.r \rightarrow \theta_{tuncstart 1032.1}
this.$r.value(heapIs heap_{tuncstart = 1032.1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs $heap<sub>funcstart_1032,1</sub>, this.$r.value(heapIs
\rho_{uncstart\_1032,1}.p1, 177).rem))._replace(p2 \rightarrow ((-35 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p2,
176).quot) + (172 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
\theta_{funcstart\_1032,1}.p2, 176).rem)))).\_replace(this.$r \rightarrow
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this.$r.value(heapIs \rho_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{uncstart\_1032,1}, this.r.value(heapIs \rho_{uncstart\_1032,1}).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.}\text{\$r.value}(\text{heapIs}))
\rho_{funcstart\_1032,1}.p1, 177).rem))._replace(p2 \rightarrow ((-35 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p2,
176).quot) + (172 * div(heapIs $heap<sub>funcstart_1032,1</sub>, this.$r.value(heapIs
\rho_{tuncstart_{-1032,1}}, this. r.value(heapIs \rho_{tuncstart_{-1032,1}}).p3,
178).quot) + (170 * \text{div}(\text{heapIs } \text{heap}_{funcstart\_1032,1}, \text{this.} \text{$r.value}(\text{heapIs}))
heap_{funcstart_{-1032,1}}.p3, 178).rem)), (real((-63 * div(heapIs))))
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p3,
178).quot) + (170^{\circ} * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.} \text{\$r.value}(\text{heapIs}))
\rho_{funcstart\_1032,1}.p3, 178.rem) / 30323.0) + (real((-35 * div(heapIs)) / 30323.0) + (real((-35 * div(heapIs))) / 30323.0) 
\rho_{uncstart\_1032,1}, this.r.value(heapIs \rho_{uncstart\_1032,1}).p2,
176).quot) + (172 * div(\mathbf{heapIs} \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}))
\rho_{uncstart\_1032,1}.p2, 176).rem) / 30307.0) + (real((-2 * div(heapIs)) / 30307.0) + (real((-2 * div(heapI
\rho_{tuncstart_{1032.1}}, this. r.value(heapIs \rho_{tuncstart_{1032.1}}).p1,
177).quot) + (171 * div(\mathbf{heapIs} \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}))
\frac{\text{sheap}_{funcstart\_1032,1}.p1, 177).rem}{0.269.0}, \frac{1.0}{0.269.0}, \frac{1.0}{0.0} < asType < real > (1.0)}{0.00}
\rightarrow [simplify]
[72.3] ((0.0 \leq ((real((-63 * div(heapIs $heap_{funcstart\_1032,1},
this.r.value(heapIs \ensuremath{\$}heap_{funcstart\_1032,1}).p3, 178).quot) + (170 *
div(\mathbf{heapIs} \$ heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
\text{heap}_{funcstart\_1032,1}.p3, 178).rem)) / 30323.0) + (real((-35 * div(heapIs
$heap_funcstart_1032.1, this.$r.value(heapIs $heap_funcstart_1032.1).p2,
(176).\text{quot} + (172 * \text{div}(\text{heapIs } \text{heap}_{funcstart\_1032,1}, \text{this.}\text{$r.value}(\text{heapIs}))
\text{heap}_{funcstart\_1032,1}.\text{p2}, 176).\text{rem})) / 30307.0) + (\text{real}((-2 * \text{div}(\text{heapIs}))) / 30307.0)) + (\text{real}((-2 * \text{div}(\text{heapIs})))))
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
\theta_{funcstart_{1032,1}}.p1, 177).rem)) / 30269.0))) &&
(\mathbf{asType} {<} \mathbf{real} {>} ((\mathbf{double})0.0) \leq \mathbf{asType} {<} \mathbf{real} {>} (1.0))) = >
((asType < real > ((double)0.0) \le asType < real > (fmod(heapIs)))
\rho_{tuncstart\_1032,1}._replace(this.r \to this.r.value(heapIs)
\text{Sheap}_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs \text{Sheap}_{funcstart\_1032,1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177).quot) + (171)
div(\mathbf{heapIs} \$ heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
\theta_{funcstart\_1032,1}.p1, 177).rem)))._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this. r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs $heap<sub>funcstart_1032.1</sub>, this.$r.value(heapIs
\rho_{uncstart\_1032,1}.p1, 177).rem))._replace(p2 \rightarrow ((-35 * div(heapIs
\$heap_{funcstart\_1032,1},\, \textbf{this.} \$r. \textbf{value} (\textbf{heapIs} \,\,\$heap_{funcstart\_1032,1}).p2,
176).quot) + (172 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
\theta_{funcstart=1032,1}.p2, 176).rem)))._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart = 1032.1})._replace(p1 \rightarrow ((-2 * div(heapIs
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\rho_{funcstart=1032,1}, this.r.value(heapIs \rho_{funcstart=1032,1}).p1,
177).quot) + (171 * div(heapIs \theta_{funcstart\_1032,1}, this.r.value(heapIs)
\rho_{uncstart\_1032,1}.p1, 177).rem))._replace(p2 \rightarrow ((-35 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p2,
176).quot) + (172 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.}\text{\$r.value}(\text{heapIs}))
\rho_{funcstart\_1032,1}.p2, 176).rem))).\_replace(p3 \rightarrow (-63 * div(heapIs))).
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p3,
178).quot) + (170 * \text{div}(\text{heapIs } \text{heap}_{funcstart\_1032.1}, \text{this.}\text{\$r.value}(\text{heapIs}))
heap_{funcstart_{1032,1}}.p3, 178.rem)), (real((-63 * div(heapIs))))
\rho_{funcstart_1032,1}, this. r.value(heapIs \rho_{funcstart_1032,1}).p3,
178).quot) + (170 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.} \text{\$r.value}(\text{heapIs}))
\frac{1}{30323.0} + \frac{1}{10323.1} \cdot \frac{1}{10323.1} \cdot \frac{1}{10323.1} \cdot \frac{1}{10323.0} + \frac{1}{10323.0} \cdot \frac{1}{10323.0} \cdot \frac{1}{10323.1} \cdot \frac{1}{10323.1
\rho_{funcstart\_1032,1}, this. r.value(heapIs \rho_{funcstart\_1032,1}).p2,
176).quot) + (172 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
heap_{funcstart\_1032,1}.p2, 176).rem) / 30307.0) + (real((-2 * div(heapIs)) / 30307.0) + (real((-2 * div(heapIs))) / 30307.0) + (real
\rho_{funcstart\_1032.1}, this.r.value(heapIs \rho_{funcstart\_1032.1}).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.} \text{\$r.value}(\text{heapIs}))
heap_{funcstart_{1032,1}}.p1, 177).rem) / 30269.0, 1.0)) &&
(asType < real > (fmod(heapIs \$heap_{funcstart\_1032.1}.\_replace(this.\$r \rightarrow funcstart\_1032.1))
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(\mathbf{heapIs} \ \$heap_{funcstart\_1032,1}, \ \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
\theta_{funcstart\_1032,1}.p1, 177).rem)))).\_replace(this.$r \rightarrow
this.$r.value(heapIs \rho_{uncstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs)
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
\rho_{uncstart\_1032,1}.p1, 177).rem))).\_replace(p2 \rightarrow ((-35 * div(heapIs)))._replace(p2 \rightarrow ((-35 * div(heapIs))))._replace(p3 + div(heapIs)))
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p2,
176).quot) + (172 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
\theta_{funcstart\_1032,1}.p2, 176).rem)))).replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs))
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(\mathbf{heapIs} \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}))
\rho_{tuncstart\_1032.1}, this.r.value(heapIs \rho_{tuncstart\_1032.1}).p2,
176).quot) + (172 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.} \text{\$r.value}(\text{heapIs}))
$heap_funcstart_1032.1, this.$r.value(heapIs $heap_funcstart_1032.1).p3,
178).quot) + (170 * div(heapIs $heap<sub>funcstart 1032.1</sub>, this.$r.value(heapIs
heap_{funcstart\_1032,1}.p3, 178.rem)), (real((-63 * div(heapIs))))
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p3,
178).quot) + (170 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
heap_{funcstart_1032,1}.p3, 178).rem) / 30323.0) + (real((-35 * div(heapIs)) / 30323.0) + (real((-35 * div(heapIs))) / 30323
\rho_{funcstart\_1032,1}, this. r.value(heapIs \rho_{funcstart\_1032,1}).p2,
176).quot) + (172 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
\rho_{tuncstart\_1032,1}.p2, 176).rem / 30307.0) + (real((-2 * div(heapIs)) / 30307.0) + (real((-2 * div(heapIs))) / 30307.0)
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\rho_{funcstart_{-1032,1}}, this. r.value(heapIs \rho_{funcstart_{-1032,1}}).p1,
177).quot) + (171 * div(heapIs \theta_{funcstart\_1032,1}, this.r.value(heapIs)
\text{Sheap}_{funcstart\_1032,1}.\text{p1}, 177).\text{rem})) / 30269.0), 1.0)) < asType < real > (1.0)))
\rightarrow [from term 68.9, literala \leq ((real((-63 * div(heapIs $heap_{funcstart\_1032,1},
this.r.value(heapIs \ heap_{funcstart\_1032.1}).p3, 178).quot) + (170 *
div(\mathbf{heapIs} \ \$heap_{funcstart\_1032,1}, \ \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
heap_{funcstart\_1032,1}.p3, 178).rem) / 30323.0) + (real((-2 * div(heapIs) + (real((-2 * div(h
heap_{funcstart\_1032,1}, this.r.value(heapIs heap_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(\mathbf{heapIs} * heap_{funcstart\_1032,1}, \mathbf{this}. * r.value(\mathbf{heapIs} 
heap_{funcstart\_1032,1}.p1, 177).rem) / 30269.0) + (real((-35 * div(heapIs)) / 30269.0) + (real((-35 * div(heapIs))) / 30269.0) + (real((-35 * div(heapIs)))) / 30269.0) + (real((-35 * div(heapIs))) + (real((
heap_{funcstart\_1032,1}, this.r.value(heapIs heap_{funcstart\_1032,1}).p2,
(176).quot) + (172 * div(\textbf{heapIs} \$heap_{funcstart\_1032,1}, \textbf{this}.\$r.\textbf{value}(\textbf{heapIs}))
heap_{funcstart\_1032,1}.p2, 176).rem) / 30307.0) is true whenever literala \leq
        Proof of rule precondition:
        [72.3.0] \ 0.0 < 0.0
        \rightarrow [simplify]
        [72.3.1] true
[72.4] (true && (asType<real>((double)0.0) \leq asType<real>(1.0))) =>
((asType < real > ((double)0.0) \le asType < real > (fmod(heapIs)))
\theta_{uncstart\ 1032,1}._replace(this.r \to this.r.value(heapIs)
\rho_{tuncstart\_1032.1}._replace(p1 \rightarrow ((-2 * div(heapIs \rho_{tuncstart\_1032.1})
this.r.value(heapIs \ heap_{funcstart\_1032.1}).p1, 177).quot) + (171)
div(\mathbf{heapIs} \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
\theta_{funcstart\_1032,1}.p1, 177).rem)))._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, his.\r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.} \text{\$r.value}(\text{heapIs}))
\rho_{funcstart\_1032,1}.p1, 177).rem))._replace(p2 \rightarrow ((-35 * div(heapIs
\rho_{funcstart\_1032,1}, this.\r.value(heapIs \rho_{funcstart\_1032,1}).p2,
176).quot) + (172 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
\theta_{tuncstart\_1032.1}.p2, 176).rem)))._replace(this.$r \rightarrow
\textbf{this.}\$r.\textbf{value}(\textbf{heapIs}~\$heap_{funcstart\_1032,1}).\_\textbf{replace}(p1 \rightarrow ((-2~*div(\textbf{heapIs})))))
\rho_{funcstart\_1032,1}, this.\r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
\rho_{funcstart\_1032,1}.p1, 177).rem)._replace\rho_{funcstart\_1032,1}.p1, 177).rem)._replace
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p2,
176).quot) + (172 * div(heapIs \rho_{funcstart\_1032,1}, this.r.value(heapIs)
\rho_{funcstart\_1032,1}.p2, 176).rem))).\_replace(p3 \rightarrow (-63 * div(heapIs))).
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p3,
178).quot) + (170 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032.1}, \text{this.} \text{\$r.value}(\text{heapIs}))
```

 $heap_{funcstart_1032,1}.p3, 178).rem)), (real((-63 * div(heapIs heap_{funcstart_1032,1}, this.$r.value(heapIs heap_{funcstart_1032,1}).p3,$

```
178).quot) + (170 * div(heapIs $heap_{funcstart\_1032,1}, this.$r.value(heapIs)
\rho_{funcstart\_1032,1}.p3, 178).rem / 30323.0) + (real((-35 * div(heapIs)))
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p2,
176).quot) + (172 * div(heapIs $heap<sub>funcstart_1032,1</sub>, this.$r.value(heapIs
\rho_{uncstart\_1032,1}.p2, 176).rem) / 30307.0) + (real((-2 * div(heapIs)) / 30307.0) + (real((-2 * div(heapI
$heap_funcstart_1032,1, this.$r.value(heapIs $heap_funcstart_1032,1).p1,
177).quot) + (171 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
$heap_tuncstart_1032.1).p1, 177).rem)) / 30269.0), 1.0))) &&
(asType < real > (fmod(heapIs \$heap_{funcstart\_1032,1}.\_replace(this.\$r \rightarrow funcstart\_1032,1}))
\textbf{this.\$r.value}(\textbf{heapIs}~\$ heap_{funcstart\_1032,1}).\_\textbf{replace}(p1 \rightarrow ((-2~*div(\textbf{heapIs})))))
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.} \text{\$r.value}(\text{heapIs}))
\label{eq:heap_funcstart_1032,1} $$ \text{heap}_{funcstart_1032,1}.\text{p1},\ 177).\text{rem})))).$$ \ref{eq:heap_funcstart_1032,1}.\text{p2},\ 177).\text{rem}))))$
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.} \text{\$r.value}(\text{heapIs}))
\rho_{funcstart\_1032,1}.p1, 177).rem))._replace(p2 \rightarrow ((-35 * div(heapIs
\label{eq:heapIs} $  heap_{funcstart\_1032,1}, \ \mathbf{this}. \$r. \mathbf{value} (\mathbf{heapIs} \ \$heap_{funcstart\_1032,1}).p2, \\
176).quot) + (172 * div(heapIs $heap<sub>funcstart_1032.1</sub>, this.$r.value(heapIs
\theta_{funcstart\_1032,1}.p2, 176).rem))))._replace(this.$r \rightarrow
this.$r.value(heapIs \frac{1}{2} heap\frac{1}{2} heap\frac{1}{2}
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.} \text{\$r.value}(\text{heapIs}))
\theta_{funcstart\_1032,1}.p1, 177).rem))._replace(p2 \rightarrow ((-35 * div(heapIs
\rho_{funcstart\_1032,1}, this. r.value(heapIs \rho_{funcstart\_1032,1}).p2,
176).quot) + (172 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p3,
178).quot) + (170 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
heap_{funcstart\_1032,1}.p3, 178).rem)), (real((-63 * div(heapIs))))
\rho_{tuncstart\_1032.1}, this.r.value(heapIs \rho_{tuncstart\_1032.1}).p3,
178).quot) + (170 * \text{div}(\text{heapIs } \text{heap}_{funcstart\_1032,1}, \text{this.} \text{$r.value}(\text{heapIs}))
heap_{funcstart\_1032,1}.p3, 178).rem) / 30323.0) + (real((-35 * div(heapIs)) / 30323.0) + (real((-35 * div(heapIs))) / 30323
\rho_{funcstart\_1032,1}, this. r.value(heapIs \rho_{funcstart\_1032,1}).p2,
176).quot) + (172 * \text{div}(\text{heapIs } \text{heap}_{funcstart\_1032,1}, \text{this.} \text{$r.value}(\text{heapIs}))
\rho_{uncstart\_1032,1}.p2, 176).rem) / 30307.0) + (real((-2 * div(heapIs)) / 30307.0) + (real((-2 * div(heapI
\rho_{funcstart\_1032,1}, this. r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs $heap<sub>funcstart_1032.1</sub>, this.$r.value(heapIs
\text{Sheap}_{funcstart\_1032,1}.\text{p1}, 177).\text{rem})) / 30269.0), 1.0)) < asType < real > (1.0)))
\rightarrow [simplify]
[72.21] (-1.0 < -\text{fmod}(\mathbf{heapIs} \ \text{$heap}_{funcstart\_1032,1}.\_\mathbf{replace}(\mathbf{this}.\$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs $heap<sub>funcstart_1032.1</sub>, this.$r.value(heapIs
\theta_{funcstart\_1032,1}.p1, 177).rem)))._replace(this.$r \rightarrow
```

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this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{tuncstart\_1032,1}, this.r.value(heapIs \rho_{tuncstart\_1032,1}).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.}\text{\$r.value}(\text{heapIs}))
\rho_{funcstart\_1032,1}.p1, 177).rem))._replace(p2 \rightarrow ((-35 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p2,
176).quot) + (172 * div(heapIs $heap<sub>funcstart_1032,1</sub>, this.$r.value(heapIs
\theta_{funcstart\_1032,1}.p2, 176).rem)))).replace(this.$r \rightarrow
this.$r.value(heapIs \rho_{tuncstart\_1032.1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
\rho_{uncstart\_1032,1}.p1, 177).rem))).\_replace(p2 \rightarrow ((-35 * div(heapIs)))._replace(p2 \rightarrow ((-35 * div(heapIs))))._replace(p3 + div(heapIs)))
\rho_{tuncstart\_1032.1}, this.r.value(heapIs \rho_{tuncstart\_1032.1}).p2,
176).quot) + (172 * div(heapIs heapI_{uncstart\_1032,1}, this.r.value(heapIs)
\rho_{funcstart\_1032,1}, this.\r.value(heapIs \rho_{funcstart\_1032,1}).p3,
178).quot) + (170 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.}\text{\$r.value}(\text{heapIs}))
heap_{funcstart\_1032,1}.p3, 178).rem)), (real((-63 * div(heapIs))))
\label{eq:heapIs} $ heap_{funcstart\_1032,1}, \, \mathbf{this.} \$r. \mathbf{value} (\mathbf{heapIs} \, \$ heap_{funcstart\_1032,1}).p3, \\
178).quot) + (170^{\circ} * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.} \text{\$r.value}(\text{heapIs}))
\frac{1}{30323.0} + \frac{1}{10323.0} + \frac{1}{10323.0
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p2,
176).quot) + (172 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.}\text{\$r.value}(\text{heapIs}))
\rho_{funcstart\_1032,1}.p2, 176).rem / 30307.0) + (real((-2 * div(heapIs)) / 30307.0)
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.}\text{\$r.value}(\text{heapIs}))
\text{Sheap}_{funcstart\_1032,1}.\text{p1}, 177).\text{rem})) / 30269.0), 1.0)) \land (0.0 \le \text{fmod}(\textbf{heapIs})
\$heap_{funcstart\_1032,1}.\_\textbf{replace}(\textbf{this}.\$r \rightarrow \textbf{this}.\$r.\textbf{value}(\textbf{heapIs}
horizontal properties (1.5) = 1.5 horizontal properties (1.5) 
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177).quot) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_1032,1}, \ \mathbf{this}. \text{\$r.value}(\mathbf{heapIs})
\theta_{tuncstart\_1032.1}.p1, 177).rem)))).\_replace(this.\$r \rightarrow
\textbf{this.\$r.value}(\textbf{heapIs}~\$ heap_{funcstart\_1032,1}).\_\textbf{replace}(p1 \rightarrow ((-2 * div(\textbf{heapIs}) + (-2 * div(\textbf{heapI
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
\rho_{funcstart\_1032,1}.p1, 177).rem))._replace(p2 \rightarrow ((-35 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p2,
176).quot) + (172 * div(\mathbf{heapIs} \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}))
\theta_{funcstart\_1032,1}.p2, 176).rem)))._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{tuncstart = 1032.1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.}\text{\$r.value}(\text{heapIs}))
\rho_{uncstart\_1032,1}.p1, 177).rem))._replace(p2 \rightarrow ((-35 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p2,
176).quot) + (172 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.}\text{\$r.value}(\text{heapIs}))
\rho_{funcstart\_1032,1}.p2, 176).rem))._replace(p3 \rightarrow (-63 * div(heapIs
\rho_{tuncstart\_1032,1}, this.r.value(heapIs \rho_{tuncstart\_1032,1}).p3,
```

```
heap_{funcstart\_1032,1}, p3, 178).rem))), (real((-63 * div(heapIs))))
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p3,
178).quot) + (170 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.} \text{\$r.value}(\text{heapIs}))
heap_{funcstart\_1032,1}.p3, 178).rem) / 30323.0) + (real((-35 * div(heapIs)) / 30323.0) + (real((-35 * div(heapIs))) / 30323
$heap_funcstart_1032,1, this.$r.value(heapIs $heap_funcstart_1032,1).p2,
176).quot) + (172 * div(heapIs $heap<sub>funcstart_1032,1</sub>, this.$r.value(heapIs
heap_{funcstart\_1032,1}.p2, 176).rem) / 30307.0) + (real((-2 * div(heapIs)) / 30307.0) + (real((-2 * div(heapIs))) + (real((-2 * div(heapIs))) + (real((-2 * div(heapIs))) +
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs $heap<sub>funcstart_1032,1</sub>, this.$r.value(heapIs
heap_{funcstart\_1032,1}.p1, 177).rem) / 30269.0, 1.0)
\rightarrow [separate conjunction and work on first sub-term]
[72.22] -1.0 < -\text{fmod}(\mathbf{heapIs} \ \text{sheap}_{funcstart\_1032,1}.\_\mathbf{replace}(\mathbf{this}.\text{sr} \rightarrow
this.$r.value(heapIs \frac{1}{2} heap\frac{1}{2} heap\frac{1}{2}
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
\theta_{funcstart\_1032,1}.p1, 177).rem))))._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\theta_{funcstart\_1032,1}, this.r.value(heapIs \theta_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
\rho_{funcstart\_1032.1}.p1, 177).rem))._replace(p2 \rightarrow ((-35 * div(heapIs
\rho_{tuncstart\_1032.1}, this.r.value(heapIs \rho_{tuncstart\_1032.1}).p2,
176).quot) + (172 * div(\mathbf{heapIs} \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}))
\label{eq:continuous_function} $ \text{heap}_{funcstart\_1032,1} . \text{p2}, \ 176).rem)))).$ \_\textbf{replace}(\textbf{this}.\$r \rightarrow
this.$r.value(heapIs \rho_{tuncstart\_1032.1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.}\text{\$r.value}(\text{heapIs}))
\rho_{uncstart\_1032,1}.p1, 177).rem))).\_replace(p2 \rightarrow ((-35 * div(heapIs)))._replace(p2 \rightarrow ((-35 * div(heapIs))))._replace(p3 + div(heapIs)))
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p2,
176).quot) + (172 * div(heapIs \theta_{funcstart\_1032,1}, this.r.value(heapIs)
\rho_{funcstart\_1032.1}.p2, 176).rem))._replace(p3 \rightarrow (-63 * div(heapIs
\rho_{funcstart\_1032,1}, this. r.value(heapIs \rho_{funcstart\_1032,1}).p3,
178).quot) + (170 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
\$heap_{funcstart\_1032,1}).p3,\ 178).rem))),\ (\textbf{real}((-63\ *\ div(\textbf{heapIs}
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p3,
178).quot) + (170 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.} \text{\$r.value}(\text{heapIs}))
\rho_{uncstart_{1032,1},1}, p3, 178).rem)) / 30323.0) + (real((-35 * div(heapIs))) / 30323.0)
\rho_{funcstart\_1032,1}, this. r.value(heapIs \rho_{funcstart\_1032,1}).p2,
176).quot) + (172 * div(\mathbf{heapIs} \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}))
\frac{\text{sheap}_{funcstart\_1032.1}.p2, 176).rem}{} / 30307.0} + (real((-2 * div(heapIs)) / 30307.0) + (real((-2 * div(heapIs))) + (real((-2 * d
\rho_{tuncstart\_1032.1}, this.r.value(heapIs \rho_{tuncstart\_1032.1}).p1,
177).quot) + (171 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
heap_{funcstart_{1032,1}}.p1, 177).rem)) / 30269.0), 1.0)
[Take goal term]
```

178).quot) + (170 * div(heapIs $heapIs = f_{uncstart_1032,1}$, this.r.value(heapIs)

```
[1.0] asType<real>(result) < asType<real>((double)1.0)
\rightarrow [from term 69.7, result is equal to fmod(heapIs
\$heap_{funcstart\_1032,1}.\_\textbf{replace}(\textbf{this}.\$r \rightarrow \textbf{this}.\$r.\textbf{value}(\textbf{heapIs}
heap_{funcstart\_1032,1}._replace(p1 \rightarrow ((-2 * div(heapIs p_{funcstart\_1032,1}),
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177).quot) + (171 *
div(\mathbf{heapIs} \ \$heap_{funcstart\_1032,1}, \ \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs})
\theta_{funcstart\_1032,1}.p1, 177).rem)))).\_replace(this.\$r \rightarrow 0
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs)))
heap_{funcstart\_1032,1}, this.r.value(heapIs heap_{funcstart\_1032,1}).p1,
 177).quot) + (171 * div(\mathbf{heapIs} \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}))
\rho_{funcstart\_1032,1}.p1, 177).rem))).\_replace(p2 \rightarrow ((-35 * div(heapIs))).\_replace(p2 \rightarrow ((-35 * div(heapIs)))).\_replace(p2 \rightarrow ((-35 * div(heapIs)))))
heap_{funcstart\_1032.1}, this.r.value(heapIs heap_{funcstart\_1032.1}).p2,
176).quot) + (172 * div(heapIs $heap_{funcstart=1032.1}, this.$r.value(heapIs
\theta_{tuncstart\_1032.1}.p2, 176).rem)))).\_replace(this.\$r \rightarrow 0
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
$heap_funcstart_1032,1, this.$r.value(heapIs $heap_funcstart_1032,1).p1,
177).quot) + (171 * div(\textbf{heapIs } \$heap_{funcstart\_1032,1}, \textbf{this.}\$r.\textbf{value(heapIs}))
\rho_{funcstart\_1032,1}.p1, 177).rem)))_replace\rho_{funcstart\_1032,1}.p1, 177).rem)))
heap_{funcstart\_1032,1}, this.r.value(heapIs heap_{funcstart\_1032,1}).p2,
 176).quot) + (172 * div(\textbf{heapIs} \$heap_{funcstart\_1032,1}, \textbf{this}.\$r.\textbf{value}(\textbf{heapIs}))
heap_{funcstart\_1032,1}.p2, 176).rem))).\_replace(p3 \rightarrow (-63 * div(heapIs))).
heap_{funcstart\_1032,1}, this.r.value(heapIs heap_{funcstart\_1032,1}).p3,
 178).quot) + (170 * div(\mathbf{heapIs} \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}))
heap_{funcstart\_1032.1}.p3, 178.rem)), (real((-63 * div(heapIs))))
$heap_{funcstart\_1032,1}$, this. $r.value(heapIs $heap_{funcstart\_1032,1}).p3,
178).quot) + (170 * div(\mathbf{heapIs} \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}
heap_{funcstart\_1032,1}.p3, 178).rem)) / 30323.0) + (real((-35 * div(heapIs)) / 30323.0) + (real((-35 * div(heapIs))) / 30323.0) + (real((-35 * div(heapIs)))) / 30323.0) + (real((-35 * div(heapIs))) / 303233.0) + (r
heap_{funcstart\_1032.1}, this.r.value(heapIs heap_{funcstart\_1032.1}).p2,
176).quot) + (172 * div(\mathbf{heapIs} \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}))
heap_{funcstart\_1032,1}.p2, 176).rem) / 30307.0) + (real((-2 * div(heapIs)) / 30307.0) + (real((-2 * div(heapIs))) / 30307.0) + (real
heap_{funcstart\_1032,1}, this.r.value(heapIs heap_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs $heap_{funcstart=1032.1}, this.$r.value(heapIs
heap_{funcstart\_1032,1}.p1, 177).rem) / 30269.0, 1.0
[1.1] \textbf{ asType} < \textbf{real} > (fmod(\textbf{heapIs} \$heap_{funcstart\_1032,1}. \textbf{\_replace}(\textbf{this}.\$r \rightarrow \texttt{astart}\_1032,1))
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(\mathbf{heapIs} \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}))
\theta_{funcstart\_1032,1}.p1, 177).rem))))._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
$heap_funcstart_1032.1, this.$r.value(heapIs $heap_funcstart_1032.1).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.} \text{\$r.value}(\text{heapIs}))
\rho_{funcstart\_1032,1}.p1, 177).rem))._replace(p2 \rightarrow ((-35 * div(heapIs
\rho_{funcstart\_1032,1}, this.\r.value(heapIs \rho_{funcstart\_1032,1}).p2,
176).quot) + (172 * div(heapIs $heap<sub>funcstart_1032.1</sub>, this.$r.value(heapIs
\theta_{funcstart\_1032,1}.p2, 176).rem)))._replace(this.$r \rightarrow
```

```
this.$r.value(heapIs \rho_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{uncstart\_1032,1}, this.r.value(heapIs \rho_{uncstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs \theta_{funcstart\_1032,1}, this.r.value(heapIs)
\rho_{funcstart\_1032,1}.p1, 177).rem))._replace(p2 \rightarrow ((-35 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p2,
176).quot) + (172 * div(heapIs $heap<sub>funcstart_1032,1</sub>, this.$r.value(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p3,
178).quot) + (170 * \text{div}(\text{heapIs } \text{heap}_{funcstart\_1032,1}, \text{this.} \text{$r.value}(\text{heapIs}))
heap_{funcstart_{-1032,1}}.p3, 178).rem)), (real((-63 * div(heapIs))))
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p3,
178).quot) + (170^{\circ} * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.} \text{\$r.value}(\text{heapIs}))
\rho_{funcstart\_1032,1}.p3, 178.rem) / 30323.0) + (real((-35 * div(heapIs)) / 30323.0) + (real((-35 * div(heapIs))) / 30323.0) 
\rho_{uncstart\_1032,1}, this.r.value(heapIs \rho_{uncstart\_1032,1}).p2,
176).quot) + (172 * div(\mathbf{heapIs} \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}))
\theta_{uncstart\_1032,1}.p2, 176).rem / 30307.0) + (real((-2 * div(heapIs)) / 30307.0)
\rho_{tuncstart_{1032.1}}, this. r.value(heapIs \rho_{tuncstart_{1032.1}}).p1,
177).quot) + (171 * div(\mathbf{heapIs} \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}))
heap_{funcstart_{1032,1}}.p1, 177).rem) / 30269.0, 1.0) <
asType<real>((double)1.0)
\rightarrow [simplify]
[1.7] -1.0 < -\text{fmod}(\mathbf{heapIs} \ \text{sheap}_{funcstart\_1032,1}. \mathbf{replace}(\mathbf{this}. \text{sr} \rightarrow
this.$r.value(heapIs $heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs))._replace(p1 \rightarrow (-2 * div(heapIs))._r
\rho_{funcstart\_1032,1}, this.\r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.} \text{\$r.value}(\text{heapIs}))
\theta_{funcstart\_1032,1}.p1, 177).rem)))._replace(this.$r \rightarrow
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
\rho_{funcstart\_1032,1}.p1, 177).rem))._replace(p2 \rightarrow ((-35 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p2,
176).quot) + (172 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_1032,1}, \text{this.} \text{\$r.value}(\text{heapIs}))
\theta_{funcstart\_1032,1}.p2, 176).rem)))).replace(this.r \rightarrow 0
this.$r.value(heapIs heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs heapIs = f_{uncstart\_1032,1}, this.r.value(heapIs)
\rho_{uncstart\_1032,1}.p1, 177).rem))._replace(p2 \rightarrow ((-35 * div(heapIs
\rho_{funcstart\_1032,1}, this. r.value(heapIs \rho_{funcstart\_1032,1}).p2,
176).quot) + (172 * div(\mathbf{heapIs} \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}))
\rho_{funcstart\_1032.1}.p2, 176).rem))._replace(p3 \rightarrow (-63 * div(heapIs
\rho_{tuncstart\_1032.1}, this.r.value(heapIs \rho_{tuncstart\_1032.1}).p3,
```

178).quot) + (170 * div(heapIs $heapIs = f_{uncstart_1032,1}$, this.r.value(heapIs)

 $\hat{s}_{1032,1}.p3, 178.rem)), (real((-63 * div(heapIs $heap_{funcstart_{1032,1}}, this.$r.value(heapIs $heap_{funcstart_{1032,1}}, thi$

```
heap_{funcstart_{-1032,1}}.p3, 178).rem) / 30323.0) + (real((-35 * div(heapIs)) / 30323.0) + (real((-35 * div(heapIs))) / 30
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p2,
176).quot) + (172 * div(heapIs \theta_{funcstart\_1032,1}, this.r.value(heapIs)
\rho_{funcstart\_1032,1}.p2, 176).rem / 30307.0) + (real((-2 * div(heapIs)) / 30307.0)
\rho_{funcstart\_1032,1}, this.r.value(heapIs \rho_{funcstart\_1032,1}).p1,
177).quot) + (171 * div(heapIs $heap<sub>funcstart_1032,1</sub>, this.$r.value(heapIs
heap_{funcstart\_1032,1}.p1, 177).rem) / 30269.0, 1.0
\rightarrow [from term 72.22, literala < -fmod(heapIs
$heap_{funcstart\_1032,1}.$_replace(this.$r \rightarrow this.$r.value(heapIs)
heap_{funcstart\_1032,1}._replace(p1 \rightarrow ((-2 * div(heapIs $heap_{funcstart\_1032,1},
this.r.value(heapIs \ heap_{funcstart\_1032,1}).p1, 177).quot) + (171 * leapIs \ heap_{funcstart\_1032,1}).p1, 177).quot) + (171 * leapIs \ heapIs \ heap_{funcstart\_1032,1}).p1, 177).quot) + (171 * leapIs \ heapIs \ hea
div(heapIs $heap_{tuncstart_1032.1}, this.$r.value(heapIs
\theta_{tuncstart=1032.1}.p1, 177).rem)))._replace(this.$r \rightarrow
this.r.value(heapIs \ heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs
\$heap_{funcstart\_1032,1},\ \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}\ \$heap_{funcstart\_1032,1}).p1,
  177).quot) + (171 * div(\mathbf{heapIs} \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}))
\rho_{funcstart\_1032,1}.p1, 177).rem))._replace\rho_{funcstart\_1032,1}.p1, 177).rem))
heap_{funcstart\_1032,1}, this.r.value(heapIs heap_{funcstart\_1032,1}).p2,
 176).quot) + (172 * div(\mathbf{heapIs} \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}))
\theta_{funcstart\_1032,1}.p2, 176).rem)))).\_replace(this.\$r \rightarrow 0
this.r.value(heapIs \ heap_{funcstart\_1032,1})._replace(p1 \rightarrow ((-2 * div(heapIs \ heap_{funcstart\_1032,1}))._replace(p1 \rightarrow ((-2 * div(heap_{funcstart\_1032,1}))._replace(p1 \rightarrow ((-2 * div(heap_{funcstart\_1
\$heap_{funcstart\_1032,1},\ \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}\ \$heap_{funcstart\_1032,1}).p1,
  177).quot) + (171 * div(\mathbf{heapIs} \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}))
 \rho_{funcstart\_1032,1}.p1, 177).rem))._replace\rho_{funcstart\_1032,1}.p1, 177).rem))._replace
heap_{funcstart\_1032.1}, this.r.value(heapIs heap_{funcstart\_1032.1}).p2,
 (176).quot) + (172*div(\textbf{heapIs} \$heap_{funcstart\_1032,1}, \textbf{this}.\$r.\textbf{value}(\textbf{heapIs}))
heap_{funcstart\_1032,1}.p2, 176).rem))).\_replace(p3 \rightarrow (-63 * div(heapIs))).
heap_{funcstart\_1032.1}, this.r.value(heapIs heap_{funcstart\_1032.1}).p3,
 178).quot) + (170 * div(\mathbf{heapIs} \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}))
heap_{funcstart\_1032,1}.p3, 178).rem)), (real((-63 * div(heapIs))))
heap_{funcstart\_1032,1}, this.r.value(heapIs heap_{funcstart\_1032,1}).p3,
 178).quot) + (170 * div(\mathbf{heapIs} \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}))
heap_{funcstart\_1032,1}.p3, 178).rem) / 30323.0) + (real((-35 * div(heapIs)) / 30323.0) + (real((-35 * div(heapIs))) / 30323
$heap_funcstart_1032,1, this.$r.value(heapIs $heap_funcstart_1032,1).p2,
 (176).quot) + (172 * div(heapIs $heap_{funcstart\_1032,1}, this.$r.value(heapIs)]
heap_{funcstart\_1032,1}.p2, 176).rem) / 30307.0) + (real((-2 * div(heapIs) + (real(-2 * div(he
 heap_{funcstart\_1032,1}, this.r.value(heapIs heap_{funcstart\_1032,1}).p1,
  177).quot) + (171 * div(\mathbf{heapIs} \$heap_{funcstart\_1032,1}, \mathbf{this}.\$r.\mathbf{value}(\mathbf{heapIs}))
\leq -1.0]
```

Proof of rule precondition:

$$[1.7.0]$$
 -1.0 \leq -1.0 \rightarrow [simplify]

```
[1.8] true
Proof of verification condition: Loop initialisation establishes end
condition or a valid variant
Condition generated at: C:\Escher\Customers\prang-cpp\prang.cpp
(115,5)
Condition defined at: C:\Escher\Customers\prang-cpp\prang.cpp (117,20)
To prove: 0 \le (asType < integer const > (limit) - limit)
asType<integer>(count))
Given:
heap_{init}.LIMIT == (int)80
heap_{init}.class WHPrang \in M1 == (int)30269
heap_{init}.class WHPrang \in r1 == (int)171
\text{heap}_{init}.\mathbf{class} \text{ WHPrang } \in \text{a1} == (\mathbf{int})177
heap_{init}.class WHPrang \in b1 == (int)2
heap_{init}.class WHPrang \in M2 == (int)30307
heap_{init}.class WHPrang \in r2 == (int)172
heap_{init}.class WHPrang \in a2 == (int)176
heap_{init}.class WHPrang \in b2 == (int)35
heap_{init}.class WHPrang \in M3 == (int)30323
heap_{init}.class WHPrang \in r3 == (int)170
heap_{init}.class WHPrang \in a3 == (int)178
heap_{init}.class WHPrang \in b3 == (int)63
\text{Sheap}_{1079,1;1081,13,m1} == \text{Sheap}_{funcstart\_1079,1}.\_alloc(\text{prang} \rightarrow \text{prang})
heap_{1079,1;1081,13} = 
\label{eq:heap1079,1;1081,13,m1.replace} $$ \hat{s}_{1079,1;1081,13,m1.prang}.$$ r \to $$
writes_1081_5)
limit == $heap_{1079,1;1081,13}.LIMIT
minof(int const) \leq limit
limit \leq maxof(int const)
count == (int)0
minof(int) \le count
count \le maxof(int)
```

[1.7.1] **true**

```
heap_{1079,1;1086,5} ==
\$heap_{1079,1;1081,13}.\_\mathbf{replace}((\&\$heap_{1079,1;1081,13}.\_ecv\_files[1]).\$r \to \$propertion + \$pro
writes_1086_5)
count < limit
Proof:
[Take given term]
[2.0] $\text{heap}_{1079,1;1081,13,m1} == $\text{heap}_{funcstart\_1079,1}._\text{-alloc}(\text{prang} \rightarrow \text{prang})
[Take given term]
[3.0] $heap<sub>1079,1;1081,13</sub> ==
\text{heap}_{1079,1;1081,13,m1}._replace((&\text{heap}_{1079,1;1081,13,m1}.prang).\text{$r} \rightarrow
writes_1081_5)
\rightarrow [from term 2.0, $heap_{1079,1;1081,13,m1}$ is equal to
heap_{funcstart\_1079,1}.\_alloc(prang \rightarrow prang)
[3.1] $\text{heap}_{1079,1;1081,13} == $\text{heap}_{funcstart\_1079,1}._\text{-alloc}(\text{prang} \rightarrow)
prang)._replace((&$heap_{1079,1;1081,13,m1}.prang).$r \rightarrow writes_1081_5)
\rightarrow [simplify]
[3.2] \text{Sheap}_{1079,1;1081,13} == \text{Sheap}_{funcstart\_1079,1}.\_\mathbf{alloc}(\text{prang} \rightarrow
prang).\_replace((&$heap.prang).$r \rightarrow writes\_1081\_5)
→ [attribute value is known from postcondition]
[3.3] $\text{heap}_{1079,1;1081,13} == $\text{heap}_{funcstart\_1079,1}._\text{-alloc}(\text{prang} \rightarrow)
prang)._replace(&heap.prang \rightarrow writes_1081_5)
→ [replacing contents of address-of object is same as replacing object]
[3.4] heap_{1079,1;1081,13} == heap_{funcstart\_1079,1}._alloc(prang \rightarrow
prang)._replace(prang \rightarrow writes_1081_5)
[Take given term]
[4.0] $heap<sub>1079,1;1081,13</sub>.LIMIT == limit
\rightarrow [from term 3.4, $heap<sub>1079,1;1081,13</sub> is equal to
\$heap_{funcstart\_1079,1}.\_\textbf{alloc}(prang \rightarrow prang).\_\textbf{replace}(prang \rightarrow writes\_1081\_5)]
[4.1] \ \$ heap_{funcstart\_1079,1}. \_ \textbf{alloc} (prang \rightarrow prang). \_ \textbf{replace} (prang \rightarrow
writes_1081_5).LIMIT == limit
\rightarrow [const member of object with modified fields]
[4.3] $heap<sub>funcstart_1079,1</sub>.LIMIT == limit
\rightarrow [const static or extern object]
[4.4] $heap<sub>init</sub>.LIMIT == limit
\rightarrow [expand definition of constant 'LIMIT' at prang.cpp (13,18)]
[4.5] (int)80 == limit
```

```
\rightarrow [simplify]
[4.6] 80 == limit
[Take given term]
[5.0] (int)0 == count
\rightarrow [simplify]
[5.1] 0 == count
[Take goal term]
[1.0] 0 \leq (asType<integer const>(limit) - asType<integer>(count))
\rightarrow [from term 4.6, limit is equal to 80]
[1.1] 0 \leq (asType<integer const>(80) - asType<integer>(count))
\rightarrow [simplify]
[1.2] 0 \le (80 - \mathbf{asType} < \mathbf{integer} > (\mathbf{count}))
\rightarrow [from term 5.1, count is equal to 0]
[1.3] 0 \le (80 - asType < integer > (0))
\rightarrow [simplify]
[1.6] true
Proof of verification condition: Loop body establishes end condition or
decreases variant
Condition generated at: C:\Escher\Customers\prang-cpp\prang.cpp
(118,5)
Condition defined at: C:\Escher\Customers\prang-cpp\prang.cpp (117,5)
To prove: (asType<integer const>(limit) -
asType < integer > (count_{loopend})) < (asType < integer const > (limit) - limit) = limit > (limit) > (limit) = limit > (limit) = limit > (limit) > (limit)
asType < integer > (count_{loopstart\_1088.5}))
Given:
heap_{init}.LIMIT == (int)80
heap_{init}.class WHPrang \in M1 == (int)30269
heap_{init}.class WHPrang \in r1 == (int)171
heap_{init}.class WHPrang \in a1 == (int)177
heap_{init}.class WHPrang \in b1 == (int)2
heap_{init}.class WHPrang \in M2 == (int)30307
heap_{init}.class WHPrang \in r2 == (int)172
heap_{init}.class WHPrang \in a2 == (int)176
```

```
heap_{init}.class WHPrang \in b2 == (int)35
heap_{init}.class WHPrang \in M3 == (int)30323
heap_{init}.class WHPrang \in r3 == (int)170
heap_{init}.class WHPrang \in a3 == (int)178
heap_{init}.class WHPrang \in b3 == (int)63
\text{Sheap}_{1079,1;1081,13,m1} == \text{Sheap}_{funcstart\_1079,1}.\_\mathbf{alloc}(\text{prang} \to \text{prang})
heap_{1079,1;1081,13} ==
\rho_{1079,1;1081,13,m1}.replace((&\partial_{heap_{1079,1;1081,13,m1}.prang).\partial_{r}\rightarrow
writes_1081_5)
limit == \$heap_{1079,1:1081,13}.LIMIT
minof(int const) \le limit
limit \leq maxof(int const)
count == (int)0
minof(int) \le count
count < maxof(int)
heap_{1079,1;1086,5} ==
\rho_{1079,1;1081,13}.\_replace((\&\rho_{1079,1;1081,13}.\_ecv\_files[1]).r \rightarrow 0
writes_1086_5)
\text{Sheap}_{loopstart\_1088,5} == \text{Sheap}_{1079,1;1086,5}.\_\mathbf{replace}(\text{prang} \rightarrow
writes_1089_12)._replace(\_ecv\_files \rightarrow writes\_1089\_12)
\#writes_1089_12 == \#$heap<sub>1079_1:1086_5</sub>._ecv_files
minof(int) \leq count_{loopstart\_1088,5}
count_{loopstart\_1088,5} \le maxof(int)
\operatorname{count}_{loopstart\_1088.5} < \operatorname{limit}
0 \le (asType < integer const > (limit) -
asType < integer > (count_{loopstart\_1088,5}))
(\mathbf{asType} < \mathbf{integer\ const} > (\mathbf{limit}) - \mathbf{asType} < \mathbf{integer} > (\mathbf{count}_{loopstart\_1088,5}))
≤ (asType<integer const>(limit) - asType<integer>(count))
(++\text{count}_{loopstart\_1088,5} == \text{count}_{loopend}) \land (\$\text{heap}_{1092,16} ==
\rho_{loopstart\_1088,5}.\_replace((\&\rho_{loopstart\_1088,5}.prang).r)
operator*(heapIs $heap_{loopstart\_1088,5},
&$heap_loopstart\_1088.5.prang)._replace(p1 \rightarrow
writes_1092_31))._replace((&$heap_{loopstart\_1088,5}.prang).$r \rightarrow
operator*(heapIs $heap_loopstart_1088.5,
&$heap_{loopstart\_1088,5}.prang)._replace(p2 \rightarrow
writes_1092_31))._replace((&$heap_{loopstart\_1088,5}.prang).$r \rightarrow
operator*(heapIs $heap_loopstart_1088.5,
```

```
&heap_{loopstart\_1088,5}.prang)._replace(p3 \rightarrow writes_1092_31))) \land (heap_{loopend}
== $heap<sub>1092,16</sub>._replace((&$heap<sub>1092,16</sub>._ecv_files[1]).$r \rightarrow writes_1092_9)) \land
(asType < real > ((double)0.0) < asType < real > (\$result\_1092\_31)) \land
(asType < real > (\$result\_1092\_31) < asType < real > ((double)1.0))
count_{loopend} < limit
Proof:
[Take given term]
[2.0] $heap<sub>1079,1:1081,13,m1</sub> == $heap<sub>funcstart_1079,1</sub>._alloc(prang \rightarrow prang)
[Take given term]
[3.0] $heap<sub>1079,1;1081,13</sub> ==
\rho_{1079,1;1081,13,m1}.replace((&\partial_{heap_{1079,1;1081,13,m1}.prang).\partial_{r} \rightarrow
writes_1081_5)
\rightarrow [from term 2.0, heap_{1079,1;1081,13,m1} is equal to
heap_{funcstart\_1079,1}.\_alloc(prang \rightarrow prang)
[3.1] heap_{1079,1;1081,13} == heap_{funcstart\_1079,1}._alloc(prang \rightarrow
prang)._replace((&$heap_{1079,1;1081,13,m1}.prang).$r \rightarrow writes_1081_5)
\rightarrow [simplify]
[3.2] \text{Sheap}_{1079,1;1081,13} == \text{Sheap}_{funcstart\_1079,1}.\_\mathbf{alloc}(\text{prang} \rightarrow
prang).\_replace((&$heap.prang).$r \rightarrow writes\_1081\_5)
→ [attribute value is known from postcondition]
[3.3] $heap<sub>1079,1;1081,13</sub> == $heap<sub>funcstart_1079,1</sub>._alloc(prang \rightarrow
prang)._replace(&heap.prang \rightarrow writes_1081_5)
→ [replacing contents of address-of object is same as replacing object]
[3.4] $\text{heap}_{1079,1:1081,13} == \text{$heap}_{funcstart\_1079,1}._\text{-alloc}(\text{prang} \to \text{})
prang).\_replace(prang \rightarrow writes\_1081\_5)
[Take given term]
[4.0] $heap<sub>1079,1;1081,13</sub>.LIMIT == limit
\rightarrow [from term 3.4, p_{1079,1;1081,13} is equal to
heap_{funcstart\_1079,1}._alloc(prang \rightarrow prang)._replace(prang \rightarrow writes_1081_5)]
[4.1] heap_{funcstart\_1079,1}._alloc(prang \rightarrow prang)._replace(prang \rightarrow
writes_1081_5).LIMIT == limit
\rightarrow [const member of object with modified fields]
[4.3] $heap<sub>funcstart_1079,1</sub>.LIMIT == limit
\rightarrow [const static or extern object]
[4.4] $heap<sub>init</sub>.LIMIT == limit
\rightarrow [expand definition of constant 'LIMIT' at prang.cpp (13,18)]
```

```
[4.5] (int)80 == limit
\rightarrow [simplify]
[4.6] 80 == limit
[Take given term]
[13.0] (++\text{count}_{loopstart\_1088,5} == \text{count}_{loopend}) \land (\$\text{heap}_{1092,16} ==
\$ heap_{loopstart\_1088,5}.\_\mathbf{replace}((\&\$ heap_{loopstart\_1088,5}.prang).\$r \rightarrow
operator*(heapIs $heap_{loopstart\_1088,5},
&$heap<sub>loopstart_1088.5</sub>.prang)._replace(p1 \rightarrow
writes_1092_31))._replace((&$heap_{loopstart\_1088.5}.prang).$r \rightarrow
operator*(heapIs $heap_{loopstart\_1088,5},
&$heap_{loopstart\_1088,5}.prang)._replace(p2 \rightarrow
writes_1092_31))._replace((&$heap_{loopstart\_1088,5}.prang).$r \rightarrow
\mathbf{operator}^*(\mathbf{heapIs}\ \$\mathbf{heap}_{loopstart\_1088,5},
&heap_{loopstart\_1088,5}.prang).\_replace(p3 \rightarrow writes\_1092\_31))) \land (heap_{loopend})
== $heap<sub>1092,16</sub>._replace((&$heap<sub>1092,16</sub>._ecv_files[1]).$r \rightarrow writes_1092_9)) \land
(asType < real > ((double)0.0) < asType < real > (\$result_1092_31)) \land
(asType < real > (\$result\_1092\_31) < asType < real > ((double)1.0))
\rightarrow [simplify]
[13.8] (1 == (count_{loopend} + -count_{loopstart\_1088,5})) \land (\$heap_{1092,16} ==
\rho_{loopstart\_1088.5}.\_replace((\&\rho_{loopstart\_1088.5}.prang).r \rightarrow 0
operator*(heapIs $heap_{loopstart\_1088,5},
&$heap<sub>loopstart_1088,5</sub>.prang)._replace(p1 \rightarrow
writes_1092_31))._replace((&$heap_{loopstart\_1088,5}.prang).$r \rightarrow
operator*(heapIs $heap_loopstart_1088,5,
&$heap_{loopstart\_1088,5}.prang)._replace(p2 \rightarrow
writes_1092_31))._replace((&$heap_{loopstart\_1088,5}.prang).$r \rightarrow
operator*(heapIs $heap_{loopstart\_1088,5},
&heap_{loopstart\_1088,5}.prang).\_replace(p3 \rightarrow writes\_1092\_31))) \land (heap_{loopend})
== $heap<sub>1092.16</sub>._replace((&$heap<sub>1092.16</sub>._ecv_files[1]).$r \rightarrow writes_1092_9)) \land
(\mathbf{asType} < \mathbf{real} > ((\mathbf{double})0.0) < \mathbf{asType} < \mathbf{real} > (\$result\_1092\_31)) \ \land \\
(\mathbf{asType} < \mathbf{real} > (\$ result\_1092\_31) < \mathbf{asType} < \mathbf{real} > ((\mathbf{double})1.0))
\rightarrow [Dereference address-of object]
[13.9] (1 == (-\text{count}_{loopstart\_1088,5} + \text{count}_{loopend})) \land (\$\text{heap}_{1092,16} ==
\rho_{loopstart\_1088,5}.\_replace((\&\rho_{loopstart\_1088,5}.prang).r \rightarrow 0
heap_{loopstart\_1088,5}.prang.\_replace(p1 \rightarrow
writes_1092_31))._replace((&$heap_{loopstart\_1088,5}.prang).$r \rightarrow
operator*(heapIs $heap_{loopstart\_1088,5},
&\heap_{loopstart_1088.5}.prang)._replace(p2 \rightarrow
writes_1092_31))._replace((&$heap_{loopstart\_1088,5}.prang).$r \rightarrow
\mathbf{operator}^*(\mathbf{heapIs}\ \$ \mathrm{heap}_{loopstart\_1088,5},
&heap_{loopstart\_1088,5}.prang).\_replace(p3 \rightarrow writes\_1092\_31))) \land (heap_{loopend})
== $heap<sub>1092,16</sub>._replace((&$heap<sub>1092,16</sub>._ecv_files[1]).$r \rightarrow writes_1092_9)) \land
```

```
(asType < real > ((double)0.0) < asType < real > (\$result_1092_31)) \land
(asType < real > (\$result\_1092\_31) < asType < real > ((double)1.0))
\rightarrow [simplify]
[13.10] (1 == (-\text{count}_{loopstart\_1088,5} + \text{count}_{loopend})) \land ($heap<sub>1092,16</sub> ==
\theta_{loopstart\_1088,5}.\_\mathbf{replace}((\$\theta_{prang}).\r
heap_{loopstart\_1088.5}.prang.\_replace(p1 \rightarrow
writes_1092_31))._replace((&$heap_{loopstart\_1088.5}.prang).$r \rightarrow
operator*(heapIs $heap_{loopstart\_1088,5},
&$heap_{loopstart\_1088,5}.prang)._replace(p2 \rightarrow
writes_1092_31))._replace((&$heap_{loopstart\_1088,5}.prang).$r \rightarrow
\mathbf{operator}^*(\mathbf{heapIs}\ \$ \mathrm{heap}_{loopstart\_1088,5},
&heap_{loopstart\_1088,5}.prang)._replace(p3 \rightarrow writes_1092_31))) \land (heap_{loopend}
== $heap<sub>1092,16</sub>._replace((&$heap<sub>1092,16</sub>._ecv_files[1]).$r \rightarrow writes_1092_9)) \land
(asType < real > ((double)0.0) < asType < real > (\$result_1092_31)) \land
(asType < real > (\$result\_1092\_31) < asType < real > ((double)1.0))
→ [attribute value is known from postcondition]
[13.11] (1 == (-\text{count}_{loopstart\_1088,5} + \text{count}_{loopend})) \land (\$\text{heap}_{1092,16} ==
heap_{loopstart\_1088,5}.replace((&heap.prang) \rightarrow
heap_{loopstart_{-1088.5}}.prang.\_replace(p1 \rightarrow
writes_1092_31))._replace((&$heap_{loopstart\_1088,5}.prang).$r \rightarrow
operator*(heapIs $heap_{loopstart\_1088,5},
&$heap_{loopstart\_1088,5}.prang)._replace(p2 \rightarrow
writes_1092_31))._replace((&$heap_{loopstart\_1088.5}.prang).$r \rightarrow
operator*(heapIs $heap_{loopstart\_1088,5},
&\hat{heap}_{loopstart\_1088,5}.prang)._replace(p3 \rightarrow writes_1092_31))) \land (\hat{heap}_{loopend})
== $heap<sub>1092,16</sub>._replace((&$heap<sub>1092,16</sub>._ecv_files[1]).$r \rightarrow writes_1092_9)) \land
(\mathbf{asType}{<}\mathbf{real}{>}((\mathbf{double})0.0) < \mathbf{asType}{<}\mathbf{real}{>}(\$result\_1092\_31)) \ \land \\
(asType < real > (\$result\_1092\_31) < asType < real > ((double)1.0))
→ [replacing contents of address-of object is same as replacing object]
[13.12] (1 == (-\text{count}_{loopstart\_1088,5} + \text{count}_{loopend})) \land (\$\text{heap}_{1092,16} ==
\$heap_{loopstart\_1088,5}.\_\mathbf{replace}(prang \rightarrow \$heap_{loopstart\_1088,5}.prang.\_\mathbf{replace}(p1)
\rightarrow writes_1092_31))._replace((&$heap_{loopstart\_1088,5}.prang).$r \rightarrow
operator*(heapIs $heap_{loopstart\_1088,5},
&$heap_loopstart_1088,5.prang)._replace(p2 \rightarrow
writes_1092_31))._replace((&$heap_{loopstart\_1088,5}.prang).$r \rightarrow
operator*(heapIs $heap_{loopstart\_1088,5},
&$heap_{loopstart\_1088.5}.prang)._replace(p3 \rightarrow writes_1092_31))) \land ($heap_{loopend}
== $heap<sub>1092,16</sub>._replace((&$heap<sub>1092,16</sub>._ecv_files[1]).$r \rightarrow writes_1092_9)) \land
(asType < real > ((double)0.0) < asType < real > (\$result\_1092\_31)) \land
(\mathbf{asType} < \mathbf{real} > (\$\mathbf{result\_1092\_31}) < \mathbf{asType} < \mathbf{real} > ((\mathbf{double})1.0))
\rightarrow [Dereference address-of object]
[13.13] (1 == (-\text{count}_{loopstart\_1088.5} + \text{count}_{loopend})) \land (\$\text{heap}_{1092.16} ==
```

```
\rho_{loopstart\_1088,5}.\_replace(prang \rightarrow \rho_{loopstart\_1088,5}.prang.\_replace(p1)
\rightarrow writes_1092_31))._replace((&$heap_{loopstart\_1088,5}.prang).$r \rightarrow
heap_{loopstart\_1088,5}.prang.\_replace(p2 \rightarrow
writes_1092_31))._replace((&$heap_{loopstart\_1088.5}.prang).$r \rightarrow
operator*(heapIs $heap_{loopstart\_1088,5},
&\hat{heap}_{loopstart\_1088,5}.prang)._replace(p3 \rightarrow writes_1092_31))) \land (\hat{heap}_{loopend})
== $heap<sub>1092,16</sub>._replace((&$heap<sub>1092,16</sub>._ecv_files[1]).$r \rightarrow writes_1092_9)) \land
(asType < real > ((double)0.0) < asType < real > (\$result_1092.31)) \land
(asType < real > (\$result\_1092\_31) < asType < real > ((double)1.0))
\rightarrow [simplify]
[13.14] (1 == (-\text{count}_{loopstart\_1088,5} + \text{count}_{loopend})) \land (\$\text{heap}_{1092,16} ==
\$heap_{loopstart\_1088,5}.\mathbf{\_replace}(prang \rightarrow \$heap_{loopstart\_1088,5}.prang.\mathbf{\_replace}(p1)
\rightarrow writes_1092_31))._replace((&$heap.prang).$r \rightarrow
heap_{loopstart\_1088,5}.prang.\_replace(p2 \rightarrow
writes_1092_31))._replace((&$heap_{loopstart\_1088,5}.prang).$r \rightarrow
operator*(heapIs $heap_{loopstart\_1088,5},
&heap_{loopstart\_1088,5}.prang).\_replace(p3 \rightarrow writes\_1092\_31))) \land (heap_{loopend})
== $heap<sub>1092.16</sub>._replace((&$heap<sub>1092.16</sub>._ecv_files[1]).$r \rightarrow writes_1092_9)) \land
(asType < real > ((double)0.0) < asType < real > (\$result_1092_31)) \land
(asType < real > (\$result\_1092\_31) < asType < real > ((double)1.0))
\rightarrow [attribute value is known from postcondition]
[13.15] (1 == (-\text{count}_{loopstart\_1088,5} + \text{count}_{loopend})) \land (\$\text{heap}_{1092,16} ==
\text{Sheap}_{loopstart\_1088,5}.\_\mathbf{replace}(\text{prang} \rightarrow \text{Sheap}_{loopstart\_1088,5}.\text{prang}.\_\mathbf{replace}(\text{p1})
\rightarrow writes_1092_31))._replace((&$heap.prang) \rightarrow
heap_{loopstart\_1088,5}.prang.\_replace(p2 \rightarrow
writes_1092_31))._replace((&$heap_{loopstart\_1088,5}.prang).$r \rightarrow
operator*(heapIs $heap<sub>loopstart_1088.5</sub>,
&heap_{loopstart\_1088,5}.prang)._replace(p3 \rightarrow writes_1092_31))) \land (heap_{loopend}
== \$ heap_{1092,16}. \_\mathbf{replace}((\&\$ heap_{1092,16}. \_ecv\_files[1]).\$r \rightarrow writes\_1092\_9)) \ \land \\
(asType < real > ((double)0.0) < asType < real > (\$result_1092_31)) \land
(asType < real > (\$result\_1092\_31) < asType < real > ((double)1.0))
→ [replacing contents of address-of object is same as replacing object]
[13.16] (1 == (-\text{count}_{loopstart\_1088,5} + \text{count}_{loopend})) \land (\$\text{heap}_{1092,16} ==
\rho_{loopstart\_1088,5}.\_replace(prang \rightarrow \rho_{loopstart\_1088,5}.prang.\_replace(p1)
\rightarrow \text{writes\_1092\_31})).\_\textbf{replace}(\text{prang} \rightarrow \$\text{heap}_{loopstart\_1088,5}.\text{prang}.\_\textbf{replace}(\text{p2}))
\rightarrow writes_1092_31))._replace((&$heap_{loopstart\_1088.5}.prang).$r \rightarrow
\mathbf{operator}^*(\mathbf{heapIs}\ \$\mathbf{heap}_{loopstart\_1088,5},
&heap_{loopstart\_1088,5}.prang)._replace(p3 \rightarrow writes_1092_31))) \land (heap_{loopend}
== $heap<sub>1092,16</sub>._replace((&$heap<sub>1092,16</sub>._ecv_files[1]).$r \rightarrow writes_1092_9)) \land
(asType < real > ((double)0.0) < asType < real > (\$result_1092_31)) \land
(asType < real > (\$result\_1092\_31) < asType < real > ((double)1.0))
\rightarrow [Dereference address-of object]
```

```
[13.17] (1 == (-\text{count}_{loopstart\_1088,5} + \text{count}_{loopend})) \land (\$\text{heap}_{1092,16} ==
\text{Sheap}_{loopstart\_1088,5}._replace(prang \rightarrow \text{Sheap}_{loopstart\_1088,5}.prang._replace(p1
\rightarrow \text{writes\_1092\_31})).\_\textbf{replace}(\text{prang} \rightarrow \$\text{heap}_{loopstart\_1088,5}.\text{prang}.\_\textbf{replace}(\text{p2}))
\rightarrow writes_1092_31))._replace((&$heap_{loopstart\_1088,5}.prang).$r \rightarrow
\rho_{loopstart\_1088.5}.prang._replace(p3 \rightarrow writes_1092_31))) \land ($heap<sub>loopend</sub>
== $heap<sub>1092,16</sub>._replace((&$heap<sub>1092,16</sub>._ecv_files[1]).$r \rightarrow writes_1092_9)) \land
(asType < real > ((double)0.0) < asType < real > (\$result_1092_31)) \land
(asType < real > (\$result\_1092\_31) < asType < real > ((double)1.0))
\rightarrow [simplify]
[13.18] (1 == (-\text{count}_{loopstart\_1088,5} + \text{count}_{loopend})) \land (\$\text{heap}_{1092,16} ==
\text{Sheap}_{loopstart\_1088,5}._replace(prang \rightarrow \text{Sheap}_{loopstart\_1088,5}.prang._replace(p1
\rightarrow \text{writes\_1092\_31})).\_\textbf{replace}(\text{prang} \rightarrow \$\text{heap}_{loopstart\_1088,5}.\text{prang}.\_\textbf{replace}(\text{p2}))
\rightarrow writes_1092_31))._replace((&$heap.prang).$r \rightarrow
\text{Sheap}_{loopstart\_1088.5}.\text{prang}.\_\text{replace}(p3 \rightarrow \text{writes}\_1092\_31))) \land (\text{Sheap}_{loopend})
== $heap<sub>1092,16</sub>._replace((&$heap<sub>1092,16</sub>._ecv_files[1]).$r \rightarrow writes_1092_9)) \land
(asType < real > ((double)0.0) < asType < real > (\$result_1092_31)) \land
(asType < real > (\$result\_1092\_31) < asType < real > ((double)1.0))
\rightarrow [attribute value is known from postcondition]
[13.19] (1 == (-\text{count}_{loopstart\_1088,5} + \text{count}_{loopend})) \land (\$\text{heap}_{1092,16} ==
\$heap_{loopstart\_1088,5}.\mathbf{\_replace}(prang \rightarrow \$heap_{loopstart\_1088,5}.prang.\mathbf{\_replace}(p1)
\rightarrow \text{writes\_1092\_31})).\_\textbf{replace}(\text{prang} \rightarrow \$\text{heap}_{loopstart\_1088,5}.\text{prang}.\_\textbf{replace}(\text{p2}))
\rightarrow writes_1092_31))._replace(&\text{heap.prang} \rightarrow
\text{heap}_{loopstart\_1088.5}.\text{prang.\_replace}(\text{p3} \rightarrow \text{writes\_1092\_31}))) \land (\text{heap}_{loopend})
== $heap<sub>1092.16</sub>._replace((&$heap<sub>1092.16</sub>._ecv_files[1]).$r \rightarrow writes_1092_9)) \land
(asType < real > ((double)0.0) < asType < real > (\$result_1092_31)) \land
(asType < real > (\$result\_1092\_31) < asType < real > ((double)1.0))
→ [replacing contents of address-of object is same as replacing object]
[13.20] (1 == (-\text{count}_{loopstart\_1088,5} + \text{count}_{loopend})) \land (\$\text{heap}_{1092,16} ==
\theta_{loopstart\_1088,5}._replace(prang \rightarrow \theta_{loopstart\_1088,5}.prang._replace(p1)
\rightarrow writes_1092_31))._replace(prang \rightarrow $heap<sub>loopstart_1088,5</sub>.prang._replace(p2
\rightarrow \text{writes\_1092\_31})).\_\textbf{replace}(\text{prang} \rightarrow \$\text{heap}_{loopstart\_1088,5}.\text{prang}.\_\textbf{replace}(\text{p3}))
\rightarrow writes_1092_31))) \land ($heap<sub>loopend</sub> ==
\rho_{1092.16.}-replace((&\parallelefta_{1092.16.}-ecv_files[1]).\Psr \rightarrow writes_1092_9)) \rightarrow
(asType < real > ((double)0.0) < asType < real > (\$result_1092_31)) \land
(asType < real > (\$result\_1092\_31) < asType < real > ((double)1.0))
\rightarrow [simplify]
[13.21] (1 == (-\text{count}_{loopstart\_1088,5} + \text{count}_{loopend})) \land (\$\text{heap}_{1092,16} ==
\theta
\rightarrow writes_1092_31))._replace(prang \rightarrow $heap<sub>loopstart_1088,5</sub>.prang._replace(p2
\rightarrow \text{writes\_1092\_31)}).\_\textbf{replace}(\text{prang} \rightarrow \$\text{heap}_{loopstart\_1088,5}.\text{prang}.\_\textbf{replace}(\text{p3}))
\rightarrow writes_1092_31))) \land ($heap<sub>loopend</sub> ==
\theta_{1092,16}.replace((&\text{heap._ecv_files}[1]).\text{$r$} \to \text{writes}_1092_9)) \lambda
```

```
(asType < real > ((double)0.0) < asType < real > (\$result_1092_31)) \land
(asType < real > (\$result\_1092\_31) < asType < real > ((double)1.0))
→ [attribute value is known from postcondition]
[13.22] (1 == (-\text{count}_{loopstart\_1088,5} + \text{count}_{loopend})) \land ($heap<sub>1092,16</sub> ==
\rho_{loopstart\_1088,5}.\_replace(prang \rightarrow \rho_{loopstart\_1088,5}.prang.\_replace(p1)
\rightarrow writes_1092_31))._replace(prang \rightarrow $heap<sub>loopstart_1088,5</sub>.prang._replace(p2
\rightarrow \text{writes\_1092\_31})). \textbf{\_replace}(\text{prang} \rightarrow \$\text{heap}_{loopstart\_1088,5}.\text{prang}. \textbf{\_replace}(\text{p3}))
\rightarrow writes_1092_31))) \land ($heap<sub>loopend</sub> ==
\rho_{1092.16.}-replace(&\heap._ecv_files[1] \rightarrow writes_1092_9)) \land
(asType < real > ((double)0.0) < asType < real > (\$result_1092_31)) \land
(asType < real > (\$result\_1092\_31) < asType < real > ((double)1.0))
\rightarrow [simplify]
[13.31] (1 == (-\text{count}_{loopstart\_1088,5} + \text{count}_{loopend})) \land (\$\text{heap}_{1092,16} ==
\$heap_{loopstart\_1088,5}.\mathbf{\_replace}(prang \rightarrow \$heap_{loopstart\_1088,5}.prang.\mathbf{\_replace}(p1)
\rightarrow writes_1092_31))._replace(prang \rightarrow $heap<sub>loopstart_1088,5</sub>.prang._replace(p2
\rightarrow \text{writes\_1092\_31})).\_\textbf{replace}(\text{prang} \rightarrow \$\text{heap}_{loopstart\_1088,5}.\text{prang}.\_\textbf{replace}(\text{p3}))
\rightarrow writes_1092_31))) \land ($heap<sub>loopend</sub> ==
\rho_{1092,16}._replace(&\pi_exp._ecv_files[1] \rightarrow writes_1092_9)) \rangle (0.0 <
\rightarrow [separate conjunction and work on first sub-term]
[13.32] 1 == (-\operatorname{count}_{loopstart\_1088,5} + \operatorname{count}_{loopend})
[Take goal term]
[1.0] (asType<integer const>(limit) - asType<integer>(count_loonend)) <
(asType < integer const > (limit) - asType < integer > (count_{loopstart\_1088.5}))
\rightarrow [from term 4.6, limit is equal to 80]
[1.1] (asType<integer const>(80) - asType<integer>(count_loopend)) <
(asType < integer const > (limit) - asType < integer > (count_{loopstart\_1088,5}))
\rightarrow [simplify]
[1.2] \; (80 - \mathbf{asType} < \mathbf{integer} > (\mathbf{count}_{loopend})) < (\mathbf{asType} < \mathbf{integer})
const>(limit) - asType < integer>(count_{loopstart\_1088,5}))
\rightarrow [from term 13.32, count<sub>loopend</sub> is equal to 1 + count<sub>loopstart_1088.5</sub>]
[1.3] (80 - asType<integer>(1 + count_{loopstart\_1088,5})) <
(asType < integer const > (limit) - asType < integer > (count_{loopstart\_1088,5}))
\rightarrow [simplify]
[1.9] (79 + -\text{count}_{loopstart\_1088,5}) < (asType<integer const>(limit) -
asType<integer>(count_loopstart_1088.5))
\rightarrow [from term 4.6, limit is equal to 80]
[1.10] (79 + -\text{count}_{loopstart\_1088.5}) < (asType < integer const > (80) -
```

```
\mathbf{asType}{<}\mathbf{integer}{>}(\mathsf{count}_{loopstart\_1088,5}))
\rightarrow [simplify]
[1.22] true
Proof of verification condition: Loop body establishes end condition or
preserves validity of variant
Condition generated at: C:\Escher\Customers\prang-cpp\prang.cpp
Condition defined at: C:\Escher\Customers\prang-cpp\prang.cpp (117,20)
To prove: 0 < (asType < integer const > (limit) - (limit) = (limi
\mathbf{asType}{<}\mathbf{integer}{>}(\mathtt{count}_{loopend}))
Given:
heap_{init}.LIMIT == (int)80
heap_{init}.class WHPrang \in M1 == (int)30269
heap_{init}.class WHPrang \in r1 == (int)171
heap_{init}.class WHPrang \in a1 == (int)177
heap_{init}.class WHPrang \in b1 == (int)2
\$heap_{init}.\mathbf{class}\ WHPrang \in M2 == (\mathbf{int})30307
heap_{init}.class WHPrang \in r2 == (int)172
heap_{init}.class WHPrang \in a2 == (int)176
heap_{init}.class WHPrang \in b2 == (int)35
heap_{init}.class WHPrang \in M3 == (int)30323
heap_{init}.class WHPrang \in r3 == (int)170
heap_{init}.class WHPrang \in a3 == (int)178
heap_{init}.class WHPrang \in b3 == (int)63
\text{Sheap}_{1079,1;1081,13,m1} == \text{Sheap}_{funcstart\_1079,1}.\_\mathbf{alloc}(\text{prang} \rightarrow \text{prang})
heap_{1079,1;1081,13} = 
\$ heap_{1079,1;1081,13,m1}. \textbf{\_replace}((\&\$ heap_{1079,1;1081,13,m1}. prang).\$ r \rightarrow \$ r + \$ r +
writes_1081_5)
limit == $heap<sub>1079,1;1081,13</sub>.LIMIT
minof(int const) \le limit
limit \leq maxof(int const)
count == (int)0
minof(int) \le count
```

```
count < maxof(int)
heap_{1079,1;1086,5} ==
\rho_{1079,1;1081,13}.replace((&\parallel{place}) heap_{1079,1;1081,13}._ecv_files[1]).$r \rightarrow
writes_1086_5)
\text{\$heap}_{loopstart\_1088,5} == \text{\$heap}_{1079,1;1086,5}.\_\mathbf{replace}(\text{prang} \rightarrow
writes_1089_12)._replace(_ecv_files \rightarrow writes_1089_12)
\#writes_1089_12 == \#$heap<sub>1079,1;1086,5</sub>._ecv_files
minof(int) \leq count_{loopstart\_1088.5}
count_{loopstart\_1088,5} \leq maxof(int)
\operatorname{count}_{loopstart\_1088.5} < \operatorname{limit}
0 \le (asType < integer const > (limit) -
asType < integer > (count_{loopstart\_1088,5}))
(\mathbf{asType} < \mathbf{integer\ const} > (\mathbf{limit}) - \mathbf{asType} < \mathbf{integer} > (\mathbf{count}_{loopstart\_1088,5}))
≤ (asType<integer const>(limit) - asType<integer>(count))
(++\text{count}_{loopstart\_1088,5} == \text{count}_{loopend}) \land (\$\text{heap}_{1092,16} ==
\$ heap_{loopstart\_1088,5}.\_\textbf{replace}((\&\$ heap_{loopstart\_1088,5}.prang).\$r \rightarrow
operator*(heapIs $heap_{loopstart\_1088,5},
&$heap_{loopstart\_1088,5}.prang)._replace(p1 \rightarrow
writes_1092_31))._replace((&$heap_{loopstart\_1088,5}.prang).$r \rightarrow
operator*(heapIs $heap_loopstart_1088,5,
&$heap_{loopstart\_1088,5}.prang)._replace(p2 \rightarrow
writes_1092_31))._replace((&$heap_{loopstart\_1088,5}.prang).$r \rightarrow
operator*(heapIs $heap_loopstart_1088.5,
&$heap_{loopstart\_1088.5}.prang)._replace(p3 \rightarrow writes_1092_31))) \land ($heap_{loopend}
== \$ heap_{1092,16}. \mathbf{replace}((\&\$ heap_{1092,16}. \mathbf{lecv\_files}[1]).\$r \rightarrow writes\_1092\_9)) \land \\
(\mathbf{asType} < \mathbf{real} > ((\mathbf{double})0.0) < \mathbf{asType} < \mathbf{real} > (\$result\_1092\_31)) \ \land \\
(asType < real > (\$result\_1092\_31) < asType < real > ((double)1.0))
count_{loopend} < limit
Proof:
[Take given term]
[2.0] $\text{heap}_{1079,1:1081,13,m1} == $\text{heap}_{funcstart\_1079,1}._\text{-alloc}(\text{prang}) \rightarrow \text{prang})
[Take given term]
[3.0] $heap<sub>1079,1:1081,13</sub> ==
heap_{1079,1;1081,13,m1}.replace((&p_{1079,1;1081,13,m1}.prang).r \rightarrow p_{1079,1;1081,13,m1}.
writes_1081_5)
\rightarrow [from term 2.0, p_{1079,1;1081,13,m1} is equal to
heap_{funcstart\_1079.1}._alloc(prang \rightarrow prang)
[3.1] heap_{1079,1;1081,13} == heap_{funcstart\_1079,1}._alloc(prang \rightarrow
```

```
prang)._replace((&$heap_{1079,1:1081,13,m1}.prang).$r \rightarrow writes_1081_5)
\rightarrow [simplify]
[3.2] \text{$heap}_{1079,1;1081,13} == \text{$heap}_{funcstart\_1079,1}.\_alloc(prang \rightarrow
prang)._replace((&$heap.prang).$r \rightarrow writes_1081_5)
→ [attribute value is known from postcondition]
[3.3] \text{sheap}_{1079,1;1081,13} == \text{sheap}_{funcstart\_1079,1}.\_\text{alloc}(\text{prang} \rightarrow
prang).\_replace(&$heap.prang \rightarrow writes_1081_5)
→ [replacing contents of address-of object is same as replacing object]
[3.4] $heap<sub>1079,1;1081,13</sub> == $heap<sub>funcstart_1079,1</sub>._alloc(prang \rightarrow
prang)._replace(prang \rightarrow writes_1081_5)
[Take given term]
[4.0] $heap<sub>1079,1;1081,13</sub>.LIMIT == limit
\rightarrow [from term 3.4, $heap<sub>1079,1;1081,13</sub> is equal to
heap_{funcstart\_1079,1}._alloc(prang \rightarrow prang)._replace(prang \rightarrow writes_1081_5)]
[4.1] \; \$ heap_{funcstart\_1079,1}.\_ \textbf{alloc} (prang \rightarrow prang).\_ \textbf{replace} (prang \rightarrow prang).\_ \textbf{replace
writes_1081_5).LIMIT == limit
\rightarrow [const member of object with modified fields]
[4.3] $heap<sub>funcstart_1079,1</sub>.LIMIT == limit
\rightarrow [const static or extern object]
[4.4] $heap<sub>init</sub>.LIMIT == limit
\rightarrow [expand definition of constant 'LIMIT' at prang.cpp (13,18)]
[4.5] (int)80 == limit
\rightarrow [simplify]
[4.6] 80 == limit
[Take given term]
[13.0] (++\text{count}_{loopstart\_1088,5} == \text{count}_{loopend}) \land (\$\text{heap}_{1092,16} ==
\$heap_{loopstart\_1088,5}.\_\textbf{replace}((\&\$heap_{loopstart\_1088,5}.prang).\$r \rightarrow
operator*(heapIs $heap_{loopstart\_1088,5},
&$heap_loopstart_1088,5.prang)._replace(p1 \rightarrow
writes_1092_31))._replace((&$heap_{loopstart\_1088,5}.prang).$r \rightarrow
\mathbf{operator}^*(\mathbf{heapIs}\ \$ \mathrm{heap}_{loopstart\_1088,5},
&$heap_{loopstart\_1088,5}.prang)._replace(p2 \rightarrow
writes_1092_31))._replace((&$heap_{loopstart\_1088,5}.prang).$r \rightarrow
\mathbf{operator}^*(\mathbf{heapIs}\ \$ \mathrm{heap}_{loopstart\_1088,5},
&heap_{loopstart\_1088,5}.prang)._replace(p3 \rightarrow writes_1092_31))) \land (heap_{loopend}
== $heap<sub>1092,16</sub>._replace((&$heap<sub>1092,16</sub>._ecv_files[1]).$r \rightarrow writes_1092_9)) \land
(asType < real > ((double)0.0) < asType < real > (\$result\_1092\_31)) \land
```

```
(asType < real > (\$result\_1092\_31) < asType < real > ((double)1.0))
\rightarrow [simplify]
[13.8] (1 == (count_{loopend} + -count_{loopstart\_1088,5})) \land (\$heap_{1092,16} ==
\rho_{loopstart\_1088,5}. replace((&\heap_{loopstart\_1088,5}.prang).\hat{r} \rightarrow
operator*(heapIs $heap_{loopstart\_1088,5},
&heap_{loopstart\_1088.5}.prang)._replace(p1 \rightarrow
writes_1092_31))._replace((&$heap_{loopstart\_1088,5}.prang).$r \rightarrow
operator*(heapIs $heap_{loopstart\_1088,5},
&$heap_{loopstart\_1088,5}.prang)._replace(p2 \rightarrow
writes_1092_31))._replace((&$heap_{loopstart\_1088,5}.prang).$r \rightarrow
\mathbf{operator}^*(\mathbf{heapIs}\ \$\mathbf{heap}_{loopstart\_1088,5},
&heap_{loopstart\_1088,5}.prang)._replace(p3 \rightarrow writes_1092_31))) \land (heap_{loopend}
== $heap<sub>1092,16</sub>._replace((&$heap<sub>1092,16</sub>._ecv_files[1]).$r \rightarrow writes_1092_9)) \land
(asType < real > ((double)0.0) < asType < real > (\$result_1092_31)) \land
(asType < real > (\$result\_1092\_31) < asType < real > ((double)1.0))
\rightarrow [Dereference address-of object]
[13.9] (1 == (-\text{count}_{loopstart\_1088,5} + \text{count}_{loopend})) \land (\$\text{heap}_{1092,16} ==
\rho_{loopstart\_1088,5}.\_replace((\&\rho_{loopstart\_1088,5}.prang).r)
heap_{loopstart_{-1088.5}}.prang._replace(p1 \rightarrow
writes_1092_31))._replace((&$heap_{loopstart\_1088,5}.prang).$r \rightarrow
operator*(heapIs $heap_{loopstart\_1088,5},
&$heap_loopstart_1088,5.prang)._replace(p2 \rightarrow
writes_1092_31))._replace((&$heap_{loopstart\_1088.5}.prang).$r \rightarrow
operator*(heapIs $heap_{loopstart\_1088,5},
&\hat{heap}_{loopstart\_1088,5}.prang)._replace(p3 \rightarrow writes_1092_31))) \land (\hat{heap}_{loopend})
== \$ heap_{1092,16}. \mathbf{\_replace}((\&\$ heap_{1092,16}. \underline{\_ecv\_files}[1]).\$r \rightarrow writes\_1092\_9)) \ \land \\
(asType < real > ((double)0.0) < asType < real > (\$result\_1092\_31)) \land
(asType < real > (\$result\_1092\_31) < asType < real > ((double)1.0))
\rightarrow [simplify]
[13.10] (1 == (-\text{count}_{loopstart\_1088,5} + \text{count}_{loopend})) \land (\$\text{heap}_{1092,16} ==
\rho_{loopstart\_1088,5}._replace((&$heap.prang).$r \rightarrow
heap_{loopstart\_1088,5}.prang.\_replace(p1 \rightarrow
writes_1092_31))._replace((&$heap_{loopstart\_1088,5}.prang).$r \rightarrow
operator*(heapIs $heap_{loopstart\_1088,5},
&$heap_loopstart_1088,5.prang)._replace(p2 \rightarrow
writes_1092_31))._replace((&$heap_{loopstart_1088,5}.prang).$r \rightarrow
\mathbf{operator}^*(\mathbf{heapIs}\ \$\mathbf{heap}_{loopstart\_1088,5},
&heap_{loopstart\_1088,5}.prang)._replace(p3 \rightarrow writes_1092_31))) \land (heap_{loopend}
== $heap<sub>1092,16</sub>._replace((&$heap<sub>1092,16</sub>._ecv_files[1]).$r \rightarrow writes_1092_9)) \land
(asType < real > ((double)0.0) < asType < real > (\$result_1092_31)) \land
(asType < real > (\$result\_1092\_31) < asType < real > ((double)1.0))
\rightarrow [attribute value is known from postcondition]
```

```
[13.11] (1 == (-\text{count}_{loopstart\_1088,5} + \text{count}_{loopend})) \land (\$\text{heap}_{1092,16} ==
\text{Sheap}_{loopstart\_1088,5}.\_\mathbf{replace}((\&\text{Sheap.prang}) \rightarrow
heap_{loopstart\_1088,5}.prang.\_replace(p1 \rightarrow
writes_1092_31))._replace((&$heap_{loopstart\_1088.5}.prang).$r \rightarrow
operator*(heapIs $heap_loopstart_1088.5,
&$heap_loopstart_1088.5.prang)._replace(p2 \rightarrow
writes_1092_31))._replace((&$heap_{loopstart\_1088,5}.prang).$r \rightarrow
operator*(heapIs $heap<sub>loonstart_1088.5</sub>,
&heap_{loopstart\_1088.5}.prang)._replace(p3 \rightarrow writes_1092_31))) \land (heap_{loopend}
== $heap<sub>1092,16</sub>._replace((&$heap<sub>1092,16</sub>._ecv_files[1]).$r \rightarrow writes_1092_9)) \land
(asType < real > ((double)0.0) < asType < real > (\$result\_1092\_31)) \land
(asType < real > (\$result\_1092\_31) < asType < real > ((double)1.0))
→ [replacing contents of address-of object is same as replacing object]
[13.12] (1 == (-\text{count}_{loopstart\_1088,5} + \text{count}_{loopend})) \land (\$\text{heap}_{1092,16} ==
\text{Sheap}_{loopstart\_1088,5}.replace(prang \rightarrow \text{Sheap}_{loopstart\_1088,5}.prang._replace(p1
\rightarrow writes_1092_31))._replace((&$heap_{loopstart\_1088,5}.prang).$r \rightarrow
operator*(heapIs $heap_{loopstart\_1088,5},
&heap_{loopstart\_1088.5}.prang)._replace(p2 \rightarrow
writes_1092_31))._replace((&$heap_{loopstart\_1088,5}.prang).$r \rightarrow
operator*(heapIs $heap_loopstart_1088,5,
&heap_{loopstart\_1088.5}.prang)._replace(p3 \rightarrow writes_1092_31))) \land (heap_{loopend}
== $heap<sub>1092,16</sub>._replace((&$heap<sub>1092,16</sub>._ecv_files[1]).$r \rightarrow writes_1092_9)) \land
(\mathbf{asType} < \mathbf{real} > ((\mathbf{double})0.0) < \mathbf{asType} < \mathbf{real} > (\$ result\_1092\_31)) \ \land \\
(\mathbf{asType} < \mathbf{real} > (\$\mathbf{result\_1092\_31}) < \mathbf{asType} < \mathbf{real} > ((\mathbf{double})1.0))
\rightarrow [Dereference address-of object]
[13.13] (1 == (-\text{count}_{loopstart\_1088,5} + \text{count}_{loopend})) \land (\$\text{heap}_{1092,16} ==
\text{Sheap}_{loopstart\_1088.5}.replace(prang \rightarrow \text{Sheap}_{loopstart\_1088.5}.prang.replace(p1
\rightarrow writes_1092_31))._replace((&$heap_{loopstart\_1088,5}.prang).$r \rightarrow
heap_{loopstart\_1088,5}.prang.\_replace(p2 \rightarrow
writes_1092_31))._replace((&$heap_{loopstart\_1088,5}.prang).$r \rightarrow
operator*(heapIs $heap_loopstart_1088,5,
&heap_{loopstart\_1088,5}.prang).\_replace(p3 \rightarrow writes\_1092\_31))) \land (heap_{loopend})
== $heap<sub>1092,16</sub>._replace((&$heap<sub>1092,16</sub>._ecv_files[1]).$r \rightarrow writes_1092_9)) \land
(asType < real > ((double)0.0) < asType < real > (\$result\_1092\_31)) \land
(asType < real > (\$result\_1092\_31) < asType < real > ((double)1.0))
\rightarrow [simplify]
[13.14] (1 == (-\text{count}_{loopstart\_1088,5} + \text{count}_{loopend})) \land (\$\text{heap}_{1092,16} ==
\text{Sheap}_{loopstart\_1088,5}._replace(prang \rightarrow \text{Sheap}_{loopstart\_1088,5}.prang._replace(p1
\rightarrow writes_1092_31))._replace((&$heap.prang).$r \rightarrow
heap_{loopstart\_1088,5}.prang.\_replace(p2 \rightarrow
writes_1092_31))._replace((&$heap_{loopstart\_1088,5}.prang).$r \rightarrow
operator*(heapIs $heap_{loopstart\_1088,5},
&heap_{loopstart\_1088,5}.prang).\_replace(p3 \rightarrow writes\_1092\_31))) \land (heap_{loopend})
```

```
== $heap<sub>1092.16</sub>._replace((&$heap<sub>1092.16</sub>._ecv_files[1]).$r \rightarrow writes_1092_9)) \land
(asType < real > ((double)0.0) < asType < real > (\$result\_1092\_31)) \land
(asType < real > (\$result\_1092\_31) < asType < real > ((double)1.0))
→ [attribute value is known from postcondition]
[13.15] (1 == (-\text{count}_{loopstart\_1088,5} + \text{count}_{loopend})) \land (\$\text{heap}_{1092,16} ==
\$heap_{loopstart\_1088,5}.\mathbf{replace}(prang \rightarrow \$heap_{loopstart\_1088,5}.prang.\mathbf{\_replace}(p1)
\rightarrow writes_1092_31))._replace((&$heap.prang) \rightarrow
heap_{loopstart\_1088,5}.prang.\_replace(p2 \rightarrow
writes_1092_31))._replace((&$heap_{loopstart\_1088,5}.prang).$r \rightarrow
operator*(heapIs $heap<sub>loonstart 1088.5</sub>,
&heap_{loopstart\_1088,5}.prang).\_replace(p3 \rightarrow writes\_1092\_31))) \land (heap_{loopend})
== $heap<sub>1092,16</sub>._replace((&$heap<sub>1092,16</sub>._ecv_files[1]).$r \rightarrow writes_1092_9)) \land
(asType < real > ((double)0.0) < asType < real > (\$result_1092.31)) \land
(asType < real > (\$result\_1092\_31) < asType < real > ((double)1.0))
→ [replacing contents of address-of object is same as replacing object]
[13.16] (1 == (-\text{count}_{loopstart\_1088,5} + \text{count}_{loopend})) \land (\$\text{heap}_{1092,16} ==
\text{Sheap}_{loopstart\_1088,5}._replace(prang \rightarrow \text{Sheap}_{loopstart\_1088,5}.prang._replace(p1
\rightarrow writes_1092_31))._replace(prang \rightarrow $heap_loopstart_1088,5.prang._replace(p2
\rightarrow writes_1092_31))._replace((&$heap_{loopstart\_1088,5}.prang).$r \rightarrow
\mathbf{operator}^*(\mathbf{heapIs}\ \$ \mathrm{heap}_{loopstart\_1088,5},
&heap_{loopstart\_1088,5}.prang)._replace(p3 \rightarrow writes_1092_31))) \land (heap_{loopend}
== $heap<sub>1092.16</sub>._replace((&$heap<sub>1092.16</sub>._ecv_files[1]).$r \rightarrow writes_1092_9)) \land
(asType < real > ((double)0.0) < asType < real > (\$result_1092_31)) \land
(asType < real > (\$result\_1092\_31) < asType < real > ((double)1.0))
\rightarrow [Dereference address-of object]
[13.17] (1 == (-\text{count}_{loopstart\_1088,5} + \text{count}_{loopend})) \land ($heap<sub>1092,16</sub> ==
\theta = \theta_{loopstart\_1088,5}._replace(prang \to \theta_{loopstart\_1088,5}.prang._replace(p1)
\rightarrow writes_1092_31))._replace(prang \rightarrow $heap<sub>loopstart_1088,5</sub>.prang._replace(p2
\rightarrow writes_1092_31))._replace((&$heap_{loopstart\_1088,5}.prang).$r \rightarrow
\rho_{loopstart\_1088,5}.prang.\_replace(p3 \rightarrow writes\_1092\_31))) \land (\rho_{loopstart\_1088,5}.prang.\_replace(p3 \rightarrow writes\_1092\_31)))
== $heap<sub>1092.16</sub>._replace((&$heap<sub>1092.16</sub>._ecv_files[1]).$r \rightarrow writes_1092_9)) \land
(asType < real > ((double)0.0) < asType < real > (\$result_1092_31)) \land
(asType < real > (\$result\_1092\_31) < asType < real > ((double)1.0))
\rightarrow [simplify]
[13.18] (1 == (-\text{count}_{loopstart\_1088,5} + \text{count}_{loopend})) \land (\$\text{heap}_{1092,16} ==
\rho_{loopstart\_1088,5}.\_replace(prang \rightarrow \rho_{loopstart\_1088,5}.prang.\_replace(p1)
\rightarrow \text{writes\_1092\_31})).\_\textbf{replace}(\text{prang} \rightarrow \$\text{heap}_{loopstart\_1088,5}.\text{prang}.\_\textbf{replace}(\text{p2}))
\rightarrow writes_1092_31))._replace((&$heap.prang).$r \rightarrow
\text{heap}_{loopstart\_1088,5}.\text{prang.\_replace}(\text{p3} \rightarrow \text{writes\_1092\_31}))) \land (\text{heap}_{loopend})
== $heap<sub>1092,16</sub>._replace((&$heap<sub>1092,16</sub>._ecv_files[1]).$r \rightarrow writes_1092_9)) \land
(asType < real > ((double)0.0) < asType < real > (\$result_1092_31)) \land
(asType < real > (\$result\_1092\_31) < asType < real > ((double)1.0))
```

```
\rightarrow [attribute value is known from postcondition]
[13.19] (1 == (-\text{count}_{loopstart\_1088,5} + \text{count}_{loopend})) \land (\$\text{heap}_{1092,16} ==
\rho_{loopstart\_1088,5}.\_replace(prang \rightarrow \rho_{loopstart\_1088,5}.prang.\_replace(p1)
\rightarrow writes_1092_31))._replace(prang \rightarrow $heap_loopstart_1088,5.prang._replace(p2
\rightarrow writes_1092_31))._replace(&$heap.prang \rightarrow
\text{heap}_{loopstart\_1088,5}.\text{prang.\_replace}(\text{p3} \rightarrow \text{writes\_1092\_31}))) \land (\text{heap}_{loopend})
== $heap<sub>1092,16</sub>._replace((&$heap<sub>1092,16</sub>._ecv_files[1]).$r \rightarrow writes_1092_9)) \land
(asType < real > ((double)0.0) < asType < real > (\$result_1092_31)) \land
(asType < real > (\$result\_1092\_31) < asType < real > ((double)1.0))
→ [replacing contents of address-of object is same as replacing object]
[13.20] (1 == (-\text{count}_{loopstart\_1088,5} + \text{count}_{loopend})) \land (\$\text{heap}_{1092,16} ==
\$heap_{loopstart\_1088,5}.\mathbf{replace}(prang \rightarrow \$heap_{loopstart\_1088,5}.prang.\mathbf{\_replace}(p1)
\rightarrow \text{writes\_1092\_31})).\_\textbf{replace}(\text{prang} \rightarrow \$\text{heap}_{loopstart\_1088,5}.\text{prang}.\_\textbf{replace}(\text{p2}))
\rightarrow writes_1092_31))._replace(prang \rightarrow $heap<sub>loopstart_1088,5</sub>.prang._replace(p3
\rightarrow writes_1092_31)) \land ($heap<sub>loopend</sub> ==
\rho_{1092.16.}-replace((&\parallelefta_{1092.16.}-ecv_files[1]).\Psr \rightarrow writes_1092_9)) \rightarrow
(asType < real > ((double)0.0) < asType < real > (\$result_1092_31)) \land
(asType < real > (\$result\_1092\_31) < asType < real > ((double)1.0))
\rightarrow [simplify]
[13.21] (1 == (-\text{count}_{loopstart\_1088,5} + \text{count}_{loopend})) \land (\$\text{heap}_{1092,16} ==
\rho_{loopstart\_1088,5}.\_replace(prang \rightarrow \rho_{loopstart\_1088,5}.prang.\_replace(p1)
\rightarrow \text{writes\_1092\_31)}).\_\textbf{replace}(\text{prang} \rightarrow \$\text{heap}_{loopstart\_1088,5}.\text{prang}.\_\textbf{replace}(\text{p2}))
\rightarrow \text{writes\_1092\_31})).\_\textbf{replace}(\text{prang} \rightarrow \$\text{heap}_{loopstart\_1088,5}.\text{prang}.\_\textbf{replace}(\text{p3}))
\rightarrow writes_1092_31))) \land ($heap<sub>loopend</sub> ==
\theta_{1092,16}. replace((&\text{heap._ecv_files}[1]).\text{$r$} \to \text{writes}_1092_9)) \lambda
(asType < real > ((double)0.0) < asType < real > (\$result_1092_31)) \land
(asType < real > (\$result\_1092\_31) < asType < real > ((double)1.0))
\rightarrow [attribute value is known from postcondition]
[13.22] (1 == (-\text{count}_{loopstart\_1088,5} + \text{count}_{loopend})) \land (\$\text{heap}_{1092,16} ==
\text{Sheap}_{loopstart\_1088,5}.\_\mathbf{replace}(\text{prang} \rightarrow \text{Sheap}_{loopstart\_1088,5}.\text{prang}.\_\mathbf{replace}(\text{p1})
\rightarrow \text{writes\_1092\_31})).\_\textbf{replace}(\text{prang} \rightarrow \$\text{heap}_{loopstart\_1088,5}.\text{prang}.\_\textbf{replace}(\text{p2}))
\rightarrow \text{writes\_1092\_31})).\_\textbf{replace}(\text{prang} \rightarrow \$\text{heap}_{loopstart\_1088,5}.\text{prang}.\_\textbf{replace}(\text{p3}))
\rightarrow writes_1092_31))) \land ($heap<sub>loopend</sub> ==
heap_{1092,16}._replace(&\heap._ecv_files[1] \rightarrow writes_1092_9)) \lambda
(asType < real > ((double)0.0) < asType < real > (\$result_1092_31)) \land
(asType < real > (\$result\_1092\_31) < asType < real > ((double)1.0))
\rightarrow [simplify]
[13.31] (1 == (-\text{count}_{loopstart\_1088,5} + \text{count}_{loopend})) \land ($heap<sub>1092,16</sub> ==
\theta_{loopstart\_1088,5}._replace(prang \to \theta_{loopstart\_1088,5}.prang._replace(p1)
\rightarrow writes_1092_31))._replace(prang \rightarrow $heap<sub>loopstart_1088,5</sub>.prang._replace(p2
\rightarrow writes_1092_31))._replace(prang \rightarrow $heap<sub>loopstart_1088,5</sub>.prang._replace(p3
\rightarrow writes_1092_31))) \land ($heap<sub>loopend</sub> ==
```

```
\rho_{1092.16}._replace(&\hat{heap._ecv_files}[1] \rightarrow writes_1092_9)) \wedge (0.0 <
\text{sresult}_{1092\_31}) \land (-1.0 < -\text{sresult}_{1092\_31})
\rightarrow [separate conjunction and work on first sub-term]
[13.32] 1 == (-\operatorname{count}_{loopstart\_1088,5} + \operatorname{count}_{loopend})
[Take given term]
[26.0] count<sub>loopend</sub> < limit
\rightarrow [from term 13.32, count_{loopend} is equal to 1 + count_{loopstart\_1088,5}]
[26.1] (1 + count_{loopstart_{-1088,5}}) < limit
\rightarrow [from term 4.6, limit is equal to 80]
[26.2] (1 + count_{loopstart\_1088,5}) < 80
\rightarrow [simplify]
[26.9] \ \hbox{--} 79 < -\text{count}_{loopstart\_1088,5}
[Take goal term]
[1.0] 0 \leq (asType<integer const>(limit) -
asType < integer > (count_{loopend}))
\rightarrow [from term 4.6, limit is equal to 80]
[1.1] 0 \le (asType < integer\ const > (80) - asType < integer > (count_{loopend}))
\rightarrow [simplify]
[1.2] 0 \le (80 - \mathbf{asType} < \mathbf{integer} > (\mathbf{count}_{loopend}))
\rightarrow [from term 13.32, count<sub>loopend</sub> is equal to 1 + count<sub>loopstart_1088,5</sub>]
[1.3] 0 \le (80 - \mathbf{asType} < \mathbf{integer} > (1 + \mathbf{count}_{loopstart\_1088,5}))
\rightarrow [simplify]
\textit{[1.13]} -80 < -\text{count}_{loopstart\_1088,5}
\rightarrow [from term 26.9, literala <-count_{loopstart\_1088,5} is true whenever (-1 +
literala) < -79
    Proof of rule precondition:
    [1.13.0](-80 + -1) < -79
    \rightarrow [simplify]
    [1.13.2] true
[1.14] true
```

Proof of verification condition: Arithmetic result of operator '++' is within limit of type 'int'

Condition generated at: C:\Escher\Customers\prang-cpp\prang.cpp

```
(120,9)
Condition defined at:
To prove: minof(int) \le ++count_{loopstart\_1088,5}
Given:
heap_{init}.LIMIT == (int)80
heap_{init}.class WHPrang \in M1 == (int)30269
heap_{init}.class WHPrang \in r1 == (int)171
heap_{init}.class WHPrang \in a1 == (int)177
heap_{init}.class WHPrang \in b1 == (int)2
heap_{init}.class WHPrang \in M2 == (int)30307
heap_{init}.class WHPrang \in r2 == (int)172
heap_{init}.class WHPrang \in a2 == (int)176
heap_{init}.class WHPrang \in b2 == (int)35
heap_{init}.class WHPrang \in M3 == (int)30323
heap_{init}.class WHPrang \in r3 == (int)170
heap_{init}.class WHPrang \in a3 == (int)178
heap_{init}.class WHPrang \in b3 == (int)63
\text{Sheap}_{1079,1;1081,13,m1} == \text{Sheap}_{funcstart\_1079,1}.\_\mathbf{alloc}(\text{prang} \rightarrow \text{prang})
heap_{1079,1;1081,13} = 
\text{Sheap}_{1079,1;1081,13,m1}._replace((&\text{$heap}_{1079,1;1081,13,m1}.prang).\text{$r} \rightarrow
writes_1081_5)
limit == \$ heap_{1079,1;1081,13}.LIMIT
minof(int \ const) \le limit
limit \leq maxof(int const)
count == (int)0
minof(int) \le count
\mathrm{count} \leq \mathbf{maxof}(\mathbf{int})
heap_{1079,1;1086,5} ==
heap_{1079,1;1081,13}.replace((&place(),place(),place(),place(),place(),place(),place(),place(),place(),place(),place(),place(),place(),place(),place(),place(),place(),place(),place(),place(),place(),place(),place(),place(),place(),place(),place(),place(),place(),place(),place(),place(),place(),place(),place(),place(),place(),place(),place(),place(),place(),place(),place(),place(),place(),place(),place(),place(),place(),place(),place(),place(),place(),place(),place(),place(),place(),place(),place(),place(),place(),place(),place(),place(),place(),place(),place(),place(),place(),place(),place(),place(),place(),place(),place(),place(),place(),place(),place(),place(),place(),place(),place(),place(),place(),place(),place(),place(),place(),place(),place(),place(),place(),place(),place(),place(),place(),place(),place(),place(),place(),place(),place(),place(),place(),place(),place(),place(),place(),place(),place(),place(),place(),place(),place(),place(),place(),place(),place(),place(),place(),place(),place(),place(),place(),place(),place(),place(),place(),place(),place(),place(),place(),place(),place(),place(),place(),place(),place(),place(),place(),place(),place(),place(),place(),place(),place(),place(),place(),place(),place(),place(),place(),place(),place(),place(),place(),place(),place(),place(),place(),place(),place(),place(),place(),place(),place(),place(),place(),place(),place(),place(),place(),place(),place(),place(),place(),place(),place(),place(),place(),place(),place(),place(),place(),place(),place(),place(),place(),place(),place(),place(),place(),place(),place(),place(),place(),place(),place(),place(),place()
writes_1086_5)
\text{\$heap}_{loopstart\_1088,5} == \text{\$heap}_{1079,1;1086,5}.\_\mathbf{replace}(\text{prang} \rightarrow
writes_1089_12)._replace(_ecv_files \rightarrow writes_1089_12)
\#writes_1089_12 == \#$heap<sub>1079,1:1086,5</sub>._ecv_files
minof(int) \leq count_{loopstart\_1088,5}
```

```
count_{loopstart\_1088,5} \le maxof(int)
count_{loopstart\_1088,5} < limit
0 < (asType < integer const > (limit) -
\mathbf{asType}{<}\mathbf{integer}{>}(\mathsf{count}_{loopstart\_1088,5}))
(\mathbf{asType} < \mathbf{integer\ const} > (\mathbf{limit}) - \mathbf{asType} < \mathbf{integer} > (\mathbf{count}_{loopstart\_1088,5}))
\leq (asType < integer const > (limit) - asType < integer > (count))
\rho_{1092,16} == \rho_{loopstart\_1088,5}.replace((&\hat{heap}_{loopstart\_1088,5}.prang).\hat{sr}
\rightarrow operator*(heapIs $heap_{loopstart\_1088.5},
&heap_{loopstart\_1088.5}.prang)._replace(p1 \rightarrow
writes_1092_31))._replace((&$heap_{loopstart\_1088,5}.prang).$r \rightarrow
operator*(heapIs $heap_loopstart_1088,5,
&$heap_{loopstart\_1088.5}.prang)._replace(p2 \rightarrow
writes_1092_31))._replace((&$heap_{loopstart\_1088,5}.prang).$r \rightarrow
\mathbf{operator}^*(\mathbf{heapIs}\ \$ \mathrm{heap}_{loopstart\_1088,5},
&heap_{loopstart\_1088,5}.prang)._replace(p3 \rightarrow writes_1092_31))
heap_{loopend} == heap_{1092.16}. replace((\& heap_{1092.16}. ecv_files[1]). r \rightarrow
writes_1092_9)
asType < real > ((double)0.0) < asType < real > ($result_1092_31)
asType < real > (\$result\_1092\_31) < asType < real > ((double)1.0)
Proof:
[Take given term]
[2.0] $\text{heap}_{1079,1;1081,13,m1} == $\text{heap}_{funcstart\_1079,1}._\text{alloc}(\text{prang} \rightarrow \text{prang})
[Take given term]
[3.0] $heap<sub>1079,1;1081,13</sub> ==
\text{Sheap}_{1079,1;1081,13,m1}.\text{-replace}((\&\text{Sheap}_{1079,1;1081,13,m1}.\text{prang}).\text{Sr} \rightarrow
writes_1081_5)
\rightarrow [from term 2.0, $heap<sub>1079,1;1081,13,m1</sub> is equal to
heap_{funcstart\_1079,1}._alloc(prang \rightarrow prang)
[3.1] heap_{1079,1;1081,13} == heap_{funcstart\_1079,1}._alloc(prang \rightarrow
prang)._replace((&$heap_{1079,1;1081,13,m1}.prang).$r \rightarrow writes_1081_5)
\rightarrow [simplify]
[3.2] \text{Sheap}_{1079,1;1081,13} == \text{Sheap}_{funcstart\_1079,1}.\_\mathbf{alloc}(\text{prang} \rightarrow
prang)._replace((&$heap.prang).$r \rightarrow writes_1081_5)
\rightarrow [attribute value is known from postcondition]
[3.3] \text{Sheap}_{1079,1:1081,13} == \text{Sheap}_{funcstart\_1079,1}.\_\mathbf{alloc}(\text{prang} \rightarrow
prang).\_replace(&$heap.prang \rightarrow writes_1081_5)
→ [replacing contents of address-of object is same as replacing object]
```

```
[3.4] heap_{1079,1;1081,13} == heap_{funcstart\_1079,1}._alloc(prang \rightarrow
prang).\_replace(prang \rightarrow writes\_1081\_5)
[Take given term]
[4.0] $heap<sub>1079,1;1081,13</sub>.LIMIT == limit
\rightarrow [from term 3.4, $heap_{1079,1;1081,13} is equal to
heap_{funcstart\_1079,1}._alloc(prang \rightarrow prang)._replace(prang \rightarrow writes_1081_5)]
[4.1] heap_{funcstart\_1079,1}._alloc(prang \rightarrow prang)._replace(prang \rightarrow
writes_1081_5).LIMIT == limit
\rightarrow [const member of object with modified fields]
[4.3] $heap<sub>funcstart_1079,1</sub>.LIMIT == limit
\rightarrow [const static or extern object]
[4.4] $heap<sub>init</sub>.LIMIT == limit
\rightarrow [expand definition of constant 'LIMIT' at prang.cpp (13,18)]
[4.5] (int)80 == limit
\rightarrow [simplify]
[4.6] 80 == limit
[Take given term]
[5.0] (int)0 == count
\rightarrow [simplify]
[5.1] 0 == count
[Take given term]
[12.0] (asType<integer const>(limit) -
asType < integer > (count_{loopstart\_1088,5})) \le (asType < integer const > (limit)
- asType<integer>(count))
\rightarrow [from term 4.6, limit is equal to 80]
[12.1] (asType<integer const>(80) -
asType < integer > (count_{loopstart\_1088,5})) \le (asType < integer const > (limit)
- asType<integer>(count))
\rightarrow [simplify]
[12.4] (80 + -\text{count}_{loopstart\_1088,5}) \leq (asType<integer const>(limit) -
asType<integer>(count))
\rightarrow [from term 4.6, limit is equal to 80]
[12.5] (80 + -count_{loopstart\_1088,5}) \le (asType < integer const > (80) - (80)
asType<integer>(count))
\rightarrow [simplify]
```

```
[12.6] (80 + -\text{count}_{loopstart\_1088,5}) \le (80 - \text{asType} < \text{integer} > (\text{count}))
\rightarrow [from term 5.1, count is equal to 0]
[12.7] (80 + -\text{count}_{loopstart\_1088,5}) \le (80 - \text{asType} < \text{integer} > (0))
\rightarrow [simplify]
[12.20] -1 < count<sub>loopstart_1088,5</sub>
[Take goal term]
[1.0] minof(int) \leq ++count<sub>loopstart_1088,5</sub>
\rightarrow [simplify]
\textit{[1.6]} \ -32770 < \operatorname{count}_{loopstart\_1088,5}
\rightarrow [from term 12.20, literala < count_{loopstart\_1088,5} is true whenever (-1 +
literala) < -1
   Proof of rule precondition:
   [1.6.0](-32770 + -1) < -1
   \rightarrow [simplify]
   [1.6.2] true
[1.7] true
Proof of verification condition: Arithmetic result of operator '++' is
within limit of type 'int'
Condition generated at: C:\Escher\Customers\prang-cpp\prang.cpp
(120,9)
Condition defined at:
To prove: ++\text{count}_{loopstart\_1088,5} \leq \text{maxof}(\text{int})
Given:
heap_{init}.LIMIT == (int)80
heap_{init}.class WHPrang \in M1 == (int)30269
heap_{init}.class WHPrang \in r1 == (int)171
heap_{init}.class WHPrang \in a1 == (int)177
heap_{init}.class WHPrang \in b1 == (int)2
heap_{init}.class WHPrang \in M2 == (int)30307
heap_{init}.class WHPrang \in r2 == (int)172
heap_{init}.class WHPrang \in a2 == (int)176
heap_{init}.class WHPrang \in b2 == (int)35
```

```
heap_{init}.class WHPrang \in M3 == (int)30323
heap_{init}.class WHPrang \in r3 == (int)170
heap_{init}.class WHPrang \in a3 == (int)178
heap_{init}.class WHPrang \in b3 == (int)63
\text{Sheap}_{1079,1;1081,13,m1} == \text{Sheap}_{funcstart\_1079,1}.\_\mathbf{alloc}(\text{prang} \rightarrow \text{prang})
heap_{1079,1;1081,13} = 
\rho_{1079,1;1081,13,m1}.replace((&\pi_{1079,1;1081,13,m1}.prang).\pi_r \rightarrow
writes_1081_5)
limit == $heap<sub>1079,1;1081,13</sub>.LIMIT
minof(int const) \leq limit
limit \leq maxof(int const)
count == (int)0
minof(int) \le count
count \leq maxof(int)
heap_{1079,1;1086,5} = 
\rho_{1079,1;1081,13}._replace((&\parallel{place}) heap_{1079,1;1081,13}._ecv_files[1]).\parallel{place}$r \to \text{heap}
writes_1086_5)
\text{\$heap}_{loopstart\_1088,5} == \text{\$heap}_{1079,1;1086,5}.\_\mathbf{replace}(\text{prang} \rightarrow
writes_1089_12)._replace(_ecv_files \rightarrow writes_1089_12)
\#writes_1089_12 == \#$heap<sub>1079,1:1086.5</sub>.-ecv_files
minof(int) \leq count_{loopstart\_1088,5}
\operatorname{count}_{loopstart\_1088,5} \leq \operatorname{maxof}(\operatorname{int})
count_{loopstart\_1088,5} < limit
0 \le (asType < integer const > (limit) -
\mathbf{asType}{<}\mathbf{integer}{>}(\mathsf{count}_{loopstart\_1088,5}))
(asType<integer const>(limit) - asType<integer>(count_loopstart_1088.5))
\leq (asType < integer const > (limit) - asType < integer > (count))
\rho_{1092,16} == \rho_{loopstart\_1088,5}.replace((&\rho_{loopstart\_1088,5}.prang).\rho_{replace}
\rightarrow operator*(heapIs heap_{loopstart\_1088,5},
&$heap<sub>loopstart_1088,5</sub>.prang)._replace(p1 \rightarrow
writes_1092_31))._replace((&$heap_{loopstart\_1088,5}.prang).$r \rightarrow
operator*(heapIs $heap_{loopstart\_1088,5},
&\heap_{loopstart_1088,5}.prang)._replace(p2 \rightarrow
writes_1092_31))._replace((&$heap_{loopstart\_1088,5}.prang).$r \rightarrow
\mathbf{operator}^*(\mathbf{heapIs}\ \$\mathbf{heap}_{loopstart\_1088,5},
&heap_{loopstart\_1088,5}.prang).\_replace(p3 \rightarrow writes\_1092\_31))
heap_{loopend} == heap_{1092,16}.replace((&heap_{1092,16}.ecv_files[1]).$r \rightarrow
```

```
writes_1092_9)
asType < real > ((double)0.0) < asType < real > ($result_1092_31)
asType < real > (\$result\_1092\_31) < asType < real > ((double)1.0)
Proof:
[Take given term]
[2.0] $\text{heap}_{1079,1;1081,13,m1} == \text{$heap}_{funcstart\_1079,1}._\text{alloc}(\text{prang} \rightarrow \text{prang})
[Take given term]
[3.0] $heap<sub>1079,1;1081,13</sub> ==
\text{Sheap}_{1079,1;1081,13,m1}._replace((&\sheap}_{1079,1;1081,13,m1}.\text{prang}).\shr
writes_1081_5)
\rightarrow [from term 2.0, $heap<sub>1079,1;1081,13,m1</sub> is equal to
heap_{funcstart\_1079,1}._alloc(prang \rightarrow prang)]
[3.1] heap_{1079,1;1081,13} == heap_{funcstart\_1079,1}._alloc(prang \rightarrow
prang)._replace((&$heap_{1079,1;1081,13,m1}.prang).$r \rightarrow writes_1081_5)
\rightarrow [simplify]
[3.2] $\text{heap}_{1079,1;1081,13} == $\text{heap}_{funcstart\_1079,1}._\text{-alloc}(\text{prang} \rightarrow)
prang).\_replace((&$heap.prang).$r \rightarrow writes\_1081\_5)
\rightarrow [attribute value is known from postcondition]
[3.3] $heap<sub>1079,1;1081,13</sub> == $heap<sub>funcstart_1079,1</sub>._alloc(prang \rightarrow
prang)._replace(&\$heap.prang \rightarrow writes_1081_5)
→ [replacing contents of address-of object is same as replacing object]
[3.4] $heap<sub>1079,1;1081,13</sub> == $heap<sub>funcstart_1079,1</sub>._alloc(prang \rightarrow
prang).\_replace(prang \rightarrow writes\_1081\_5)
[Take given term]
[4.0] $heap<sub>1079,1;1081,13</sub>.LIMIT == limit
\rightarrow [from term 3.4, $heap<sub>1079,1;1081,13</sub> is equal to
heap_{funcstart\_1079.1}._alloc(prang \rightarrow prang)._replace(prang \rightarrow writes_1081_5)]
[4.1] heap_{funcstart\_1079,1}._alloc(prang \rightarrow prang)._replace(prang \rightarrow
writes_1081_5).LIMIT == limit
→ [const member of object with modified fields]
[4.3] $heap<sub>funcstart_1079,1</sub>.LIMIT == limit
\rightarrow [const static or extern object]
[4.4] $heap<sub>init</sub>.LIMIT == limit
\rightarrow [expand definition of constant 'LIMIT' at prang.cpp (13,18)]
[4.5] (int)80 == limit
```

```
\rightarrow [simplify]
[4.6] 80 == limit
[Take given term]
[11.0] \operatorname{count}_{loopstart\_1088,5} < \operatorname{limit}
\rightarrow [from term 4.6, limit is equal to 80]
[11.1] \operatorname{count}_{loopstart\_1088,5} < 80
\rightarrow [\text{simplify}]
[11.4] \text{ --80} < -\text{count}_{loopstart\_1088,5}
[Take goal term]
[1.0] ++count<sub>loopstart_1088,5</sub> \leq maxof(int)
\rightarrow [simplify]
[1.9] \ \hbox{--32767} < -\text{count}_{loopstart\_1088,5}
\rightarrow [from term 11.4, literala < -count_{loopstart\_1088,5} is true whenever (-1 +
literala) < -80
    Proof of rule precondition:
    [1.9.0](-32767 + -1) < -80
    \rightarrow [simplify]
    [1.9.2] true
[1.10] true
```

End of proofs for file C:\Escher\Customers\prang-cpp\prang.cpp