# Proofs for file C:\Escher\Customers\prang\prang.c Generated by Escher C Verifier Critical Systems Edition at 15:38:41 UTC on Monday July 13th 2020

#### **Escher Verification Studio file versions**

EscherTool 7.00 ecv 7.00.00.00rubric 7.00.00.01

## Proved 153 of 164 verification conditions.

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

Condition generated at: C:\Escher\Customers\prang\prang.c (47,22)

Condition defined at:

```
To prove: minof(int) \leq \$heap_{funcstart\_724,1}.p1
```

## Given:

```
heap_{init}.LIMIT == (int)80
\theta
\theta_{init}.r1 == asType < short int > ((int)171)
heap_{init}.a1 == asType < short int > ((int)177)
heap_{init}.M2 == asType < short int > ((int)30307)
\theta_{init}.r2 == asType<short int>((int)172)
```

 $heap_{init}.a2 == asType < short int > ((int)176)$ 

 $\theta$  sheap<sub>init</sub>.b2 == asType<short int>((int)35)

 $heap_{init}.M3 == asType < short int > ((int)30323)$ 

 $\theta_{init}$ .r3 == asType<short int>((int)170)

 $heap_{init}.a3 == asType < short int > ((int)178)$ 

 $heap_{init}.b3 == asType < short int > ((int)63)$ 

 $\theta$ 

 $\theta$ 

 $\theta = asType < short int > ((int)3)$ 

invariant1(heapIs  $heap_{funcstart_{-724,1}}$ )

#### **Proof:**

[Take given term]

```
[5.0] invariant1(heapIs heap_{funcstart_{-724,1}})
\rightarrow [expand definition of function 'invariant1' at prang.c (34,1)]
[5.1] ((((((0 < asType < integer > ($heap_{funcstart\_724,1}.p1)) &&
(asType < integer > (\$heap_{funcstart\_724,1}.p1) < 
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{M1})))~\&\&~(0<
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{p2})))\ \&\&
(\mathbf{asType} < \mathbf{integer} > (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p2}) <
asType < integer > (\$heap_{funcstart\_724,1}.M2))) \&\& (0 <
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{p3})))\ \&\&
(asType < integer > (\$heap_{funcstart\_724,1}.p3) < 
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{M3}))
\rightarrow [simplify]
[5.3] (((((0 < \theta_{funcstart\_724,1.p1) && (\theta_{funcstart\_724,1.p1)
\mathbf{asType} \small{<} \mathbf{integer} \small{>} (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{M1}))) \ \&\& \ (0 <
asType < integer > (\$heap_{funcstart\_724,1}.p2))) \&\&
(\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{p2}) <
asType < integer > (\$heap_{funcstart\_724,1}.M2))) \&\& (0 < funcstart\_724,1)
\mathbf{asType} {<} \mathbf{integer} {>} (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p3}))) \ \&\& \\
(asType < integer > (\$heap_{funcstart_{-724,1}}.p3) < 
asType < integer > (\$heap_{funcstart\_724,1}.M3))
\rightarrow [const static or extern object]
[5.4] (((((0 < \text{heap}_{funcstart\_724,1}.p1) && (\text{heap}_{funcstart\_724,1}.p1 <
asType < integer > (\$heap_{init}.M1))) \&\& (0 <
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p2})))\ \&\&
(asType < integer > ($heap_{funcstart\_724,1}.p2) < 
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{M2})))~\&\&~(0<
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{p3})))\ \&\&
(\mathbf{asType} < \mathbf{integer} > (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p3}) <
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{M3}))
\rightarrow [expand definition of constant 'M1' at prang.c (14,20)]
[5.5] (((((0 < $heap_{funcstart_724,1}.p1) && ($heap_{funcstart_724,1}.p1 < 
asType<integer>(asType<short int>((int)30269)))) && (0 <
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p2})))\ \&\&
(\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{p2}) <
asType < integer > (\$heap_{funcstart\_724,1}.M2))) \&\& (0 <
asType < integer > (\$heap_{funcstart\_724,1}.p3))) \&\&
(\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{p3}) <
asType < integer > (\$heap_{funcstart\_724.1}.M3))
\rightarrow [simplify]
[5.16] ((((-30269 < -\$heap_{funcstart\_724,1}.p1) \land (0 < \$heap_{funcstart\_724,1}.p1) 
(0 < \text{\$heap}_{funcstart\_724,1}.p2)) \&\& (\text{\$heap}_{funcstart\_724,1}.p2 <
```

```
asType<integer>(heap_{funcstart\_724,1}.M2))) && (0 <
asType < integer > (\$heap_{funcstart\_724,1}.p3))) \&\&
(\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{p3}) <
asType < integer > (\$heap_{funcstart\_724,1}.M3))
\rightarrow [const static or extern object]
[5.17] \left( \left( \left( \left( -30269 < -\$ \text{heap}_{funcstart\_724,1}.\text{p1} \right) \right. \wedge \left. \left( 0 < \$ \text{heap}_{funcstart\_724,1}.\text{p1} \right) \right. \wedge \right. \right)
(0 < \text{\$heap}_{funcstart\_724,1}.p2)) \&\& (\text{\$heap}_{funcstart\_724,1}.p2 <
asType < integer > (\$heap_{init}.M2))) \&\& (0 <
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{p3})))\ \&\&
(asType < integer > ($heap_{funcstart\_724,1}.p3) < 
asType < integer > (\$heap_{funcstart\_724,1}.M3))
\rightarrow [expand definition of constant 'M2' at prang.c (19,20)]
[5.18] ((((-30269 < -\$heap_{funcstart\_724,1}.p1) \land (0 < \$heap_{funcstart\_724,1}.p1) 
(0 < \text{\$heap}_{funcstart\_724,1}.p2)) \&\& (\text{\$heap}_{funcstart\_724,1}.p2 <
asType<integer>(asType<short int>((int)30307)))) && (0 <
asType < integer > (\$heap_{funcstart\_724,1}.p3))) \&\&
(asType < integer > (\$heap_{funcstart\_724,1}.p3) < 
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{M3}))
\rightarrow [simplify]
[5.30] ((-30307 < -$heap_funcstart_724,1.p2) \land (-30269 <
-\$heap_{funcstart\_724,1}.p1) \land (0 < \$heap_{funcstart\_724,1}.p1) \land (0 < \$heap_{funcstart\_724,1}.p1)
\text{heap}_{funcstart\_724,1.p2} \land (0 < \text{heap}_{funcstart\_724,1.p3})) \&\&
(\text{\$heap}_{funcstart\_724,1}.p3 < asType < integer > (\text{\$heap}_{funcstart\_724,1}.M3))
\rightarrow [const static or extern object]
[5.31] ((-30307 < -\$heap_{funcstart\_724,1}.p2) \land (-30269 <
-\$heap_{funcstart\_724,1}.p1) \land (0 < \$heap_{funcstart\_724,1}.p1) \land (0 < \$heap_{funcstart\_724,1}.p1)
\text{Sheap}_{funcstart_{724,1}.p2} \land (0 < \text{Sheap}_{funcstart_{724,1}.p3})) \&\&
(\text{\$heap}_{funcstart\_724,1}.\text{p3} < \mathbf{asType} < \mathbf{integer} > (\text{\$heap}_{init}.\text{M3}))
\rightarrow [expand definition of constant 'M3' at prang.c (24,20)]
[5.32] ((-30307 < -$heap<sub>funcstart_724,1.</sub>p2) \land (-30269 <
-\$heap_{funcstart\_724,1}.p1) \land (0 < \$heap_{funcstart\_724,1}.p1) \land (0 < \$heap_{funcstart\_724,1}.p1)
\text{Sheap}_{funcstart_{724,1}.p2} \land (0 < \text{Sheap}_{funcstart_{724,1}.p3})) \&\&
(\$heap_{funcstart\_724,1}.p3 < \mathbf{asType} < \mathbf{integer} > (\mathbf{asType} < \mathbf{short}
int > ((int)30323)))
\rightarrow [simplify]
[5.40] (-30323 < -\$heap_{funcstart\_724,1}.p3) \land (-30307 < -30307)
-\$heap_{funcstart\_724,1}.p2) \land (-30269 < -\$heap_{funcstart\_724,1}.p1) \land (0 < -\$heap_{funcstart\_724,1}.p1)
\text{Sheap}_{funcstart\_724,1}.\text{p1}) \land (0 < \text{Sheap}_{funcstart\_724,1}.\text{p2}) \land (0 <
heap_{funcstart_{-724,1}.p3}
[Work on sub-term 4 of conjunction in term 5.40]
```

```
[8.0] 0 < \text{$heap}_{funcstart\_724,1}.p1
[Take goal term]
[1.0] minof(int) \leq $heap<sub>funcstart_724,1</sub>.p1
\rightarrow [simplify]
[1.3] -32769 < heap_{funcstart\_724,1}.p1
\rightarrow [from term 8.0, literala < $heap<sub>funcstart_724,1</sub>.p1 is true whenever (-1 +
literala) < 0
   Proof of rule precondition:
   [1.3.0](-32769 + -1) < 0
   \rightarrow [simplify]
   [1.3.2] true
[1.4] true
Proof of verification condition: Type constraint satisfied in explicit
conversion from 'short int' to 'int'
Condition generated at: C:\Escher\Customers\prang\prang.c (47,22)
Condition defined at:
To prove: heap_{funcstart\_724,1}.p1 \le maxof(int)
Given:
heap_{init}.LIMIT == (int)80
\theta sheap<sub>init</sub>.M1 == asType<short int>((int)30269)
\theta_{init}.r1 == asType < short int > ((int)171)
heap_{init}.a1 == asType < short int > ((int)177)
\theta
heap_{init}.M2 == asType < short int > ((int)30307)
\theta_{init}.r2 == asType < short int > ((int)172)
heap_{init}.a2 == asType < short int > ((int)176)
\theta = asType < short int > ((int)35)
\theta = asType < short int > ((int)30323)
heap_{init}.r3 == asType < short int > ((int)170)
heap_{init}.a3 == asType < short int > ((int)178)
\theta = asType < short int > ((int)63)
\theta = asType < short int > ((int)1)
```

```
\rho_{init}.p2 == asType < short int > ((int)2)
\theta = asType < short int > ((int)3)
invariant1(heapIs heap_{funcstart\_724,1})
Proof:
[Take given term]
[5.0] invariant1(heapIs heap_{funcstart\_724,1}
\rightarrow [expand definition of function 'invariant1' at prang.c (34,1)]
[5.1] (((((0 < asType<integer>(sheap_{funcstart\_724,1}.p1)) &&
(asType < integer > (\$heap_{funcstart\_724,1}.p1) < 
asType < integer > (\$heap_{funcstart\_724,1}.M1))) \&\& (0 <
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p2})))\ \&\&
(asType < integer > (\$heap_{funcstart\_724,1}.p2) < 
asType < integer > (\$heap_{funcstart\_724,1}.M2))) \&\& (0 <
asType < integer > (\$heap_{funcstart\_724,1}.p3))) \&\&
(\mathbf{asType} < \mathbf{integer} > (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p3}) <
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{M3}))
\rightarrow [simplify]
[5.3] (((((0 < \theta_{funcstart\_724,1.p1}) && (\theta_{funcstart\_724,1.p1})
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{M1})))~\&\&~(0<
asType < integer > (\$heap_{funcstart\_724,1}.p2))) \&\&
(\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{p2}) <
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{M2})))~\&\&~(0<
asType < integer > (\$heap_{funcstart\_724,1}.p3))) \&\&
(asType < integer > ($heap_{funcstart\_724,1}.p3) < 
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{M3}))
\rightarrow [const static or extern object]
[5.4] (((((0 < $heap_{funcstart_{724,1}}.p1) && ($heap_{funcstart_{724,1}}.p1 < ])
asType<integer>(heap_{init}.M1))) && (0 <
asType < integer > (\$heap_{funcstart\_724,1}.p2))) \&\&
(\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{p2}) <
\mathbf{asType} \small{<} \mathbf{integer} \small{>} (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{M2}))) \ \&\& \ (0 <
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p3})))\ \&\&
(asType < integer > (\$heap_{funcstart_{-724.1}}.p3) < 
asType < integer > (\$heap_{funcstart\_724,1}.M3))
\rightarrow [expand definition of constant 'M1' at prang.c (14.20)]
asType<integer>(asType<short int>((int)30269)))) && (0 <
asType < integer > (\$heap_{funcstart\_724,1}.p2))) \&\&
(asType < integer > (\$heap_{funcstart\_724,1}.p2) <
asType<integer>(heap_{funcstart\_724,1}.M2))) && (0 <
```

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asType < integer > (\$heap_{funcstart\_724,1}.p3))) \&\&
(asType < integer > (\$heap_{funcstart\_724,1}.p3) < 
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{M3}))
\rightarrow [simplify]
[5.16] \left( \left( \left( \left( -30269 < -\$ \text{heap}_{funcstart\_724,1}.\text{p1} \right) \right. \wedge \left. \left( 0 < \$ \text{heap}_{funcstart\_724,1}.\text{p1} \right) \right. \wedge \right. \right)
(0 < \text{$heap}_{funcstart\_724.1}.p2)) \&\& (\text{$heap}_{funcstart\_724.1}.p2 <
asType < integer > (\$heap_{funcstart\_724,1}.M2))) \&\& (0 <
asType < integer > (\$heap_{funcstart\_724,1}.p3))) \&\&
(\mathbf{asType} {<} \mathbf{integer} {>} (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p3}) <
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{M3}))
\rightarrow [const static or extern object]
[5.17] ((((-30269 < -$heap_{funcstart\_724,1}.p1) \lambda (0 < $heap_{funcstart\_724,1}.p1) \lambda
(0 < \text{\$heap}_{funcstart\_724,1}.\text{p2})) && (\text{\$heap}_{funcstart\_724,1}.\text{p2} <
asType < integer > (\$heap_{init}.M2))) \&\& (0 <
asType < integer > (\$heap_{funcstart\_724,1}.p3))) \&\&
(\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{p3}) <
asType < integer > (\$heap_{funcstart\_724,1}.M3))
\rightarrow [expand definition of constant 'M2' at prang.c (19,20)]
[5.18] \; ((((-30269 < -\$ heap_{funcstart\_724,1}.p1) \; \land \; (0 < \$ heap_{funcstart\_724
(0 < \text{$heap}_{funcstart\_724,1}.p2)) \&\& (\text{$heap}_{funcstart\_724,1}.p2 <
asType<integer>(asType<short int>((int)30307)))) && (0 <
asType < integer > (\$heap_{funcstart\_724,1}.p3))) \&\&
(asType<integer>($heap_funcstart_724,1.p3) <
asType < integer > (\$heap_{funcstart\_724,1}.M3))
\rightarrow [simplify]
[5.30] ((-30307 < -$heap<sub>funcstart_724,1</sub>.p2) \land (-30269 <
-\$heap_{funcstart\_724,1}.p1) \land (0 < \$heap_{funcstart\_724,1}.p1) \land (0 < \$heap_{funcstart\_724,1}.p1)
\text{Sheap}_{funcstart\_724,1.p2}) \land (0 < \text{Sheap}_{funcstart\_724,1.p3})) \&\&
(\text{\$heap}_{funcstart\_724,1}.p3 < asType < integer > (\text{\$heap}_{funcstart\_724,1}.M3))
\rightarrow [const static or extern object]
[5.31] ((-30307 < -$heap_funcstart_724,1.p2) \land (-30269 <
-\$heap_{funcstart\_724,1}.p1) \land (0 < \$heap_{funcstart\_724,1}.p1) \land (0 < \$heap_{funcstart\_724,1}.p1)
\text{Sheap}_{funcstart\_724,1.p2} \land (0 < \text{Sheap}_{funcstart\_724,1.p3})) \&\&
(\text{\$heap}_{funcstart\_724,1}.p3 < asType < integer > (\text{\$heap}_{init}.M3))
\rightarrow [expand definition of constant 'M3' at prang.c (24,20)]
[5.32] ((-30307 < -$heap<sub>funcstart_724,1.</sub>p2) \wedge (-30269 <
-\$heap_{funcstart\_724,1}.p1) \land (0 < \$heap_{funcstart\_724,1}.p1) \land (0 < \$heap_{funcstart\_724,1}.p1)
\text{Sheap}_{funcstart_{724,1}.p2} \land (0 < \text{Sheap}_{funcstart_{724,1}.p3})) \&\&
(\$heap_{funcstart\_724,1}.p3 < \mathbf{asType} < \mathbf{integer} > (\mathbf{asType} < \mathbf{short}
int > ((int)30323)))
```

```
\rightarrow [simplify]
[5.40] (-30323 < -\text{$heap}_{funcstart\_724,1}.p3) \land (-30307 < -\text{$partstart}_{funcstart}]
-\$heap_{funcstart\_724,1}.p2) \land (-30269 < -\$heap_{funcstart\_724,1}.p1) \land (0 < -\$heap_{funcstart\_724,1}.p1)
\text{Sheap}_{funcstart\_724,1}.\text{p1}) \land (0 < \text{Sheap}_{funcstart\_724,1}.\text{p2}) \land (0 <
heap_{funcstart_{724,1}.p3}
[Work on sub-term 3 of conjunction in term 5.40]
\label{eq:continuous} \mbox{[7.0] -30269} < -\$ heap_{funcstart\_724,1}.p1
[Take goal term]
[1.0] $\text{heap}_{funcstart_724,1}.p1 \leq \text{maxof(int)}
\rightarrow [simplify]
\label{eq:continuous} \mbox{$[1.9]$ -32768} < -\$ heap_{funcstart\_724,1}.p1
\rightarrow [from term 7.0, literala < –$heap_{uncstart\_724,1}.p1 is true whenever (-1 +
literala) < -30269
   Proof of rule precondition:
   [1.9.0](-32768 + -1) < -30269
   \rightarrow [simplify]
   [1.9.2] true
[1.10] true
Proof of verification condition: Type constraint satisfied in explicit
conversion from 'short int const' to 'int'
Condition generated at: C:\Escher\Customers\prang\prang.c (47,31)
Condition defined at:
To prove: minof(int) \leq \text{$heap}_{funcstart\_724,1}.a1
Given:
heap_{init}.LIMIT == (int)80
\theta sheap<sub>init</sub>.M1 == asType<short int>((int)30269)
\label{eq:short_int} $$ \theta_{init}.r1 == asType < short int > ((int)171)$
\theta
\theta
\theta sheap<sub>init</sub>.M2 == asType<short int>((int)30307)
\theta_{init}.r2 == asType<short int>((int)172)
heap_{init}.a2 == asType < short int > ((int)176)
\theta
```

```
\theta = asType < short int > ((int)30323)
heap_{init}.r3 == asType < short int > ((int)170)
heap_{init}.a3 == asType < short int > ((int)178)
heap_{init}.b3 == asType < short int > ((int)63)
\theta = asType < short int > ((int)1)
\theta
\theta = asType < short int > ((int)3)
invariant
1<br/>({\bf heapIs}\ \${\rm heap}_{funcstart\_724,1})
Proof:
[Take goal term]
[1.0] minof(int) \leq $heap<sub>funcstart_724,1</sub>.a1
\rightarrow [simplify]
\textit{[1.1] -32768} \leq \$ \text{heap}_{funcstart\_724,1}.\text{a1}
\rightarrow [const static or extern object]
[1.2] -32768 \leq $heap<sub>init</sub>.a1
\rightarrow [expand definition of constant 'a1' at prang.c (16,20)]
[1.3] -32768 \le asType < short int > ((int)177)
\rightarrow [simplify]
[1.6] true
Proof of verification condition: Type constraint satisfied in explicit
conversion from 'short int const' to 'int'
Condition generated at: C:\Escher\Customers\prang\prang.c (47,31)
Condition defined at:
To prove: heap_{funcstart\_724,1}.a1 \leq maxof(int)
Given:
heap_{init}.LIMIT == (int)80
\theta sheap<sub>init</sub>.M1 == asType<short int>((int)30269)
\theta
\theta
\theta
heap_{init}.M2 == asType < short int > ((int)30307)
\theta
```

```
heap_{init}.b2 == asType<short int>((int)35)
\theta = asType < short int > ((int)30323)
heap_{init}.r3 == asType < short int > ((int)170)
heap_{init}.a3 == asType < short int > ((int)178)
heap_{init}.b3 == asType < short int > ((int)63)
\theta
\theta
\theta = asType < short int > ((int)3)
invariant1(heapIs heap_{funcstart_724,1})
Proof:
[Take goal term]
[1.0] heap_{funcstart\_724,1}.a1 \leq maxof(int)
\rightarrow [const static or extern object]
[1.1] $heap<sub>init</sub>.a1 \leq maxof(int)
\rightarrow [expand definition of constant 'a1' at prang.c (16,20)]
[1.2] asType<short int>((int)177) \le maxof(int)
\rightarrow [simplify]
[1.6] true
Proof of verification condition: Precondition of 'div' satisfied
Condition generated at: C:\Escher\Customers\prang\prang.c (47,18)
Condition defined at: C:\Escher\ecv\standard\stdlib.h (94,10)
To prove: 0 < asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a1))
Given:
heap_{init}.LIMIT == (int)80
heap_{init}.M1 == asType < short int > ((int)30269)
\theta_{init}.r1 == asType < short int > ((int)171)
heap_{init}.a1 == asType < short int > ((int)177)
\theta = asType < short int > ((int)2)
heap_{init}.M2 == asType < short int > ((int)30307)
heap_{init}.r2 == asType < short int > ((int)172)
heap_{init}.a2 == asType < short int > ((int)176)
```

 $\theta$ 

```
heap_{init}.M3 == asType < short int > ((int)30323)
\theta_{init}.r3 == asType<short int>((int)170)
heap_{init}.a3 == asType < short int > ((int)178)
heap_{init}.b3 == asType < short int > ((int)63)
\theta
\theta
\theta = asType < short int > ((int)3)
invariant1(heapIs heap_{funcstart\_724,1})
Proof:
[Take goal term]
[1.0] 0 < asType<integer>(asType<int>($heap_{funcstart\_724,1}.a1))
\rightarrow [const static or extern object]
[1.1] 0 < asType < integer > (asType < int > (\$heap_{init}.a1))
\rightarrow [expand definition of constant 'a1' at prang.c (16,20)]
[1.2] 0 < asType<integer>(asType<int>(asType<short
int>((int)177))
\rightarrow [simplify]
[1.7] true
Proof of verification condition: Type constraint satisfied in explicit
conversion from 'short int' to 'int'
Condition generated at: C:\Escher\Customers\prang\prang.c (49,22)
Condition defined at:
To prove: minof(int) \le \$heap_{funcstart\_724,1}.p2
Given:
heap_{init}.LIMIT == (int)80
heap_{init}.M1 == asType < short int > ((int)30269)
\theta_{init}.r1 == asType < short int > ((int)171)
heap_{init}.a1 == asType < short int > ((int)177)
\theta
heap_{init}.M2 == asType < short int > ((int)30307)
\theta_{init}.r2 == asType<short int>((int)172)
```

 $heap_{init}.b2 == asType < short int > ((int)35)$ 

```
\theta_{init}.a2 == asType<short int>((int)176)
heap_{init}.b2 == asType<short int>((int)35)
\theta sheap<sub>init</sub>.M3 == asType<short int>((int)30323)
heap_{init}.r3 == asType < short int > ((int)170)
heap_{init}.a3 == asType < short int > ((int)178)
heap_{init}.b3 == asType < short int > ((int)63)
\theta
\theta
\theta = asType < short int > ((int)3)
invariant1(heapIs heap_{funcstart\_724,1})
\operatorname{div1} == \operatorname{div}(\mathbf{heapIs} \ \operatorname{\$heap}_{funcstart\_724,1},
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p1}),
asType < int > (\$heap_{funcstart\_724,1}.a1))
(asType<integer>(asType<int>($heap_{tuncstart\_724.1}.p1)) /
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a1))) = =
asType<integer>(div1.quot)
(asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.p1)) \%
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a1))) = =
asType<integer>(div1.rem)
!(0 == asType < integer > (div1.rem)) || !(0 ==
asType<integer>(div1.quot))
Proof:
[Take given term]
[5.0] invariant1(heapIs heap_{funcstart\_724,1})
\rightarrow [expand definition of function 'invariant1' at prang.c (34,1)]
[5.1] ((((((0 < asType < integer > ($heap_{funcstart\_724.1}.p1)) &&
(asType<integer>($heap_funcstart_724.1.p1) <
asType < integer > (\$heap_{funcstart\_724,1}.M1))) \&\& (0 <
asType < integer > (\$heap_{funcstart\_724,1}.p2))) \&\&
(\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{p2}) <
asType < integer > (\$heap_{funcstart\_724,1}.M2))) \&\& (0 <
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p3})))\ \&\&
(\mathbf{asType} < \mathbf{integer} > (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p3}) <
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{M3}))
\rightarrow [simplify]
[5.3] \ (((((0 < \$heap_{funcstart\_724,1}.p1) \&\& \ (\$heap_{funcstart\_724,1}.p1 < (
asType < integer > (\$heap_{funcstart\_724,1}.M1))) \&\& (0 < function for the start of the start
```

```
asType < integer > (\$heap_{funcstart\_724,1}.p2))) \&\&
(asType < integer > (\$heap_{funcstart\_724,1}.p2) < 
\mathbf{asType} {<} \mathbf{integer} {>} (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{M2}))) \ \&\& \ (0 <
asType < integer > (\$heap_{funcstart\_724,1}.p3))) \&\&
(\mathbf{asType} < \mathbf{integer} > (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p3}) <
asType<integer>($heap_funcstart_724,1.M3))
\rightarrow [const static or extern object]
[5.4] (((((0 < \theta_{funcstart\_724,1.p1}) && (\theta_{funcstart\_724,1.p1})
asType<integer>(heap_{init}.M1))) && (0 <
asType < integer > (\$heap_{funcstart\_724,1}.p2))) \&\&
(\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{p2}) <
\mathbf{asType} \small{<} \mathbf{integer} \small{>} (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{M2}))) \ \&\& \ (0 <
asType < integer > (\$heap_{funcstart\_724,1}.p3))) \&\&
(\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{p3}) <
asType < integer > (\$heap_{funcstart\_724,1}.M3))
\rightarrow [expand definition of constant 'M1' at prang.c (14,20)]
[5.5] (((((0 < $heap_{funcstart\_724,1}.p1) && ($heap_{funcstart\_724,1}.p1 < ])
asType<integer>(asType<short int>((int)30269)))) && (0 <
asType < integer > (\$heap_{funcstart\_724,1}.p2))) \&\&
(\mathbf{asType} < \mathbf{integer} > (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p2}) <
as
Type<integer>($heap_{funcstart\_724,1}.M2))) && (0 <
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p3})))\ \&\&
(asType < integer > (\$heap_{funcstart_{-724.1}}.p3) < 
asType < integer > (\$heap_{funcstart_{-724.1}}.M3))
\rightarrow [simplify]
[5.16] \; ((((-30269 < -\$heap_{funcstart\_724,1}.p1) \; \land \; (0 < \$heap_{funcstart\_724,1}.p1) \; \land 
(0 < \mathrm{\$heap}_{funcstart\_724,1}.\mathrm{p2})) && (\mathrm{\$heap}_{funcstart\_724,1}.\mathrm{p2} <
asType < integer > (\$heap_{funcstart\_724,1}.M2))) \&\& (0 < 1)
asType < integer > (\$heap_{funcstart\_724,1}.p3))) \&\&
(\mathbf{asType} < \mathbf{integer} > (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p3}) <
\mathbf{asType} {<} \mathbf{integer} {>} (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{M3}))
\rightarrow [const static or extern object]
\label{eq:final_start_724,1.p1} [(((-30269 < -\$heap_{funcstart\_724,1}.p1) \land (0 < \$heap_{funcstart\_724,1}.p1) \land (0 < \$he
(0 < \text{\$heap}_{funcstart_{724,1},p2})) \&\& (\text{\$heap}_{funcstart_{724,1},p2} <
asType < integer > (\$heap_{init}.M2))) \&\& (0 <
asType < integer > (\$heap_{funcstart\_724,1}.p3))) \&\&
(asType < integer > (\$heap_{funcstart\_724,1}.p3) < 
asType < integer > (\$heap_{funcstart\_724,1}.M3))
\rightarrow [expand definition of constant 'M2' at prang.c (19,20)]
[5.18] ((((-30269 < -\$heap_{funcstart\_724,1}.p1) \land (0 < \$heap_{funcstart\_724,1}.p1) 
(0 < \text{\$heap}_{funcstart\_724,1}.p2)) \&\& (\text{\$heap}_{funcstart\_724,1}.p2 <
```

```
asType<integer>(asType<short int>((int)30307)))) && (0 <
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{p3})))\ \&\&
(\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{p3}) <
asType < integer > (\$heap_{funcstart\_724,1}.M3))
\rightarrow [simplify]
[5.30] ((-30307 < -$heap<sub>funcstart_724,1</sub>.p2) \wedge (-30269 <
-\$heap_{funcstart\_724,1}.p1) \land (0 < \$heap_{funcstart\_724,1}.p1) \land (0 < \$heap_{funcstart\_724,1}.p1)
\text{Sheap}_{funcstart_{724,1}.p2} \land (0 < \text{Sheap}_{funcstart_{724,1}.p3})) \&\&
(\text{\$heap}_{funcstart\_724,1}.p3 < asType < integer > (\text{\$heap}_{funcstart\_724,1}.M3))
\rightarrow [const static or extern object]
[5.31] ((-30307 < -$heap_funcstart_724.1.p2) \land (-30269 <
-\$heap_{funcstart\_724,1}.p1) \land (0 < \$heap_{funcstart\_724,1}.p1) \land (0 < \$heap_{funcstart\_724,1}.p1)
\text{Sheap}_{funcstart\_724,1}.p2) \land (0 < \text{Sheap}_{funcstart\_724,1}.p3)) \&\&
(\$heap_{funcstart\_724,1}.p3 < \textbf{asType} < \textbf{integer} > (\$heap_{init}.M3))
\rightarrow [expand definition of constant 'M3' at prang.c (24,20)]
[5.32] ((-30307 < -$heap<sub>funcstart_724,1.</sub>p2) \wedge (-30269 <
-\$heap_{funcstart_{-724,1}.p1}) \land (0 < \$heap_{funcstart_{-724,1}.p1}) \land (0 < \$heap_{funcstart_{-724,1}.p1})
\text{Sheap}_{funcstart\_724,1.p2}) \land (0 < \text{Sheap}_{funcstart\_724,1.p3})) \&\&
(\text{sheap}_{funcstart\_724,1}.\text{p3} < \text{asType} < \text{integer} > (\text{asType} < \text{short})
int > ((int)30323)))
\rightarrow [simplify]
[5.40] (-30323 < -$heap<sub>funcstart_724.1</sub>.p3) \land (-30307 <
-\$heap_{funcstart\_724,1}.p2) \land (-30269 < -\$heap_{funcstart\_724,1}.p1) \land (0 <
\text{Sheap}_{funcstart\_724,1}.\text{p1}) \land (0 < \text{Sheap}_{funcstart\_724,1}.\text{p2}) \land (0 <
heap_{funcstart_{-724,1}.p3}
[Work on sub-term 5 of conjunction in term 5.40]
\textit{[9.0] 0} < \$ heap_{funcstart\_724,1}.p2
[Take goal term]
[1.0] minof(int) \leq $heap<sub>funcstart_724,1</sub>.p2
\rightarrow [simplify]
\label{eq:continuous} \mbox{ $[1.3]$ -32769 < $$heap_{funcstart\_724,1}.p2$}
\rightarrow [from term 9.0, literala < $heap<sub>funcstart-724,1</sub>.p2 is true whenever (-1 +
literala) < 0
    Proof of rule precondition:
    [1.3.0](-32769 + -1) < 0
    \rightarrow [simplify]
    [1.3.2] true
```

## [1.4] true

```
Proof of verification condition: Type constraint satisfied in explicit
conversion from 'short int' to 'int'
Condition generated at: C:\Escher\Customers\prang\prang.c (49,22)
Condition defined at:
To prove: \text{$heap}_{funcstart\_724,1}.p2 \leq \max(int)
Given:
heap_{init}.LIMIT == (int)80
\theta
heap_{init}.r1 == asType < short int > ((int)171)
heap_{init}.a1 == asType < short int > ((int)177)
\theta
heap_{init}.M2 == asType < short int > ((int)30307)
\rho_{init}.r2 == asType < short int > ((int)172)
heap_{init}.a2 == asType < short int > ((int)176)
\theta = asType < short int > ((int)35)
\theta sheap<sub>init</sub>.M3 == asType<short int>((int)30323)
heap_{init}.r3 == asType < short int > ((int)170)
heap_{init}.a3 == asType<short int>((int)178)
heap_{init}.b3 == asType < short int > ((int)63)
\theta = asType < short int > ((int)1)
\theta
\theta = asType < short int > ((int)3)
invariant1(heapIs heap_{funcstart_{724,1}})
\operatorname{div1} == \operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724,1},
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p1}),
asType < int > (\$heap_{funcstart_{-724,1}}.a1))
(asType<integer>(asType<int>($heap_{tuncstart}, 724,1.p1)) /
\mathbf{asType} < \mathbf{integer} > (\mathbf{asType} < \mathbf{int} > (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{a1}))) = =
asType<integer>(div1.quot)
(asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.p1)) \%
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a1))) = =
asType<integer>(div1.rem)
!(0 == asType < integer > (div1.rem)) || !(0 ==
```

```
asType<integer>(div1.quot))
Proof:
[Take given term]
[5.0] invariant1(heapIs heap_{funcstart\_724,1})
\rightarrow [expand definition of function 'invariant1' at prang.c (34,1)]
[5.1] ((((((0 < asType < integer > ($heap_{funcstart\_724,1}.p1)) &&
(asType < integer > (\$heap_{funcstart\_724,1}.p1) < 
asType<integer>(heap_{funcstart\_724,1}.M1))) && (0 <
\mathbf{asType} < \mathbf{integer} > (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p2}))) \&\&
(\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{p2}) <
\mathbf{asType} \small{<} \mathbf{integer} \small{>} (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{M2}))) \ \&\& \ (0 <
asType < integer > (\$heap_{funcstart\_724,1}.p3))) \&\&
(asType < integer > (\$heap_{funcstart\_724,1}.p3) < 
asType < integer > (\$heap_{funcstart\_724,1}.M3))
\rightarrow [simplify]
[5.3] (((((0 < $heap_{funcstart_724,1}.p1) && ($heap_{funcstart_724,1}.p1 < function for the content of the 
asType < integer > (\$heap_{funcstart\_724,1}.M1))) \&\& (0 <
asType < integer > (\$heap_{funcstart\_724,1}.p2))) \&\&
(\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p2}) <
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{M2})))~\&\&~(0<
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p3})))\ \&\&
(asType < integer > (\$heap_{funcstart\_724,1}.p3) < 
\mathbf{asType} < \mathbf{integer} > (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{M3}))
\rightarrow [const static or extern object]
[5.4] (((((0 < $heap_{funcstart\_724,1}.p1) && ($heap_{funcstart\_724,1}.p1 < 
asType < integer > ($heap_{init}.M1))) && (0 <
asType < integer > (\$heap_{funcstart\_724,1}.p2))) \&\&
(\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{p2}) <
asType < integer > (\$heap_{funcstart\_724,1}.M2))) \&\& (0 <
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p3})))\ \&\&
(asType<integer>($heap_funcstart_724.1.p3) <
\mathbf{asType} < \mathbf{integer} > (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{M3}))
\rightarrow [expand definition of constant 'M1' at prang.c (14,20)]
[5.5] (((((0 < $heap_{funcstart_{724,1}}.p1) && ($heap_{funcstart_{724,1}}.p1 < 
asType<integer>(asType<short int>((int)30269)))) && (0 <
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{p2})))\ \&\&
(asType < integer > (\$heap_{funcstart\_724,1}.p2) < 
asType<integer>(heap_{funcstart\_724,1}.M2))) && (0 <
asType < integer > (\$heap_{funcstart\_724,1}.p3))) \&\&
(asType < integer > (\$heap_{funcstart\_724,1}.p3) < 
asType < integer > (\$heap_{funcstart\_724,1}.M3))
```

```
\rightarrow [simplify]
[5.16] \; ((((-30269 < -\$heap_{funcstart\_724,1}.p1) \land (0 < \$heap_{funcstart\_724,1}.p1) \land (0 < \$heap_{funcstart\_724,1}.p1
(0 < \text{\$heap}_{funcstart\_724,1}.p2)) \&\& (\text{\$heap}_{funcstart\_724,1}.p2 <
asType<integer>($heap_{funcstart\_724,1}.M2))) && (0 <
asType < integer > (\$heap_{funcstart\_724,1}.p3))) \&\&
(\mathbf{asType} {<} \mathbf{integer} {>} (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p3}) <
asType < integer > (\$heap_{funcstart\_724,1}.M3))
\rightarrow [const static or extern object]
[5.17] \; ((((-30269 < -\$heap_{funcstart\_724,1}.p1) \; \land \; (0 < \$heap_{funcstart\_724,1}.p1) \; \land 
(0 < \text{\$heap}_{funcstart\_724,1}.p2)) \&\& (\text{\$heap}_{funcstart\_724,1}.p2 <
asType < integer > (\$heap_{init}.M2))) \&\& (0 <
\mathbf{asType} < \mathbf{integer} > (\$ heap_{funcstart\_724,1}.p3))) \&\&
(asType<integer>($heap_funcstart_724.1.p3) <
asType < integer > (\$heap_{funcstart\_724.1}.M3))
\rightarrow [expand definition of constant 'M2' at prang.c (19,20)]
[5.18] \left( \left( \left( \left( -30269 < -\$ \text{heap}_{funcstart\_724,1}.\text{p1} \right) \right. \wedge \left. \left( 0 < \$ \text{heap}_{funcstart\_724,1}.\text{p1} \right) \right. \wedge \right. \right)
(0 < \text{$heap}_{funcstart_{724,1}.p2})) \&\& (\text{$heap}_{funcstart_{724,1}.p2} <
asType < integer > (asType < short int > ((int)30307)))) && (0 < integer) && (0 < integer
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p3})))\ \&\&
(asType < integer > (\$heap_{funcstart\_724.1}.p3) < 
\mathbf{asType} < \mathbf{integer} > (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{M3}))
\rightarrow [simplify]
[5.30] ((-30307 < -$heap_{funcstart\_724,1}.p2) \land (-30269 <
-\$ heap_{funcstart\_724,1}.p1) \land (0 < \$ heap_{funcstart\_724,1}.p1) \land (0 < \$ heap_{funcstart\_724,1}.p1) \land (0 < \$ heap_{funcstart\_724,1}.p1)
\text{Sheap}_{funcstart\_724,1}.p2) \land (0 < \text{Sheap}_{funcstart\_724,1}.p3)) \&\&
(\$heap_{funcstart\_724,1}.p3 < \mathbf{asType} < \mathbf{integer} > (\$heap_{funcstart\_724,1}.M3))
\rightarrow [const static or extern object]
[5.31] ((-30307 < -$heap_{tuncstart_724.1}.p2) \land (-30269 <
-\$heap_{funcstart\_724,1}.p1) \land (0 < \$heap_{funcstart\_724,1}.p1) \land (0 < \$heap_{funcstart\_724,1}.p1)
\text{Sheap}_{funcstart\_724,1.p2}) \land (0 < \text{Sheap}_{funcstart\_724,1.p3})) \&\&
(\text{\$heap}_{funcstart\_724.1}.p3 < asType < integer > (\text{\$heap}_{init}.M3))
\rightarrow [expand definition of constant 'M3' at prang.c (24,20)]
[5.32] ((-30307 < -$heap_{funcstart_724,1}.p2) \land (-30269 <
-\$heap_{funcstart\_724,1}.p1) \land (0 < \$heap_{funcstart\_724,1}.p1) \land (0 < \$heap_{funcstart\_724,1}.p1)
\text{Sheap}_{funcstart_{-724,1}.p2} \land (0 < \text{Sheap}_{funcstart_{-724,1}.p3})) \&\&
(\text{sheap}_{funcstart\_724,1}.\text{p3} < \text{asType} < \text{integer} > (\text{asType} < \text{short})
int > ((int)30323)))
\rightarrow [simplify]
[5.40] (-30323 < -$heap<sub>funcstart_724,1.</sub>p3) \wedge (-30307 <
 -\$heap_{funcstart\_724,1}.p2) \land (-30269 < -\$heap_{funcstart\_724,1}.p1) \land (0 < -\$heap_{funcstart\_724,1}.p1)
```

```
\text{Sheap}_{funcstart\_724,1}.\text{p1}) \land (0 < \text{Sheap}_{funcstart\_724,1}.\text{p2}) \land (0 <
heap_{funcstart_{724,1}.p3}
[Work on sub-term 2 of conjunction in term 5.40]
[6.0] -30307 < -$heap<sub>funcstart_724,1</sub>.p2
[Take goal term]
[1.0] \operatorname{heap}_{funcstart\_724,1}.p2 \leq \operatorname{maxof(int)}
\rightarrow [simplify]
\textit{[1.9]} \; \text{-32768} < -\$ \text{heap}_{funcstart\_724,1}.\text{p2}
\rightarrow [from term 6.0, literala < -$heap<sub>funcstart_724,1</sub>.p2 is true whenever (-1 +
literala) < -30307
   Proof of rule precondition:
   [1.9.0] (-32768 + -1) < -30307
   \rightarrow [simplify]
   [1.9.2] true
[1.10] true
Proof of verification condition: Type constraint satisfied in explicit
conversion from 'short int const' to 'int'
Condition generated at: C:\Escher\Customers\prang\prang.c (49,31)
Condition defined at:
To prove: minof(int) \leq \$heap_{funcstart\_724,1}.a2
Given:
heap_{init}.LIMIT == (int)80
heap_{init}.M1 == asType < short int > ((int)30269)
\theta_{init}.r1 == asType < short int > ((int)171)
heap_{init}.a1 == asType < short int > ((int)177)
\theta = asType < short int > ((int)2)
heap_{init}.M2 == asType < short int > ((int)30307)
\theta_{init}.r2 == asType < short int > ((int)172)
\theta
\theta = asType < short int > ((int)35)
\theta = asType < short int > ((int)30323)
heap_{init}.r3 == asType < short int > ((int)170)
```

```
heap_{init}.a3 == asType < short int > ((int)178)
heap_{init}.b3 == asType < short int > ((int)63)
\theta = asType < short int > ((int)1)
\theta
\theta = asType < short int > ((int)3)
invariant1(heapIs heap_{funcstart_{724,1}})
\mathrm{div1} == \mathrm{div}(\mathbf{heapIs} \ \$ \mathrm{heap}_{funcstart\_724,1},
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p1}),
asType < int > (\$heap_{funcstart\_724,1}.a1))
(asType<int>(asType<int>($heap_{tuncstart\_724.1}.p1)) /
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a1))) = =
asType<integer>(div1.quot)
(asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.p1)) \%
\mathbf{asType}{<}\mathbf{integer}{>}(\mathbf{asType}{<}\mathbf{int}{>}(\$\mathbf{heap}_{funcstart\_724,1}.\mathbf{a1}))) = =
asType<integer>(div1.rem)
!(0 == asType < integer > (div1.rem)) || !(0 ==
asType<integer>(div1.quot))
Proof:
[Take goal term]
[1.0] minof(int) \leq $heap<sub>funcstart_724,1</sub>.a2
\rightarrow [simplify]
[1.1] -32768 \leq $heap<sub>funcstart_724,1</sub>.a2
\rightarrow [const static or extern object]
[1.2] -32768 \le \text{$heap}_{init}.a2
\rightarrow [expand definition of constant 'a2' at prang.c (21,20)]
[1.3] -32768 \leq asType<short int>((int)176)
\rightarrow [simplify]
[1.6] true
Proof of verification condition: Type constraint satisfied in explicit
conversion from 'short int const' to 'int'
Condition generated at: C:\Escher\Customers\prang\prang.c (49,31)
Condition defined at:
To prove: heap_{funcstart\_724,1}.a2 \le maxof(int)
Given:
```

```
heap_{init}.LIMIT == (int)80
heap_{init}.M1 == asType < short int > ((int)30269)
\theta_{init}.r1 == asType < short int > ((int)171)
heap_{init}.a1 == asType < short int > ((int)177)
heap_{init}.M2 == asType < short int > ((int)30307)
\theta_{init}.r2 == asType < short int > ((int)172)
heap_{init}.a2 == asType < short int > ((int)176)
\theta = asType < short int > ((int)35)
heap_{init}.M3 == asType < short int > ((int)30323)
heap_{init}.r3 == asType < short int > ((int)170)
heap_{init}.a3 == asType < short int > ((int)178)
\theta = asType < short int > ((int)63)
\theta = asType < short int > ((int)1)
\theta
\theta = asType < short int > ((int)3)
invariant1(heapIs heap_{funcstart\_724,1})
\operatorname{div1} == \operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724,1},
asType < int > (\$heap_{funcstart\_724,1}.p1),
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{a1}))
(\mathbf{asType}{<}\mathbf{integer}{>}(\mathbf{asType}{<}\mathbf{int}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{p1})) \ / \\
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a1))) = =
asType<integer>(div1.quot)
(asType<int>(asType<int>($heap_{tuncstart\_724.1}.p1)) %
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a1))) = =
asType<integer>(div1.rem)
!(0 == asType < integer > (div1.rem)) || !(0 ==
asType<integer>(div1.quot))
Proof:
[Take goal term]
[1.0] heap_{funcstart\_724,1}.a2 \leq maxof(int)
\rightarrow [const static or extern object]
[1.1] heap_{init}.a2 \leq maxof(int)
\rightarrow [expand definition of constant 'a2' at prang.c (21,20)]
```

```
[1.2] asType<short int>((int)176) \le maxof(int)
\rightarrow [simplify]
[1.6] true
Proof of verification condition: Precondition of 'div' satisfied
Condition generated at: C:\Escher\Customers\prang\prang.c (49,18)
Condition defined at: C:\Escher\ecv\standard\stdlib.h (94,10)
To prove: 0 < asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a2))
Given:
heap_{init}.LIMIT == (int)80
heap_{init}.M1 == asType < short int > ((int)30269)
\theta_{init}.r1 == asType < short int > ((int)171)
heap_{init}.a1 == asType < short int > ((int)177)
\theta = asType < short int > ((int)2)
\theta sheap<sub>init</sub>.M2 == asType<short int>((int)30307)
\theta_{init}.r2 == asType < short int > ((int)172)
heap_{init}.a2 == asType < short int > ((int)176)
\theta == asType<short int>((int)35)
heap_{init}.M3 == asType < short int > ((int)30323)
heap_{init}.r3 == asType < short int > ((int)170)
heap_{init}.a3 == asType < short int > ((int)178)
\theta = asType < short int > ((int)63)
\theta
\theta
\theta = asType < short int > ((int)3)
invariant1(heapIs heap_{funcstart\_724,1})
div1 == div(\mathbf{heapIs} \$heap_{funcstart\_724,1},
asType < int > (\$heap_{funcstart\_724,1}.p1),
asType < int > (\$heap_{funcstart\_724,1}.a1))
(asType<int>(asType<int>($heap_{tuncstart\_724.1}.p1)) /
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a1))) = =
asType<integer>(div1.quot)
(\mathbf{asType}{<}\mathbf{int}{>}(\mathbf{asType}{<}\mathbf{int}{>}(\$\mathbf{heap}_{funcstart\_724,1}.\mathbf{p1}))~\%
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a1))) ==
```

```
asType<integer>(div1.rem)
!(0 == asType < integer > (div1.rem)) || !(0 ==
asType<integer>(div1.quot))
Proof:
[Take goal term]
[1.0] 0 < asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a2))
\rightarrow [const static or extern object]
[1.1] 0 < asType < integer > (asType < int > (\$heap_{init}.a2))
\rightarrow [expand definition of constant 'a2' at prang.c (21,20)]
[1.2] 0 < asType<integer>(asType<int>(asType<short
int > ((int)176))
\rightarrow [simplify]
[1.7] true
Proof of verification condition: Type constraint satisfied in explicit
conversion from 'short int' to 'int'
Condition generated at: C:\Escher\Customers\prang\prang.c (51,22)
Condition defined at:
To prove: minof(int) \leq \$heap_{funcstart\_724,1}.p3
Given:
heap_{init}.LIMIT == (int)80
\theta
\theta_{init}.r1 == asType < short int > ((int)171)
heap_{init}.a1 == asType < short int > ((int)177)
\theta
heap_{init}.M2 == asType < short int > ((int)30307)
\theta_{init}.r2 == asType < short int > ((int)172)
heap_{init}.a2 == asType < short int > ((int)176)
heap_{init}.b2 == asType < short int > ((int)35)
\theta = asType < short int > ((int)30323)
heap_{init}.r3 == asType < short int > ((int)170)
heap_{init}.a3 == asType < short int > ((int)178)
\theta = asType < short int > ((int)63)
```

```
\theta
\theta
\theta = asType < short int > ((int)3)
invariant1(heapIs heap_{funcstart\_724,1})
div1 == div(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1},
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p1}),
asType < int > (\$heap_{funcstart\_724,1}.a1))
(\mathbf{asType}{<}\mathbf{integer}{>}(\mathbf{asType}{<}\mathbf{int}{>}(\$\mathbf{heap}_{funcstart\_724,1}.\mathbf{p1})) \ / \\
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a1))) = =
asType<integer>(div1.quot)
(\mathbf{asType} < \mathbf{integer} > (\mathbf{asType} < \mathbf{int} > (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p1})) \ \%
\mathbf{asType}{<}\mathbf{integer}{>}(\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{a1}))) ==
asType<integer>(div1.rem)
!(0 == asType < integer > (div1.rem)) || !(0 ==
asType<integer>(div1.quot))
div2 == div(\mathbf{heapIs} \$heap_{funcstart\_724,1},
asType < int > (\$heap_{funcstart\_724,1}.p2),
asType < int > (\$heap_{funcstart\_724,1}.a2))
(\mathbf{asType} < \mathbf{integer} > (\mathbf{asType} < \mathbf{int} > (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p2})) \ / \\
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a2))) = =
asType<integer>(div2.quot)
(\mathbf{asType} < \mathbf{integer} > (\mathbf{asType} < \mathbf{int} > (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p2})) \%
\mathbf{asType}{<}\mathbf{integer}{>}(\mathbf{asType}{<}\mathbf{int}{>}(\$\mathbf{heap}_{funcstart\_724,1}.\mathbf{a2}))) = =
asType<integer>(div2.rem)
!(0 == asType < integer > (div2.rem)) || !(0 ==
asType<integer>(div2.quot))
Proof:
[Take given term]
[5.0] invariant
1(heapIs \rho_{funcstart\_724,1}
\rightarrow [expand definition of function 'invariant1' at prang.c (34,1)]
 \texttt{[5.1]} \left( \left( \left( \left( \left( 0 < \mathbf{asType} {<} \mathbf{integer} {>} \left( \$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p1} \right) \right) \right. \&\& \right. \right. 
(asType < integer > (\$heap_{funcstart\_724,1}.p1) < 
asType < integer > (\$heap_{funcstart\_724,1}.M1))) \&\& (0 <
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p2})))\ \&\&
(asType < integer > (\$heap_{funcstart\_724,1}.p2) <
asType<integer>($heap_{funcstart\_724,1}.M2))) && (0 <
asType < integer > (\$heap_{funcstart\_724,1}.p3))) \&\&
(asType<integer>($heap_{tuncstart_724.1}.p3) <
asType < integer > (\$heap_{funcstart\_724,1}.M3))
```

```
\rightarrow [simplify]
[5.3] (((((0 < \text{heap}_{funcstart\_724,1}.p1) && (\text{heap}_{funcstart\_724,1}.p1 <
asType < integer > (\$heap_{funcstart\_724,1}.M1))) \&\& (0 <
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p2}))) \ \&\&
(asType < integer > (\$heap_{funcstart\_724,1}.p2) < 
asType < integer > (\$heap_{funcstart\_724,1}.M2))) \&\& (0 <
asType < integer > (\$heap_{funcstart\_724,1}.p3))) \&\&
(\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{p3}) <
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{M3}))
\rightarrow [const static or extern object]
[5.4] \ (((((0 < \text{\$heap}_{funcstart\_724,1}.\text{p1}) \&\& \ (\text{\$heap}_{funcstart\_724,1}.\text{p1} <
asType < integer > (\$heap_{init}.M1))) \&\& (0 <
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p2})))\ \&\&
(asType<integer>($heap_funcstart_724.1.p2) <
asType < integer > (\$heap_{funcstart\_724,1}.M2))) \&\& (0 <
asType < integer > (\$heap_{funcstart\_724,1}.p3))) \&\&
(\mathbf{asType} < \mathbf{integer} > (\$ heap_{funcstart\_724,1}.p3) <
\mathbf{asType} < \mathbf{integer} > (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{M3}))
\rightarrow [expand definition of constant 'M1' at prang.c (14,20)]
[5.5] (((((0 < $heap_{funcstart_724,1}.p1) && ($heap_{funcstart_724,1}.p1 <
asType<integer>(asType<short int>((int)30269)))) && (0 <
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p2})))\ \&\&
(\mathbf{asType} {<} \mathbf{integer} {>} (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p2}) <
asType < integer > (\$heap_{funcstart\_724,1}.M2))) \&\& (0 <
asType < integer > (\$heap_{funcstart\_724,1}.p3))) \&\&
(asType<integer>($heap_{tuncstart\_724,1}.p3) <
asType < integer > (\$heap_{funcstart\_724,1}.M3))
\rightarrow [simplify]
[5.16] ((((-30269 < -\$heap_{funcstart\_724,1}.p1) \land (0 < \$heap_{funcstart\_724,1}.p1) 
(0 < \text{\$heap}_{funcstart\_724,1}.\text{p2})) && (\text{\$heap}_{funcstart\_724,1}.\text{p2} <
asType < integer > (\$heap_{funcstart\_724,1}.M2))) \&\& (0 <
asType < integer > (\$heap_{funcstart\_724,1}.p3))) \&\&
(asType < integer > (\$heap_{funcstart\_724,1}.p3) < 
asType < integer > (\$heap_{funcstart\_724,1}.M3))
\rightarrow [const static or extern object]
[5.17] \left( \left( \left( \left( -30269 < -\$ \text{heap}_{funcstart\_724,1}.\text{p1} \right) \right. \wedge \left. \left( 0 < \$ \text{heap}_{funcstart\_724,1}.\text{p1} \right) \right. \wedge \right. \right) \\
(0 < \text{\$heap}_{funcstart\_724,1}.p2)) \&\& (\text{\$heap}_{funcstart\_724,1}.p2 <
asType < integer > (\$heap_{init}.M2))) \&\& (0 <
asType < integer > (\$heap_{funcstart\_724,1}.p3))) \&\&
(\mathbf{asType} < \mathbf{integer} > (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p3}) <
asType<integer>($heap_funcstart_724,1.M3))
```

```
\rightarrow [expand definition of constant 'M2' at prang.c (19,20)]
[5.18] \; ((((-30269 < -\$heap_{funcstart\_724,1}.p1) \; \land \; (0 < \$heap_{funcstart\_724,1}.p1) \; \land 
(0 < $heap_{funcstart\_724,1}.p2)) && ($heap_{funcstart\_724,1}.p2 <
asType < integer > (asType < short int > ((int)30307)))) && (0 < integer) && (0 < integer
asType < integer > (\$heap_{funcstart\_724,1}.p3))) \&\&
(\mathbf{asType} {<} \mathbf{integer} {>} (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p3}) <
asType < integer > (\$heap_{funcstart\_724,1}.M3))
\rightarrow [simplify]
[5.30] ((-30307 < -$heap<sub>funcstart_724,1</sub>.p2) \wedge (-30269 <
-\$heap_{funcstart\_724,1}.p1) \land (0 < \$heap_{funcstart\_724,1}.p1) \land (0 < \$heap_{funcstart\_724,1}.p1)
\text{Sheap}_{funcstart_{724,1}.p2} \land (0 < \text{Sheap}_{funcstart_{724,1}.p3})) \&\&
(\text{\$heap}_{funcstart\_724,1}.\text{p3} < \text{asType} < \text{integer} > (\text{\$heap}_{funcstart\_724,1}.\text{M3}))
\rightarrow [const static or extern object]
[5.31] ((-30307 < -$heap<sub>funcstart_724,1</sub>.p2) \wedge (-30269 <
-\$heap_{funcstart\_724,1}.p1) \land (0 < \$heap_{funcstart\_724,1}.p1) \land (0 < \$heap_{funcstart\_724,1}.p1)
\text{Sheap}_{funcstart\_724,1.p2} \land (0 < \text{Sheap}_{funcstart\_724,1.p3})) \&\&
(\text{\$heap}_{funcstart\_724,1}.p3 < asType < integer > (\text{\$heap}_{init}.M3))
\rightarrow [expand definition of constant 'M3' at prang.c (24,20)]
[5.32] ((-30307 < -$heap_funcstart_724,1.p2) \land (-30269 <
 -\$heap_{funcstart\_724,1}.p1) \land (0 < \$heap_{funcstart\_724,1}.p1) \land (0 < \$heap_{funcstart\_724,1}.p1)
\text{Sheap}_{funcstart_{724,1}.p2} \land (0 < \text{Sheap}_{funcstart_{724,1}.p3})) \&\&
(\text{sheap}_{funcstart\_724.1}.\text{p3} < \text{asType} < \text{integer} > (\text{asType} < \text{short})
int > ((int)30323))
\rightarrow [simplify]
[5.40] (-30323 < -$heap<sub>funcstart_724,1</sub>.p3) \land (-30307 <
-\$heap_{funcstart\_724,1}.p2) \land (-30269 < -\$heap_{funcstart\_724,1}.p1) \land (0 < -\$heap_{funcstart\_724,1}.p1)
\text{Sheap}_{funcstart\_724.1.p1} \land (0 < \text{Sheap}_{funcstart\_724.1.p2}) \land (0 <
heap_{funcstart_{724,1}.p3}
[Work on sub-term 6 of conjunction in term 5.40]
[10.0]~0 < \$ \mathrm{heap}_{funcstart\_724,1}.\mathrm{p3}
[Take goal term]
[1.0] minof(int) \leq $heap<sub>funcstart_724,1</sub>.p3
\rightarrow [simplify]
[1.3] \ \hbox{-}32769 < \$ heap_{funcstart\_724,1}.p3
\rightarrow [from term 10.0, literala < $heap<sub>funcstart_724,1</sub>.p3 is true whenever (-1 +
literala) < 0
            Proof of rule precondition:
            [1.3.0](-32769 + -1) < 0
```

```
[1.3.2] true
[1.4] true
Proof of verification condition: Type constraint satisfied in explicit
conversion from 'short int' to 'int'
Condition generated at: C:\Escher\Customers\prang\prang.c (51,22)
Condition defined at:
To prove: \text{$heap}_{funcstart\_724,1}.p3 \leq \max(int)
Given:
heap_{init}.LIMIT == (int)80
heap_{init}.M1 == asType < short int > ((int)30269)
heap_{init}.r1 == asType < short int > ((int)171)
heap_{init}.a1 == asType < short int > ((int)177)
\theta = asType < short int > ((int)2)
\theta sheap<sub>init</sub>.M2 == asType<short int>((int)30307)
\theta_{init}.r2 == asType < short int > ((int)172)
\theta sheap<sub>init</sub>.a2 == asType<short int>((int)176)
\theta
heap_{init}.M3 == asType < short int > ((int)30323)
heap_{init}.r3 == asType < short int > ((int)170)
heap_{init}.a3 == asType < short int > ((int)178)
\theta = asType < short int > ((int)63)
\theta = asType < short int > ((int)1)
\theta
\theta = asType < short int > ((int)3)
invariant1(heapIs heap_{funcstart_{-724,1}})
\operatorname{div1} == \operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724,1},
asType < int > (\$heap_{funcstart\_724,1}.p1),
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{a1}))
(asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.p1)) /
asType<integer>(asType<int>($heap_{tuncstart\_724.1}.a1))) ==
asType<integer>(div1.quot)
(\mathbf{asType} {<} \mathbf{int} {>} (\mathbf{asType} {<} \mathbf{int} {>} (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p1})) \ \%
```

 $\rightarrow$  [simplify]

```
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a1))) = =
asType<integer>(div1.rem)
!(0 == asType < integer > (div1.rem)) || !(0 ==
asType<integer>(div1.quot))
div2 == div(\mathbf{heapIs} \$heap_{funcstart\_724,1},
asType < int > (\$heap_{funcstart\_724,1}.p2),
asType < int > (\$heap_{funcstart\_724,1}.a2))
(\mathbf{asType}{<}\mathbf{integer}{>}(\mathbf{asType}{<}\mathbf{int}{>}(\$\mathbf{heap}_{funcstart\_724,1}.\mathbf{p2})) \ / \\
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a2))) = =
asType<integer>(div2.quot)
(asType<int>(asType<int>($heap_{tuncstart\_724.1}.p2)) %
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a2))) = =
asType<integer>(div2.rem)
!(0 == asType < integer > (div2.rem)) || !(0 ==
asType<integer>(div2.quot))
Proof:
[Take given term]
[5.0] invariant1(heapIs heapIs 
\rightarrow [expand definition of function 'invariant1' at prang.c (34,1)]
[5.1] (((((0 < asType<integer>(sheap_{funcstart\_724,1}.p1)) &&
(\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{p1}) <
as
Type<integer>(\rho_{funcstart\_724,1}.M1))) & (0 <
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p2})))\ \&\&
(asType<integer>($heap_{tuncstart\_724.1}.p2) <
asType < integer > (\$heap_{funcstart\_724,1}.M2))) \&\& (0 <
asType < integer > (\$heap_{funcstart\_724,1}.p3))) \&\&
(\mathbf{asType} < \mathbf{integer} > (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p3}) <
asType < integer > (\$heap_{funcstart\_724,1}.M3))
\rightarrow [simplify]
[5.3] \ (((((0 < \$heap_{funcstart\_724,1}.p1) \&\& \ (\$heap_{funcstart\_724,1}.p1 < 
asType < integer > (\$heap_{funcstart\_724,1}.M1))) \&\& (0 <
asType < integer > (\$heap_{funcstart\_724,1}.p2))) \&\&
(asType < integer > (\$heap_{funcstart\_724,1}.p2) <
asType < integer > (\$heap_{funcstart\_724,1}.M2))) \&\& (0 <
asType < integer > (\$heap_{funcstart\_724,1}.p3))) \&\&
(asType<integer>($heap_funcstart_724,1.p3) <
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{M3}))
\rightarrow [const static or extern object]
[5.4] (((((0 < $heap_{funcstart_{724,1}}.p1) && ($heap_{funcstart_{724,1}}.p1 < ]
asType < integer > (\$heap_{init}.M1))) \&\& (0 <
```

```
asType < integer > (\$heap_{funcstart\_724,1}.p2))) \&\&
 (asType < integer > (\$heap_{funcstart\_724,1}.p2) < 
\mathbf{asType} {<} \mathbf{integer} {>} (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{M2}))) \ \&\& \ (0 <
asType < integer > (\$heap_{funcstart\_724,1}.p3))) \&\&
 (asType<integer>($heap_{tuncstart\_724,1}.p3) <
asType<integer>($heap_funcstart_724,1.M3))
 \rightarrow [expand definition of constant 'M1' at prang.c (14,20)]
 [5.5] (((((0 < $heap_{funcstart_724,1}.p1) && ($heap_{funcstart_724,1}.p1 < footnote{in the content of the c
asType<integer>(asType<short int>((int)30269)))) && (0 <
asType < integer > (\$heap_{funcstart\_724,1}.p2))) \&\&
 (\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{p2}) <
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{M2})))~\&\&~(0<
asType < integer > (\$heap_{funcstart\_724,1}.p3))) \&\&
 (\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{p3}) <
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{M3}))
 \rightarrow [simplify]
 [5.16] \; ((((-30269 < -\$ heap_{funcstart\_724,1}.p1) \; \land \; (0 < \$ heap_{funcstart\_724
 (0 < \text{\$heap}_{funcstart\_724,1}.p2)) \&\& (\text{\$heap}_{funcstart\_724,1}.p2 <
asType < integer > (\$heap_{funcstart\_724,1}.M2))) \&\& (0 <
asType < integer > ($heap_{funcstart\_724,1}.p3))) &&
 (\mathbf{asType} < \mathbf{integer} > (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p3}) <
\mathbf{asType} < \mathbf{integer} > (\$ \mathrm{heap}_{funcstart\_724,1}.\mathrm{M3}))
 \rightarrow [const static or extern object]
 |5.17| \; ((((-30269 < -\$heap_{funcstart\_724,1}.p1) \; \land \; (0 < \$heap_{funcstart\_724,1}.p1) \; \land 
 (0 < \text{$heap}_{funcstart\_724,1}.p2)) \&\& (\text{$heap}_{funcstart\_724,1}.p2 <
asType < integer > (\$heap_{init}.M2))) \&\& (0 <
asType < integer > (\$heap_{funcstart\_724,1}.p3))) \&\&
 (\mathbf{asType} < \mathbf{integer} > (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p3}) <
asType < integer > (\$heap_{funcstart\_724,1}.M3))
 \rightarrow [expand definition of constant 'M2' at prang.c (19,20)]
 [5.18] ((((-30269 < -\$heap_{funcstart\_724,1}.p1) \land (0 < \$heap_{funcstart\_724,1}.p1) 
(0 < \text{$heap}_{funcstart\_724,1}.p2)) \&\& (\text{$heap}_{funcstart\_724,1}.p2 <
asType < integer > (asType < short int > ((int)30307)))) && (0 < integer) && (0 < integer
asType < integer > (\$heap_{funcstart\_724,1}.p3))) \&\&
 (\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{p3}) <
\mathbf{asType} < \mathbf{integer} > (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{M3}))
 \rightarrow [simplify]
 [5.30] ((-30307 < -$heap_{funcstart\_724,1}.p2) \land (-30269 <
 -\$heap_{funcstart\_724,1}.p1) \land (0 < \$heap_{funcstart\_724,1}.p1) \land (0 < \$heap_{funcstart\_724,1}.p1)
\text{Sheap}_{funcstart_{724,1},p2} \land (0 < \text{Sheap}_{funcstart_{724,1},p3})) \&\&
 (\text{\$heap}_{funcstart\_724,1}.p3 < asType < integer > (\text{\$heap}_{funcstart\_724,1}.M3))
```

```
\rightarrow [const static or extern object]
[5.31] ((-30307 < -$heap_{funcstart\_724,1}.p2) \land (-30269 <
-$heap_{funcstart_724,1}.p1) \land (0 < $heap_{funcstart_724,1}.p1) \land (0 <
\text{Sheap}_{funcstart\_724,1}.p2) \land (0 < \text{Sheap}_{funcstart\_724,1}.p3)) \&\&
(\$heap_{funcstart\_724,1}.p3 < \textbf{asType} < \textbf{integer} > (\$heap_{init}.M3))
\rightarrow [expand definition of constant 'M3' at prang.c (24,20)]
[5.32] ((-30307 < -$heap_funcstart_724,1.p2) \land (-30269 <
-\$heap_{funcstart\_724,1}.p1) \land (0 < \$heap_{funcstart\_724,1}.p1) \land (0 < \$heap_{funcstart\_724,1}.p1)
\text{Sheap}_{funcstart\_724,1}.p2) \land (0 < \text{Sheap}_{funcstart\_724,1}.p3)) \&\&
(\text{sheap}_{funcstart\_724,1}.\text{p3} < \text{asType} < \text{integer} > (\text{asType} < \text{short})
int > ((int)30323)))
\rightarrow [simplify]
[5.40] (-30323 < -\text{$heap}_{funcstart\_724,1}.p3) \land (-30307 <
-\$heap_{funcstart\_724,1}.p2) \land (-30269 < -\$heap_{funcstart\_724,1}.p1) \land (0 < -\$heap_{funcstart\_724,1}.p1)
\text{Sheap}_{funcstart\_724,1}.\text{p1}) \land (0 < \text{Sheap}_{funcstart\_724,1}.\text{p2}) \land (0 <
heap_{funcstart_{724.1}.p3}
\rightarrow [separate conjunction and work on first sub-term]
[5.41] -30323 < -\$heap_{funcstart\_724,1}.p3
[Take goal term]
[1.0] $heap<sub>funcstart_724,1</sub>.p3 \leq maxof(int)
\rightarrow [simplify]
\label{eq:continuous} \mbox{$[1.9]$ -32768} < -\$ heap_{funcstart\_724,1}.p3
\rightarrow [from term 5.41, literala < -$heap<sub>funcstart_724,1</sub>.p3 is true whenever (-1 +
literala) < -30323
    Proof of rule precondition:
    [1.9.0] (-32768 + -1) < -30323
    \rightarrow [simplify]
    [1.9.2] true
[1.10] true
Proof of verification condition: Type constraint satisfied in explicit
conversion from 'short int const' to 'int'
Condition generated at: C:\Escher\Customers\prang\prang.c (51,31)
Condition defined at:
To prove: minof(int) \leq \$heap_{funcstart\_724,1}.a3
```

Given:

```
heap_{init}.LIMIT == (int)80
heap_{init}.M1 == asType < short int > ((int)30269)
\theta_{init}.r1 == asType < short int > ((int)171)
heap_{init}.a1 == asType < short int > ((int)177)
heap_{init}.M2 == asType < short int > ((int)30307)
\theta_{init}.r2 == asType < short int > ((int)172)
heap_{init}.a2 == asType < short int > ((int)176)
\theta = asType < short int > ((int)35)
heap_{init}.M3 == asType < short int > ((int)30323)
heap_{init}.r3 == asType < short int > ((int)170)
heap_{init}.a3 == asType < short int > ((int)178)
\theta = asType < short int > ((int)63)
\theta = asType < short int > ((int)1)
\theta
\theta = asType < short int > ((int)3)
invariant1(heapIs heap_{funcstart\_724,1})
\operatorname{div1} == \operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724,1},
asType < int > (\$heap_{funcstart\_724,1}.p1),
asType < int > (\$heap_{funcstart\_724,1}.a1))
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a1))) = =
asType<integer>(div1.quot)
(asType<integer>(asType<int>($heap_{tuncstart\_724.1}.p1)) %
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a1))) = =
asType<integer>(div1.rem)
!(0 == asType < integer > (div1.rem)) || !(0 ==
asType<integer>(div1.quot))
div2 == div(\mathbf{heapIs} \$heap_{funcstart\_724,1},
asType < int > (\$heap_{funcstart\_724,1}.p2),
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{a2}))
(\mathbf{asType} < \mathbf{integer} > (\mathbf{asType} < \mathbf{int} > (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p2})) \ / \\
\mathbf{asType}{<}\mathbf{integer}{>}(\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{a2}))) ==
asType<integer>(div2.quot)
(asType<int>(asType<int>($heap_{funcstart\_724,1}.p2)) %
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a2))) = =
```

```
asType<integer>(div2.rem)
!(0 == asType < integer > (div2.rem)) || !(0 ==
asType<integer>(div2.quot))
Proof:
[Take goal term]
[1.0] \operatorname{minof}(\operatorname{int}) \leq \operatorname{\$heap}_{funcstart\_724,1}.a3
\rightarrow [simplify]
\textit{[1.1] -32768} \leq \$ heap_{funcstart\_724,1}.a3
\rightarrow [const static or extern object]
[1.2] -32768 \leq $heap<sub>init</sub>.a3
\rightarrow [expand definition of constant 'a3' at prang.c (26,20)]
[1.3] -32768 \le asType < short int > ((int)178)
\rightarrow [simplify]
[1.6] true
Proof of verification condition: Type constraint satisfied in explicit
conversion from 'short int const' to 'int'
Condition generated at: C:\Escher\Customers\prang\prang.c (51,31)
Condition defined at:
To prove: heap_{funcstart\_724,1}.a3 \le maxof(int)
Given:
heap_{init}.LIMIT == (int)80
heap_{init}.M1 == asType < short int > ((int)30269)
\theta_{init}.r1 == asType < short int > ((int)171)
heap_{init}.a1 == asType < short int > ((int)177)
\theta
heap_{init}.M2 == asType < short int > ((int)30307)
\theta_{init}.r2 == asType < short int > ((int)172)
heap_{init}.a2 == asType < short int > ((int)176)
\theta = asType < short int > ((int)35)
\theta = asType < short int > ((int)30323)
heap_{init}.r3 == asType < short int > ((int)170)
heap_{init}.a3 == asType < short int > ((int)178)
```

```
heap_{init}.b3 == asType < short int > ((int)63)
\theta = asType < short int > ((int)1)
\theta
heap_{init}.p3 == asType < short int > ((int)3)
invariant1(heapIs heap_{funcstart\_724,1})
\operatorname{div1} == \operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1},
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p1}),
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{a1}))
(asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.p1)) /
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a1))) = =
asType<integer>(div1.quot)
(\mathbf{asType}{<}\mathbf{int}{>}(\mathbf{asType}{<}\mathbf{int}{>}(\$\mathbf{heap}_{funcstart\_724,1}.\mathbf{p1}))~\%
\mathbf{asType}{<}\mathbf{integer}{>}(\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{a1}))) = =
asType<integer>(div1.rem)
!(0 == asType < integer > (div1.rem)) || !(0 ==
asType<integer>(div1.quot))
div2 == div(\mathbf{heapIs} \$heap_{funcstart\_724,1},
asType < int > (\$heap_{funcstart\_724,1}.p2),
asType < int > (\$heap_{funcstart\_724,1}.a2))
(asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.p2)) /
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a2))) = =
asType<integer>(div2.quot)
(\mathbf{asType}{<}\mathbf{integer}{>}(\mathbf{asType}{<}\mathbf{int}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{p2}))~\%
\mathbf{asType}{<}\mathbf{integer}{>}(\mathbf{asType}{<}\mathbf{int}{>}(\$\mathbf{heap}_{funcstart\_724,1}.\mathbf{a2}))) = =
asType<integer>(div2.rem)
!(0 == asType < integer > (div2.rem)) || !(0 ==
asType<integer>(div2.quot))
Proof:
[Take goal term]
[1.0] \text{heap}_{funcstart\_724,1}.a3 \leq \text{maxof(int)}
\rightarrow [const static or extern object]
[1.1] $heap<sub>init</sub>.a3 \leq maxof(int)
\rightarrow [expand definition of constant 'a3' at prang.c (26,20)]
[1.2] asType<short int>((int)178) \le maxof(int)
\rightarrow [simplify]
[1.6] true
```

```
Proof of verification condition: Precondition of 'div' satisfied
Condition generated at: C:\Escher\Customers\prang\prang.c (51,18)
Condition defined at: C:\Escher\ecv\standard\stdlib.h (94,10)
To prove: 0 < asType<integer>(asType<int>($heap_{tuncstart\ 724.1}.a3))
Given:
heap_{init}.LIMIT == (int)80
\theta sheap<sub>init</sub>.M1 == asType<short int>((int)30269)
\theta_{init}.r1 == asType < short int > ((int)171)
\theta
\theta
\theta
\theta_{init}.r2 == asType<short int>((int)172)
heap_{init}.a2 == asType < short int > ((int)176)
\theta = asType < short int > ((int)35)
heap_{init}.M3 == asType < short int > ((int)30323)
\theta_{init}.r3 == asType<short int>((int)170)
heap_{init}.a3 == asType < short int > ((int)178)
heap_{init}.b3 == asType < short int > ((int)63)
\theta = asType < short int > ((int)1)
\theta
\theta = asType < short int > ((int)3)
invariant1(heapIs heap_{funcstart_{-724.1}})
div1 == div(\mathbf{heapIs} \$ heap_{funcstart_{-724.1}},
asType < int > (\$heap_{funcstart\_724,1}.p1),
asType < int > (\$heap_{funcstart\_724,1}.a1))
(\mathbf{asType} < \mathbf{integer} > (\mathbf{asType} < \mathbf{int} > (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p1})) \ / \ 
\mathbf{asType}{<}\mathbf{integer}{>}(\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{a1}))) ==
asType<integer>(div1.quot)
(asType<integer>(asType<int>($heap_funcstart_724,1.p1)) %
\mathbf{asType}{<}\mathbf{int}{>}(\mathbf{\$heap}_{funcstart\_724,1}.\mathbf{a1}))) ==
asType<integer>(div1.rem)
!(0 == asType < integer > (div1.rem)) || !(0 ==
asType<integer>(div1.quot))
div2 == div(\mathbf{heapIs} \$ heap_{funcstart_{-724.1}},
asType < int > (\$heap_{funcstart\_724,1}.p2),
```

```
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{a2}))
(asType < integer > (asType < int > (\$heap_{funcstart\_724.1}.p2)) /
\mathbf{asType} < \mathbf{integer} > (\mathbf{asType} < \mathbf{int} > (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{a2}))) = =
asType<integer>(div2.quot)
(asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.p2)) \%
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a2))) = =
asType<integer>(div2.rem)
!(0 == asType < integer > (div2.rem)) || !(0 ==
asType<integer>(div2.quot))
Proof:
[Take goal term]
[1.0] 0 < asType<integer>(asType<int>($heap_{funcstart\_724.1}.a3))
\rightarrow [const static or extern object]
[1.1] 0 < asType < integer > (asType < int > (\$heap_{init}.a3))
\rightarrow [expand definition of constant 'a3' at prang.c (26,20)]
[1.2] 0 < asType<integer>(asType<int>(asType<short
int > ((int)178))
\rightarrow [simplify]
[1.7] true
Proof of verification condition: Type constraint satisfied in explicit
conversion from 'int' to 'short int'
Condition generated at: C:\Escher\Customers\prang\prang.c (56,15)
Condition defined at:
To prove: minof(short int) < div1.rem
Given:
heap_{init}.LIMIT == (int)80
\theta sheap<sub>init</sub>.M1 == asType<short int>((int)30269)
\theta_{init}.r1 == asType < short int > ((int)171)
heap_{init}.a1 == asType < short int > ((int)177)
\theta
heap_{init}.M2 == asType < short int > ((int)30307)
heap_{init}.r2 == asType < short int > ((int)172)
\theta
\theta = asType < short int > ((int)35)
```

```
heap_{init}.M3 == asType < short int > ((int)30323)
\theta_{init}.r3 == asType < short int > ((int)170)
heap_{init}.a3 == asType < short int > ((int)178)
heap_{init}.b3 == asType < short int > ((int)63)
\theta = asType < short int > ((int)1)
\theta
\theta = asType < short int > ((int)3)
invariant1(heapIs $heap_{tuncstart_724.1})
div1 == div(\mathbf{heapIs} \$heap_{funcstart\_724,1},
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p1}),
asType < int > (\$heap_{funcstart_{-724,1}}.a1))
(asType<int>(asType<int>($heap_{tuncstart\_724.1}.p1)) /
\mathbf{asType}{<}\mathbf{integer}{>}(\mathbf{asType}{<}\mathbf{int}{>}(\$\mathbf{heap}_{funcstart\_724,1}.\mathbf{a1}))) = =
asType<integer>(div1.quot)
(asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.p1)) \%
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a1))) = =
asType<integer>(div1.rem)
!(0 == asType < integer > (div1.rem)) || !(0 ==
asType<integer>(div1.quot))
\label{eq:div2} \text{div2} == \text{div}(\mathbf{heapIs} \ \$ \text{heap}_{funcstart\_724,1},
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p2}),
asType < int > (\$heap_{funcstart\_724,1}.a2))
(asType<integer>(asType<int>($heap_{tuncstart\_724.1}.p2)) /
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a2))) = =
asType<integer>(div2.quot)
(asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.p2)) \%
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a2))) = =
asType<integer>(div2.rem)
!(0 == asType < integer > (div2.rem)) || !(0 ==
asType<integer>(div2.quot))
\mathrm{div3} == \mathrm{div}(\mathbf{heapIs} \ \$ \mathrm{heap}_{funcstart\_724,1},
\mathbf{asType} < \mathbf{int} > (\$ \mathrm{heap}_{funcstart\_724,1}.\mathrm{p3}),
asType < int > (\$heap_{funcstart\_724,1}.a3))
(asType<int>(asType<int>($heap_{tuncstart\_724.1}.p3)) /
\mathbf{asType}{<}\mathbf{integer}{>}(\mathbf{asType}{<}\mathbf{int}{>}(\$\mathbf{heap}_{funcstart\_724,1}.\mathbf{a3}))) = =
asType<integer>(div3.quot)
(\mathbf{asType} {<} \mathbf{integer} {>} (\mathbf{asType} {<} \mathbf{int} {>} (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p3})) \ \%
\mathbf{asType}{<}\mathbf{integer}{>}(\mathbf{asType}{<}\mathbf{int}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathtt{a3}))) ==
```

```
asType<integer>(div3.rem)
!(0 == asType < integer > (div3.rem)) || !(0 ==
asType<integer>(div3.quot))
Proof:
[Take given term]
[5.0] invariant1(heapIs heap_{funcstart\_724,1})
\rightarrow [expand definition of function 'invariant1' at prang.c (34.1)]
[5.1] (((((0 < \mathbf{asType} < \mathbf{integer} > (\$ heap_{funcstart\_724,1}.p1)) \&\&
(asType < integer > (\$heap_{funcstart\_724,1}.p1) <
asType < integer > (\$heap_{funcstart_{-724,1}}.M1))) \&\& (0 <
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{p2})))\ \&\&
(\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{p2}) <
asType < integer > (\$heap_{funcstart\_724,1}.M2))) \&\& (0 <
asType < integer > (\$heap_{funcstart_{-724,1}}.p3))) \&\&
(asType < integer > (\$heap_{funcstart\_724,1}.p3) < 
\mathbf{asType} < \mathbf{integer} > (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{M3}))
\rightarrow [simplify]
asType < integer > (\$heap_{funcstart\_724,1}.M1))) \&\& (0 <
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p2})))\ \&\&
(\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{p2}) <
asType < integer > (\$heap_{funcstart_{-724,1}}.M2))) \&\& (0 <
asType < integer > (\$heap_{funcstart\_724,1}.p3))) \&\&
(\mathbf{asType} < \mathbf{integer} > (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p3}) <
asType < integer > (\$heap_{funcstart\_724,1}.M3))
\rightarrow [const static or extern object]
asType < integer > (\$heap_{init}.M1))) \&\& (0 <
asType < integer > ($heap_{funcstart\_724,1}.p2))) &&
(asType < integer > (\$heap_{funcstart\_724,1}.p2) < 
asType<integer>(sheap_{funcstart\_724,1}.M2)) && (0 <
asType < integer > (\$heap_{funcstart\_724,1}.p3))) \&\&
(asType<integer>($heap_{tuncstart_724,1}.p3) <
\mathbf{asType} < \mathbf{integer} > (\$ heap_{funcstart\_724,1}.M3))
\rightarrow [expand definition of constant 'M1' at prang.c (14,20)]
[5.5] (((((0 < $heap_{funcstart_724,1}.p1) && ($heap_{funcstart_724,1}.p1 < footnote{in the content of the c
\mathbf{asType} \small{<} \mathbf{integer} \small{>} (\mathbf{asType} \small{<} \mathbf{short} \ \mathbf{int} \small{>} ((\mathbf{int})30269)))) \ \&\& \ (0 <
asType < integer > (\$heap_{funcstart\_724,1}.p2))) \&\&
(\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{p2}) <
\mathbf{asType} \small{<} \mathbf{integer} \small{>} (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{M2}))) \ \&\& \ (0 <
asType < integer > (\$heap_{funcstart\_724,1}.p3))) \&\&
```

```
(\mathbf{asType} {<} \mathbf{integer} {>} (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p3}) <
asType < integer > (\$heap_{funcstart\_724,1}.M3))
\rightarrow [simplify]
[5.16] \; ((((-30269 < -\$heap_{funcstart\_724,1}.p1) \; \land \; (0 < \$heap_{funcstart\_724,1}.p1) \; \land 
(0 < \mathrm{\$heap}_{funcstart\_724,1}.\mathrm{p2})) && (\mathrm{\$heap}_{funcstart\_724,1}.\mathrm{p2} <
asType < integer > (\$heap_{funcstart\_724,1}.M2))) \&\& (0 <
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p3})))\ \&\&
(asType<integer>($heap_{tuncstart\_724,1}.p3) <
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{M3}))
\rightarrow [const static or extern object]
[5.17] \left( \left( \left( \left( -30269 < -\$ \text{heap}_{funcstart\_724,1}.\text{p1} \right) \right. \wedge \left. \left( 0 < \$ \text{heap}_{funcstart\_724,1}.\text{p1} \right) \right. \wedge \right. \right)
(0 < \text{\$heap}_{funcstart\_724,1}.p2)) \&\& (\text{\$heap}_{funcstart\_724,1}.p2 <
asType < integer > (\$heap_{init}.M2))) \&\& (0 <
asType < integer > ($heap_{funcstart\_724,1}.p3))) &&
(asType < integer > ($heap_{funcstart\_724,1}.p3) < 
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{M3}))
\rightarrow [expand definition of constant 'M2' at prang.c (19,20)]
[5.18] ((((-30269 < -\$heap_{funcstart\_724,1}.p1) \land (0 < \$heap_{funcstart\_724,1}.p1) 
(0 < \$ heap_{funcstart\_724,1}.p2)) && (\$ heap_{funcstart\_724,1}.p2 <
asType < integer > (asType < short int > ((int)30307)))) && (0 < integer) && (0 < integer
asType < integer > (\$heap_{funcstart\_724,1}.p3))) \&\&
(\mathbf{asType} {<} \mathbf{integer} {>} (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p3}) <
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{M3}))
\rightarrow [simplify]
[5.30] ((-30307 < -\$heap_{funcstart\_724,1}.p2) \land (-30269 <
-\$heap_{funcstart\_724,1}.p1) \land (0 < \$heap_{funcstart\_724,1}.p1) \land (0 < \$heap_{funcstart\_724,1}.p1)
\text{Sheap}_{funcstart_{724,1}.p2} \land (0 < \text{Sheap}_{funcstart_{724,1}.p3})) \&\&
(\text{\$heap}_{funcstart\_724,1}.\text{p3} < \text{asType} < \text{integer} > (\text{\$heap}_{funcstart\_724,1}.\text{M3}))
\rightarrow [const static or extern object]
[5.31] ((-30307 < -$heap<sub>funcstart_724,1.</sub>p2) \land (-30269 <
 -\$heap_{funcstart\_724,1}.p1) \land (0 < \$heap_{funcstart\_724,1}.p1) \land (0 < \$heap_{funcstart\_724,1}.p1)
\text{Sheap}_{funcstart_{724,1}.p2} \land (0 < \text{Sheap}_{funcstart_{724,1}.p3})) \&\&
(\$heap_{funcstart\_724,1}.p3 < \textbf{asType} < \textbf{integer} > (\$heap_{init}.M3))
\rightarrow [expand definition of constant 'M3' at prang.c (24,20)]
[5.32] ((-30307 < -$heap_funcstart_724,1.p2) \land (-30269 <
-$heap_{funcstart\_724,1}.p1) \land (0 < $heap_{funcstart\_724,1}.p1) \land (0 <
\text{Sheap}_{funcstart_{724,1}.p2} \land (0 < \text{Sheap}_{funcstart_{724,1}.p3})) \&\&
(\text{sheap}_{funcstart\_724,1}.p3 < asType < integer > (asType < short)
int > ((int)30323)))
\rightarrow [simplify]
```

```
[5.40] (-30323 < -$heap<sub>funcstart_724,1.</sub>p3) \land (-30307 <
-\$heap_{funcstart\_724,1}.p2) \land (-30269 < -\$heap_{funcstart\_724,1}.p1) \land (0 < -\$heap_{funcstart\_724,1}.p1)
\text{Sheap}_{funcstart\_724,1}.\text{p1}) \land (0 < \text{Sheap}_{funcstart\_724,1}.\text{p2}) \land (0 <
heap_{funcstart_{-724,1}.p3}
[Work on sub-term 4 of conjunction in term 5.40]
[8.0] 0 < \text{$heap}_{funcstart\_724,1}.p1
[Take given term]
[11.0] \operatorname{div1} == \operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724,1},
asType < int > (\$heap_{funcstart\_724,1}.p1),
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{a1}))
\rightarrow [simplify]
[11.1] \ \mathrm{div1} == \mathrm{div}(\mathbf{heapIs} \ \$ \mathrm{heap}_{funcstart\_724,1}, \ \$ \mathrm{heap}_{funcstart\_724,1}.\mathrm{p1},
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{a1}))
\rightarrow [const static or extern object]
[11.2] div1 == div(heapIs heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p1,
asType < int > (\$heap_{init}.a1))
\rightarrow [expand definition of constant 'a1' at prang.c (16,20)]
[11.3] \ \mathrm{div1} == \mathrm{div}(\mathbf{heapIs} \ \$ \mathrm{heap}_{funcstart\_724,1}, \ \$ \mathrm{heap}_{funcstart\_724,1}.\mathrm{p1},
asType<int>(asType<short int>((int)177)))
\rightarrow [simplify]
[11.6]~{\rm div1} == {\rm div}(\mathbf{heapIs}~\$ \mathrm{heap}_{funcstart\_724,1},~\$ \mathrm{heap}_{funcstart\_724,1}.\mathrm{p1},~177)
[Assume known post-assertion, class invariant or type constraint for term 11.6]
[15.0] (asType<integer>(sheap_{funcstart\_724,1}.p1) %
asType<integer>(177)) == asType<integer>(div(heapIs
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.\text{p1}, 177).\text{rem}
\rightarrow [simplify]
[15.2] (\theta_{15.2}) (\theta_{15.2}
\$ \mathrm{heap}_{funcstart\_724,1}, \$ \mathrm{heap}_{funcstart\_724,1}.\mathrm{p1}, \ 177).\mathrm{rem})
→ [expand definition of operator '.%' in class 'int' at built in declaration]
[15.3] ([asType<integer>(sheap_{funcstart\_724,1}.p1) < 0]:
-(-asType < integer > (\$heap_{tuncstart\_724.1}.p1) \% 177), []:
asType < integer > (\$heap_{funcstart\_724,1}.p1) \% 177) = =
asType<integer>(div(heapIs heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p1,
177).\text{rem}
→ [explicitly assert falsehood of skipped guards in subsequent guards]
[15.4] ([asType<integer>(sheap_{funcstart\_724,1.p1}) < 0]:
 -(-asType < integer > (\$heap_{funcstart\_724,1}.p1) \% 177),
```

```
[!(asType < integer > (\$heap_{funcstart\_724,1}.p1) < 0)]:
asType < integer > (\$heap_{funcstart\_724,1}.p1) \% 177) ==
\mathbf{asType} {<} \mathbf{integer} {>} ( \mathbf{div} (\mathbf{heapIs} \ \$ \mathbf{heap}_{funcstart\_724,1}, \ \$ \mathbf{heap}_{funcstart\_724,1}. \mathbf{p1}, \\
177).\text{rem}
\rightarrow [simplify]
[15.7] ([0 < -\text{$heap}_{funcstart\_724,1.p1}]:
-(-asType < integer > (\$heap_{funcstart\_724,1}.p1) \% 177),
[!(asType < integer > (\$heap_{funcstart\_724,1}.p1) < 0)]:
asType < integer > (\$heap_{funcstart\_724,1}.p1) \% 177) ==
asType<integer>(div(heapIs $heap_{funcstart\_724,1}, $heap_{funcstart\_724,1}.p1,
177).rem)
\rightarrow [from term 8.0, literala < -$heap<sub>funcstart_724,1.</sub>p1 is false whenever -2 < (0
+ literala)]
    Proof of rule precondition:
    [15.7.0] - 2 < (0 + 0)
    \rightarrow [simplify]
    [15.7.2] true
[15.8] ([false]: -(-asType < integer > (\$heap_{funcstart\_724,1}.p1) \% 177),
[!(asType < integer > (\$heap_{funcstart\_724,1}.p1) < 0)]:
asType < integer > (\$heap_{funcstart\_724,1}.p1) \% 177) ==
\mathbf{asType} {<} \mathbf{integer} {>} ( \mathrm{div}(\mathbf{heapIs} \ \$ \mathrm{heap}_{funcstart\_724,1}, \ \$ \mathrm{heap}_{funcstart\_724,1}.\mathrm{p1}, \\
177).rem)
\rightarrow [simplify]
[15.11] ([false]: -(-asType<integer>($heap_{funcstart\_724.1}.p1) % 177), [!(0
<-\$ heap_{funcstart\_724,1}.p1)]: \ \mathbf{asType} < \mathbf{integer} > (\$ heap_{funcstart\_724,1}.p1) \ \%
177) == asType<integer>(div(heapIs heap_{funcstart\_724,1},
heap_{funcstart_{-724,1}}.p1, 177).rem
\rightarrow [from term 8.0, literala < –$heap_{uncstart\_724,1}.p1 is false whenever -2 < (0
+ literala)]
    Proof of rule precondition:
    [15.11.0] - 2 < (0 + 0)
    \rightarrow [simplify]
    [15.11.2] true
[15.12] ([false]: -(-asType < integer > (\$heap_{funcstart\_724,1}.p1) \% 177),
[!false]: asType<integer>(sheap_{funcstart_{-724,1}}.p1) % 177) ==
\mathbf{asType} < \mathbf{integer} > (\mathbf{div}(\mathbf{heapIs} \ \$ \mathbf{heap}_{funcstart\_724,1}, \ \$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p1}, \\
177).rem)
\rightarrow [simplify]
```

```
[15.17] \ 0 == (-\mathrm{div}(\mathbf{heapIs} \ \$ \mathrm{heap}_{funcstart\_724,1}, \ \$ \mathrm{heap}_{funcstart\_724,1}.\mathrm{p1},
177).rem + (\text{$heap}_{funcstart\_724,1}.p1 \% 177))
[Assume known post-assertion, class invariant or type constraint for term
15.17]
[22.0] \operatorname{minof(int)} \leq \operatorname{div}(\operatorname{heapIs} \operatorname{\$heap}_{funcstart\_724,1}, \operatorname{\$heap}_{funcstart\_724,1}.p1,
177).rem
\rightarrow [simplify]
\label{eq:condition} \textit{[22.3] -32769} < \text{div}(\textbf{heapIs} \ \$ \text{heap}_{funcstart\_724,1}, \ \$ \text{heap}_{funcstart\_724,1}.\text{p1},
177).rem
[Take goal term]
[1.0] minof(short int) \leq div1.rem
\rightarrow [simplify]
[1.1] -32768 \le \text{div} 1.\text{rem}
\rightarrow [from term 11.6, div1 is equal to div(heapIs $heap_{funcstart\_724,1},
heap_{funcstart_{-724,1}}.p1, 177
[1.2] -32768 \le \operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724,1}, \$ \operatorname{heap}_{funcstart\_724,1}.\operatorname{p1},
177).rem
\rightarrow [simplify]
[1.4] -32769 < \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_724,1}, \text{\$heap}_{funcstart\_724,1}.\text{p1},
177).rem
\rightarrow [from term 22.3, literala < div(heapIs $heap_{funcstart\_724,1},
heap_{funcstart_{724,1}.p1, 177}.rem is true whenever (-1 + literala) < -32769
    Proof of rule precondition:
    [1.4.0](-32769 + -1) < -32769
    \rightarrow [simplify]
    [1.4.2] true
[1.5] true
Proof of verification condition: Type constraint satisfied in explicit
conversion from 'int' to 'short int'
Condition generated at: C:\Escher\Customers\prang\prang.c (56,15)
Condition defined at:
To prove: div1.rem \le maxof(short int)
Given:
heap_{init}.LIMIT == (int)80
```

```
heap_{init}.M1 == asType < short int > ((int)30269)
\theta_{init}.r1 == asType < short int > ((int)171)
heap_{init}.a1 == asType < short int > ((int)177)
\theta = asType < short int > ((int)2)
\theta sheap<sub>init</sub>.M2 == asType<short int>((int)30307)
\theta_{init}.r2 == asType < short int > ((int)172)
heap_{init}.a2 == asType < short int > ((int)176)
\theta = asType < short int > ((int)35)
\theta = asType < short int > ((int)30323)
heap_{init}.r3 == asType < short int > ((int)170)
heap_{init}.a3 == asType < short int > ((int)178)
\theta = asType < short int > ((int)63)
\theta = asType < short int > ((int)1)
\theta
\theta = asType < short int > ((int)3)
invariant1(heapIs heap_{funcstart_{-724,1}})
\operatorname{div1} == \operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724,1},
asType < int > (\$heap_{funcstart\_724.1}.p1),
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{a1}))
(\mathbf{asType}{<}\mathbf{integer}{>}(\mathbf{asType}{<}\mathbf{int}{>}(\$\mathbf{heap}_{funcstart\_724,1}.\mathbf{p1})) \ / \\
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a1))) = =
asType<integer>(div1.quot)
(asType < int > (asType < int > (\$heap_{funcstart\_724,1}.p1)) \%
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a1))) = =
asType<integer>(div1.rem)
!(0 == asType < integer > (div1.rem)) || !(0 ==
\mathbf{asType}{<}\mathbf{integer}{>}(\mathbf{div1}.\mathbf{quot}))
div2 == div(\mathbf{heapIs} \$heap_{funcstart\_724,1},
asType < int > (\$heap_{funcstart\_724.1}.p2),
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{a2}))
(\mathbf{asType} < \mathbf{integer} > (\mathbf{asType} < \mathbf{int} > (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p2})) \ / \\
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a2))) = =
asType<integer>(div2.quot)
(asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.p2)) \%
asType < integer > (asType < int > (\$heap_{funcstart\_724.1}.a2))) = =
asType<integer>(div2.rem)
```

```
!(0 == asType < integer > (div2.rem)) || !(0 ==
asType<integer>(div2.quot))
div3 == div(\mathbf{heapIs} \$ heap_{funcstart\_724,1},
asType < int > (\$heap_{funcstart\_724,1}.p3),
asType < int > (\$heap_{funcstart\_724.1}.a3))
(asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.p3)) /
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a3))) = =
asType<integer>(div3.quot)
(asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.p3)) \%
\mathbf{asType}{<}\mathbf{integer}{>}(\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{a3}))) ==
asType<integer>(div3.rem)
!(0 == asType < integer > (div3.rem)) || !(0 ==
asType<integer>(div3.quot))
Proof:
[Take given term]
[5.0] invariant1(heapIs heap_{funcstart\_724,1})
\rightarrow [expand definition of function 'invariant1' at prang.c (34,1)]
[5.1] (((((0 < \mathbf{asType} < \mathbf{integer} > (\$ heap_{funcstart\_724,1}.p1)) \&\&
(\mathbf{asType} < \mathbf{integer} > (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p1}) <
asType < integer > (\$heap_{funcstart\_724,1}.M1))) \&\& (0 <
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{p2})))\ \&\&
(\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{p2}) <
asType<integer>(heap_{funcstart\_724,1}.M2))) && (0 <
asType < integer > (\$heap_{funcstart\_724,1}.p3))) \&\&
(\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{p3}) <
\mathbf{asType} {<} \mathbf{integer} {>} (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{M3}))
\rightarrow [simplify]
[5.3] (((((0 < \theta_{funcstart\_724,1.p1) && (\theta_{funcstart\_724,1.p1)
asType < integer > (\$heap_{funcstart\_724,1}.M1))) \&\& (0 <
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{p2})))\ \&\&
(\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{p2}) <
asType < integer > (\$heap_{funcstart\_724,1}.M2))) \&\& (0 <
asType < integer > (\$heap_{funcstart\_724,1}.p3))) \&\&
(\mathbf{asType} < \mathbf{integer} > (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p3}) <
asType < integer > (\$heap_{funcstart\_724,1}.M3))
\rightarrow [const static or extern object]
[5.4] (((((0 < \text{heap}_{funcstart\_724,1}.p1) && (\text{heap}_{funcstart\_724,1}.p1 <
asType<integer>(heap_{init}.M1))) && (0 <
asType < integer > (\$heap_{funcstart\_724,1}.p2))) \&\&
(asType<integer>($heap_{tuncstart\_724.1}.p2) <
```

```
asType<integer>(heap_{funcstart\_724,1}.M2))) && (0 <
asType < integer > (\$heap_{funcstart\_724,1}.p3))) \&\&
(\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{p3}) <
asType < integer > (\$heap_{funcstart\_724,1}.M3))
\rightarrow [expand definition of constant 'M1' at prang.c (14,20)]
[5.5] (((((0 < $heap_{funcstart_{724,1}}.p1) && ($heap_{funcstart_{724,1}}.p1 <
asType<integer>(asType<short int>((int)30269)))) && (0 <
asType < integer > (\$heap_{funcstart\_724,1}.p2))) \&\&
(\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{p2}) <
asType < integer > (\$heap_{funcstart\_724,1}.M2))) \&\& (0 <
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{p3})))\ \&\&
(asType<integer>($heap_{tuncstart\_724,1}.p3) <
asType < integer > (\$heap_{funcstart\_724,1}.M3))
\rightarrow [simplify]
|5.16| \left( \left( \left( \left( -30269 < -\$ \text{heap}_{funcstart\_724,1}.\text{p1} \right) \right. \wedge \left. \left( 0 < \$ \text{heap}_{funcstart\_724,1}.\text{p1} \right) \right. \wedge \right. |
(0 < \mathrm{\$heap}_{funcstart\_724,1}.\mathrm{p2})) && (\mathrm{\$heap}_{funcstart\_724,1}.\mathrm{p2} <
asType<integer>($heap_{funcstart\_724,1}.M2))) && (0 <
asType < integer > (\$heap_{funcstart\_724,1}.p3))) \&\&
(asType < integer > (\$heap_{funcstart_{-724,1}}.p3) < 
asType < integer > (\$heap_{funcstart\_724,1}.M3))
\rightarrow [const static or extern object]
[5.17] ((((-30269 < -$heap_{funcstart\_724,1}.p1) \lambda (0 < $heap_{funcstart\_724,1}.p1) \lambda
(0 < \$ heap_{funcstart\_724,1}.p2)) && (\$ heap_{funcstart\_724,1}.p2 <
asType < integer > (\$heap_{init}.M2))) \&\& (0 <
asType < integer > (\$heap_{funcstart\_724,1}.p3))) \&\&
(asType < integer > (\$heap_{funcstart\_724,1}.p3) < 
asType < integer > (\$heap_{funcstart\_724,1}.M3))
\rightarrow [expand definition of constant 'M2' at prang.c (19,20)]
[5.18] \; ((((-30269 < -\$heap_{funcstart\_724,1}.p1) \; \land \; (0 < \$heap_{funcstart\_724,1}.p1) \; \land 
(0 < \text{$heap}_{funcstart\_724,1}.p2)) \&\& (\text{$heap}_{funcstart\_724,1}.p2 <
asType<integer>(asType<short int>((int)30307)))) && (0 <
asType < integer > (\$heap_{funcstart\_724,1}.p3))) \&\&
(\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{p3}) <
asType < integer > (\$heap_{funcstart\_724.1}.M3))
\rightarrow [simplify]
[5.30] ((-30307 < -$heap_{funcstart\_724,1}.p2) \land (-30269 <
-\$heap_{funcstart\_724,1}.p1) \land (0 < \$heap_{funcstart\_724,1}.p1) \land (0 < \$heap_{funcstart\_724,1}.p1)
\text{Sheap}_{funcstart\_724,1}.p2) \land (0 < \text{Sheap}_{funcstart\_724,1}.p3)) \&\&
(\text{\$heap}_{funcstart\_724,1}.\text{p3} < \text{asType} < \text{integer} > (\text{\$heap}_{funcstart\_724,1}.\text{M3}))
\rightarrow [const static or extern object]
[5.31] ((-30307 < -$heap_{tuncstart\_724,1}.p2) \land (-30269 <
```

```
-\$heap_{funcstart\_724,1}.p1) \land (0 < \$heap_{funcstart\_724,1}.p1) \land (0 < \$heap_{funcstart\_724,1}.p1)
\text{Sheap}_{funcstart\_724,1}.p2) \land (0 < \text{Sheap}_{funcstart\_724,1}.p3)) \&\&
(\text{\$heap}_{funcstart\_724,1}.p3 < asType < integer > (\text{\$heap}_{init}.M3))
\rightarrow [expand definition of constant 'M3' at prang.c (24,20)]
[5.32] ((-30307 < -$heap<sub>funcstart_724,1.</sub>p2) \land (-30269 <
-\$heap_{funcstart\_724,1}.p1) \land (0 < \$heap_{funcstart\_724,1}.p1) \land (0 < \$heap_{funcstart\_724,1}.p1)
\text{Sheap}_{funcstart_{724,1}.p2} \land (0 < \text{Sheap}_{funcstart_{724,1}.p3})) \&\&
(\text{sheap}_{funcstart\_724,1}.\text{p3} < \text{asType} < \text{integer} > (\text{asType} < \text{short})
int > ((int)30323)))
\rightarrow [simplify]
[5.40] (-30323 < -$heap<sub>funcstart_724,1.</sub>p3) \wedge (-30307 <
-\$heap_{funcstart_{724,1},p2}) \land (-30269 < -\$heap_{funcstart_{724,1},p1}) \land (0 < -\$heap_{funcstart_{724,1},p1}) \land (0 < -\$heap_{funcstart_{724,1},p1})
\$heap_{funcstart\_724,1}.p1) \land (0 < \$heap_{funcstart\_724,1}.p2) \land (0 <
heap_{funcstart_{724,1}.p3}
[Work on sub-term 4 of conjunction in term 5.40]
[8.0]~0 < \$ heap_{funcstart\_724,1}.p1
[Take given term]
[11.0] \operatorname{div1} == \operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724,1},
asType < int > (\$heap_{funcstart\_724,1}.p1),
asType < int > (\$heap_{funcstart\_724,1}.a1))
\rightarrow [simplify]
[11.1] \ \mathrm{div1} == \mathrm{div}(\mathbf{heapIs} \ \$ \mathrm{heap}_{funcstart\_724,1}, \ \$ \mathrm{heap}_{funcstart\_724,1}.\mathrm{p1},
asType < int > (\$heap_{funcstart\_724,1}.a1))
\rightarrow [const static or extern object]
[11.2] \ \mathrm{div1} == \mathrm{div}(\mathbf{heapIs} \ \$ \mathrm{heap}_{funcstart\_724,1}, \ \$ \mathrm{heap}_{funcstart\_724,1}.\mathrm{p1},
asType < int > (\$heap_{init}.a1))
\rightarrow [expand definition of constant 'a1' at prang.c (16,20)]
[11.3] \ \mathrm{div1} == \mathrm{div}(\mathbf{heapIs} \ \$ \mathrm{heap}_{funcstart\_724,1}, \ \$ \mathrm{heap}_{funcstart\_724,1}.\mathrm{p1},
asType<int>(asType<short int>((int)177)))
\rightarrow [simplify]
[11.6] \ \mathrm{div1} == \mathrm{div}(\mathbf{heapIs} \ \$ \mathrm{heap}_{funcstart\_724,1}, \ \$ \mathrm{heap}_{funcstart\_724,1}.\mathrm{p1}, \ 177)
[Assume known post-assertion, class invariant or type constraint for term 11.6]
[15.0] (asType<integer>(heap_{funcstart\_724,1}.p1) %
asType<integer>(177)) == asType<integer>(div(heapIs
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.\text{p1}, 177).\text{rem}
\rightarrow [simplify]
[15.2] (\text{heap}_{funcstart\_724,1}.\text{p1} \% 177) == asType<integer>(div(heapIs
```

```
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.\text{p1}, 177).\text{rem}
→ [expand definition of operator '.%' in class 'int' at built in declaration]
\textit{[15.3]} \; ([\mathbf{asType} < \mathbf{integer} > (\$ \mathrm{heap}_{funcstart\_724,1}.\mathrm{p1}) < 0]:
-(-asType < integer > (\$heap_{funcstart\_724,1}.p1) \% 177), []:
asType < integer > (\$heap_{funcstart\_724,1}.p1) \% 177) ==
asType<integer>(div(heapIs heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p1,
177).rem)
→ [explicitly assert falsehood of skipped guards in subsequent guards]
[15.4] ([asType<integer>(sheap_{funcstart\_724,1}.p1) < 0]:
-(-asType < integer > (\$heap_{funcstart\_724,1}.p1) \% 177),
[!(asType < integer > (\$heap_{funcstart\_724.1}.p1) < 0)]:
asType < integer > (\$heap_{funcstart_{-724,1}}.p1) \% 177) = =
asType<integer>(div(heapIs p_{funcstart\_724,1}, p_{funcstart\_724,1}),
177).\text{rem}
\rightarrow [simplify]
[15.7] ([0 < -$heap<sub>funcstart_724,1.</sub>p1]:
-(-asType < integer > (\$heap_{funcstart\_724,1}.p1) \% 177),
[!(\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{p1}) < 0)]:
asType < integer > (\$heap_{funcstart\_724,1}.p1) \% 177) ==
asType<integer>(div(heapIs $heap_{tuncstart\_724.1}, $heap_{tuncstart\_724.1}.p1,
177).rem)
\rightarrow [from term 8.0, literala < -$heap<sub>funcstart_724,1</sub>.p1 is false whenever -2 < (0
+ literala)]
   Proof of rule precondition:
   [15.7.0] - 2 < (0 + 0)
   \rightarrow [simplify]
   [15.7.2] true
[15.8] ([false]: -(-asType < integer > (\$heap_{funcstart\_724,1}.p1) \% 177),
[!(asType < integer > (\$heap_{funcstart\_724,1}.p1) < 0)]:
asType < integer > (\$heap_{funcstart\_724.1}.p1) \% 177) = =
asType<integer>(div(heapIs heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p1,
177).rem)
\rightarrow [simplify]
[15.11] ([false]: -(-asType < integer > (\$heap_{funcstart\_724,1}.p1) \% 177), [!(0
< -$heap<sub>funcstart_724.1</sub>.p1)]: asType<integer>($heap<sub>funcstart_724.1</sub>.p1) %
177) == asType<integer>(div(heapIs heap_{funcstart\_724.1}),
heap_{funcstart_{-724,1}.p1, 177}.rem
\rightarrow [from term 8.0, literala < -$heap<sub>funcstart_724,1</sub>.p1 is false whenever -2 < (0
+ literala)]
```

```
Proof of rule precondition:
   [15.11.0] - 2 < (0 + 0)
   \rightarrow [simplify]
   [15.11.2] true
[15.12] ([false]: -(-asType < integer > (\$heap_{funcstart\_724,1}.p1) \% 177),
[!false]: asType<integer>($heap_{funcstart\_724,1}.p1) % 177) ==
asType<integer>(div(heapIs $heap_{funcstart\_724,1}, $heap_{funcstart\_724,1}.p1,
177).rem)
\rightarrow [simplify]
[15.17] \ 0 == (-{\rm div}(\mathbf{heapIs} \ \$ {\rm heap}_{funcstart\_724,1}, \ \$ {\rm heap}_{funcstart\_724,1}.{\rm p1},
177).rem + (\text{$heap}_{funcstart\_724,1}.p1 \% 177))
[Assume known post-assertion, class invariant or type constraint for term
15.17
[23.0] div(heapIs heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p1, 177).rem \leq
maxof(int)
\rightarrow [simplify]
[23.9] -32768 < -\text{div}(\mathbf{heapIs} \$ \text{heap}_{funcstart\_724,1}, \$ \text{heap}_{funcstart\_724,1}.\text{p1},
177).rem
[Take goal term]
[1.0] div1.rem \leq maxof(short int)
\rightarrow [from term 11.6, div1 is equal to div(heapIs $heap_{funcstart\_724,1},
heap_{funcstart_{-724,1}}.p1, 177
[1.1] div(heapIs heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p1, 177).rem \leq
maxof(short int)
\rightarrow [simplify]
[1.10] -32768 < -\text{div}(\text{heapIs }\text{\$heap}_{funcstart\_724,1}, \text{\$heap}_{funcstart\_724,1}.p1,
177).rem
\rightarrow [from term 23.9, literala < -div(\mathbf{heapIs} \ \$heap_{funcstart\_724,1},
heap_{funcstart\_724,1}.p1, 177).rem is true whenever (-1 + literala) < -32768
   Proof of rule precondition:
   [1.10.0](-32768 + -1) < -32768
   \rightarrow [simplify]
   [1.10.2] true
[1.11] true
```

**Proof of verification condition:** Type constraint satisfied in implicit

```
Condition generated at: C:\Escher\Customers\prang\prang.c (56,15)
Condition defined at:
To prove: minof(int) \le asType < short int > (div1.rem)
Given:
heap_{init}.LIMIT == (int)80
\theta sheap<sub>init</sub>.M1 == asType<short int>((int)30269)
\theta_{init}.r1 == asType < short int > ((int)171)
\theta
\theta
\theta_{init}.M2 == asType < short int > ((int)30307)
\theta_{init}.r2 == asType < short int > ((int)172)
heap_{init}.a2 == asType < short int > ((int)176)
\theta = asType < short int > ((int)35)
heap_{init}.M3 == asType < short int > ((int)30323)
\theta_{init}.r3 == asType<short int>((int)170)
heap_{init}.a3 == asType < short int > ((int)178)
\theta = asType < short int > ((int)63)
\theta = asType < short int > ((int)1)
\theta
\theta = asType < short int > ((int)3)
invariant1(heapIs heap_{funcstart_{-724.1}})
div1 == div(\mathbf{heapIs} \$ heap_{funcstart_{-724.1}},
asType < int > (\$heap_{funcstart\_724,1}.p1),
asType < int > (\$heap_{funcstart\_724,1}.a1))
(\mathbf{asType} < \mathbf{integer} > (\mathbf{asType} < \mathbf{int} > (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p1})) \ / \ 
\mathbf{asType}{<}\mathbf{integer}{>}(\mathbf{asType}{<}\mathbf{int}{>}(\$\mathbf{heap}_{funcstart\_724,1}.\mathbf{a1}))) = =
asType<integer>(div1.quot)
(asType<integer>(asType<int>($heap_{tuncstart}, 724,1.p1)) %
\mathbf{asType} < \mathbf{integer} > (\mathbf{asType} < \mathbf{int} > (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{a1}))) = =
asType<integer>(div1.rem)
!(0 == asType < integer > (div1.rem)) || !(0 ==
asType<integer>(div1.quot))
div2 == div(\mathbf{heapIs} \$ heap_{funcstart\_724,1},
asType < int > (\$heap_{funcstart\_724,1}.p2),
```

conversion from 'short int' to 'int'

```
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{a2}))
(asType<integer>(asType<int>($heap_funcstart_724.1.p2)) /
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a2))) = =
asType<integer>(div2.quot)
(asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.p2)) \%
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a2))) = =
asType<integer>(div2.rem)
!(0 == asType < integer > (div2.rem)) || !(0 ==
asType<integer>(div2.quot))
div3 == div(\mathbf{heapIs} \$heap_{funcstart\_724,1},
asType < int > (\$heap_{funcstart\_724.1}.p3),
asType < int > (\$heap_{funcstart_{-724.1}}.a3))
(asType<int>(asType<int>($heap_{funcstart\_724,1}.p3)) /
\mathbf{asType}{<}\mathbf{integer}{>}(\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{a3}))) ==
asType<integer>(div3.quot)
(asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.p3)) \%
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a3))) = =
asType<integer>(div3.rem)
!(0 == asType < integer > (div3.rem)) || !(0 ==
asType<integer>(div3.quot))
Proof:
[Take given term]
[5.0] invariant1(heapIs heap_{funcstart\_724,1})
\rightarrow [expand definition of function 'invariant1' at prang.c (34,1)]
 \texttt{[5.1]} \; (((((0 < \mathbf{asType} < \mathbf{integer} > (\$ heap_{funcstart\_724,1}.p1)) \; \&\& \\
(asType<integer>($heap_funcstart_724.1.p1) <
asType < integer > (\$heap_{funcstart\_724.1}.M1))) \&\& (0 <
asType < integer > (\$heap_{funcstart\_724,1}.p2))) \&\&
(\mathbf{asType} {<} \mathbf{integer} {>} (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p2}) <
asType < integer > (\$heap_{funcstart\_724,1}.M2))) \&\& (0 < 1)
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p3})))\ \&\&
(asType < integer > (\$heap_{funcstart\_724,1}.p3) < 
asType<integer>($heap_{tuncstart_724,1}.M3))
\rightarrow [simplify]
[5.3] \ (((((0 < \$heap_{funcstart\_724,1}.p1) \&\& \ (\$heap_{funcstart\_724,1}.p1 < (
asType < integer > (\$heap_{funcstart\_724.1}.M1))) \&\& (0 <
asType < integer > (\$heap_{funcstart\_724,1}.p2))) \&\&
(\mathbf{asType} {<} \mathbf{integer} {>} (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p2}) <
asType < integer > (\$heap_{funcstart_{-724,1}}.M2))) \&\& (0 <
asType < integer > (\$heap_{funcstart\_724,1}.p3))) \&\&
```

```
(\mathbf{asType} {<} \mathbf{integer} {>} (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p3}) <
asType < integer > (\$heap_{funcstart\_724,1}.M3))
\rightarrow [const static or extern object]
[5.4] \ (((((0 < \text{\$heap}_{funcstart\_724,1}.\text{p1}) \&\& \ (\text{\$heap}_{funcstart\_724,1}.\text{p1} <
asType<integer>(heap_{init}.M1))) && (0 <
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{p2})))\ \&\&
(\mathbf{asType} < \mathbf{integer} > (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p2}) <
asType < integer > (\$heap_{funcstart\_724,1}.M2))) \&\& (0 <
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{p3})))\ \&\&
(asType < integer > (\$heap_{funcstart\_724,1}.p3) <
\mathbf{asType} < \mathbf{integer} > (\$ heap_{funcstart\_724,1}.M3))
\rightarrow [expand definition of constant 'M1' at prang.c (14,20)]
[5.5] (((((0 < $heap_{funcstart_{724,1}}.p1) && ($heap_{funcstart_{724,1}}.p1 < 
asType<integer>(asType<short int>((int)30269)))) && (0 <
asType < integer > (\$heap_{funcstart\_724,1}.p2))) \&\&
(\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{p2}) <
asType < integer > (\$heap_{funcstart\_724,1}.M2))) \&\& (0 <
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{p3})))\ \&\&
(asType < integer > (\$heap_{funcstart_{-724,1}}.p3) < 
asType < integer > (\$heap_{funcstart\_724,1}.M3))
\rightarrow [simplify]
[5.16] ((((-30269 < -$heap_{funcstart\_724,1}.p1) \lambda (0 < $heap_{funcstart\_724,1}.p1) \lambda
(0 < \$ heap_{funcstart\_724,1}.p2)) && (\$ heap_{funcstart\_724,1}.p2 <
asType < integer > (\$heap_{funcstart\_724,1}.M2))) \&\& (0 <
asType < integer > (\$heap_{funcstart\_724,1}.p3))) \&\&
(asType < integer > (\$heap_{funcstart\_724,1}.p3) < 
asType < integer > (\$heap_{funcstart\_724,1}.M3))
\rightarrow [const static or extern object]
[5.17] \; ((((-30269 < -\$heap_{funcstart\_724,1}.p1) \; \land \; (0 < \$heap_{funcstart\_724,1}.p1) \; \land 
(0 < \text{$heap}_{funcstart\_724,1}.p2)) \&\& (\text{$heap}_{funcstart\_724,1}.p2 <
asType < integer > (\$heap_{init}.M2))) \&\& (0 <
asType < integer > (\$heap_{funcstart\_724,1}.p3))) \&\&
(\mathbf{asType} {<} \mathbf{integer} {>} (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p3}) <
\mathbf{asType} {<} \mathbf{integer} {>} (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{M3}))
\rightarrow [expand definition of constant 'M2' at prang.c (19,20)]
[5.18] ((((-30269 < -\$heap_{funcstart\_724,1}.p1) \land (0 < \$heap_{funcstart\_724,1}.p1) 
(0 < \text{\$heap}_{funcstart\_724,1}.p2)) \&\& (\text{\$heap}_{funcstart\_724,1}.p2 <
asType<integer>(asType<short int>((int)30307)))) && (0 <
asType < integer > (\$heap_{funcstart\_724,1}.p3))) \&\&
(asType < integer > (\$heap_{funcstart\_724.1}.p3) < 
\mathbf{asType} < \mathbf{integer} > (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{M3}))
```

```
\rightarrow [simplify]
[5.30] ((-30307 < -$heap<sub>funcstart_724,1.</sub>p2) \wedge (-30269 <
-\$heap_{funcstart\_724,1}.p1) \land (0 < \$heap_{funcstart\_724,1}.p1) \land (0 < \$heap_{funcstart\_724,1}.p1)
\text{Sheap}_{funcstart\_724,1.p2} \land (0 < \text{Sheap}_{funcstart\_724,1.p3})) \&\&
(\$heap_{funcstart\_724,1}.p3 < \mathbf{asType} < \mathbf{integer} > (\$heap_{funcstart\_724,1}.M3))
\rightarrow [const static or extern object]
[5.31] ((-30307 < -$heap_{funcstart\_724,1}.p2) \land (-30269 <
-\$heap_{funcstart\_724,1}.p1) \land (0 < \$heap_{funcstart\_724,1}.p1) \land (0 < \$heap_{funcstart\_724,1}.p1)
\text{Sheap}_{funcstart\_724,1}.p2) \land (0 < \text{Sheap}_{funcstart\_724,1}.p3)) \&\&
(\text{\$heap}_{funcstart\_724,1}.p3 < asType < integer > (\text{\$heap}_{init}.M3))
\rightarrow [expand definition of constant 'M3' at prang.c (24,20)]
[5.32] ((-30307 < -$heap<sub>funcstart_724,1.</sub>p2) \land (-30269 <
-\$heap_{funcstart\_724,1}.p1) \land (0 < \$heap_{funcstart\_724,1}.p1) \land (0 < \$heap_{funcstart\_724,1}.p1)
\text{Sheap}_{funcstart\_724,1.p2} \land (0 < \text{Sheap}_{funcstart\_724,1.p3})) \&\&
(\$heap_{funcstart\_724,1}.p3 < \textbf{asType} < \textbf{integer} > (\textbf{asType} < \textbf{short}
int > ((int)30323)))
\rightarrow [simplify]
[5.40] (-30323 < -$heap<sub>funcstart_724,1.</sub>p3) \land (-30307 <
-\$heap_{funcstart\_724,1}.p2) \wedge (-30269 < -\$heap_{funcstart\_724,1}.p1) \wedge (0 <
\text{Sheap}_{funcstart\_724,1}.\text{p1}) \land (0 < \text{Sheap}_{funcstart\_724,1}.\text{p2}) \land (0 <
heap_{funcstart_{-724,1}.p3}
[Work on sub-term 4 of conjunction in term 5.40]
[8.0] 0 < $heap_{funcstart_724,1}.p1
[Take given term]
[11.0] \operatorname{div1} == \operatorname{div}(\mathbf{heapIs} \ \hat{\mathbf{s}}_{heap}) + \operatorname{div1}_{funcstart} = \mathbf{f}_{funcstart}
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p1}),
asType < int > (\$heap_{funcstart\_724,1}.a1))
\rightarrow [simplify]
[11.1] \ \mathrm{div1} == \mathrm{div}(\mathbf{heapIs} \ \$ \mathrm{heap}_{funcstart\_724,1}, \ \$ \mathrm{heap}_{funcstart\_724,1}.\mathrm{p1},
asType < int > (\$heap_{funcstart\_724,1}.a1))
\rightarrow [const static or extern object]
[11.2] div1 == div(heapIs heap_{funcstart_{-724,1}}, heap_{funcstart_{-724,1}}.p1,
asType < int > (\$heap_{init}.a1))
\rightarrow [expand definition of constant 'a1' at prang.c (16,20)]
[11.3] \ \mathrm{div1} == \mathrm{div}(\mathbf{heapIs} \ \$ \mathrm{heap}_{funcstart\_724,1}, \ \$ \mathrm{heap}_{funcstart\_724,1}.\mathrm{p1},
asType<int>(asType<short int>((int)177)))
\rightarrow [simplify]
[11.6] div1 == div(heapIs $heap_{funcstart\_724,1}, $heap_{funcstart\_724,1}.p1, 177)
```

```
[Assume known post-assertion, class invariant or type constraint for term 11.6]
[15.0] (asType<integer>(peq_{funcstart\_724,1}.p1) %
asType<integer>(177)) == asType<integer>(div(heapIs
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.\text{p1}, 177).\text{rem}
\rightarrow [simplify]
[15.2] (\theta_{tuncstart\_724,1.p1} \% 177) == asType<integer>(div(heapIs
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.\text{p1}, 177).\text{rem}
→ [expand definition of operator '.%' in class 'int' at built in declaration]
[15.3] \; ([\mathbf{asType} < \mathbf{integer} > (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p1}) < 0] :
-(-asType < integer > (\$heap_{funcstart\_724,1}.p1) \% 177), []:
asType < integer > (\$heap_{funcstart\_724,1}.p1) \% 177) ==
asType<integer>(div(heapIs $heap_{funcstart\_724,1}, $heap_{funcstart\_724,1}.p1,
177).rem)
→ [explicitly assert falsehood of skipped guards in subsequent guards]
[15.4] ([asType<integer>($heap_{funcstart\_724,1}.p1) < 0]:
-(-\mathbf{asType} < \mathbf{integer} > (\$ \mathrm{heap}_{funcstart\_724,1}.\mathrm{p1}) \% \ 177),
[!(asType < integer > (\$heap_{funcstart\_724,1}.p1) < 0)]:
asType < integer > (\$heap_{funcstart\_724,1}.p1) \% 177) ==
\mathbf{asType} {<} \mathbf{integer} {>} ( \mathrm{div}(\mathbf{heapIs} \ \$ \mathrm{heap}_{funcstart\_724,1}, \ \$ \mathrm{heap}_{funcstart\_724,1}. \mathrm{p1}, \\
177).rem)
\rightarrow [simplify]
[15.7] ([0 < -\$heap_{funcstart\_724,1}.p1]:
-(-\mathbf{asType} < \mathbf{integer} > (\$ \mathrm{heap}_{funcstart\_724,1}.\mathrm{p1}) \% \ 177),
[!(asType < integer > (\$heap_{funcstart\_724,1}.p1) < 0)]:
asType < integer > (\$heap_{funcstart-724,1}.p1) \% 177) ==
asType<integer>(div(heapIs $heap_{funcstart\_724,1}, $heap_{funcstart\_724,1}.p1,
177).rem)
\rightarrow [from term 8.0, literala < -$heap<sub>funcstart_724.1</sub>.p1 is false whenever -2 < (0
+ literala)
    Proof of rule precondition:
    [15.7.0] - 2 < (0 + 0)
    \rightarrow [simplify]
    [15.7.2] true
[15.8] \; ([\mathbf{false}]: \; -(-\mathbf{asType} < \mathbf{integer} > (\$ \mathrm{heap}_{funcstart\_724,1}.\mathrm{p1}) \; \% \; 177),
[!(\mathbf{asType} < \mathbf{integer} > (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p1}) < 0)]:
asType < integer > (\$heap_{funcstart\_724,1}.p1) \% 177) = =
asType<integer>(div(heapIs heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p1,
177).rem)
\rightarrow [simplify]
```

```
[15.11] \; ([\mathbf{false}]: \; -(-\mathbf{asType} < \mathbf{integer} > (\$ heap_{funcstart\_724,1}.p1) \; \% \; 177), \; [!(0.15.11)] \; ((1.15.11)] \; ((1.15.11)] \; ((1.15.11)] \; ((1.15.11)] \; ((1.15.11)] \; ((1.15.11)] \; ((1.15.11)] \; ((1.15.11)] \; ((1.15.11)] \; ((1.15.11)] \; ((1.15.11)] \; ((1.15.11)] \; ((1.15.11)] \; ((1.15.11)] \; ((1.15.11)] \; ((1.15.11)] \; ((1.15.11)] \; ((1.15.11)] \; ((1.15.11)] \; ((1.15.11)] \; ((1.15.11)] \; ((1.15.11)] \; ((1.15.11)] \; ((1.15.11)] \; ((1.15.11)] \; ((1.15.11)] \; ((1.15.11)] \; ((1.15.11)] \; ((1.15.11)] \; ((1.15.11)] \; ((1.15.11)] \; ((1.15.11)] \; ((1.15.11)] \; ((1.15.11)] \; ((1.15.11)] \; ((1.15.11)] \; ((1.15.11)] \; ((1.15.11)] \; ((1.15.11)] \; ((1.15.11)] \; ((1.15.11)] \; ((1.15.11)] \; ((1.15.11)] \; ((1.15.11)] \; ((1.15.11)] \; ((1.15.11)] \; ((1.15.11)] \; ((1.15.11)] \; ((1.15.11)] \; ((1.15.11)] \; ((1.15.11)] \; ((1.15.11)] \; ((1.15.11)] \; ((1.15.11)] \; ((1.15.11)] \; ((1.15.11)] \; ((1.15.11)] \; ((1.15.11)] \; ((1.15.11)] \; ((1.15.11)] \; ((1.15.11)] \; ((1.15.11)] \; ((1.15.11)] \; ((1.15.11)] \; ((1.15.11)] \; ((1.15.11)] \; ((1.15.11)] \; ((1.15.11)] \; ((1.15.11)] \; ((1.15.11)] \; ((1.15.11)] \; ((1.15.11)] \; ((1.15.11)] \; ((1.15.11)] \; ((1.15.11)] \; ((1.15.11)] \; ((1.15.11)] \; ((1.15.11)] \; ((1.15.11)] \; ((1.15.11)] \; ((1.15.11)] \; ((1.15.11)] \; ((1.15.11)] \; ((1.15.11)] \; ((1.15.11)] \; ((1.15.11)] \; ((1.15.11)] \; ((1.15.11)] \; ((1.15.11)] \; ((1.15.11)] \; ((1.15.11)] \; ((1.15.11)] \; ((1.15.11)] \; ((1.15.11)] \; ((1.15.11)] \; ((1.15.11)] \; ((1.15.11)] \; ((1.15.11)] \; ((1.15.11)] \; ((1.15.11)] \; ((1.15.11)] \; ((1.15.11)] \; ((1.15.11)] \; ((1.15.11)] \; ((1.15.11)] \; ((1.15.11)] \; ((1.15.11)] \; ((1.15.11)] \; ((1.15.11)] \; ((1.15.11)] \; ((1.15.11)] \; ((1.15.11)] \; ((1.15.11)] \; ((1.15.11)] \; ((1.15.11)] \; ((1.15.11)] \; ((1.15.11)] \; ((1.15.11)] \; ((1.15.11)] \; ((1.15.11)] \; ((1.15.11)] \; ((1.15.11)] \; ((1.15.11)] \; ((1.15.11)] \; ((1.15.11)] \; ((1.15.11)] \; ((1.15.11)] \; ((1.15.11)] \; ((1.15.11)] \; ((1.15.11)] \; ((1.15.11)] \; ((1.15.11)] \; ((1.15.11)] \; ((1.15.11)] \; ((1.15.11)] \; ((1.15.11)] \; ((1.15.11)] \; ((1.15.11)] \; 
<-$heap<sub>funcstart_724,1</sub>.p1)]: asType<integer>($heap<sub>funcstart_724,1</sub>.p1) %
177) == asType<integer>(div(heapIs heap_{funcstart\_724,1},
heap_{funcstart_{-724,1}.p1, 177}.rem
\rightarrow [from term 8.0, literala < -$heap<sub>funcstart_724,1.</sub>p1 is false whenever -2 < (0
+ literala)]
        Proof of rule precondition:
        [15.11.0] - 2 < (0 + 0)
        \rightarrow [simplify]
        [15.11.2] true
[15.12] ([false]: -(-asType < integer > (\$heap_{funcstart\_724,1}.p1) \% 177),
[!false]: asType<integer>(p_{funcstart\_724,1}.p_1) \% 177) ==
asType<integer>(div(heapIs $heap_{funcstart\_724,1}, $heap_{funcstart\_724,1}.p1,
177).rem)
\rightarrow [simplify]
[15.17] \ 0 == (-\text{div}(\mathbf{heapIs} \ \$ \text{heap}_{funcstart\_724,1}, \ \$ \text{heap}_{funcstart\_724,1}.\text{p1},
177).rem + (\text{$heap}_{funcstart\_724,1}.p1 \% 177))
[Assume known post-assertion, class invariant or type constraint for term
15.17
[22.0] \operatorname{minof(int)} \leq \operatorname{div}(\operatorname{heapIs} \operatorname{\$heap}_{funcstart\_724,1}, \operatorname{\$heap}_{funcstart\_724,1}.p1,
177).rem
\rightarrow [simplify]
[22.3] -32769 < div(heapIs $heap_{tuncstart\_724.1}, $heap_{tuncstart\_724.1}.p1,
177).rem
[Take goal term]
[1.0] minof(int) \leq asType<short int>(div1.rem)
\rightarrow [simplify]
[1.1] -32768 \leq asType<short int>(div1.rem)
\rightarrow [from term 11.6, div1 is equal to div(heapIs $heap_{funcstart\_724,1},
heap_{funcstart_{-724,1}}.p1, 177
[1.2] -32768 \leq asType<short int>(div(heapIs $heap<sub>funcstart_724,1</sub>,
heap_{funcstart_{-724,1}.p1, 177}.rem
\rightarrow [simplify]
[1.5] -32769 < div(heapIs $heap_{funcstart\_724,1}, $heap_{funcstart\_724,1}.p1,
177).rem
\rightarrow [from term 22.3, literala < div(heapIs $heap_{funcstart\_724,1},
heap_{funcstart_{-724,1}}.p1, 177).rem is true whenever (-1 + literala) < -32769
```

```
[1.5.0] (-32769 + -1) < -32769
   \rightarrow [simplify]
   [1.5.2] true
[1.6] true
Proof of verification condition: Type constraint satisfied in implicit
conversion from 'short int' to 'int'
Condition generated at: C:\Escher\Customers\prang\prang.c (56,15)
Condition defined at:
To prove: asType<short int>(div1.rem) \leq maxof(int)
Given:
heap_{init}.LIMIT == (int)80
heap_{init}.M1 == asType < short int > ((int)30269)
\theta_{init}.r1 == asType < short int > ((int)171)
\theta
\theta = asType < short int > ((int)2)
\theta sheap<sub>init</sub>.M2 == asType<short int>((int)30307)
\rho_{init}.r2 == asType < short int > ((int)172)
heap_{init}.a2 == asType < short int > ((int)176)
\theta = asType < short int > ((int)35)
```

Proof of rule precondition:

```
\label{eq:sheap} \begin{split} & \text{$$ \text{sheap}_{init}.p3 == asType < short int} > ((int)3) \\ & \text{invariant1}(\textbf{heapIs} \ \text{$$ \text{sheap}_{funcstart\_724,1}, } \\ & \text{div1} == \text{div}(\textbf{heapIs} \ \text{$$ \text{sheap}_{funcstart\_724,1}, } \\ & \text{asType} < \text{int} > (\text{$$ \text{sheap}_{funcstart\_724,1}.p1), } \\ & \text{asType} < \text{int} > (\text{$$ \text{sheap}_{funcstart\_724,1}.a1))} \\ & \text{($$ \text{asType} < \text{integer} > (asType < \text{int} > (\text{$$ \text{sheap}_{funcstart\_724,1}.p1)) / } \\ & \text{asType} < \text{integer} > (asType < \text{int} > (\text{$$ \text{sheap}_{funcstart\_724,1}.a1)))} = = \\ \end{split}
```

 $\label{eq:short_int} $$ \ $ = asType < short int > ((int)30323) $$ \ $ = asType < short int > ((int)170) $$ \ $ = asType < short int > ((int)178) $$ \ $ = asType < short int > ((int)178) $$ \ $ = asType < short int > ((int)63) $$ \ $ = asType < short int > ((int)1) $$ \ $ = asType < short int > ((int)1) $$ \ $ = asType < short int > ((int)2) $$$ 

```
asType<integer>(div1.quot)
(asType<integer>(asType<int>($heap_{tuncstart_724,1}.p1)) %
\mathbf{asType}{<}\mathbf{integer}{>}(\mathbf{asType}{<}\mathbf{int}{>}(\$\mathbf{heap}_{funcstart\_724,1}.\mathbf{a1}))) = =
asType<integer>(div1.rem)
!(0 == asType < integer > (div1.rem)) || !(0 ==
asType<integer>(div1.quot))
div2 == div(\mathbf{heapIs} \$heap_{funcstart\_724,1},
asType < int > (\$heap_{funcstart\_724,1}.p2),
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{a2}))
(asType<int>(asType<int>($heap_{tuncstart\_724.1}.p2)) /
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a2))) = =
asType<integer>(div2.quot)
(asType<int>(asType<int>($heap_{funcstart\_724,1}.p2)) %
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a2))) = =
asType<integer>(div2.rem)
!(0 == asType < integer > (div2.rem)) || !(0 ==
asType<integer>(div2.quot))
div3 == div(\mathbf{heapIs} \$heap_{funcstart\_724,1},
asType < int > (\$heap_{funcstart\_724,1}.p3),
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{a3}))
(asType<integer>(asType<int>($heap_{tuncstart\_724.1}.p3)) /
asType < integer > (asType < int > (\$heap_{funcstart\_724.1}.a3))) = =
asType<integer>(div3.quot)
(asType < int > (asType < int > (\$heap_{tuncstart\_724,1}.p3)) \%
\mathbf{asType} < \mathbf{integer} > (\mathbf{asType} < \mathbf{int} > (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{a3}))) = =
asType<integer>(div3.rem)
!(0 == asType < integer > (div3.rem)) || !(0 ==
asType<integer>(div3.quot))
Proof:
[Take given term]
[5.0] invariant1(heapIs heap_{funcstart\_724,1})
\rightarrow [expand definition of function 'invariant1' at prang.c (34,1)]
[5.1] ((((((0 < asType < integer > ($heap_{funcstart\_724,1}.p1)) &&
(asType < integer > (\$heap_{funcstart\_724,1}.p1) < 
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{M1})))~\&\&~(0<
asType < integer > (\$heap_{funcstart\_724,1}.p2))) \&\&
(asType < integer > ($heap_{funcstart\_724,1}.p2) < 
asType < integer > (\$heap_{funcstart\_724,1}.M2))) \&\& (0 < function for the sum of the 
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{p3})))\ \&\&
```

```
(\mathbf{asType} {<} \mathbf{integer} {>} (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p3}) <
asType < integer > (\$heap_{funcstart\_724,1}.M3))
\rightarrow [simplify]
[5.3] (((((0 < $heap_{funcstart\_724,1}.p1) && ($heap_{funcstart\_724,1}.p1 <
asType<integer>(heap_{funcstart\_724,1}.M1))) && (0 <
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{p2})))\ \&\&
(\mathbf{asType} < \mathbf{integer} > (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p2}) <
asType < integer > (\$heap_{funcstart\_724,1}.M2))) \&\& (0 <
asType < integer > (\$heap_{funcstart\_724,1}.p3))) \&\&
(asType < integer > (\$heap_{funcstart\_724,1}.p3) <
\mathbf{asType} < \mathbf{integer} > (\$ heap_{funcstart\_724,1}.M3))
\rightarrow [const static or extern object]
[5.4] \; (((((0 < \mathrm{\$heap}_{funcstart\_724,1}.\mathrm{p1}) \; \&\& \; (\mathrm{\$heap}_{funcstart\_724,1}.\mathrm{p1} <
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathrm{heap}_{init}.\mathrm{M1})))~\&\&~(0<
asType < integer > (\$heap_{funcstart\_724,1}.p2))) \&\&
(\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{p2}) <
asType < integer > (\$heap_{funcstart\_724,1}.M2))) \&\& (0 <
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{p3})))\ \&\&
(asType < integer > (\$heap_{funcstart_{-724,1}}.p3) < 
asType < integer > (\$heap_{funcstart\_724,1}.M3))
\rightarrow [expand definition of constant 'M1' at prang.c (14,20)]
[5.5] (((((0 < \text{heap}_{funcstart\_724,1}.p1) && (\text{heap}_{funcstart\_724,1}.p1 <
asType<integer>(asType<short int>((int)30269)))) && (0 <
asType < integer > (\$heap_{funcstart\_724,1}.p2))) \&\&
(asType < integer > ($heap_{funcstart\_724,1}.p2) < 
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{M2})))~\&\&~(0<
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathtt{heap}_{funcstart\_724,1}.\mathtt{p3})))\ \&\&
(asType < integer > ($heap_{funcstart\_724,1}.p3) < 
asType < integer > (\$heap_{funcstart\_724,1}.M3))
\rightarrow [simplify]
[5.16] ((((-30269 < -$heap_{funcstart\_724,1}.p1) \lambda (0 < $heap_{funcstart\_724,1}.p1) \lambda
(0 < \text{$heap}_{funcstart\_724,1}.p2)) \&\& (\text{$heap}_{funcstart\_724,1}.p2 <
asType<integer>($heap_{funcstart\_724,1}.M2))) && (0 <
asType < integer > (\$heap_{funcstart\_724,1}.p3))) \&\&
(\mathbf{asType} {<} \mathbf{integer} {>} (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p3}) <
asType < integer > (\$heap_{funcstart\_724,1}.M3))
\rightarrow [const static or extern object]
[5.17] \; ((((-30269 < -\$heap_{funcstart\_724,1}.p1) \; \land \; (0 < \$heap_{funcstart\_724,1}.p1) \; \land 
(0 < \text{\$heap}_{funcstart\_724,1}.p2)) \&\& (\text{\$heap}_{funcstart\_724,1}.p2 <
asType < integer > (\$heap_{init}.M2))) \&\& (0 <
asType < integer > (\$heap_{funcstart\_724,1}.p3))) \&\&
```

```
(\mathbf{asType} {<} \mathbf{integer} {>} (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p3}) <
asType < integer > (\$heap_{funcstart\_724,1}.M3))
\rightarrow [expand definition of constant 'M2' at prang.c (19,20)]
[5.18] ((((-30269 < -$heap<sub>funcstart_724,1.</sub>p1) \land (0 < $heap<sub>funcstart_724,1.</sub>p1) \land
(0 < \mathrm{\$heap}_{funcstart\_724,1}.\mathrm{p2})) && (\mathrm{\$heap}_{funcstart\_724,1}.\mathrm{p2} <
asType<integer>(asType<short int>((int)30307)))) && (0 <
asType < integer > ($heap_{funcstart\_724,1}.p3))) &&
(asType<integer>($heap_{tuncstart\_724,1}.p3) <
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{M3}))
\rightarrow [simplify]
[5.30] ((-30307 < -$heap<sub>funcstart_724.1.</sub>p2) \wedge (-30269 <
-\$heap_{funcstart_{-724,1}.p1}) \land (0 < \$heap_{funcstart_{-724,1}.p1}) \land (0 <
\text{Sheap}_{funcstart\_724,1}.\text{p2}) \land (0 < \text{Sheap}_{funcstart\_724,1}.\text{p3})) \&\&
(\$heap_{funcstart\_724,1}.p3 < \mathbf{asType} < \mathbf{integer} > (\$heap_{funcstart\_724,1}.M3))
\rightarrow [const static or extern object]
[5.31] ((-30307 < -$heap<sub>funcstart_724,1.</sub>p2) \land (-30269 <
-\$heap_{funcstart\_724,1}.p1) \land (0 < \$heap_{funcstart\_724,1}.p1) \land (0 < \$heap_{funcstart\_724,1}.p1)
\text{Sheap}_{funcstart\_724,1.p2}) \land (0 < \text{Sheap}_{funcstart\_724,1.p3})) \&\&
(\text{\$heap}_{funcstart\_724,1}.p3 < asType < integer > (\text{\$heap}_{init}.M3))
\rightarrow [expand definition of constant 'M3' at prang.c (24,20)]
[5.32] ((-30307 < -$heap_{funcstart\_724,1}.p2) \land (-30269 <
-\$heap_{funcstart_{724,1}.p1}) \land (0 < \$heap_{funcstart_{724,1}.p1}) \land (0 <
\text{Sheap}_{funcstart_{724,1},p2} \land (0 < \text{Sheap}_{funcstart_{724,1},p3})) \&\&
(\$heap_{funcstart\_724,1}.p3 < \textbf{asType} < \textbf{integer} > (\textbf{asType} < \textbf{short}
int > ((int)30323))
\rightarrow [simplify]
[5.40] \; (-30323 < -\$ heap_{funcstart\_724,1}.p3) \; \wedge \; (-30307 < -30307) \; \wedge \; (-30307 < -30307) \; \wedge \; (-30307) \; \wedge \; (-3030
 -\$heap_{funcstart\_724,1}.p2) \land (-30269 < -\$heap_{funcstart\_724,1}.p1) \land (0 < -\$heap_{funcstart\_724,1}.p2)
\text{Sheap}_{funcstart_{724,1}.p1} \land (0 < \text{Sheap}_{funcstart_{724,1}.p2}) \land (0 <
\$ heap_{funcstart\_724,1}.p3)
[Work on sub-term 4 of conjunction in term 5.40]
[8.0] 0 < $heap_{funcstart_724,1}.p1
[Take given term]
[11.0] \operatorname{div1} == \operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724,1},
asType < int > (\$heap_{funcstart\_724,1}.p1),
asType < int > (\$heap_{funcstart\_724,1}.a1))
\rightarrow [simplify]
[11.1] \operatorname{div1} == \operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724,1}, \$ \operatorname{heap}_{funcstart\_724,1}.p1,
asType < int > (\$heap_{funcstart\_724,1}.a1))
```

```
\rightarrow [const static or extern object]
[11.2] \operatorname{div1} == \operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724,1}, \$ \operatorname{heap}_{funcstart\_724,1}.p1,
asType < int > (\$heap_{init}.a1))
\rightarrow [expand definition of constant 'a1' at prang.c (16,20)]
[11.3] \operatorname{div1} == \operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724,1}, \$ \operatorname{heap}_{funcstart\_724,1}.p1,
asType<int>(asType<short int>((int)177)))
\rightarrow [simplify]
[11.6] div1 == div(heapIs $heap_{funcstart\_724,1}, $heap_{funcstart\_724,1}.p1, 177)
[Assume known post-assertion, class invariant or type constraint for term 11.6]
[15.0] (asType<integer>(heap_{funcstart\_724,1}.p1) %
asType<integer>(177)) == asType<integer>(div(heapIs
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.\text{p1}, 177).\text{rem}
\rightarrow [simplify]
[15.2] (\text{heap}_{funcstart\_724,1}.p1 % 177) == asType<integer>(div(heapIs)
\theta_{funcstart_{724,1}}, \theta_{funcstart_{724,1},p1,177}.rem
→ [expand definition of operator '.%' in class 'int' at built in declaration]
[15.3] ([asType<integer>(heap_{funcstart}_724.1.p1) < 0]:
-(-asType < integer > (\$heap_{tuncstart\_724,1}.p1) \% 177), []:
asType < integer > (\$heap_{funcstart\_724,1}.p1) \% 177) ==
asType<integer>(div(heapIs $heap_{funcstart\_724,1}, $heap_{funcstart\_724,1}.p1,
177).rem)
→ [explicitly assert falsehood of skipped guards in subsequent guards]
[15.4] ([asType<integer>($heap_{funcstart\_724,1}.p1) < 0]:
-(-asType < integer > (\$heap_{funcstart\_724,1}.p1) \% 177),
[!(\mathbf{asType} < \mathbf{integer} > (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p1}) < 0)]:
asType < integer > (\$heap_{funcstart\_724,1}.p1) \% 177) ==
\mathbf{asType} < \mathbf{integer} > (\mathbf{div}(\mathbf{heapIs} \ \$ \mathbf{heap}_{funcstart\_724,1}, \ \$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p1}, \\
177).rem)
\rightarrow [simplify]
[15.7] ([0 < -$heap<sub>funcstart_724,1.</sub>p1]:
-(-asType < integer > (\$heap_{funcstart\_724,1}.p1) \% 177),
[!(asType<integer>(\theta_{funcstart\_724,1}.p1) < 0)]:
asType < integer > (\$heap_{funcstart\_724,1}.p1) \% 177) = =
asType<integer>(div(heapIs p_{funcstart\_724,1}, p_{funcstart\_724,1}),
177).rem)
\rightarrow [from term 8.0, literala < -$heap<sub>funcstart_724.1</sub>.p1 is false whenever -2 < (0
+ literala)]
```

Proof of rule precondition:

```
[15.7.0] - 2 < (0 + 0)
    \rightarrow [simplify]
    [15.7.2] true
[15.8] ([false]: -(-asType < integer > (\$heap_{funcstart\_724,1}.p1) \% 177),
[!(\mathbf{asType} < \mathbf{integer} > (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p1}) < 0)]:
asType < integer > (\$heap_{funcstart\_724,1}.p1) \% 177) ==
\mathbf{asType} \small{<} \mathbf{integer} \small{>} ( \mathrm{div}(\mathbf{heapIs} \ \$ \mathrm{heap}_{funcstart\_724,1}, \ \$ \mathrm{heap}_{funcstart\_724,1}.\mathrm{p1}, \\
177).rem)
\rightarrow [simplify]
[15.11] ([false]: -(-asType < integer > (\$heap_{funcstart\_724,1}.p1) \% 177), [!(0
<-$heap<sub>funcstart_724,1</sub>.p1)]: asType<integer>($heap<sub>funcstart_724,1</sub>.p1) %
177) == asType<integer>(div(heapIs $heap_{funcstart\_724,1},)
heap_{funcstart_{-724,1}.p1, 177}.rem
\rightarrow [from term 8.0, literala < -$heap<sub>funcstart_724.1</sub>.p1 is false whenever -2 < (0
+ literala)]
    Proof of rule precondition:
    [15.11.0] - 2 < (0 + 0)
    \rightarrow [simplify]
    [15.11.2] true
[15.12] ([false]: -(-asType < integer > (\$heap_{funcstart\_724,1}.p1) \% 177),
[!false]: asType<integer>(sheap_{funcstart_{-724,1}}.p1) % 177) ==
\mathbf{asType} < \mathbf{integer} > (\mathbf{div}(\mathbf{heapIs} \ \$ \mathbf{heap}_{funcstart\_724,1}, \ \$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p1},
177).rem)
\rightarrow [simplify]
[15.17] \ 0 == (-\text{div}(\mathbf{heapIs} \ \$ \text{heap}_{funcstart\_724,1}, \ \$ \text{heap}_{funcstart\_724,1}.\text{p1},
177).rem + (\text{$heap}_{funcstart\_724,1}.p1 \% 177))
[Assume known post-assertion, class invariant or type constraint for term
15.17
[23.0] div(heapIs heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p1, 177).rem \leq
maxof(int)
\rightarrow [simplify]
\label{eq:condition} \textit{[23.9] -32768} < -\text{div}(\textbf{heapIs} \ \$ \text{heap}_{funcstart\_724,1}, \ \$ \text{heap}_{funcstart\_724,1}.\text{p1},
177).rem
[Take goal term]
[1.0] asType<short int>(div1.rem) \le maxof(int)
\rightarrow [from term 11.6, div1 is equal to div(heapIs $heap_{funcstart\_724,1},
heap_{funcstart_{-724,1}}.p1, 177
```

```
[1.1] asType<short int>(div(heapIs $heap_{funcstart_724,1},
\text{Sheap}_{funcstart\_724,1}.\text{p1}, 177).\text{rem} \leq \text{maxof(int)}
\rightarrow [simplify]
\label{eq:loss_funcstart_724,1} \mbox{-}32768 < -\mbox{div}(\mbox{\bf heapIs} \ \mbox{\$heap}_{funcstart\_724,1}, \ \mbox{\$heap}_{funcstart\_724,1}.\mbox{p1},
177).rem
\rightarrow [from term 23.9, literala < -\text{div}(\text{heapIs }\$\text{heap}_{funcstart\_724.1},
\rho_{funcstart\_724,1}.p1,\ 177).rem is true whenever (-1 + literala) < -32768
   Proof of rule precondition:
   [1.11.0](-32768 + -1) < -32768
   \rightarrow [simplify]
   [1.11.2] true
[1.12] true
Proof of verification condition: Type constraint satisfied in implicit
conversion from 'short int const' to 'int'
Condition generated at: C:\Escher\Customers\prang\prang.c (56,10)
Condition defined at:
To prove: minof(int) \leq \$heap_{funcstart\_724,1}.r1
Given:
heap_{init}.LIMIT == (int)80
heap_{init}.M1 == asType < short int > ((int)30269)
\theta_{init}.r1 == asType < short int > ((int)171)
heap_{init}.a1 == asType < short int > ((int)177)
\theta
\theta sheap<sub>init</sub>.M2 == asType<short int>((int)30307)
\theta_{init}.r2 == asType < short int > ((int)172)
\theta_{init}.a2 == asType<short int>((int)176)
heap_{init}.b2 == asType<short int>((int)35)
heap_{init}.M3 == asType < short int > ((int)30323)
heap_{init}.r3 == asType < short int > ((int)170)
heap_{init}.a3 == asType < short int > ((int)178)
\theta = asType < short int > ((int)63)
\theta = asType < short int > ((int)1)
\theta
```

```
\theta = asType < short int > ((int)3)
invariant1(heapIs heap_{funcstart_{-724,1}})
div1 == div(\mathbf{heapIs} \$heap_{funcstart\_724,1},
asType < int > (\$heap_{funcstart\_724,1}.p1),
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{a1}))
(asType<integer>(asType<int>($heap_{funcstart\_724,1}.p1)) /
\mathbf{asType}{<}\mathbf{integer}{>}(\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{a1}))) = =
asType<integer>(div1.quot)
(asType<int>(asType<int>($heap_{funcstart\_724,1}.p1)) %
\mathbf{asType}{<}\mathbf{integer}{>}(\mathbf{asType}{<}\mathbf{int}{>}(\$\mathbf{heap}_{funcstart\_724,1}.\mathbf{a1}))) = =
asType<integer>(div1.rem)
!(0 == asType < integer > (div1.rem)) || !(0 ==
asType<integer>(div1.quot))
div2 == div(\mathbf{heapIs} \$heap_{funcstart\_724,1},
asType < int > (\$heap_{funcstart\_724,1}.p2),
asType < int > (\$heap_{funcstart\_724,1}.a2))
(\mathbf{asType}{<}\mathbf{integer}{>}(\mathbf{asType}{<}\mathbf{int}{>}(\$\mathbf{heap}_{funcstart\_724,1}.\mathbf{p2})) \ / \\
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a2))) = =
asType<integer>(div2.quot)
(\mathbf{asType} < \mathbf{integer} > (\mathbf{asType} < \mathbf{int} > (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p2})) \ \%
\mathbf{asType}{<}\mathbf{integer}{>}(\mathbf{asType}{<}\mathbf{int}{>}(\$\mathbf{heap}_{funcstart\_724,1}.\mathbf{a2}))) = =
asType<integer>(div2.rem)
!(0 == asType < integer > (div2.rem)) || !(0 ==
asType<integer>(div2.quot))
div3 == div(\mathbf{heapIs} \$heap_{funcstart\_724,1},
asType < int > (\$heap_{funcstart\_724,1}.p3),
asType < int > (\$heap_{funcstart\_724,1}.a3))
(asType < int > (sheap_{funcstart\_724,1}.p3)) / 
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a3))) = =
asType<integer>(div3.quot)
(\mathbf{asType} < \mathbf{integer} > (\mathbf{asType} < \mathbf{int} > (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p3})) \%
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a3))) = =
asType<integer>(div3.rem)
!(0 == asType < integer > (div3.rem)) || !(0 ==
asType<integer>(div3.quot))
Proof:
[Take goal term]
[1.0] minof(int) \leq $heap<sub>funcstart_724,1</sub>.r1
```

```
\rightarrow [simplify]
[1.1] -32768 \leq $heap<sub>funcstart_724,1</sub>.r1
\rightarrow [const static or extern object]
[1.2] -32768 \le \text{\$heap}_{init}.r1
\rightarrow [expand definition of constant 'r1' at prang.c (15,20)]
[1.3] - 32768 \le asType < short int > ((int)171)
\rightarrow [simplify]
[1.6] true
Proof of verification condition: Type constraint satisfied in implicit
conversion from 'short int const' to 'int'
Condition generated at: C:\Escher\Customers\prang\prang.c (56,10)
Condition defined at:
To prove: \text{$heap}_{funcstart\_724,1}.r1 \leq \max(\text{int})
Given:
heap_{init}.LIMIT == (int)80
\theta
\theta_{init}.r1 == asType < short int > ((int)171)
\theta
\theta
\theta sheap<sub>init</sub>.M2 == asType<short int>((int)30307)
\rho_{init}.r2 == asType < short int > ((int)172)
heap_{init}.a2 == asType < short int > ((int)176)
\theta = asType < short int > ((int)35)
\theta = asType < short int > ((int)30323)
\theta_{init}.r3 == asType<short int>((int)170)
\theta == asType<short int>((int)178)
\theta = asType < short int > ((int)63)
\theta
\theta
\theta = asType < short int > ((int)3)
invariant1(heapIs heap_{funcstart_{-724,1}})
\operatorname{div1} == \operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724,1},
```

```
asType < int > (\$heap_{funcstart\_724,1}.p1),
asType < int > (\$heap_{funcstart\_724,1}.a1))
(\mathbf{asType}{<}\mathbf{integer}{>}(\mathbf{asType}{<}\mathbf{int}{>}(\$\mathbf{heap}_{funcstart\_724,1}.\mathbf{p1})) \ / \\
\mathbf{asType}{<}\mathbf{integer}{>}(\mathbf{asType}{<}\mathbf{int}{>}(\$\mathbf{heap}_{funcstart\_724,1}.\mathbf{a1}))) = =
asType<integer>(div1.quot)
(\mathbf{asType} < \mathbf{integer} > (\mathbf{asType} < \mathbf{int} > (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p1})) \ \%
\mathbf{asType} < \mathbf{integer} > (\mathbf{asType} < \mathbf{int} > (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{a1}))) = =
asType<integer>(div1.rem)
!(0 == asType < integer > (div1.rem)) || !(0 ==
asType<integer>(div1.quot))
div2 == div(\mathbf{heapIs} \$ heap_{funcstart_{-724.1}},
asType < int > (\$heap_{funcstart\_724.1}.p2),
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{a2}))
(\mathbf{asType}{<}\mathbf{int}{>}(\mathbf{asType}{<}\mathbf{int}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{p2}))\ /
\mathbf{asType}{<}\mathbf{integer}{>}(\mathbf{asType}{<}\mathbf{int}{>}(\$\mathbf{heap}_{funcstart\_724,1}.\mathbf{a2}))) = =
asType<integer>(div2.quot)
(asType < int > (asType < int > (\$heap_{funcstart\_724,1}.p2)) \%
\mathbf{asType} < \mathbf{integer} > (\mathbf{asType} < \mathbf{int} > (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{a2}))) = =
asType<integer>(div2.rem)
!(0 == asType < integer > (div2.rem)) || !(0 ==
asType<integer>(div2.quot))
div3 == div(\mathbf{heapIs} \$ heap_{funcstart\_724.1},
asType < int > (\$heap_{funcstart\_724,1}.p3),
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{a3}))
(\mathbf{asType}{<}\mathbf{integer}{>}(\mathbf{asType}{<}\mathbf{int}{>}(\$\mathbf{heap}_{funcstart\_724,1}.\mathbf{p3})) \ / \\
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a3))) = =
asType<integer>(div3.quot)
(asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.p3)) \%
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a3))) = =
asType<integer>(div3.rem)
!(0 == asType < integer > (div3.rem)) || !(0 ==
asType<integer>(div3.quot))
Proof:
[Take goal term]
[1.0] $\text{heap}_{funcstart_724.1}.r1 \leq \text{maxof(int)}
\rightarrow [const static or extern object]
[1.1] $heap<sub>init</sub>.r1 \leq maxof(int)
\rightarrow [expand definition of constant 'r1' at prang.c (15,20)]
```

```
[1.2] asType<short int>((int)171) \le maxof(int)
\rightarrow [simplify]
[1.6] true
Proof of verification condition: Arithmetic result of operator '*' is within
limit of type 'int'
Condition generated at: C:\Escher\Customers\prang\prang.c (56,13)
Condition defined at:
To prove: minof(int) \le (asType<int>(asType<short int>(div1.rem)) *
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{r1}))
Given:
heap_{init}.LIMIT == (int)80
\theta sheap<sub>init</sub>.M1 == asType<short int>((int)30269)
\theta_{init}.r1 == asType < short int > ((int)171)
heap_{init}.a1 == asType < short int > ((int)177)
\theta = asType < short int > ((int)2)
\theta sheap<sub>init</sub>.M2 == asType<short int>((int)30307)
\rho_{init}.r2 == asType < short int > ((int)172)
heap_{init}.a2 == asType < short int > ((int)176)
\theta = asType < short int > ((int)35)
\theta = asType < short int > ((int)30323)
\theta sheap<sub>init</sub>.r3 == asType<short int>((int)170)
heap_{init}.a3 == asType < short int > ((int)178)
\theta = asType < short int > ((int)63)
\theta = asType < short int > ((int)1)
\theta
\theta = asType < short int > ((int)3)
invariant1(heapIs $heap_{tuncstart_724.1})
\operatorname{div1} == \operatorname{div}(\mathbf{heapIs} \ \operatorname{heap}_{funcstart\_724,1},
asType < int > (\$heap_{funcstart\_724,1}.p1),
asType < int > (\$heap_{funcstart\_724,1}.a1))
(asType<int>(asType<int>($heap_{tuncstart\_724.1}.p1)) /
\mathbf{asType}{<}\mathbf{integer}{>}(\mathbf{asType}{<}\mathbf{int}{>}(\$\mathbf{heap}_{funcstart\_724,1}.\mathbf{a1}))) = =
asType<integer>(div1.quot)
```

```
(asType < int > (asType < int > (\$heap_{funcstart\_724,1}.p1)) \%
\mathbf{asType} < \mathbf{integer} > (\mathbf{asType} < \mathbf{int} > (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{a1}))) = =
asType<integer>(div1.rem)
!(0 == asType < integer > (div1.rem)) || !(0 ==
asType<integer>(div1.quot))
div2 == div(\mathbf{heapIs} \$ heap_{funcstart\_724,1},
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p2}),
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{a2}))
(\mathbf{asType} < \mathbf{integer} > (\mathbf{asType} < \mathbf{int} > (\$ \mathbf{heap}_{funcstart\_724,1} \cdot \mathbf{p2})) \ / \ 
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a2))) = =
asType<integer>(div2.quot)
(asType < integer > (asType < int > (\$heap_{funcstart\_724.1}.p2)) \%
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a2))) = =
asType<integer>(div2.rem)
!(0 == asType < integer > (div2.rem)) || !(0 ==
asType<integer>(div2.quot))
div3 == div(\mathbf{heapIs} \$heap_{funcstart\_724,1},
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p3}),
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{a3}))
(\mathbf{asType}{<}\mathbf{integer}{>}(\mathbf{asType}{<}\mathbf{int}{>}(\$\mathbf{heap}_{funcstart\_724,1}.\mathbf{p3})) \ / \\
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a3))) = =
asType<integer>(div3.quot)
(\mathbf{asType} < \mathbf{integer} > (\mathbf{asType} < \mathbf{int} > (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p3})) \%
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a3))) = =
asType<integer>(div3.rem)
!(0 == asType < integer > (div3.rem)) || !(0 ==
asType<integer>(div3.quot))
Proof:
[Take given term]
[5.0] invariant1(heapIs heap_{funcstart\_724,1})
\rightarrow [expand definition of function 'invariant1' at prang.c (34,1)]
[5.1] ((((((0 < asType < integer > (heap_{funcstart_{-724,1}}.p1)) &&
(asType < integer > (\$heap_{funcstart\_724,1}.p1) <
as
Type<integer>(\rho_{funcstart\_724,1}.M1))) & (0 <
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{p2})))\ \&\&
(asType<integer>($heap_funcstart_724.1.p2) <
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{M2})))~\&\&~(0<
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p3})))\ \&\&
(asType<integer>($heap_funcstart_724.1.p3) <
asType < integer > (\$heap_{funcstart\_724,1}.M3))
```

```
\rightarrow [simplify]
[5.3] (((((0 < \text{heap}_{funcstart\_724,1}.p1) && (\text{heap}_{funcstart\_724,1}.p1 <
asType < integer > (\$heap_{funcstart\_724,1}.M1))) \&\& (0 <
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p2}))) \ \&\&
(\mathbf{asType} < \mathbf{integer} > (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p2}) <
asType < integer > (\$heap_{funcstart\_724,1}.M2))) \&\& (0 <
asType < integer > (\$heap_{funcstart\_724,1}.p3))) \&\&
(\mathbf{asType} {<} \mathbf{integer} {>} (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p3}) <
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{M3}))
\rightarrow [const static or extern object]
[5.4] \ (((((0 < \text{\$heap}_{funcstart\_724,1}.\text{p1}) \&\& \ (\text{\$heap}_{funcstart\_724,1}.\text{p1} <
asType < integer > (\$heap_{init}.M1))) \&\& (0 <
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p2})))\ \&\&
(asType<integer>($heap_funcstart_724.1.p2) <
asType < integer > (\$heap_{funcstart\_724,1}.M2))) \&\& (0 <
asType < integer > (\$heap_{funcstart\_724,1}.p3))) \&\&
(\mathbf{asType} < \mathbf{integer} > (\$ heap_{funcstart\_724,1}.p3) <
\mathbf{asType} < \mathbf{integer} > (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{M3}))
\rightarrow [expand definition of constant 'M1' at prang.c (14,20)]
[5.5] (((((0 < $heap_{funcstart_724,1}.p1) && ($heap_{funcstart_724,1}.p1 <
asType<integer>(asType<short int>((int)30269)))) && (0 <
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p2})))\ \&\&
(\mathbf{asType} {<} \mathbf{integer} {>} (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p2}) <
asType < integer > (\$heap_{funcstart\_724,1}.M2))) \&\& (0 <
asType < integer > ($heap_{funcstart\_724,1}.p3))) &&
(asType<integer>($heap_{tuncstart\_724,1}.p3) <
asType < integer > (\$heap_{funcstart\_724,1}.M3))
\rightarrow [simplify]
[5.16] ((((-30269 < -\$heap_{funcstart\_724,1}.p1) \land (0 < \$heap_{funcstart\_724,1}.p1) 
(0 < \text{\$heap}_{funcstart\_724,1}.\text{p2})) && (\text{\$heap}_{funcstart\_724,1}.\text{p2} <
asType < integer > (\$heap_{funcstart\_724,1}.M2))) \&\& (0 <
asType < integer > (\$heap_{funcstart\_724,1}.p3))) \&\&
(asType < integer > (\$heap_{funcstart\_724,1}.p3) < 
asType < integer > (\$heap_{funcstart\_724,1}.M3))
\rightarrow [const static or extern object]
[5.17] \left( \left( \left( \left( -30269 < -\$ \text{heap}_{funcstart\_724,1}.\text{p1} \right) \right. \wedge \left. \left( 0 < \$ \text{heap}_{funcstart\_724,1}.\text{p1} \right) \right. \wedge \right. \right) \\
(0 < \text{\$heap}_{funcstart\_724,1}.p2)) \&\& (\text{\$heap}_{funcstart\_724,1}.p2 <
asType < integer > (\$heap_{init}.M2))) \&\& (0 <
asType < integer > (\$heap_{funcstart\_724,1}.p3))) \&\&
(\mathbf{asType} < \mathbf{integer} > (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p3}) <
asType<integer>($heap_funcstart_724,1.M3))
```

```
\rightarrow [expand definition of constant 'M2' at prang.c (19,20)]
[5.18] ((((-30269 < -\$heap_{funcstart\_724,1}.p1) \land (0 < \$heap_{funcstart\_724,1}.p1) 
(0 < $heap_{funcstart\_724,1}.p2)) && ($heap_{funcstart\_724,1}.p2 <
asType < integer > (asType < short int > ((int)30307)))) && (0 < integer) && (0 < integer
asType < integer > (\$heap_{funcstart\_724,1}.p3))) \&\&
(\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{p3}) <
asType < integer > (\$heap_{funcstart\_724,1}.M3))
\rightarrow [simplify]
[5.30] ((-30307 < -\$heap_{funcstart\_724,1}.p2) \land (-30269 <
-\$heap_{funcstart\_724,1}.p1) \land (0 < \$heap_{funcstart\_724,1}.p1) \land (0 < \$heap_{funcstart\_724,1}.p1)
\text{Sheap}_{funcstart_{724,1}.p2} \land (0 < \text{Sheap}_{funcstart_{724,1}.p3})) \&\&
(\text{\$heap}_{funcstart\_724,1}.\text{p3} < \text{asType} < \text{integer} > (\text{\$heap}_{funcstart\_724,1}.\text{M3}))
\rightarrow [const static or extern object]
[5.31] ((-30307 < -$heap<sub>funcstart_724,1</sub>.p2) \wedge (-30269 <
-\$heap_{funcstart\_724,1}.p1) \land (0 < \$heap_{funcstart\_724,1}.p1) \land (0 < \$heap_{funcstart\_724,1}.p1)
\text{Sheap}_{funcstart\_724,1.p2} \land (0 < \text{Sheap}_{funcstart\_724,1.p3})) \&\&
(\text{\$heap}_{funcstart\_724,1}.p3 < asType < integer > (\text{\$heap}_{init}.M3))
\rightarrow [expand definition of constant 'M3' at prang.c (24,20)]
[5.32] ((-30307 < -$heap_funcstart_724,1.p2) \land (-30269 <
 -\$heap_{funcstart\_724,1}.p1) \land (0 < \$heap_{funcstart\_724,1}.p1) \land (0 < \$heap_{funcstart\_724,1}.p1)
\text{Sheap}_{funcstart_{724,1}.p2} \land (0 < \text{Sheap}_{funcstart_{724,1}.p3})) \&\&
(\text{sheap}_{funcstart\_724.1}.\text{p3} < \text{asType} < \text{integer} > (\text{asType} < \text{short})
int > ((int)30323))
\rightarrow [simplify]
[5.40] (-30323 < -$heap<sub>funcstart_724,1</sub>.p3) \land (-30307 <
-\$heap_{funcstart\_724,1}.p2) \land (-30269 < -\$heap_{funcstart\_724,1}.p1) \land (0 < -\$heap_{funcstart\_724,1}.p1)
\text{Sheap}_{funcstart\_724.1.p1} \land (0 < \text{Sheap}_{funcstart\_724.1.p2}) \land (0 <
heap_{funcstart_{724,1}.p3}
[Work on sub-term 4 of conjunction in term 5.40]
\textit{[8.0]} \ 0 < \$ heap_{funcstart\_724,1}.p1
[Take given term]
[11.0] \operatorname{div1} == \operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724,1},
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p1}),
asType < int > (\$heap_{funcstart\_724,1}.a1))
\rightarrow [simplify]
[11.1] \operatorname{div1} == \operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724,1}, \$ \operatorname{heap}_{funcstart\_724,1}.p1,
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{a1}))
\rightarrow [const static or extern object]
```

```
[11.2] div1 == div(heapIs \theta_{funcstart_{-724,1}}, \theta_{funcstart_{-724,1}}, p1,
asType < int > (\$heap_{init}.a1))
\rightarrow [expand definition of constant 'a1' at prang.c (16,20)]
\textit{[11.3]} \ \text{div1} == \text{div}(\mathbf{heapIs} \ \$ \text{heap}_{funcstart\_724,1}, \ \$ \text{heap}_{funcstart\_724,1}.\text{p1},
asType<int>(asType<short int>((int)177)))
\rightarrow [simplify]
[11.6] div1 == div(heapIs heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p1, 177)
[Take goal term]
[1.0] minof(int) \le (asType<int>(asType<short int>(div1.rem)) *
asType < int > (\$heap_{funcstart\_724.1}.r1))
\rightarrow [simplify]
[1.1] -32768 \leq (asType<int>(asType<short int>(div1.rem)) *
asType < int > (\$heap_{funcstart\_724,1}.r1))
\rightarrow [from term 11.6, div1 is equal to div(heapIs $heap_{funcstart\_724,1},
heap_{funcstart_{-724,1}}.p1, 177)
[1.2] -32768 \leq (asType<int>(asType<short int>(div(heapIs
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.p1, 177).rem)) *
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{r1}))
\rightarrow [simplify]
 \label{eq:constant_724,1} \text{-}32768 \leq (\text{div}(\mathbf{heapIs} \ \$ \text{heap}_{funcstart\_724,1}, \ \$ \text{heap}_{funcstart\_724,1}.\text{p1},
177).rem * asType < int > (\$heap_{funcstart\_724,1}.r1))
\rightarrow [const static or extern object]
 [1.5] -32768 \leq (\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.\operatorname{p1}, 
177).rem * asType < int > (\$heap_{init}.r1))
\rightarrow [expand definition of constant 'r1' at prang.c (15,20)]
[1.6] - 32768 \leq (\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.\operatorname{p1},
177).rem * asType<int>(asType<short int>((int)171)))
\rightarrow [simplify]
 \label{eq:loss_loss} \mbox{$[1.11]$ -32769} < (171 * \mbox{div}(\mathbf{heapIs} \; \$\mbox{$heap}_{funcstart\_724,1}, \; \$\mbox{$heap}_{funcstart\_724,1}.p1, 
177).rem)
\rightarrow [literal comparison of product]
[1.12] ([171 < 0]: (-32769 / -171) < -\text{div}(\mathbf{heapIs} \$ \text{heap}_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724.1.p1, 177}.\text{rem}, [0 < 171]: (-32769 / 171) < \text{div}(\text{heapIs})
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.\text{p1}, 177).\text{rem}, [0 == 171]: -32769 < 0)
→ [explicitly assert falsehood of skipped guards in subsequent guards]
[1.13] ([171 < 0]: (-32769 / -171) < -\text{div}(\mathbf{heapIs} \$ \text{heap}_{funcstart\_724,1},
```

```
\text{Sheap}_{funcstart=724.1.p1, 177}.\text{rem}, [(0 < 171) \land !(171 < 0)]: (-32769 / 171) < 0
div(\mathbf{heapIs} \ \$heap_{funcstart\_724,1}, \ \$heap_{funcstart\_724,1}.p1, \ 177).rem, \ [(0 == 171)]
\land !(0 < 171) \land !(171 < 0)]: -32769 < 0)
\rightarrow [simplify]
[1.21] -192 < div(heapIs heap_{funcstart_{-724,1}}, heap_{funcstart_{-724,1}}.p1, 177).rem
\rightarrow [negate goal and search for contradiction]
[1.22] !(-192 < div(heapIs heap_{funcstart_{-724,1}}, heap_{funcstart_{-724,1}}.p1,
177).rem)
\rightarrow [simplify]
[1.24] 191 < -\text{div}(\text{heapIs }\text{\$heap}_{funcstart\_724,1}, \text{\$heap}_{funcstart\_724,1}.\text{p1},
177).rem
[Assume known post-assertion, class invariant or type constraint for term 11.6]
[15.0] (as
Type<integer>($heap_{funcstart\_724,1}.p1) \%
asType<integer>(177)) == asType<integer>(div(heapIs
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.\text{p1}, 177).\text{rem}
\rightarrow [simplify]
[15.2] (heap_{funcstart\_724,1}.p1 \% 177) == asType<integer>(div(heapIs
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.\text{p1}, 177).\text{rem}
→ [expand definition of operator '.%' in class 'int' at built in declaration]
[15.3] ([asType<integer>($heap_{funcstart\_724,1}.p1) < 0]:
-(-asType < integer > (\$heap_{funcstart\_724,1}.p1) \% 177), []:
asType < integer > (\$heap_{funcstart\_724,1}.p1) \% 177) ==
asType<integer>(div(heapIs $heap_{funcstart\_724.1}, $heap_{funcstart\_724.1}.p1,
177).rem)
→ [explicitly assert falsehood of skipped guards in subsequent guards]
[15.4] ([asType<integer>(heap_{funcstart\_724,1}.p1) < 0]:
-(-asType < integer > (\$heap_{funcstart\_724.1}.p1) \% 177),
[!(asType < integer > (\$heap_{funcstart\_724,1}.p1) < 0)]:
asType < integer > (\$heap_{funcstart\_724,1}.p1) \% 177) ==
asType<integer>(div(heapIs $heap_funcstart_724,1, $heap_funcstart_724,1.p1,
177).rem)
\rightarrow [simplify]
[15.7] ([0 < -$heap<sub>funcstart_724,1</sub>.p1]:
-(-asType < integer > (\$heap_{funcstart\_724,1}.p1) \% 177),
[!(asType < integer > (\$heap_{funcstart\_724,1}.p1) < 0)]:
asType < integer > (\$heap_{funcstart\_724,1}.p1) \% 177) ==
asType<integer>(div(heapIs $heap_{tuncstart_724.1}, $heap_{tuncstart_724.1}.p1,
177).rem)
```

```
\rightarrow [from term 8.0, literala < -$heap<sub>funcstart_724,1</sub>.p1 is false whenever -2 < (0
+ literala)]
    Proof of rule precondition:
    [15.7.0] - 2 < (0 + 0)
    \rightarrow [simplify]
    [15.7.2] true
[15.8] ([false]: -(-asType < integer > (\$heap_{funcstart\_724,1}.p1) \% 177),
[!(asType < integer > (\$heap_{funcstart\_724,1}.p1) < 0)]:
asType < integer > (\$heap_{funcstart\_724,1}.p1) \% 177) = =
\mathbf{asType} {<} \mathbf{integer} {>} ( \mathrm{div}(\mathbf{heapIs} \ \$ \mathrm{heap}_{funcstart\_724,1}, \ \$ \mathrm{heap}_{funcstart\_724,1}.\mathrm{p1}, \\
177).rem)
\rightarrow [simplify]
[15.11] ([false]: -(-asType < integer > (\$heap_{funcstart\_724,1}.p1) \% 177), [!(0
<-$heap<sub>funcstart_724,1.</sub>p1)]: asType<integer>($heap<sub>funcstart_724,1.</sub>p1) %
177) == asType<integer>(div(heapIs heap_{funcstart\_724,1},
heap_{funcstart_{-724,1}.p1, 177}.rem
\rightarrow [from term 8.0, literala < –$heap_{uncstart\_724,1}.p1 is false whenever -2 < (0
+ literala)]
    Proof of rule precondition:
    [15.11.0] - 2 < (0 + 0)
    \rightarrow [simplify]
    [15.11.2] true
[15.12] ([false]: -(-asType < integer > (\$heap_{funcstart\_724.1}.p1) \% 177),
[!false]: asType<integer>(sheap_{funcstart\_724,1.p1}) \% 177 ==
asType<integer>(div(heapIs heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p1,
177).rem)
\rightarrow [simplify]
[15.17] 0 == (-\operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724,1}, \$ \operatorname{heap}_{funcstart\_724,1}.p1,
177).rem + (\text{$heap}_{funcstart\_724,1}.p1 \% 177))
[Create new term from terms 1.24, 15.17 using rule: transitivity 15]
[55.0] (0 + 191) < -($heap_{funcstart_724.1}.p1 % 177)
\rightarrow [simplify]
[55.2] false
```

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

Condition generated at: C:\Escher\Customers\prang\prang.c (56,13)

## Condition defined at:

```
To prove: (asType<int>(asType<short int>(div1.rem)) *
asType < int > (\$heap_{funcstart\_724,1}.r1)) \le maxof(int)
Given:
heap_{init}.LIMIT == (int)80
\theta sheap<sub>init</sub>.M1 == asType<short int>((int)30269)
\theta_{init}.r1 == asType < short int > ((int)171)
\theta sheap<sub>init</sub>.a1 == asType<short int>((int)177)
\theta
\theta sheap<sub>init</sub>.M2 == asType<short int>((int)30307)
\theta_{init}.r2 == asType < short int > ((int)172)
heap_{init}.a2 == asType < short int > ((int)176)
\theta = asType < short int > ((int)35)
heap_{init}.M3 == asType < short int > ((int)30323)
\theta_{init}.r3 == asType<short int>((int)170)
\theta = asType < short int > ((int)178)
\theta = asType < short int > ((int)63)
\theta = asType < short int > ((int)1)
\theta
\theta = asType < short int > ((int)3)
invariant1(heapIs heap_{funcstart\_724,1})
\operatorname{div1} == \operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724,1},
asType < int > (\$heap_{funcstart\_724,1}.p1),
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{a1}))
(asType<integer>(asType<int>($heap_{tuncstart\_724.1}.p1)) /
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a1))) = =
asType<integer>(div1.quot)
(\mathbf{asType} < \mathbf{integer} > (\mathbf{asType} < \mathbf{int} > (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p1})) \ \%
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a1))) = =
asType<integer>(div1.rem)
!(0 == asType < integer > (div1.rem)) || !(0 ==
asType<integer>(div1.quot))
div2 == div(\mathbf{heapIs} \$heap_{funcstart\_724,1},
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p2}),
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{a2}))
```

```
(\mathbf{asType}{<}\mathbf{integer}{>}(\mathbf{asType}{<}\mathbf{int}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{p2}))\ /
\mathbf{asType} < \mathbf{integer} > (\mathbf{asType} < \mathbf{int} > (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{a2}))) = =
asType<integer>(div2.quot)
(asType<int>(asType<int>($heap_{funcstart\_724.1}.p2)) %
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a2))) = =
asType<integer>(div2.rem)
!(0 == asType < integer > (div2.rem)) || !(0 ==
asType<integer>(div2.quot))
div3 == div(\mathbf{heapIs} \$ heap_{funcstart\_724,1},
asType < int > (\$heap_{funcstart\_724,1}.p3),
asType < int > (\$heap_{funcstart_{-724,1}}.a3))
(asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.p3)) /
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a3))) = =
asType<integer>(div3.quot)
(asType<int>(sheap<sub>funcstart_724,1.</sub>p3)) %
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a3))) = =
asType<integer>(div3.rem)
!(0 == asType < integer > (div3.rem)) || !(0 ==
asType<integer>(div3.quot))
Proof:
[Take given term]
[5.0] invariant1(heapIs $heap_{funcstart\_724,1})
\rightarrow [expand definition of function 'invariant1' at prang.c (34,1)]
 \texttt{[5.1]} \; (((((0 < \mathbf{asType} < \mathbf{integer} > (\$ heap_{funcstart\_724,1}.p1)) \; \&\& \\
(asType < integer > ($heap_{funcstart\_724,1}.p1) < 
asType < integer > (\$heap_{funcstart\_724,1}.M1))) \&\& (0 <
asType < integer > (\$heap_{funcstart\_724,1}.p2))) \&\&
(\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p2}) <
asType < integer > (\$heap_{funcstart\_724,1}.M2))) \&\& (0 <
asType < integer > (\$heap_{funcstart\_724,1}.p3))) \&\&
(asType < integer > (\$heap_{funcstart\_724,1}.p3) < 
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{M3}))
\rightarrow [simplify]
[5.3] \ (((((0 < \$heap_{funcstart\_724,1}.p1) \&\& \ (\$heap_{funcstart\_724,1}.p1 < 
asType < integer > (\$heap_{funcstart\_724,1}.M1))) \&\& (0 <
asType < integer > (\$heap_{funcstart\_724,1}.p2))) \&\&
(\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{p2}) <
as
Type<integer>(\rho_{funcstart\_724,1}.M2))) & (0 <
asType < integer > (\$heap_{funcstart\_724,1}.p3))) \&\&
(asType<integer>($heap_{tuncstart\_724.1}.p3) <
```

```
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{M3}))
\rightarrow [const static or extern object]
[5.4] (((((0 < \text{heap}_{funcstart\_724,1}.p1) && (\text{heap}_{funcstart\_724,1}.p1 <
asType<integer>(heap_{init}.M1))) && (0 <
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{p2})))\ \&\&
(asType < integer > (\$heap_{funcstart\_724,1}.p2) <
asType < integer > (\$heap_{funcstart\_724,1}.M2))) \&\& (0 <
asType < integer > (\$heap_{funcstart\_724,1}.p3))) \&\&
(\mathbf{asType} {<} \mathbf{integer} {>} (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p3}) <
asType < integer > (\$heap_{funcstart\_724,1}.M3))
\rightarrow [expand definition of constant 'M1' at prang.c (14,20)]
[5.5] (((((0 < $heap_{funcstart_{-724,1}}.p1) && ($heap_{funcstart_{-724,1}}.p1 < 
asType<integer>(asType<short int>((int)30269)))) && (0 <
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p2})))\ \&\&
(\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{p2}) <
asType < integer > (\$heap_{funcstart\_724,1}.M2))) \&\& (0 < function for the start of the start 
asType < integer > (\$heap_{funcstart\_724,1}.p3))) \&\&
(\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{p3}) <
asType < integer > (\$heap_{tuncstart_{-724,1}}.M3))
\rightarrow [simplify]
[5.16] ((((-30269 < -\$heap_{funcstart\_724,1}.p1) \land (0 < \$heap_{funcstart\_724,1}.p1) 
(0 < \text{$heap}_{funcstart\_724,1}.p2)) \&\& (\text{$heap}_{funcstart\_724,1}.p2 <
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{M2})))~\&\&~(0<
asType < integer > (\$heap_{funcstart\_724,1}.p3))) \&\&
(asType < integer > ($heap_{funcstart\_724,1}.p3) < 
\mathbf{asType} < \mathbf{integer} > (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{M3}))
\rightarrow [const static or extern object]
[5.17] \; ((((-30269 < -\$heap_{funcstart\_724,1}.p1) \; \land \; (0 < \$heap_{funcstart\_724,1}.p1) \; \land 
(0 < \text{\$heap}_{funcstart\_724,1}.p2)) \&\& (\text{\$heap}_{funcstart\_724,1}.p2 <
asType < integer > (\$heap_{init}.M2))) \&\& (0 <
asType < integer > (\$heap_{funcstart\_724,1}.p3))) \&\&
(asType < integer > (\$heap_{funcstart\_724,1}.p3) < 
\mathbf{asType} {<} \mathbf{integer} {>} (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{M3}))
\rightarrow [expand definition of constant 'M2' at prang.c (19,20)]
[5.18] ((((-30269 < -\$heap_{funcstart\_724,1}.p1) \land (0 < \$heap_{funcstart\_724,1}.p1) 
(0 < \text{$heap}_{funcstart\_724,1}.p2)) \&\& (\text{$heap}_{funcstart\_724,1}.p2 <
asType<integer>(asType<short int>((int)30307)))) && (0 <
asType < integer > (\$heap_{funcstart\_724,1}.p3))) \&\&
(\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{p3}) <
asType < integer > (\$heap_{funcstart\_724.1}.M3))
\rightarrow [simplify]
```

```
[5.30] ((-30307 < -$heap_funcstart_724,1.p2) \land (-30269 <
-\$heap_{funcstart\_724,1}.p1) \land (0 < \$heap_{funcstart\_724,1}.p1) \land (0 < \$heap_{funcstart\_724,1}.p1)
\text{Sheap}_{funcstart\_724,1}.p2) \land (0 < \text{Sheap}_{funcstart\_724,1}.p3)) \&\&
(\text{\$heap}_{funcstart\_724,1}.p3 < asType < integer > (\text{\$heap}_{funcstart\_724,1}.M3))
\rightarrow [const static or extern object]
[5.31] ((-30307 < -$heap<sub>funcstart_724,1</sub>.p2) \wedge (-30269 <
-\text{\$heap}_{funcstart\_724,1}.\text{p1}) \land (0 < \text{\$heap}_{funcstart\_724,1}.\text{p1}) \land (0 <
\text{Sheap}_{funcstart\_724,1.p2} \land (0 < \text{Sheap}_{funcstart\_724,1.p3})) \&\&
(\text{\$heap}_{funcstart\_724,1}.\text{p3} < \mathbf{asType} < \mathbf{integer} > (\text{\$heap}_{init}.\text{M3}))
\rightarrow [expand definition of constant 'M3' at prang.c (24,20)]
[5.32] ((-30307 < -$heap<sub>funcstart_724.1.</sub>p2) \wedge (-30269 <
-\$heap_{funcstart\_724,1}.p1) \land (0 < \$heap_{funcstart\_724,1}.p1) \land (0 < \$heap_{funcstart\_724,1}.p1)
\theta_{funcstart\_724,1}.p2) \land (0 < \theta_{funcstart\_724,1}.p3)) \&\&
(\$heap_{funcstart\_724,1}.p3 < \mathbf{asType} < \mathbf{integer} > (\mathbf{asType} < \mathbf{short}
int > ((int)30323)))
\rightarrow [simplify]
[5.40] (-30323 < -\text{$heap_{funcstart\_724,1.p3}$}) \land (-30307 <
-\$heap_{funcstart\_724,1}.p2) \land (-30269 < -\$heap_{funcstart\_724,1}.p1) \land (0 < -\$heap_{funcstart\_724,1}.p2)
\text{Sheap}_{funcstart\_724,1}.\text{p1}) \land (0 < \text{Sheap}_{funcstart\_724,1}.\text{p2}) \land (0 <
heap_{funcstart_{-724,1}.p3}
[Work on sub-term 4 of conjunction in term 5.40]
[8.0] 0 < $heap_{funcstart_724,1}.p1
[Take given term]
[11.0] \operatorname{div1} == \operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724.1},
asType < int > (\$heap_{funcstart\_724,1}.p1),
asType < int > (\$heap_{funcstart\_724,1}.a1))
\rightarrow [simplify]
[11.1] \ \mathrm{div1} == \mathrm{div}(\mathbf{heapIs} \ \$ \mathrm{heap}_{funcstart\_724,1}, \ \$ \mathrm{heap}_{funcstart\_724,1}.\mathrm{p1},
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{a1}))
\rightarrow [const static or extern object]
[11.2] \ \mathrm{div1} == \mathrm{div}(\mathbf{heapIs} \ \$ \mathrm{heap}_{funcstart\_724,1}, \ \$ \mathrm{heap}_{funcstart\_724,1}.\mathrm{p1},
asType < int > (\$heap_{init}.a1))
\rightarrow [expand definition of constant 'a1' at prang.c (16,20)]
[11.3] \ \mathrm{div1} == \mathrm{div}(\mathbf{heapIs} \ \$ \mathrm{heap}_{funcstart\_724,1}, \ \$ \mathrm{heap}_{funcstart\_724,1}.\mathrm{p1},
asType<int>(asType<short int>((int)177)))
\rightarrow [simplify]
[11.6] div1 == div(heapIs $heap_{funcstart\_724,1}, $heap_{funcstart\_724,1}.p1, 177)
[Take goal term]
```

```
[1.0] (asType<int>(asType<short int>(div1.rem)) *
asType < int > (\$heap_{funcstart\_724,1}.r1)) \le maxof(int)
\rightarrow [from term 11.6, div1 is equal to div(heapIs $heap_{funcstart\_724,1},
heap_{funcstart_{724,1}}.p1, 177
[1.1] (asType<int>(asType<short int>(div(heapIs $heap_{funcstart\_724,1},)
\text{sheap}_{funcstart\_724,1}.\text{p1}, 177).\text{rem}) * asType < int > (\text{sheap}_{funcstart\_724,1}.\text{r1})) \le
maxof(int)
\rightarrow [simplify]
[1.3] (div(heapIs heap_{funcstart_{724,1}}, heap_{funcstart_{724,1}}, 177).rem *
asType < int > (\$heap_{funcstart\_724,1}.r1)) \le maxof(int)
\rightarrow [const static or extern object]
[1.4] (div(heapIs heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p1, 177).rem *
asType < int > (\$heap_{init}.r1)) \le maxof(int)
\rightarrow [expand definition of constant 'r1' at prang.c (15,20)]
[1.5] (div(heapIs \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, 177).rem *
asType < int > (asType < short int > ((int)171))) \le maxof(int)
\rightarrow [simplify]
[1.18] -32768 < (-171 * div(heapIs $heap<sub>funcstart_724,1</sub>,
heap_{funcstart_{-724,1}.p1, 177}.rem
\rightarrow [literal comparison of product]
[1.19] ([-171 < 0]: (-32768 / 171) < -\text{div}(\text{heapIs } \text{$heap}_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1}.\text{p1}, 177).\text{rem}, [0 < -171]: (-32768 / -171) < \text{div}(\textbf{heapIs})
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.\text{p1}, 177).\text{rem}, [-171 == 0]: -32768 <
→ [explicitly assert falsehood of skipped guards in subsequent guards]
[1.20] ([-171 < 0]: (-32768 / 171) < -\text{div}(\mathbf{heapIs} \ \$ heap_{funcstart\_724,1},
\rho_{tuncstart_{-724,1},p1,177}.rem, [(0 < -171) \land !(-171 < 0)]: (-32768 / -171) < 0
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.\operatorname{p1}, \ 177).\operatorname{rem}, \ [(-171 ==
0) \wedge !(-171 < 0) \wedge !(0 < -171)]: -32768 < 0)
\rightarrow [simplify]
\label{eq:loss_loss} \mbox{[1.24] -192} < -\mbox{div}(\mathbf{heapIs} \ \$\mbox{heap}_{funcstart\_724,1}, \ \$\mbox{heap}_{funcstart\_724,1}.\mbox{p1},
177).rem
\rightarrow [negate goal and search for contradiction]
 [1.25] ! (-192 < -\mathrm{div}(\mathbf{heapIs} \ \$ \mathrm{heap}_{funcstart\_724,1}, \ \$ \mathrm{heap}_{funcstart\_724,1}.\mathrm{p1}, 
177).rem)
\rightarrow [simplify]
[1.28] 191 < div(heapIs $heap_{funcstart_724,1}, $heap_{funcstart_724,1}.p1, 177).rem
```

```
[Assume known post-assertion, class invariant or type constraint for term 11.6]
[15.0] (asType<integer>(peq_{funcstart\_724,1}.p1) %
asType<integer>(177)) == asType<integer>(div(heapIs
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.\text{p1}, 177).\text{rem}
\rightarrow [simplify]
[15.2] (\theta_{tuncstart\_724,1.p1} \% 177) == asType<integer>(div(heapIs
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.\text{p1}, 177).\text{rem}
→ [expand definition of operator '.%' in class 'int' at built in declaration]
[15.3] \; ([\mathbf{asType} < \mathbf{integer} > (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p1}) < 0] :
-(-asType < integer > (\$heap_{funcstart\_724,1}.p1) \% 177), []:
asType < integer > (\$heap_{funcstart\_724,1}.p1) \% 177) ==
asType<integer>(div(heapIs $heap_{funcstart\_724,1}, $heap_{funcstart\_724,1}.p1,
177).rem)
→ [explicitly assert falsehood of skipped guards in subsequent guards]
[15.4] ([asType<integer>($heap_{funcstart\_724,1}.p1) < 0]:
-(-\mathbf{asType} < \mathbf{integer} > (\$ \mathrm{heap}_{funcstart\_724,1}.\mathrm{p1}) \% \ 177),
[!(asType < integer > (\$heap_{funcstart\_724,1}.p1) < 0)]:
asType < integer > (\$heap_{funcstart\_724,1}.p1) \% 177) ==
\mathbf{asType} {<} \mathbf{integer} {>} ( \mathrm{div}(\mathbf{heapIs} \ \$ \mathrm{heap}_{funcstart\_724,1}, \ \$ \mathrm{heap}_{funcstart\_724,1}. \mathrm{p1}, \\
177).rem)
\rightarrow [simplify]
[15.7] ([0 < -\$heap_{funcstart\_724,1}.p1]:
-(-\mathbf{asType} < \mathbf{integer} > (\$ \mathrm{heap}_{funcstart\_724,1}.\mathrm{p1}) \% \ 177),
[!(asType < integer > (\$heap_{funcstart\_724,1}.p1) < 0)]:
asType < integer > (\$heap_{funcstart-724,1}.p1) \% 177) ==
asType<integer>(div(heapIs $heap_{funcstart\_724,1}, $heap_{funcstart\_724,1}.p1,
177).rem)
\rightarrow [from term 8.0, literala < -$heap<sub>funcstart_724.1</sub>.p1 is false whenever -2 < (0
+ literala)
    Proof of rule precondition:
    [15.7.0] - 2 < (0 + 0)
    \rightarrow [simplify]
    [15.7.2] true
[15.8] \; ([\mathbf{false}]: \; -(-\mathbf{asType} < \mathbf{integer} > (\$ \mathrm{heap}_{funcstart\_724,1}.\mathrm{p1}) \; \% \; 177),
[!(\mathbf{asType} < \mathbf{integer} > (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p1}) < 0)]:
asType < integer > (\$heap_{funcstart\_724,1}.p1) \% 177) = =
asType<integer>(div(heapIs heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p1,
177).rem)
\rightarrow [simplify]
```

```
[15.11] ([false]: -(-asType < integer > (\$heap_{funcstart\_724,1}.p1) \% 177), [!(0
<-$heap<sub>funcstart_724,1</sub>.p1)]: asType<integer>($heap<sub>funcstart_724,1</sub>.p1) %
177) == asType<integer>(div(heapIs heap_{funcstart\_724,1},
heap_{funcstart_{-724,1}.p1, 177}.rem
\rightarrow [from term 8.0, literala < -$heap<sub>funcstart_724.1</sub>.p1 is false whenever -2 < (0
+ literala)]
   Proof of rule precondition:
   [15.11.0] - 2 < (0 + 0)
   \rightarrow [simplify]
   [15.11.2] true
[15.12] ([false]: -(-asType < integer > (\$heap_{funcstart\_724,1}.p1) \% 177),
[!false]: asType<integer>(p_{funcstart\_724,1}.p_1) \% 177) ==
asType<integer>(div(heapIs $heap_{tuncstart\_724.1}, $heap_{tuncstart\_724.1}.p1,
177).rem)
\rightarrow [simplify]
[15.17] 0 == (-\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1,
177).rem + (\text{$heap}_{funcstart\_724,1}.p1 \% 177))
[Create new term from terms 1.28, 15.17 using rule: transitivity 16]
[55.0] (0 + 191) < ($heap_funcstart_724,1.p1 % 177)
\rightarrow [simplify]
[55.2] false
Proof of verification condition: Type constraint satisfied in explicit
conversion from 'int' to 'short int'
Condition generated at: C:\Escher\Customers\prang\prang.c (56,40)
Condition defined at:
To prove: minof(short int) \le div1.quot
Given:
heap_{init}.LIMIT == (int)80
\theta sheap<sub>init</sub>.M1 == asType<short int>((int)30269)
\theta_{init}.r1 == asType < short int > ((int)171)
\theta sheap<sub>init</sub>.a1 == asType<short int>((int)177)
\theta
heap_{init}.M2 == asType < short int > ((int)30307)
\theta_{init}.r2 == asType<short int>((int)172)
```

```
\theta
\theta
heap_{init}.M3 == asType < short int > ((int)30323)
\theta_{init}.r3 == asType < short int > ((int)170)
heap_{init}.a3 == asType < short int > ((int)178)
heap_{init}.b3 == asType<short int>((int)63)
\theta = asType < short int > ((int)1)
\theta
\theta = asType < short int > ((int)3)
invariant
1<br/>( \mathbf{heapIs}\ \$ \mathbf{heap}_{funcstart\_724,1})
\operatorname{div1} == \operatorname{div}(\mathbf{heapIs} \ \operatorname{\$heap}_{funcstart\_724,1},
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p1}),
asType < int > (\$heap_{funcstart\_724,1}.a1))
(asType<int>(asType<int>($heap_{tuncstart\_724.1}.p1)) /
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a1))) = =
asType<integer>(div1.quot)
(asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.p1)) \%
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a1))) = =
asType<integer>(div1.rem)
!(0 == asType < integer > (div1.rem)) || !(0 ==
asType<integer>(div1.quot))
\label{eq:div2} \text{div2} == \text{div}(\mathbf{heapIs} \ \$ \text{heap}_{funcstart\_724,1},
\mathbf{asType} < \mathbf{int} > (\$ \mathrm{heap}_{funcstart\_724,1}.\mathrm{p2}),
asType < int > (\$heap_{funcstart\_724,1}.a2))
(asType<integer>(asType<int>($heap_{tuncstart\_724.1}.p2)) /
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a2))) = =
asType<integer>(div2.quot)
(asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.p2)) \%
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a2))) = =
asType<integer>(div2.rem)
!(0 == asType < integer > (div2.rem)) || !(0 ==
asType<integer>(div2.quot))
\mathrm{div3} == \mathrm{div}(\mathbf{heapIs} \ \$ \mathrm{heap}_{funcstart\_724,1},
\mathbf{asType} < \mathbf{int} > (\$ \mathrm{heap}_{funcstart\_724,1}.\mathrm{p3}),
asType < int > (\$heap_{funcstart\_724,1}.a3))
(asType<int>(asType<int>($heap_{tuncstart\_724.1}.p3)) /
\mathbf{asType}{<}\mathbf{integer}{>}(\mathbf{asType}{<}\mathbf{int}{>}(\$\mathbf{heap}_{funcstart\_724,1}.\mathbf{a3}))) = =
asType<integer>(div3.quot)
```

```
(asType < int > (asType < int > (\$heap_{funcstart\_724,1}.p3)) \%
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a3))) = =
asType<integer>(div3.rem)
!(0 == asType < integer > (div3.rem)) || !(0 ==
asType < integer > (div3.quot))
Proof:
[Take given term]
[5.0] invariant1(heapIs heap_{funcstart\_724,1})
\rightarrow [expand definition of function 'invariant1' at prang.c (34,1)]
[5.1] ((((((0 < asType < integer > (heap_{funcstart_{-724,1}}.p1)) &&
(asType < integer > (\$heap_{funcstart\_724,1}.p1) < 
as
Type<integer>(\rho_{funcstart\_724,1}.M1))) & (0 <
asType < integer > (\$heap_{funcstart\_724,1}.p2))) \&\&
(asType<integer>($heap_funcstart_724.1.p2) <
asType < integer > (\$heap_{funcstart\_724,1}.M2))) \&\& (0 <
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{p3})))\ \&\&
(\mathbf{asType} {<} \mathbf{integer} {>} (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p3}) <
asType < integer > (\$heap_{funcstart\_724,1}.M3))
\rightarrow [simplify]
asType<integer>(sheap_{funcstart_{-724,1}}.M1))) && (0 <
asType < integer > (\$heap_{funcstart_{-724,1}}.p2))) \&\&
(asType<integer>($heap_funcstart_724,1.p2) <
\mathbf{asType} \small{<} \mathbf{integer} \small{>} (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{M2}))) \ \&\& \ (0 <
asType < integer > (\$heap_{funcstart\_724,1}.p3))) \&\&
(asType < integer > ($heap_{funcstart\_724,1}.p3) < 
asType < integer > (\$heap_{funcstart\_724,1}.M3))
\rightarrow [const static or extern object]
[5.4] (((((0 < $heap_{funcstart_{724,1}}.p1) && ($heap_{funcstart_{724,1}}.p1 < ]
asType < integer > (\$heap_{init}.M1))) \&\& (0 <
asType < integer > (\$heap_{funcstart\_724,1}.p2))) \&\&
(asType<integer>($heap_funcstart_724,1.p2) <
asType < integer > (\$heap_{funcstart\_724,1}.M2))) \&\& (0 <
asType < integer > (\$heap_{funcstart\_724,1}.p3))) \&\&
(\mathbf{asType} < \mathbf{integer} > (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p3}) <
asType < integer > (\$heap_{funcstart\_724,1}.M3))
\rightarrow [expand definition of constant 'M1' at prang.c (14,20)]
[5.5] (((((0 < \text{\$heap}_{funcstart\_724,1}.p1) \&\& (\text{\$heap}_{funcstart\_724,1}.p1 <
\mathbf{asType} \small{<} \mathbf{integer} \small{>} (\mathbf{asType} \small{<} \mathbf{short} \ \mathbf{int} \small{>} ((\mathbf{int})30269)))) \ \&\& \ (0 <
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p2})))~\&\&
(asType < integer > ($heap_{funcstart\_724,1}.p2) <
```

```
asType<integer>(heap_{funcstart\_724,1}.M2))) && (0 <
asType < integer > (\$heap_{funcstart\_724,1}.p3))) \&\&
(\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{p3}) <
asType < integer > (\$heap_{funcstart\_724,1}.M3))
\rightarrow [simplify]
[5.16] \; ((((-30269 < -\$heap_{funcstart\_724,1}.p1) \land (0 < \$heap_{funcstart\_724,1}.p1) \land (0 < \$heap_{funcstart\_724,1}.p1
(0 < \text{\$heap}_{funcstart\_724,1}.p2)) \&\& (\text{\$heap}_{funcstart\_724,1}.p2 <
asType < integer > (\$heap_{funcstart\_724,1}.M2))) \&\& (0 <
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{p3})))\ \&\&
(asType < integer > ($heap_{funcstart\_724,1}.p3) < 
\mathbf{asType} < \mathbf{integer} > (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{M3}))
\rightarrow [const static or extern object]
[5.17] ((((-30269 < -$heap_{funcstart\_724,1}.p1) \lambda (0 < $heap_{funcstart\_724,1}.p1) \lambda
(0 < \text{\$heap}_{funcstart\_724,1}.p2)) \&\& (\text{\$heap}_{funcstart\_724,1}.p2 <
asType < integer > (\$heap_{init}.M2))) \&\& (0 <
asType < integer > (\$heap_{funcstart\_724,1}.p3))) \&\&
(asType < integer > (\$heap_{funcstart\_724,1}.p3) < 
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{M3}))
\rightarrow [expand definition of constant 'M2' at prang.c (19,20)]
[5.18] ((((-30269 < -\$heap_{funcstart\_724,1}.p1) \land (0 < \$heap_{funcstart\_724,1}.p1) 
(0 < \text{$heap}_{funcstart\_724,1}.p2)) \&\& (\text{$heap}_{funcstart\_724,1}.p2 <
asType<integer>(asType<short int>((int)30307)))) && (0 <
asType < integer > (\$heap_{funcstart\_724,1}.p3))) \&\&
(asType < integer > ($heap_{funcstart\_724,1}.p3) < 
asType<integer>($heap_funcstart_724,1.M3))
\rightarrow [simplify]
[5.30] ((-30307 < -$heap<sub>funcstart_724,1.</sub>p2) \land (-30269 <
-\$heap_{funcstart\_724,1}.p1) \land (0 < \$heap_{funcstart\_724,1}.p1) \land (0 < \$heap_{funcstart\_724,1}.p1)
\$heap_{funcstart\_724,1}.p2) \land (0 < \$heap_{funcstart\_724,1}.p3)) \&\&
(\text{\$heap}_{funcstart\_724,1}.\text{p3} < \text{asType} < \text{integer} > (\text{\$heap}_{funcstart\_724,1}.\text{M3}))
\rightarrow [const static or extern object]
[5.31] ((-30307 < -$heap_funcstart_724,1.p2) \land (-30269 <
-\$heap_{funcstart\_724,1}.p1) \land (0 < \$heap_{funcstart\_724,1}.p1) \land (0 < \$heap_{funcstart\_724,1}.p1)
\text{Sheap}_{funcstart\_724,1.p2} \land (0 < \text{Sheap}_{funcstart\_724,1.p3})) \&\&
(\text{\$heap}_{funcstart\_724,1}.\text{p3} < \text{asType} < \text{integer} > (\text{\$heap}_{init}.\text{M3}))
\rightarrow [expand definition of constant 'M3' at prang.c (24,20)]
[5.32] ((-30307 < -$heap<sub>funcstart_724,1.</sub>p2) \wedge (-30269 <
 -\$heap_{funcstart\_724,1}.p1) \land (0 < \$heap_{funcstart\_724,1}.p1) \land (0 < \$heap_{funcstart\_724,1}.p1)
\text{Sheap}_{funcstart\_724,1}.p2) \land (0 < \text{Sheap}_{funcstart\_724,1}.p3)) \&\&
(\text{sheap}_{funcstart\_724,1}.\text{p3} < \text{asType} < \text{integer} > (\text{asType} < \text{short})
int > ((int)30323)))
```

```
\rightarrow [simplify]
[5.40] (-30323 < -$heap<sub>funcstart_724,1.</sub>p3) \land (-30307 <
-\$heap_{funcstart\_724,1}.p2) \wedge (-30269 < -\$heap_{funcstart\_724,1}.p1) \wedge (0 <
\text{Sheap}_{funcstart\_724,1}.\text{p1}) \land (0 < \text{Sheap}_{funcstart\_724,1}.\text{p2}) \land (0 <
heap_{funcstart_{-724,1}.p3}
[Work on sub-term 4 of conjunction in term 5.40]
[8.0] 0 < \text{$heap}_{funcstart\_724,1}.p1
[Take given term]
[11.0] \operatorname{div1} == \operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724,1},
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p1}),
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{a1}))
\rightarrow [simplify]
[11.1] \ \mathrm{div1} == \mathrm{div}(\mathbf{heapIs} \ \$ \mathrm{heap}_{funcstart\_724,1}, \ \$ \mathrm{heap}_{funcstart\_724,1}.\mathrm{p1},
asType < int > (\$heap_{funcstart\_724,1}.a1))
\rightarrow [const static or extern object]
[11.2] \operatorname{div1} == \operatorname{div}(\mathbf{heapIs} \operatorname{\$heap}_{funcstart\_724,1}, \operatorname{\$heap}_{funcstart\_724,1}.p1,
asType < int > (\$heap_{init}.a1))
\rightarrow [expand definition of constant 'a1' at prang.c (16,20)]
\textit{[11.3]} \ \text{div1} == \text{div}(\mathbf{heapIs} \ \$ \text{heap}_{funcstart\_724,1}, \ \$ \text{heap}_{funcstart\_724,1}.\text{p1},
asType<int>(asType<short int>((int)177)))
\rightarrow [simplify]
[11.6] div1 == div(heapIs heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p1, 177)
[Assume known post-assertion, class invariant or type constraint for term 11.6]
[14.0] (asType<integer>($heap<sub>funcstart_724,1.</sub>p1) /
asType<integer>(177)) == asType<integer>(div(heapIs
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.p1, 177).quot
\rightarrow [simplify]
[14.2] ($heap<sub>funcstart_724,1.</sub>p1 / 177) == asType<integer>(div(heapIs)
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.\text{p1}, 177).\text{quot}
→ [expand definition of operator './' in class 'int' at built in declaration]
[14.3] ([asType<integer>(heap_{funcstart\_724,1}.p1) < 0]:
-(-asType < integer > (\$heap_{funcstart\_724,1}.p1) / 177), []:
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p1}) \ / \ 177) ==
\mathbf{asType} \small{<} \mathbf{integer} \small{>} ( \mathrm{div}(\mathbf{heapIs} \ \$ \mathrm{heap}_{funcstart\_724,1}, \ \$ \mathrm{heap}_{funcstart\_724,1}.\mathrm{p1}, \\
177).quot)
→ [explicitly assert falsehood of skipped guards in subsequent guards]
[14.4] ([asType<integer>(heap_{funcstart\_724,1}.p1) < 0]:
```

```
-(-asType < integer > (\$heap_{funcstart\_724,1}.p1) / 177),
[!(asType < integer > (\$heap_{funcstart\_724,1}.p1) < 0)]:
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p1})~/~177) ==
\mathbf{asType} < \mathbf{integer} > (\mathbf{div}(\mathbf{heapIs} \ \$ \mathbf{heap}_{funcstart\_724,1}, \ \$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p1}, \\
177).quot)
\rightarrow [simplify]
[14.7] ([0 < -$heap<sub>funcstart_724,1</sub>.p1]:
-(-\mathbf{asType} < \mathbf{integer} > (\$ \mathrm{heap}_{funcstart\_724,1}.\mathrm{p1}) \ / \ 177),
[!(asType < integer > (\$heap_{funcstart\_724,1}.p1) < 0)]:
asType < integer > (\$heap_{funcstart\_724,1}.p1) / 177) ==
\mathbf{asType} < \mathbf{integer} > (\mathbf{div}(\mathbf{heapIs} \$ \mathbf{heap}_{funcstart\_724,1}, \$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p1},
177).quot)
\rightarrow [from term 8.0, literala < -$heap<sub>funcstart_724.1</sub>.p1 is false whenever -2 < (0
+ literala)]
    Proof of rule precondition:
    [14.7.0] - 2 < (0 + 0)
    \rightarrow [simplify]
    [14.7.2] true
[14.8] ([false]: -(-asType < integer > (\$heap_{funcstart\_724,1}.p1) / 177),
[!(asType < integer > (\$heap_{funcstart\_724,1}.p1) < 0)]:
\mathbf{asType} < \mathbf{integer} > (\$ \mathrm{heap}_{funcstart\_724,1}.\mathrm{p1}) \ / \ 177) = =
asType<integer>(div(heapIs $heap_{tuncstart\_724.1}, $heap_{tuncstart\_724.1}.p1,
177).quot)
\rightarrow [simplify]
[14.11] ([false]: -(-asType < integer > (\$heap_{funcstart\_724,1}.p1) / 177), [!(0 < integer) / (\$heap_{funcstart\_724,1}.p1) / 177)
-\$heap_{funcstart\_724,1}.p1): asType<integer>(\$heap_{funcstart\_724,1}.p1) / 177)
== asType < integer > (div(heapIs $heap_{funcstart\_724,1},
heap_{funcstart_{-724,1}}.p1, 177).quot
\rightarrow [from term 8.0, literala < -$heap<sub>funcstart_724,1</sub>.p1 is false whenever -2 < (0
+ literala)]
    Proof of rule precondition:
    [14.11.0] - 2 < (0 + 0)
    \rightarrow [simplify]
    [14.11.2] true
[14.12] ([false]: -(-asType < integer > (\$heap_{funcstart\_724,1}.p1) / 177),
[!false]: asType<integer>($heap<sub>funcstart_724,1.</sub>p1) / 177) ==
\mathbf{asType} < \mathbf{integer} > (\mathbf{div}(\mathbf{heapIs} \ \$ \mathbf{heap}_{funcstart\_724,1}, \ \$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p1}, \\
177).quot)
```

```
\rightarrow [simplify]
[14.17] 0 == (-\text{div}(\mathbf{heapIs} \$ \text{heap}_{funcstart\_724,1}, \$ \text{heap}_{funcstart\_724,1}.\text{p1},
177).quot + (\text{$heap}_{funcstart\_724,1}.p1 / 177))
[Assume known post-assertion, class invariant or type constraint for term
14.17
[20.0] \ \mathbf{minof(int)} \leq \mathrm{div}(\mathbf{heapIs} \ \$ \mathrm{heap}_{funcstart\_724,1}, \ \$ \mathrm{heap}_{funcstart\_724,1}.\mathrm{p1},
177).quot
\rightarrow [simplify]
\label{eq:condition} \mbox{[20.3] -32769} < \mbox{div}(\mbox{\bf heapIs $\$heap}_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1,
177).quot
[Take goal term]
[1.0] minof(short int) \leq div1.quot
\rightarrow [simplify]
[1.1] -32768 \leq div1.quot
\rightarrow [from term 11.6, div1 is equal to div(heapIs $heap_{funcstart\_724,1},
heap_{funcstart_{-724,1}}.p1, 177
[1.2] -32768 \leq div(heapIs \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}.p1,
177).quot
\rightarrow [simplify]
 [1.4] -32769 < \operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.\operatorname{p1}, 
177).quot
\rightarrow [from term 20.3, literala < div(heapIs $heap<sub>funcstart_724,1</sub>,
\rho_{funcstart\_724,1}.p1,\ 177).quot is true whenever (-1 + literala) < -32769
    Proof of rule precondition:
    [1.4.0](-32769 + -1) < -32769
    \rightarrow [simplify]
    [1.4.2] true
[1.5] true
Proof of verification condition: Type constraint satisfied in explicit
conversion from 'int' to 'short int'
Condition generated at: C:\Escher\Customers\prang\prang.c (56,40)
Condition defined at:
```

To prove:  $div1.quot \le maxof(short int)$ 

Given:

```
heap_{init}.LIMIT == (int)80
heap_{init}.M1 == asType < short int > ((int)30269)
\theta_{init}.r1 == asType < short int > ((int)171)
heap_{init}.a1 == asType < short int > ((int)177)
\theta
heap_{init}.M2 == asType < short int > ((int)30307)
\theta_{init}.r2 == asType<short int>((int)172)
heap_{init}.a2 == asType < short int > ((int)176)
\theta = asType < short int > ((int)35)
heap_{init}.M3 == asType < short int > ((int)30323)
heap_{init}.r3 == asType < short int > ((int)170)
heap_{init}.a3 == asType < short int > ((int)178)
\theta = asType < short int > ((int)63)
\theta = asType < short int > ((int)1)
\theta
\theta = asType < short int > ((int)3)
invariant1(heapIs heap_{funcstart\_724,1})
\operatorname{div1} == \operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724,1},
asType < int > (\$heap_{funcstart\_724,1}.p1),
asType < int > (\$heap_{funcstart\_724,1}.a1))
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a1))) = =
asType<integer>(div1.quot)
(asType<integer>(asType<int>($heap_{tuncstart\_724.1}.p1)) %
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a1))) = =
asType<integer>(div1.rem)
!(0 == asType < integer > (div1.rem)) || !(0 ==
asType<integer>(div1.quot))
div2 == div(\mathbf{heapIs} \$heap_{funcstart\_724,1},
asType < int > (\$heap_{funcstart\_724,1}.p2),
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{a2}))
(\mathbf{asType} < \mathbf{integer} > (\mathbf{asType} < \mathbf{int} > (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p2})) \ / \\
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a2))) = =
asType<integer>(div2.quot)
(asType<int>(asType<int>($heap_{funcstart\_724,1}.p2)) %
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a2))) = =
```

```
asType<integer>(div2.rem)
!(0 == asType < integer > (div2.rem)) || !(0 ==
asType<integer>(div2.quot))
div3 == div(\mathbf{heapIs} \$heap_{funcstart\_724,1},
asType < int > (\$heap_{funcstart\_724,1}.p3),
asType < int > (\$heap_{funcstart\_724,1}.a3))
(\mathbf{asType}{<}\mathbf{integer}{>}(\mathbf{asType}{<}\mathbf{int}{>}(\$\mathbf{heap}_{funcstart\_724,1}.\mathbf{p3})) \ / \\
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a3))) = =
asType<integer>(div3.quot)
(asType<int>(asType<int>($heap_{funcstart\_724.1}.p3)) %
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a3))) = =
asType<integer>(div3.rem)
!(0 == asType < integer > (div3.rem)) || !(0 ==
asType<integer>(div3.quot))
Proof:
[Take given term]
[5.0] invariant1(heapIs heap_{funcstart\_724,1})
\rightarrow [expand definition of function 'invariant1' at prang.c (34,1)]
[5.1] ((((((0 < asType < integer > ($heap_{funcstart\_724,1}.p1)) &&
(\mathbf{asType} {<} \mathbf{integer} {>} (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p1}) <
asType < integer > (\$heap_{funcstart\_724,1}.M1))) \&\& (0 <
asType < integer > (\$heap_{funcstart\_724,1}.p2))) \&\&
(\mathbf{asType} {<} \mathbf{integer} {>} (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p2}) <
asType < integer > (\$heap_{funcstart\_724.1}.M2))) \&\& (0 <
asType < integer > (\$heap_{funcstart_{724,1}}.p3))) \&\&
(asType < integer > (\$heap_{funcstart\_724,1}.p3) < 
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{M3}))
\rightarrow [simplify]
[5.3] (((((0 < $heap_{funcstart_{724,1}}.p1) && ($heap_{funcstart_{724,1}}.p1 < 
asType < integer > (\$heap_{funcstart\_724,1}.M1))) \&\& (0 < footnote{1})
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{p2})))\ \&\&
(asType < integer > (\$heap_{funcstart\_724,1}.p2) <
as
Type<integer>(\rho_{funcstart\_724,1}.M2))) & (0 <
asType < integer > (\$heap_{funcstart\_724,1}.p3))) \&\&
(\mathbf{asType} < \mathbf{integer} > (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p3}) <
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{M3}))
\rightarrow [const static or extern object]
[5.4] (((((0 < $heap_{funcstart_{724,1}}.p1) && ($heap_{funcstart_{724,1}}.p1 < ]
asType < integer > (\$heap_{init}.M1))) \&\& (0 <
asType < integer > (\$heap_{funcstart\_724,1}.p2))) \&\&
```

```
(\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{p2}) <
asType < integer > (\$heap_{funcstart\_724,1}.M2))) \&\& (0 <
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{p3})))\ \&\&
 (asType < integer > ($heap_{funcstart\_724,1}.p3) < 
 \mathbf{asType} < \mathbf{integer} > (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{M3}))
 \rightarrow [expand definition of constant 'M1' at prang.c (14,20)]
 [5.5] (((((0 < $heap_{funcstart_724,1}.p1) && ($heap_{funcstart_724,1}.p1 < function for the content of the 
asType<integer>(asType<short int>((int)30269)))) && (0 <
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p2})))\ \&\&
(asType < integer > ($heap_{funcstart\_724,1}.p2) < 
\mathbf{asType} \small{<} \mathbf{integer} \small{>} (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{M2}))) \ \&\& \ (0 <
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{p3})))\ \&\&
 (asType < integer > ($heap_{funcstart\_724,1}.p3) < 
 asType < integer > (\$heap_{funcstart\_724,1}.M3))
 \rightarrow [simplify]
 [5.16] \; ((((-30269 < -\$ heap_{funcstart\_724,1}.p1) \; \land \; (0 < \$ heap_{funcstart\_724
 (0 < \text{\$heap}_{funcstart\_724,1}.p2)) \&\& (\text{\$heap}_{funcstart\_724,1}.p2 <
asType<integer>($heap_{funcstart\_724,1}.M2))) && (0 <
asType < integer > (\$heap_{funcstart\_724,1}.p3))) \&\&
 (\mathbf{asType} {<} \mathbf{integer} {>} (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p3}) <
asType < integer > (\$heap_{funcstart\_724,1}.M3))
 \rightarrow [const static or extern object]
 [5.17] \; ((((-30269 < -\$heap_{funcstart\_724,1}.p1) \; \land \; (0 < \$heap_{funcstart\_724,1}.p1) \; \land 
 (0 < \text{$heap}_{funcstart\_724,1}.p2)) \&\& (\text{$heap}_{funcstart\_724,1}.p2 <
asType < integer > (\$heap_{init}.M2))) \&\& (0 <
 \mathbf{asType}{<}\mathbf{integer}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p3})))\ \&\&
 (asType < integer > (\$heap_{funcstart\_724,1}.p3) < 
\mathbf{asType} < \mathbf{integer} > (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{M3}))
 \rightarrow [expand definition of constant 'M2' at prang.c (19,20)]
 [5.18] ((((-30269 < -\$heap_{funcstart\_724,1}.p1) \land (0 < \$heap_{funcstart\_724,1}.p1) 
 (0 < \text{\$heap}_{funcstart\_724,1}.p2)) \&\& (\text{\$heap}_{funcstart\_724,1}.p2 <
asType < integer > (asType < short int > ((int)30307)))) && (0 < integer) && (0 < integer
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p3})))\ \&\&
 (asType < integer > (\$heap_{funcstart_{-724.1}}.p3) < 
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{M3}))
 \rightarrow [simplify]
 [5.30] ((-30307 < -\$heap_{funcstart\_724,1}.p2) \land (-30269 <
 -\$heap_{funcstart\_724,1}.p1) \land (0 < \$heap_{funcstart\_724,1}.p1) \land (0 < \$heap_{funcstart\_724,1}.p1)
\text{Sheap}_{funcstart_{724,1}.p2} \land (0 < \text{Sheap}_{funcstart_{724,1}.p3})) \&\&
 (\text{\$heap}_{funcstart\_724,1}.p3 < asType < integer > (\text{\$heap}_{funcstart\_724,1}.M3))
 \rightarrow [const static or extern object]
```

```
[5.31] ((-30307 < -$heap_funcstart_724,1.p2) \land (-30269 <
-\$heap_{funcstart\_724,1}.p1) \land (0 < \$heap_{funcstart\_724,1}.p1) \land (0 < \$heap_{funcstart\_724,1}.p1)
\text{Sheap}_{funcstart\_724,1}.p2) \land (0 < \text{Sheap}_{funcstart\_724,1}.p3)) \&\&
(\text{\$heap}_{funcstart\_724,1}.\text{p3} < \mathbf{asType} < \mathbf{integer} > (\text{\$heap}_{init}.\text{M3}))
\rightarrow [expand definition of constant 'M3' at prang.c (24,20)]
[5.32] ((-30307 < -$heap_funcstart_724,1.p2) \land (-30269 <
-\$heap_{funcstart\_724,1}.p1) \land (0 < \$heap_{funcstart\_724,1}.p1) \land (0 < \$heap_{funcstart\_724,1}.p1)
\text{Sheap}_{funcstart_{724,1}.p2} \land (0 < \text{Sheap}_{funcstart_{724,1}.p3})) \&\&
(\text{sheap}_{funcstart\_724,1}.\text{p3} < \text{asType} < \text{integer} > (\text{asType} < \text{short})
int > ((int)30323))
\rightarrow [simplify]
[5.40] (-30323 < -\$heap_{funcstart\_724,1}.p3) \land (-30307 < -30307)
-\$heap_{funcstart\_724,1}.p2) \wedge (-30269 < -\$heap_{funcstart\_724,1}.p1) \wedge (0 <
\text{Sheap}_{funcstart\_724,1}.\text{p1}) \land (0 < \text{Sheap}_{funcstart\_724,1}.\text{p2}) \land (0 <
heap_{funcstart_{-724,1}.p3}
[Work on sub-term 4 of conjunction in term 5.40]
[8.0] 0 < $heap_{funcstart_724,1}.p1
[Take given term]
[11.0] \operatorname{div1} == \operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724,1},
asType < int > (\$heap_{funcstart\_724,1}.p1),
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{a1}))
\rightarrow [simplify]
[11.1] \ \mathrm{div1} == \mathrm{div}(\mathbf{heapIs} \ \$ \mathrm{heap}_{funcstart\_724,1}, \ \$ \mathrm{heap}_{funcstart\_724,1}.\mathrm{p1},
asType < int > (\$heap_{funcstart\_724,1}.a1))
\rightarrow [const static or extern object]
[11.2] div1 == div(heapIs \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}.p1,
asType < int > (\$heap_{init}.a1))
\rightarrow [expand definition of constant 'a1' at prang.c (16,20)]
[11.3] \ \mathrm{div1} == \mathrm{div}(\mathbf{heapIs} \ \$ \mathrm{heap}_{funcstart\_724,1}, \ \$ \mathrm{heap}_{funcstart\_724,1}.\mathrm{p1},
asType<int>(asType<short int>((int)177)))
\rightarrow [simplify]
[11.6] \ \mathrm{div1} == \mathrm{div}(\mathbf{heapIs} \ \$ \mathrm{heap}_{funcstart\_724,1}, \ \$ \mathrm{heap}_{funcstart\_724,1}.\mathrm{p1}, \ 177)
[Assume known post-assertion, class invariant or type constraint for term 11.6]
[14.0] \; (\mathbf{asType} {<} \mathbf{integer} {>} (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p1}) \; / \;
asType<integer>(177)) == asType<integer>(div(heapIs
\$ \mathrm{heap}_{funcstart\_724,1},\,\$ \mathrm{heap}_{funcstart\_724,1}.\mathrm{p1},\,177).\mathrm{quot})
\rightarrow [simplify]
```

```
[14.2] ($heap<sub>funcstart_724,1.</sub>p1 / 177) == asType<integer>(div(heapIs)
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.p1, 177).quot
→ [expand definition of operator './' in class 'int' at built in declaration]
[14.3] ([asType<integer>(peq_{tange}) (peq_{tange}) (peq_{tange}) (peq_{tange}) (peq_{tange}) (peq_{tange})
-(-asType < integer > (\$heap_{funcstart\_724,1}.p1) / 177), []:
asType < integer > (\$heap_{funcstart\_724,1}.p1) / 177) ==
asType<integer>(div(heapIs $heap_{tuncstart\_724,1}, $heap_{tuncstart\_724,1}.p1,
177).quot)
→ [explicitly assert falsehood of skipped guards in subsequent guards]
[14.4] \; ([\mathbf{asType} < \mathbf{integer} > (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p1}) < 0]:
-(-asType < integer > (\$heap_{funcstart\_724,1}.p1) / 177),
[!(asType < integer > (\$heap_{funcstart\_724,1}.p1) < 0)]:
asType < integer > (\$heap_{funcstart\_724,1}.p1) / 177) ==
\mathbf{asType} {<} \mathbf{integer} {>} ( \mathrm{div}(\mathbf{heapIs} \ \$ \mathrm{heap}_{funcstart\_724,1}, \ \$ \mathrm{heap}_{funcstart\_724,1}.\mathrm{p1}, \\
177).quot)
\rightarrow [simplify]
[14.7] ([0 < -$heap<sub>funcstart_724,1.</sub>p1]:
-(-asType < integer > (\$heap_{funcstart\_724,1}.p1) / 177),
[!(asType < integer > (\$heap_{funcstart\_724,1}.p1) < 0)]:
asType < integer > (\$heap_{funcstart\_724,1}.p1) / 177) ==
asType<integer>(div(heapIs $heap_{funcstart\_724,1}, $heap_{funcstart\_724,1}.p1,
177).quot)
\rightarrow [from term 8.0, literala < -$heap<sub>funcstart_724,1</sub>.p1 is false whenever -2 < (0
+ literala)]
    Proof of rule precondition:
    [14.7.0] - 2 < (0 + 0)
    \rightarrow [simplify]
    [14.7.2] true
[14.8] \; ([\mathbf{false}]: \; -(-\mathbf{asType} < \mathbf{integer} > (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p1}) \; / \; 177),
[!(asType < integer > (\$heap_{funcstart\_724.1}.p1) < 0)]:
asType < integer > (\$heap_{funcstart\_724,1}.p1) / 177) ==
asType<integer>(div(heapIs $heap_{funcstart_724,1}, $heap_{funcstart_724,1}.p1,
177).quot)
\rightarrow [simplify]
[14.11] ([false]: -(-asType < integer > (\$heap_{funcstart\_724,1}.p1) / 177), [!(0 <
-\text{$heap}_{funcstart\_724,1}.p1)]: asType<integer>($heap_{funcstart\_724,1}.p1) / 177)
== asType < integer > (div(heapIs $heap_{funcstart\_724,1},
heap_{funcstart_{-724,1}}.p1, 177).quot
\rightarrow [from term 8.0, literala < -$heap<sub>funcstart_724,1</sub>.p1 is false whenever -2 < (0
```

```
+ literala)]
    Proof of rule precondition:
    [14.11.0] - 2 < (0 + 0)
    \rightarrow [simplify]
    [14.11.2] true
\textit{[14.12]} \; ([\textbf{false}]: \; -(-\textbf{asType} < \textbf{integer} > (\$ \text{heap}_{funcstart\_724,1}.\text{p1}) \; / \; 177),
[!false]: asType<integer>($heap<sub>funcstart_724,1.</sub>p1) / 177) ==
\mathbf{asType} < \mathbf{integer} > (\mathbf{div}(\mathbf{heapIs} \$ \mathbf{heap}_{funcstart\_724,1}, \$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p1},
177).quot)
\rightarrow [simplify]
[14.17] \; 0 == \left(-\mathrm{div}(\mathbf{heapIs} \; \$ \mathrm{heap}_{funcstart\_724,1}, \, \$ \mathrm{heap}_{funcstart\_724,1}.\mathrm{p1}, \right.
177).quot + (\text{$heap}_{funcstart\_724,1}.p1 / 177))
[Assume known post-assertion, class invariant or type constraint for term
14.17
[21.0] div(heapIs heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p1, 177).quot \leq
maxof(int)
\rightarrow [simplify]
[21.9] -32768 < -\text{div}(\mathbf{heapIs} \$ \text{heap}_{funcstart\_724,1}, \$ \text{heap}_{funcstart\_724,1}.\text{p1},
177).quot
[Take goal term]
[1.0] div1.quot \leq maxof(short int)
\rightarrow [from term 11.6, div1 is equal to div(heapIs $heap_{funcstart\_724,1},
heap_{funcstart_{-724,1}}.p1, 177)
[1.1] div(heapIs \rho_{funcstart\_724,1}, \rho_{funcstart\_724,1}, 177).quot \rho_{funcstart\_724,1}
maxof(short int)
\rightarrow [simplify]
[1.10] \ -32768 < -{\rm div}(\mathbf{heapIs} \ \$ \mathrm{heap}_{funcstart\_724,1}, \ \$ \mathrm{heap}_{funcstart\_724,1}.\mathrm{p1},
177).quot
\rightarrow [from term 21.9, literala < -\text{div}(\text{heapIs } \text{\$heap}_{funcstart\_724,1},
heap_{funcstart_{-724,1}.p1, 177}, quot is true whenever (-1 + literala) < -32768
    Proof of rule precondition:
    [1.10.0](-32768 + -1) < -32768
    \rightarrow [simplify]
    [1.10.2] true
[1.11] true
```

```
conversion from 'short int' to 'int'
Condition generated at: C:\Escher\Customers\prang\prang.c (56,40)
Condition defined at:
To prove: minof(int) \le asType \le short int \rangle (\div1.quot)
Given:
heap_{init}.LIMIT == (int)80
\theta
\theta_{init}.r1 == asType < short int > ((int)171)
\theta sheap<sub>init</sub>.a1 == asType<short int>((int)177)
\theta
heap_{init}.M2 == asType < short int > ((int)30307)
\rho_{init}.r2 == asType < short int > ((int)172)
heap_{init}.a2 == asType < short int > ((int)176)
\theta = asType < short int > ((int)35)
heap_{init}.M3 == asType < short int > ((int)30323)
\theta
heap_{init}.a3 == asType < short int > ((int)178)
\theta = asType < short int > ((int)63)
\theta = asType < short int > ((int)1)
\rho = asType < short int > ((int)2)
\theta = asType < short int > ((int)3)
invariant1(heapIs heap_{funcstart_{-724,1}})
\operatorname{div1} == \operatorname{div}(\mathbf{heapIs} \ \operatorname{\$heap}_{funcstart\_724,1},
asType < int > (\$heap_{funcstart\_724,1}.p1),
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{a1}))
(\mathbf{asType}{<}\mathbf{int}{>}(\mathbf{asType}{<}\mathbf{int}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{p1})) \ / \\
asType < integer > (asType < int > (\$heap_{funcstart\_724.1}.a1))) = =
asType<integer>(div1.quot)
(\mathbf{asType} {<} \mathbf{int} {>} (\mathbf{asType} {<} \mathbf{int} {>} (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p1})) \ \%
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a1))) = =
asType<integer>(div1.rem)
!(0 == asType < integer > (div1.rem)) || !(0 ==
asType<integer>(div1.quot))
div2 == div(\mathbf{heapIs} \$ heap_{funcstart\_724,1},
```

**Proof of verification condition:** Type constraint satisfied in implicit

```
asType < int > (\$heap_{funcstart\_724,1}.p2),
asType < int > (\$heap_{funcstart\_724,1}.a2))
(\mathbf{asType}{<}\mathbf{integer}{>}(\mathbf{asType}{<}\mathbf{int}{>}(\$\mathbf{heap}_{funcstart\_724,1}.\mathbf{p2})) \ / \\
\mathbf{asType}{<}\mathbf{integer}{>}(\mathbf{asType}{<}\mathbf{int}{>}(\$\mathbf{heap}_{funcstart\_724,1}.\mathbf{a2}))) = =
asType<integer>(div2.quot)
(\mathbf{asType} < \mathbf{integer} > (\mathbf{asType} < \mathbf{int} > (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p2})) \ \%
\mathbf{asType} < \mathbf{integer} > (\mathbf{asType} < \mathbf{int} > (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{a2}))) = =
asType<integer>(div2.rem)
!(0 == asType < integer > (div2.rem)) || !(0 ==
asType<integer>(div2.quot))
div3 == div(\mathbf{heapIs} \$ heap_{funcstart_{-724.1}},
asType < int > (\$heap_{funcstart_{-724.1}}.p3),
asType < int > (\$heap_{funcstart\_724,1}.a3))
(\mathbf{asType}{<}\mathbf{integer}{>}(\mathbf{asType}{<}\mathbf{int}{>}(\$\mathbf{heap}_{funcstart\_724,1}.\mathbf{p3})) \ / \\
asType < integer > (asType < int > (\$heap_{funcstart\_724.1}.a3))) = =
asType<integer>(div3.quot)
(\mathbf{asType} < \mathbf{integer} > (\mathbf{asType} < \mathbf{int} > (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p3})) \%
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a3))) = =
asType<integer>(div3.rem)
!(0 == asType < integer > (div3.rem)) || !(0 ==
asType<integer>(div3.quot))
Proof:
[Take given term]
[5.0] invariant1(heapIs heap_{funcstart\_724,1})
\rightarrow [expand definition of function 'invariant1' at prang.c (34,1)]
[5.1] ((((((0 < asType < integer > (heap_{funcstart_{-724,1}}.p1)) &&
(\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{p1}) <
asType < integer > (\$heap_{funcstart\_724,1}.M1))) \&\& (0 <
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{p2})))\ \&\&
(asType < integer > ($heap_{funcstart\_724,1}.p2) < 
as
Type<integer>(\rho_{funcstart\_724,1}.M2))) & (0 <
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{p3})))\ \&\&
(\mathbf{asType} {<} \mathbf{integer} {>} (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p3}) <
asType < integer > (\$heap_{funcstart\_724,1}.M3))
\rightarrow [simplify]
[5.3] \ (((((0 < \$heap_{funcstart\_724,1}.p1) \&\& \ (\$heap_{funcstart\_724,1}.p1 < (
asType<integer>(heap_{funcstart\_724,1}.M1))) && (0 <
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p2})))\ \&\&
(asType<integer>($heap_funcstart_724.1.p2) <
asType < integer > (\$heap_{funcstart\_724,1}.M2))) \&\& (0 <
```

```
asType < integer > (\$heap_{funcstart\_724,1}.p3))) \&\&
(\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{p3}) <
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{M3}))
\rightarrow [const static or extern object]
[5.4] \ (((((0 < \text{\$heap}_{funcstart\_724,1}.\text{p1}) \&\& \ (\text{\$heap}_{funcstart\_724,1}.\text{p1} <
asType < integer > (\$heap_{init}.M1))) \&\& (0 <
asType < integer > (\$heap_{funcstart\_724,1}.p2))) \&\&
(asType < integer > (\$heap_{funcstart\_724,1}.p2) < 
asType < integer > (\$heap_{funcstart\_724,1}.M2))) \&\& (0 <
asType < integer > (\$heap_{funcstart\_724,1}.p3))) \&\&
(asType < integer > (\$heap_{funcstart\_724,1}.p3) < 
\mathbf{asType} < \mathbf{integer} > (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{M3}))
\rightarrow [expand definition of constant 'M1' at prang.c (14,20)]
[5.5] (((((0 < $heap_{funcstart\_724,1}.p1) && ($heap_{funcstart\_724,1}.p1 < 
asType<integer>(asType<short int>((int)30269)))) && (0 <
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p2})))~\&\&
(asType < integer > (\$heap_{funcstart\_724,1}.p2) < 
asType < integer > (\$heap_{funcstart\_724,1}.M2))) \&\& (0 <
asType < integer > (\$heap_{funcstart\_724,1}.p3))) \&\&
(\mathbf{asType} < \mathbf{integer} > (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p3}) <
asType < integer > (\$heap_{funcstart\_724,1}.M3))
\rightarrow [simplify]
[5.16] \; ((((-30269 < -\$heap_{funcstart\_724,1}.p1) \; \land \; (0 < \$heap_{funcstart\_724,1}.p1) \; \land 
(0 < \text{$heap}_{funcstart\_724,1}.p2)) \&\& (\text{$heap}_{funcstart\_724,1}.p2 <
asType < integer > (\$heap_{funcstart\_724,1}.M2))) \&\& (0 <
asType < integer > (\$heap_{funcstart\_724,1}.p3))) \&\&
(asType < integer > (\$heap_{funcstart\_724,1.p3}) < 
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{M3}))
\rightarrow [const static or extern object]
[5.17] \; ((((-30269 < -\$heap_{funcstart\_724,1}.p1) \; \land \; (0 < \$heap_{funcstart\_724,1}.p1) \; \land 
(0 < \text{\$heap}_{funcstart\_724,1}.p2)) \&\& (\text{\$heap}_{funcstart\_724,1}.p2 <
asType < integer > (\$heap_{init}.M2))) \&\& (0 <
asType < integer > (\$heap_{funcstart\_724,1}.p3))) \&\&
(asType < integer > (\$heap_{funcstart_{-724.1}}.p3) < 
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{M3}))
\rightarrow [expand definition of constant 'M2' at prang.c (19,20)]
[5.18] ((((-30269 < -\$heap_{funcstart\_724,1}.p1) \land (0 < \$heap_{funcstart\_724,1}.p1) 
(0 < \$ heap_{funcstart\_724,1}.p2)) && (\$ heap_{funcstart\_724,1}.p2 <
asType<integer>(asType<short int>((int)30307)))) && (0 <
asType < integer > (\$heap_{funcstart_{-724.1}.p3})) \&\&
(\mathbf{asType} < \mathbf{integer} > (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p3}) <
```

```
asType < integer > (\$heap_{funcstart_{-724,1}}.M3))
\rightarrow [simplify]
[5.30] ((-30307 < -$heap<sub>funcstart_724,1.</sub>p2) \land (-30269 <
-\$heap_{funcstart\_724,1}.p1) \land (0 < \$heap_{funcstart\_724,1}.p1) \land (0 < \$heap_{funcstart\_724,1}.p1)
\text{Sheap}_{funcstart_{-724,1}.p2} \land (0 < \text{Sheap}_{funcstart_{-724,1}.p3})) \&\&
(\text{\$heap}_{funcstart\_724,1}.p3 < asType < integer > (\text{\$heap}_{funcstart\_724,1}.M3))
\rightarrow [const static or extern object]
[5.31] ((-30307 < -$heap_funcstart_724.1.p2) \land (-30269 <
-\$heap_{funcstart\_724,1}.p1) \land (0 < \$heap_{funcstart\_724,1}.p1) \land (0 < \$heap_{funcstart\_724,1}.p1)
\text{Sheap}_{funcstart\_724,1.p2}) \land (0 < \text{Sheap}_{funcstart\_724,1.p3})) \&\&
(\text{\$heap}_{funcstart\_724.1}.\text{p3} < \text{asType} < \text{integer} > (\text{\$heap}_{init}.\text{M3}))
\rightarrow [expand definition of constant 'M3' at prang.c (24,20)]
[5.32] ((-30307 < -$heap_{tuncstart\_724.1}.p2) \land (-30269 <
-\$heap_{funcstart\_724,1}.p1) \land (0 < \$heap_{funcstart\_724,1}.p1) \land (0 < \$heap_{funcstart\_724,1}.p1)
\text{Sheap}_{funcstart_{-724,1}.p2} \land (0 < \text{Sheap}_{funcstart_{-724,1}.p3})) \&\&
(\$heap_{funcstart\_724,1}.p3 < \mathbf{asType} < \mathbf{integer} > (\mathbf{asType} < \mathbf{short})
int > ((int)30323)))
\rightarrow [simplify]
[5.40] (-30323 < -$heap_funcstart_724,1.p3) \land (-30307 <
-\$heap_{funcstart\_724,1}.p2) \land (-30269 < -\$heap_{funcstart\_724,1}.p1) \land (0 < -\$heap_{funcstart\_724,1}.p1)
\text{Sheap}_{funcstart\_724,1}.\text{p1}) \land (0 < \text{Sheap}_{funcstart\_724,1}.\text{p2}) \land (0 <
heap_{funcstart_{-724,1}.p3}
[Work on sub-term 4 of conjunction in term 5.40]
[8.0] 0 < $heap_{funcstart_724,1}.p1
[Take given term]
[11.0] \operatorname{div1} == \operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724.1},
asType < int > (\$heap_{funcstart\_724,1}.p1),
asType < int > (\$heap_{funcstart\_724,1}.a1))
\rightarrow [simplify]
[11.1] \operatorname{div1} == \operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1,
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{a1}))
\rightarrow [const static or extern object]
[11.2] \ \mathrm{div1} == \mathrm{div}(\mathbf{heapIs} \ \$ \mathrm{heap}_{funcstart\_724,1}, \ \$ \mathrm{heap}_{funcstart\_724,1}.\mathrm{p1},
asType < int > (\$heap_{init}.a1))
\rightarrow [expand definition of constant 'a1' at prang.c (16,20)]
[11.3] \ \mathrm{div1} == \mathrm{div}(\mathbf{heapIs} \ \$ \mathrm{heap}_{funcstart\_724,1}, \ \$ \mathrm{heap}_{funcstart\_724,1}.\mathrm{p1},
asType<int>(asType<short int>((int)177)))
\rightarrow [simplify]
```

```
[11.6] div1 == div(heapIs $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}.p1, 177)
[Assume known post-assertion, class invariant or type constraint for term 11.6]
[14.0] \; (\mathbf{asType} < \mathbf{integer} > (\$ heap_{funcstart\_724,1}.p1) \; / \;
asType < integer > (177)) == asType < integer > (div(heapIs))
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.p1, 177).quot)
\rightarrow [simplify]
[14.2] ($heap<sub>funcstart_724,1.</sub>p1 / 177) == asType<integer>(div(heapIs)
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.p1, 177).quot)
→ [expand definition of operator './' in class 'int' at built in declaration]
[14.3] ([asType<integer>($heap_{funcstart\_724,1}.p1) < 0]:
-(-asType < integer > (\$heap_{funcstart\_724,1}.p1) / 177), []:
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p1})~/~177) ==
asType<integer>(div(heapIs $heap_{tuncstart\_724.1}, $heap_{tuncstart\_724.1}.p1,
177).quot)
→ [explicitly assert falsehood of skipped guards in subsequent guards]
[14.4] \; ([\mathbf{asType} < \mathbf{integer} > (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p1}) < 0] :
-(-asType < integer > (\$heap_{funcstart\_724,1}.p1) / 177),
[!(asType < integer > (\$heap_{funcstart\_724,1}.p1) < 0)]:
asType < integer > (\$heap_{funcstart\_724,1}.p1) / 177) ==
\mathbf{asType} {<} \mathbf{integer} {>} ( \mathrm{div}(\mathbf{heapIs} \ \$ \mathrm{heap}_{funcstart\_724,1}, \ \$ \mathrm{heap}_{funcstart\_724,1}.\mathrm{p1}, \\
177).quot)
\rightarrow [simplify]
[14.7] ([0 < -\$heap_{funcstart\_724,1}.p1]:
-(-asType < integer > (\$heap_{funcstart\_724,1}.p1) / 177),
[!(asType < integer > (\$heap_{funcstart\_724,1}.p1) < 0)]:
asType < integer > (\$heap_{funcstart\_724,1}.p1) / 177) ==
asType<integer>(div(heapIs heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p1,
177).quot)
\rightarrow [from term 8.0, literala < -$heap<sub>funcstart_724,1.</sub>p1 is false whenever -2 < (0
+ literala)]
    Proof of rule precondition:
    [14.7.0] - 2 < (0 + 0)
    \rightarrow [simplify]
    [14.7.2] true
[14.8] ([false]: -(-asType < integer > (\$heap_{funcstart\_724,1}.p1) / 177),
[!(asType<integer>(\text{$heap}_{funcstart\_724,1}.p1) < 0)]:
asType < integer > (\$heap_{funcstart\_724.1}.p1) / 177) = =
\mathbf{asType} < \mathbf{integer} > (\mathbf{div}(\mathbf{heapIs} \ \$ \mathbf{heap}_{funcstart\_724,1}, \ \$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p1}, \\
177).quot)
```

```
\rightarrow [simplify]
[14.11] ([false]: -(-asType < integer > (\$heap_{funcstart\_724,1}.p1) / 177), [!(0 < integer) < integer)
-$heap_{funcstart\_724,1}.p1)]: asType<integer>($heap_{funcstart\_724,1}.p1) / 177)
== asType < integer > (div(heapIs $heap_{funcstart\_724,1},
heap_{funcstart\_724,1}.p1, 177).quot
\rightarrow [from term 8.0, literala < -$heap<sub>funcstart_724,1.</sub>p1 is false whenever -2 < (0
+ literala)]
         Proof of rule precondition:
         [14.11.0] - 2 < (0 + 0)
         \rightarrow [simplify]
         [14.11.2] true
[14.12] ([false]: -(-asType < integer > (\$heap_{funcstart\_724,1}.p1) / 177),
[!false]: asType<integer>(\protect\operatorname{sheap}_{funcstart\_724,1}.p1) / 177) ==
\mathbf{asType} < \mathbf{integer} > (\mathbf{div}(\mathbf{heapIs} \ \$ \mathbf{heap}_{funcstart\_724,1}, \ \$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p1}, \\
177).quot)
\rightarrow [simplify]
[14.17] 0 == (-\text{div}(\mathbf{heapIs} \$ \text{heap}_{funcstart\_724,1}, \$ \text{heap}_{funcstart\_724,1}.\text{p1},
177).quot + (\text{$heap}_{funcstart\_724,1}.p1 / 177))
[Assume known post-assertion, class invariant or type constraint for term
14.17
[20.0] minof(int) \leq div(heapIs \theta_{funcstart_{-724,1}}, \theta_{funcstart_{-72
177).quot
\rightarrow [simplify]
\label{eq:condition} \textit{[20.3] -32769} < \text{div}(\textbf{heapIs} \ \$ \text{heap}_{funcstart\_724,1}, \ \$ \text{heap}_{funcstart\_724,1}.\text{p1},
177).quot
[Take goal term]
[1.0] minof(int) \leq asType<short int>(div1.quot)
\rightarrow [simplify]
[1.1] -32768 \leq asType<short int>(div1.quot)
\rightarrow [from term 11.6, div1 is equal to div(heapIs $heap_{funcstart\_724,1},
heap_{funcstart_{-724,1}.p1, 177}
[1.2] -32768 \leq asType<short int>(div(heapIs $heap_{tuncstart\_724,1},)
heap_{funcstart_{-724,1}}.p1, 177).quot
\rightarrow [simplify]
[1.5] \ -32769 < {\rm div}(\mathbf{heapIs} \ \$ \mathrm{heap}_{funcstart\_724,1}, \ \$ \mathrm{heap}_{funcstart\_724,1}.\mathrm{p1},
177).quot
```

```
\rightarrow [from term 20.3, literala < div(heapIs $heap_{funcstart_724,1},
heap_{funcstart\_724,1}.p1, 177).quot is true whenever (-1 + literala) < -32769
   Proof of rule precondition:
   [1.5.0](-32769 + -1) < -32769
   \rightarrow [simplify]
   [1.5.2] true
[1.6] true
Proof of verification condition: Type constraint satisfied in implicit
conversion from 'short int' to 'int'
Condition generated at: C:\Escher\Customers\prang\prang.c (56,40)
Condition defined at:
To prove: asType<short int>(div1.quot) \leq maxof(int)
Given:
heap_{init}.LIMIT == (int)80
heap_{init}.M1 == asType < short int > ((int)30269)
\theta
heap_{init}.a1 == asType < short int > ((int)177)
\theta
heap_{init}.M2 == asType < short int > ((int)30307)
heap_{init}.r2 == asType < short int > ((int)172)
heap_{init}.a2 == asType < short int > ((int)176)
\theta = asType < short int > ((int)35)
\theta = asType < short int > ((int)30323)
heap_{init}.r3 == asType < short int > ((int)170)
heap_{init}.a3 == asType < short int > ((int)178)
\theta = asType < short int > ((int)63)
\theta = asType < short int > ((int)1)
\theta
\theta = asType < short int > ((int)3)
invariant1(heapIs heap_{funcstart_{724,1}})
\operatorname{div1} == \operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724,1},
asType < int > (\$heap_{funcstart\_724.1}.p1),
asType < int > (\$heap_{funcstart\_724,1}.a1))
```

```
(\mathbf{asType}{<}\mathbf{int}{>}(\mathbf{asType}{<}\mathbf{int}{>}(\mathbf{\$}\mathbf{heap}_{funcstart\_724,1}.\mathbf{p1})) \ / \\
\mathbf{asType} < \mathbf{integer} > (\mathbf{asType} < \mathbf{int} > (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{a1}))) = =
asType < integer > (div1.quot)
(asType<integer>(asType<int>($heap_{tuncstart\_724.1}.p1)) %
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a1))) = =
asType<integer>(div1.rem)
!(0 == asType < integer > (div1.rem)) || !(0 ==
asType<integer>(div1.quot))
div2 == div(\mathbf{heapIs} \$ heap_{funcstart\_724,1},
asType < int > (\$heap_{funcstart\_724,1}.p2),
asType < int > (\$heap_{funcstart_{-724,1}}.a2))
(asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.p2)) /
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a2))) = =
asType<integer>(div2.quot)
(asType<int>(sheap<sub>funcstart_724,1.</sub>p2)) %
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a2))) = =
asType<integer>(div2.rem)
!(0 == asType < integer > (div2.rem)) || !(0 ==
asType<integer>(div2.quot))
div3 == div(\mathbf{heapIs} \$ heap_{funcstart\_724,1},
asType < int > (\$heap_{funcstart\_724,1}.p3),
asType < int > (\$heap_{funcstart\_724.1}.a3))
(asType<int>(asType<int>($heap_{tuncstart}, 724.1.p3)) /
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a3))) = =
asType<integer>(div3.quot)
(asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.p3)) \%
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a3))) = =
asType<integer>(div3.rem)
!(0 == asType < integer > (div3.rem)) || !(0 ==
asType<integer>(div3.quot))
Proof:
[Take given term]
[5.0] invariant
1(heapIs \rho_{funcstart\_724,1}
\rightarrow [expand definition of function 'invariant1' at prang.c (34,1)]
 \texttt{[5.1]} \; (((((0 < \mathbf{asType} < \mathbf{integer} > (\$ heap_{funcstart\_724,1}.p1)) \; \&\& \\
(asType < integer > ($heap_{funcstart\_724,1}.p1) < 
asType < integer > (\$heap_{funcstart\_724,1}.M1))) \&\& (0 <
asType < integer > (\$heap_{funcstart\_724,1}.p2))) \&\&
(\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p2}) <
```

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asType < integer > (\$heap_{funcstart\_724,1}.M2))) \&\& (0 <
asType < integer > (\$heap_{funcstart\_724,1}.p3))) \&\&
(\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{p3}) <
asType < integer > (\$heap_{funcstart\_724,1}.M3))
\rightarrow [simplify]
[5.3] (((((0 < $heap_{funcstart_{724,1}}.p1) && ($heap_{funcstart_{724,1}}.p1 < 
asType < integer > (\$heap_{funcstart\_724,1}.M1))) \&\& (0 <
asType < integer > (\$heap_{funcstart\_724,1}.p2))) \&\&
(\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{p2}) <
asType < integer > (\$heap_{funcstart\_724,1}.M2))) \&\& (0 <
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{p3})))\ \&\&
(asType<integer>($heap_{tuncstart\_724,1}.p3) <
asType < integer > (\$heap_{funcstart\_724,1}.M3))
\rightarrow [const static or extern object]
[5.4] \ (((((0 < \$heap_{funcstart\_724,1}.p1) \&\& \ (\$heap_{funcstart\_724,1}.p1 < 
asType<integer>($heap<sub>init</sub>.M1))) && (0 <
asType < integer > (\$heap_{funcstart\_724,1}.p2))) \&\&
(\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{p2}) <
asType < integer > (\$heap_{funcstart\_724,1}.M2))) \&\& (0 <
asType < integer > (\$heap_{funcstart\_724,1}.p3))) \&\&
(\mathbf{asType} < \mathbf{integer} > (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p3}) <
\mathbf{asType} < \mathbf{integer} > (\$ \mathrm{heap}_{funcstart\_724,1}.\mathrm{M3}))
\rightarrow [expand definition of constant 'M1' at prang.c (14,20)]
[5.5] (((((0 < $heap_{funcstart_724,1}.p1) && ($heap_{funcstart_724,1}.p1 < 
asType<integer>(asType<short int>((int)30269)))) && (0 <
\mathbf{asType} {<} \mathbf{integer} {>} (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p2}))) \ \&\& \\
(asType < integer > (\$heap_{funcstart\_724,1}.p2) <
as
Type<integer>(\rho_{funcstart\_724,1}.M2))) & (0 <
asType < integer > (\$heap_{funcstart\_724,1}.p3))) \&\&
(\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{p3}) <
asType < integer > (\$heap_{funcstart\_724,1}.M3))
\rightarrow [simplify]
[5.16] \; ((((-30269 < -\$heap_{funcstart\_724,1}.p1) \; \land \; (0 < \$heap_{funcstart\_724,1}.p1) \; \land 
(0 < \text{$heap}_{funcstart_{724,1}.p2})) \&\& (\text{$heap}_{funcstart_{724,1}.p2} <
asType<integer>(heap_{funcstart\_724,1}.M2))) && (0 <
\mathbf{asType} {<} \mathbf{integer} {>} (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p3}))) \ \&\& \\
(\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{p3}) <
asType < integer > (\$heap_{funcstart\_724,1}.M3))
\rightarrow [const static or extern object]
\label{eq:final_start_724,1.p1} [(((-30269 < -\$heap_{funcstart\_724,1}.p1) \land (0 < \$heap_{funcstart\_724,1}.p1) \land (0 < \$he
(0 < \text{\$heap}_{funcstart\_724,1}.p2)) \&\& (\text{\$heap}_{funcstart\_724,1}.p2 <
```

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asType < integer > (\$heap_{init}.M2))) \&\& (0 <
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{p3})))\ \&\&
(\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{p3}) <
asType < integer > (\$heap_{funcstart\_724,1}.M3))
\rightarrow [expand definition of constant 'M2' at prang.c (19,20)]
[5.18] \left( \left( \left( \left( -30269 < -\$ \text{heap}_{funcstart\_724,1}.\text{p1} \right) \right. \wedge \left. \left( 0 < \$ \text{heap}_{funcstart\_724,1}.\text{p1} \right) \right. \wedge \right. \right)
(0 < \text{\$heap}_{funcstart\_724,1}.p2)) \&\& (\text{\$heap}_{funcstart\_724,1}.p2 <
asType < integer > (asType < short int > ((int)30307)))) && (0 < footnote{integer}) && (0 < footnote
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{p3})))\ \&\&
(asType < integer > (\$heap_{funcstart\_724,1}.p3) < 
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{M3}))
\rightarrow [simplify]
[5.30] ((-30307 < -\$heap_{funcstart\_724,1}.p2) \land (-30269 <
-\$heap_{funcstart\_724,1}.p1) \land (0 < \$heap_{funcstart\_724,1}.p1) \land (0 < \$heap_{funcstart\_724,1}.p1)
\text{Sheap}_{funcstart_{724,1}.p2} \land (0 < \text{Sheap}_{funcstart_{724,1}.p3})) \&\&
(\text{\$heap}_{funcstart\_724,1}.\text{p3} < \text{asType} < \text{integer} > (\text{\$heap}_{funcstart\_724,1}.\text{M3}))
\rightarrow [const static or extern object]
[5.31] ((-30307 < -$heap<sub>funcstart_724,1.</sub>p2) \land (-30269 <
-\$heap_{funcstart\_724,1}.p1) \land (0 < \$heap_{funcstart\_724,1}.p1) \land (0 < \$heap_{funcstart\_724,1}.p1)
\text{Sheap}_{funcstart_{724,1}.p2} \land (0 < \text{Sheap}_{funcstart_{724,1}.p3})) \&\&
(\text{\$heap}_{funcstart\_724,1}.p3 < asType < integer > (\text{\$heap}_{init}.M3))
\rightarrow [expand definition of constant 'M3' at prang.c (24,20)]
[5.32] ((-30307 < -$heap<sub>funcstart_724,1.</sub>p2) \land (-30269 <
-\$heap_{funcstart\_724,1}.p1) \land (0 < \$heap_{funcstart\_724,1}.p1) \land (0 < \$heap_{funcstart\_724,1}.p1)
\text{Sheap}_{funcstart_{724,1}.p2} \land (0 < \text{Sheap}_{funcstart_{724,1}.p3})) \&\&
(\text{sheap}_{funcstart\_724,1}.p3 < asType < integer > (asType < short)
int > ((int)30323)))
\rightarrow [simplify]
[5.40] (-30323 < -\$heap_{funcstart\_724,1}.p3) \land (-30307 <
-\$heap_{funcstart\_724,1}.p2) \land (-30269 < -\$heap_{funcstart\_724,1}.p1) \land (0 < -\$heap_{funcstart\_724,1}.p1)
\text{Sheap}_{funcstart\_724,1}.\text{p1}) \land (0 < \text{Sheap}_{funcstart\_724,1}.\text{p2}) \land (0 <
heap_{funcstart_{-724,1}.p3}
[Work on sub-term 4 of conjunction in term 5.40]
[8.0] 0 < $\text{heap}_{funcstart_724,1.p1}$
[Take given term]
[11.0] \operatorname{div1} == \operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724,1},
asType < int > (\$heap_{funcstart\_724,1}.p1),
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{a1}))
\rightarrow [simplify]
```

```
\textit{[11.1]} \ \text{div1} == \text{div}(\mathbf{heapIs} \ \$ \text{heap}_{funcstart\_724,1}, \ \$ \text{heap}_{funcstart\_724,1}.\text{p1},
asType < int > (\$heap_{funcstart\_724,1}.a1))
\rightarrow [const static or extern object]
\textit{[11.2]} \ \text{div1} == \text{div}(\mathbf{heapIs} \ \$ \text{heap}_{funcstart\_724,1}, \ \$ \text{heap}_{funcstart\_724,1}.\text{p1},
asType < int > (\$heap_{init}.a1))
\rightarrow [expand definition of constant 'a1' at prang.c (16,20)]
[11.3] div1 == div(heapIs \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}.p1,
asType<int>(asType<short int>((int)177)))
\rightarrow [simplify]
[11.6] div1 == div(heapIs heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p1, 177)
[Assume known post-assertion, class invariant or type constraint for term 11.6]
 [14.0] \; (\mathbf{asType} {<} \mathbf{integer} {>} (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p1}) \; / \\
asType < integer > (177)) == asType < integer > (div(heapIs))
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.p1, 177).quot)
\rightarrow [simplify]
[14.2] ($heap<sub>funcstart_724,1.</sub>p1 / 177) == asType<integer>(div(heapIs)
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.p1, 177).quot
→ [expand definition of operator './' in class 'int' at built in declaration]
[14.3] ([asType<integer>($heap<sub>funcstart_724,1.</sub>p1) < 0]:
-(-asType < integer > (\$heap_{funcstart\_724,1}.p1) / 177), []:
asType < integer > (\$heap_{funcstart\_724,1}.p1) / 177) ==
\mathbf{asType} \small{<} \mathbf{integer} \small{>} ( \mathrm{div}(\mathbf{heapIs} \ \$ \mathrm{heap}_{funcstart\_724,1}, \ \$ \mathrm{heap}_{funcstart\_724,1}.\mathrm{p1}, \\
177).quot)
→ [explicitly assert falsehood of skipped guards in subsequent guards]
[14.4] \; ([\mathbf{asType} < \mathbf{integer} > (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p1}) < 0] :
-(-asType < integer > (\$heap_{funcstart\_724,1}.p1) / 177),
[!(asType < integer > (\$heap_{funcstart\_724,1}.p1) < 0)]:
\mathbf{asType} < \mathbf{integer} > (\$ \mathrm{heap}_{funcstart\_724,1}.\mathrm{p1}) \ / \ 177) = =
\mathbf{asType} \small{<} \mathbf{integer} \small{>} ( \mathrm{div}(\mathbf{heapIs} \ \$ \mathrm{heap}_{funcstart\_724,1}, \ \$ \mathrm{heap}_{funcstart\_724,1}.\mathrm{p1}, \\
177).quot)
\rightarrow [simplify]
[14.7] ([0 < -$heap<sub>funcstart_724,1.</sub>p1]:
-(-asType < integer > (\$heap_{funcstart\_724,1}.p1) / 177),
[!(asType < integer > (\$heap_{funcstart\_724,1}.p1) < 0)]:
asType < integer > (\$heap_{funcstart\_724,1}.p1) / 177) ==
\mathbf{asType} < \mathbf{integer} > (\mathbf{div}(\mathbf{heapIs} \ \$ \mathbf{heap}_{funcstart\_724,1}, \ \$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p1}, \\
177).quot)
\rightarrow [from term 8.0, literala < -$heap<sub>funcstart-724.1</sub>.p1 is false whenever -2 < (0
```

```
+ literala)]
         Proof of rule precondition:
         [14.7.0] - 2 < (0 + 0)
         \rightarrow [simplify]
         [14.7.2] true
[14.8] ([false]: -(-asType < integer > (\$heap_{funcstart\_724,1}.p1) / 177),
[!(\mathbf{asType} < \mathbf{integer} > (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p1}) < 0)]:
asType < integer > (\$heap_{funcstart\_724,1}.p1) / 177) ==
\mathbf{asType} < \mathbf{integer} > (\mathbf{div}(\mathbf{heapIs} \ \$ \mathbf{heap}_{funcstart\_724,1}, \ \$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p1}, \\
177).quot)
\rightarrow [simplify]
[14.11] \; ([{\bf false}]: \; -({\bf -asType}{<} {\bf integer}{>} (\$ {\rm heap}_{funcstart\_724,1}.{\rm p1}) \; / \; 177), \; [!(0 < {\rm parter})] \; ([{\bf false}]: \; -({\bf -asType}{<} {\bf integer}{>} (\$ {\rm heap}_{funcstart\_724,1}.{\rm p1}) \; / \; 177), \; [!(0 < {\bf -asType}{<} {\bf integer}{>} (\$ {\bf -asType}{<} {\bf
-\$heap_{funcstart\_724,1}.p1)]: asType < integer > (\$heap_{funcstart\_724,1}.p1) / 177)
== asType<integer>(div(heapIs $heap_{tuncstart_724,1},
\text{$heap}_{funcstart\_724,1}.p1, 177).quot)
\rightarrow [from term 8.0, literala < -$heap_{uncstart\_724,1}.p1 is false whenever -2 < (0
+ literala)]
         Proof of rule precondition:
         [14.11.0] - 2 < (0 + 0)
         \rightarrow [simplify]
         [14.11.2] true
[14.12] \; ([\mathbf{false}]: \; -(-\mathbf{asType} < \mathbf{integer} > (\$ \mathrm{heap}_{funcstart\_724,1}.\mathrm{p1}) \; / \; 177),
[!false]: asType<integer>($heap<sub>funcstart_724.1</sub>.p1) / 177) ==
asType < integer > (div(heapIs \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1,
177).quot)
\rightarrow [simplify]
[14.17] \ 0 == (-\text{div}(\mathbf{heapIs} \ \$ \text{heap}_{funcstart\_724,1}, \ \$ \text{heap}_{funcstart\_724,1}.\text{p1},
177).quot + (\text{$heap}_{funcstart\_724,1}.p1 / 177))
[Assume known post-assertion, class invariant or type constraint for term
[21.0] div(heapIs heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p1, 177).quot \leq
maxof(int)
\rightarrow [simplify]
[21.9] \ -32768 < -{\rm div}(\mathbf{heapIs} \ \$ \mathrm{heap}_{funcstart\_724,1}, \ \$ \mathrm{heap}_{funcstart\_724,1}.\mathrm{p1},
177).quot
[Take goal term]
[1.0] asType<short int>(div1.quot) \le maxof(int)
```

```
\rightarrow [from term 11.6, div1 is equal to div(heapIs $heap_{funcstart\_724,1},
heap_{funcstart_{-724,1}}.p1, 177)
[1.1] asType<short int>(div(heapIs heap_{funcstart\_724,1},
\text{$heap}_{funcstart\_724,1}.p1, 177).quot) \leq \maxof(int)
\rightarrow [simplify]
[1.11] -32768 < -\text{div}(\mathbf{heapIs} \$ \text{heap}_{funcstart\_724,1}, \$ \text{heap}_{funcstart\_724,1}.\text{p1},
177).quot
\rightarrow [from term 21.9, literala < -\text{div}(\text{heapIs }\$\text{heap}_{funcstart\_724,1},
$heap_{funcstart\_724,1}.p1, 177).quot is true whenever (-1 + literala) < -32768]
   Proof of rule precondition:
   [1.11.0](-32768 + -1) < -32768
   \rightarrow [simplify]
   [1.11.2] true
[1.12] true
Proof of verification condition: Type constraint satisfied in implicit
conversion from 'short int const' to 'int'
Condition generated at: C:\Escher\Customers\prang\prang.c (56,35)
Condition defined at:
To prove: minof(int) \leq \$heap_{funcstart_{-724,1}}.b1
Given:
heap_{init}.LIMIT == (int)80
\theta sheap<sub>init</sub>.M1 == asType<short int>((int)30269)
\theta_{init}.r1 == asType < short int > ((int)171)
\theta
\theta
\theta_{init}.M2 == asType < short int > ((int)30307)
\rho_{init}.r2 == asType < short int > ((int)172)
heap_{init}.a2 == asType < short int > ((int)176)
\theta = asType < short int > ((int)35)
\theta = asType < short int > ((int)30323)
\theta
heap_{init}.a3 == asType < short int > ((int)178)
\theta = asType < short int > ((int)63)
```

```
\theta
\theta
\theta = asType < short int > ((int)3)
invariant1(heapIs heap_{funcstart\_724,1})
div1 == div(\mathbf{heapIs} \$heap_{funcstart\_724,1},
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p1}),
asType < int > (\$heap_{funcstart\_724,1}.a1))
(\mathbf{asType}{<}\mathbf{integer}{>}(\mathbf{asType}{<}\mathbf{int}{>}(\$\mathbf{heap}_{funcstart\_724,1}.\mathbf{p1})) \ / \\
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a1))) = =
asType<integer>(div1.quot)
(\mathbf{asType} < \mathbf{integer} > (\mathbf{asType} < \mathbf{int} > (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p1})) \ \%
\mathbf{asType}{<}\mathbf{integer}{>}(\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{a1}))) ==
asType<integer>(div1.rem)
!(0 == asType < integer > (div1.rem)) || !(0 ==
asType<integer>(div1.quot))
div2 == div(\mathbf{heapIs} \$heap_{funcstart\_724,1},
asType < int > (\$heap_{funcstart\_724,1}.p2),
asType < int > (\$heap_{funcstart\_724,1}.a2))
(asType<integer>(asType<int>($heap_{tuncstart\_724,1}.p2)) /
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a2))) = =
asType<integer>(div2.quot)
(\mathbf{asType} < \mathbf{integer} > (\mathbf{asType} < \mathbf{int} > (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p2})) \%
\mathbf{asType}{<}\mathbf{integer}{>}(\mathbf{asType}{<}\mathbf{int}{>}(\$\mathbf{heap}_{funcstart\_724,1}.\mathbf{a2}))) = =
asType<integer>(div2.rem)
!(0 == asType < integer > (div2.rem)) || !(0 ==
asType<integer>(div2.quot))
div3 == div(\mathbf{heapIs} \$heap_{funcstart\_724,1},
asType < int > (\$heap_{funcstart\_724,1}.p3),
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{a3}))
(asType < int > (sheap_{funcstart\_724,1}.p3)) / 
\mathbf{asType}{<}\mathbf{integer}{>}(\mathbf{asType}{<}\mathbf{int}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathtt{a3}))) ==
asType<integer>(div3.quot)
(\mathbf{asType} < \mathbf{integer} > (\mathbf{asType} < \mathbf{int} > (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p3})) \%
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a3))) = =
asType<integer>(div3.rem)
!(0 == asType < integer > (div3.rem)) || !(0 ==
asType<integer>(div3.quot))
Proof:
```

```
[Take goal term]
[1.0] minof(int) \leq $heap<sub>funcstart_724,1</sub>.b1
\rightarrow [simplify]
[1.1] -32768 \leq $heap<sub>funcstart_724,1</sub>.b1
\rightarrow [const static or extern object]
[1.2] -32768 \le \text{$heap}_{init}.b1
\rightarrow [expand definition of constant 'b1' at prang.c (17,20)]
[1.3] -32768 \leq asType<short int>((int)2)
\rightarrow [simplify]
[1.6] true
Proof of verification condition: Type constraint satisfied in implicit
conversion from 'short int const' to 'int'
Condition generated at: C:\Escher\Customers\prang\prang.c (56,35)
Condition defined at:
To prove: \text{$heap}_{funcstart\_724,1}.b1 \leq \max(\text{int})
Given:
heap_{init}.LIMIT == (int)80
\theta
heap_{init}.r1 == asType < short int > ((int)171)
\theta
\theta
\theta sheap<sub>init</sub>.M2 == asType<short int>((int)30307)
\rho_{init}.r2 == asType < short int > ((int)172)
heap_{init}.a2 == asType < short int > ((int)176)
\theta
\theta sheap<sub>init</sub>.M3 == asType<short int>((int)30323)
\theta_{init}.r3 == asType<short int>((int)170)
\theta == asType<short int>((int)178)
\theta = asType < short int > ((int)63)
\theta = asType < short int > ((int)1)
\theta
\rho = asType < short int > ((int)3)
```

```
invariant1(heapIs heap_{funcstart_{-724.1}})
\operatorname{div1} == \operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1},
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p1}),
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{a1}))
(asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.p1)) /
\mathbf{asType}{<}\mathbf{integer}{>}(\mathbf{asType}{<}\mathbf{int}{>}(\$\mathbf{heap}_{funcstart\_724,1}.\mathbf{a1}))) = =
asType<integer>(div1.quot)
(asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.p1)) \%
\mathbf{asType}{<}\mathbf{integer}{>}(\mathbf{asType}{<}\mathbf{int}{>}(\$\mathbf{heap}_{funcstart\_724,1}.\mathbf{a1}))) = =
asType<integer>(div1.rem)
!(0 == asType < integer > (div1.rem)) || !(0 ==
asType<integer>(div1.quot))
div2 == div(\mathbf{heapIs} \$heap_{funcstart\_724,1},
asType < int > (\$heap_{funcstart\_724,1}.p2),
asType < int > (\$heap_{funcstart\_724,1}.a2))
(asType < int > (sheap_{funcstart\_724,1}.p2)) /
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a2))) = =
asType<integer>(div2.quot)
(\mathbf{asType}{<}\mathbf{int}{>}(\mathbf{asType}{<}\mathbf{int}{>}(\$\mathbf{heap}_{funcstart\_724,1}.\mathbf{p2}))~\%
\mathbf{asType} < \mathbf{integer} > (\mathbf{asType} < \mathbf{int} > (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{a2}))) = =
asType<integer>(div2.rem)
!(0 == asType < integer > (div2.rem)) || !(0 ==
asType<integer>(div2.quot))
div3 == div(\mathbf{heapIs} \$ heap_{funcstart\_724,1},
asType < int > ($heap_{funcstart\_724,1}.p3),
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{a3}))
(\mathbf{asType} {<} \mathbf{integer} {>} (\mathbf{asType} {<} \mathbf{int} {>} (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p3})) \ / \\
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a3))) = =
asType<integer>(div3.quot)
(\mathbf{asType} {<} \mathbf{integer} {>} (\mathbf{asType} {<} \mathbf{int} {>} (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p3})) \ \%
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a3))) = =
asType<integer>(div3.rem)
!(0 == asType < integer > (div3.rem)) || !(0 ==
asType<integer>(div3.quot))
Proof:
[Take goal term]
[1.0] $heap<sub>funcstart_724,1</sub>.b1 \leq maxof(int)
\rightarrow [const static or extern object]
```

```
[1.1] $heap<sub>init</sub>.b1 \leq maxof(int)
\rightarrow [expand definition of constant 'b1' at prang.c (17,20)]
[1.2] asType<short int>((int)2) \le maxof(int)
\rightarrow [simplify]
[1.6] true
Proof of verification condition: Arithmetic result of operator '*' is within
limit of type 'int'
Condition generated at: C:\Escher\Customers\prang\prang.c (56,38)
Condition defined at:
To prove: minof(int) \le (asType<int>(asType<short int>(div1.quot)) *
asType < int > (\$heap_{funcstart\_724,1}.b1))
Given:
heap_{init}.LIMIT == (int)80
\theta sheap<sub>init</sub>.M1 == asType<short int>((int)30269)
\theta_{init}.r1 == asType < short int > ((int)171)
\theta
\theta
heap_{init}.M2 == asType < short int > ((int)30307)
\theta_{init}.r2 == asType < short int > ((int)172)
heap_{init}.a2 == asType < short int > ((int)176)
\theta = asType < short int > ((int)35)
heap_{init}.M3 == asType < short int > ((int)30323)
\theta_{init}.r3 == asType<short int>((int)170)
heap_{init}.a3 == asType < short int > ((int)178)
\theta = asType < short int > ((int)63)
\theta = asType < short int > ((int)1)
\theta
\theta = asType < short int > ((int)3)
invariant1(heapIs heap_{funcstart\_724,1})
\operatorname{div1} == \operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1},
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p1}),
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{a1}))
(asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.p1)) /
```

```
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a1))) = =
asType<integer>(div1.quot)
(\mathbf{asType}{<}\mathbf{int}{>}(\mathbf{asType}{<}\mathbf{int}{>}(\$\mathbf{heap}_{funcstart\_724,1}.\mathbf{p1}))~\%
\mathbf{asType}{<}\mathbf{integer}{>}(\mathbf{asType}{<}\mathbf{int}{>}(\$\mathbf{heap}_{funcstart\_724,1}.\mathbf{a1}))) = =
asType<integer>(div1.rem)
!(0 == asType < integer > (div1.rem)) || !(0 ==
asType<integer>(div1.quot))
div2 == div(\mathbf{heapIs} \$heap_{funcstart\_724,1},
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p2}),
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{a2}))
(asType<integer>(asType<int>($heap_{tuncstart\_724.1}.p2)) /
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a2))) = =
asType<integer>(div2.quot)
(asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.p2)) \%
\mathbf{asType} < \mathbf{integer} > (\mathbf{asType} < \mathbf{int} > (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{a2}))) = =
asType<integer>(div2.rem)
!(0 == asType < integer > (div2.rem)) || !(0 ==
asType<integer>(div2.quot))
div3 == div(\mathbf{heapIs} \$heap_{funcstart\_724,1},
\mathbf{asType} < \mathbf{int} > (\$ \mathrm{heap}_{funcstart\_724,1}.\mathrm{p3}),
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{a3}))
(asType<integer>(asType<int>($heap_{tuncstart\_724.1}.p3)) /
asType < integer > (asType < int > (\$heap_{funcstart, 724,1}, a3))) = =
asType<integer>(div3.quot)
(\mathbf{asType}{<}\mathbf{integer}{>}(\mathbf{asType}{<}\mathbf{int}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{p3}))\ \%
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a3))) = =
asType<integer>(div3.rem)
!(0 == asType < integer > (div3.rem)) || !(0 ==
asType<integer>(div3.quot))
Proof:
[Take given term]
[5.0] invariant1(heapIs heap_{funcstart\_724,1})
\rightarrow [expand definition of function 'invariant1' at prang.c (34,1)]
 \texttt{[5.1]} \; (((((0 < \mathbf{asType} < \mathbf{integer} > (\$ heap_{funcstart\_724,1}.p1)) \; \&\& \\
(asType < integer > (\$heap_{funcstart\_724,1}.p1) < 
asType < integer > (\$heap_{funcstart\_724,1}.M1))) \&\& (0 <
asType < integer > (\$heap_{funcstart\_724,1}.p2))) \&\&
(\mathbf{asType} {<} \mathbf{integer} {>} (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p2}) <
asType < integer > (\$heap_{funcstart\_724,1}.M2))) \&\& (0 <
```

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asType < integer > (\$heap_{funcstart\_724,1}.p3))) \&\&
(\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{p3}) <
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{M3}))
\rightarrow [simplify]
[5.3] \ (((((0 < \text{\$heap}_{funcstart\_724,1}.\text{p1}) \&\& \ (\text{\$heap}_{funcstart\_724,1}.\text{p1} <
asType < integer > (\$heap_{funcstart\_724,1}.M1))) \&\& (0 <
asType < integer > (\$heap_{funcstart\_724,1}.p2))) \&\&
(asType < integer > (\$heap_{funcstart\_724,1}.p2) < 
asType < integer > (\$heap_{funcstart\_724,1}.M2))) \&\& (0 <
asType < integer > (\$heap_{funcstart\_724,1}.p3))) \&\&
(\mathbf{asType} < \mathbf{integer} > (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p3}) <
asType < integer > (\$heap_{funcstart\_724,1}.M3))
\rightarrow [const static or extern object]
[5.4] (((((0 < \text{heap}_{funcstart\_724,1}.p1) && (\text{heap}_{funcstart\_724,1}.p1 <
asType < integer > (\$heap_{init}.M1))) \&\& (0 <
asType < integer > (\$heap_{funcstart\_724,1}.p2))) \&\&
(asType < integer > (\$heap_{funcstart\_724,1}.p2) < 
asType < integer > (\$heap_{funcstart\_724,1}.M2))) \&\& (0 <
asType < integer > (\$heap_{funcstart_{-724,1}}.p3))) \&\&
(\mathbf{asType} < \mathbf{integer} > (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p3}) <
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{M3}))
\rightarrow [expand definition of constant 'M1' at prang.c (14,20)]
[5.5] (((((0 < $heap_{funcstart_724,1}.p1) && ($heap_{funcstart_724,1}.p1 < 
asType<integer>(asType<short int>((int)30269)))) && (0 <
asType < integer > (\$heap_{funcstart\_724,1}.p2))) \&\&
(\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{p2}) <
asType<integer>(heap_{funcstart\_724,1}.M2))) && (0 <
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{p3})))\ \&\&
(asType<integer>($heap_funcstart_724,1.p3) <
\mathbf{asType} < \mathbf{integer} > (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{M3}))
\rightarrow [simplify]
[5.16] \; ((((-30269 < -\$heap_{funcstart\_724,1}.p1) \; \land \; (0 < \$heap_{funcstart\_724,1}.p1) \; \land 
(0 < \text{\$heap}_{funcstart\_724,1}.p2)) \&\& (\text{\$heap}_{funcstart\_724,1}.p2 <
asType < integer > (\$heap_{funcstart\_724,1}.M2))) \&\& (0 <
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p3})))\ \&\&
(asType < integer > (\$heap_{funcstart\_724,1}.p3) < 
\mathbf{asType} < \mathbf{integer} > (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{M3}))
\rightarrow [const static or extern object]
[5.17] \left( \left( \left( \left( -30269 < -\$ \text{heap}_{funcstart\_724,1}.\text{p1} \right) \right. \wedge \left. \left( 0 < \$ \text{heap}_{funcstart\_724,1}.\text{p1} \right) \right. \wedge \right. \right)
(0 < \text{\$heap}_{funcstart\_724,1}.p2)) \&\& (\text{\$heap}_{funcstart\_724,1}.p2 <
asType < integer > (\$heap_{init}.M2))) \&\& (0 <
```

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\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p3})))\ \&\&
(\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{p3}) <
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{M3}))
\rightarrow [expand definition of constant 'M2' at prang.c (19,20)]
[5.18] ((((-30269 < -\$heap_{funcstart\_724,1}.p1) \land (0 < \$heap_{funcstart\_724,1}.p1) 
(0 < \text{$heap}_{funcstart\_724.1}.p2)) \&\& (\text{$heap}_{funcstart\_724.1}.p2 <
asType<integer>(asType<short int>((int)30307)))) && (0 <
asType < integer > (\$heap_{funcstart\_724,1}.p3))) \&\&
(\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{p3}) <
asType < integer > (\$heap_{funcstart\_724,1}.M3))
\rightarrow [simplify]
[5.30] ((-30307 < -$heap<sub>funcstart_724,1.</sub>p2) \wedge (-30269 <
-\$heap_{funcstart\_724,1}.p1) \land (0 < \$heap_{funcstart\_724,1}.p1) \land (0 < \$heap_{funcstart\_724,1}.p1)
\text{Sheap}_{funcstart\_724,1}.p2) \land (0 < \text{Sheap}_{funcstart\_724,1}.p3)) \&\&
(\text{\$heap}_{funcstart\_724,1}.\text{p3} < \text{asType} < \text{integer} > (\text{\$heap}_{funcstart\_724,1}.\text{M3}))
\rightarrow [const static or extern object]
[5.31] ((-30307 < -$heap<sub>funcstart_724,1</sub>.p2) \wedge (-30269 <
-\$heap_{funcstart\_724,1}.p1) \land (0 < \$heap_{funcstart\_724,1}.p1) \land (0 < \$heap_{funcstart\_724,1}.p1)
\text{Sheap}_{funcstart\_724,1}.p2) \land (0 < \text{Sheap}_{funcstart\_724,1}.p3)) \&\&
(\text{\$heap}_{funcstart\_724,1}.p3 < asType < integer > (\text{\$heap}_{init}.M3))
\rightarrow [expand definition of constant 'M3' at prang.c (24,20)]
[5.32] ((-30307 < -$heap_{tuncstart_724.1}.p2) \land (-30269 <
-\$ heap_{funcstart\_724,1}.p1) \land (0 < \$ heap_{funcstart\_724,1}.p1) \land (0 < \$ heap_{funcstart\_724,1}.p1) \land (0 < \$ heap_{funcstart\_724,1}.p1)
\text{Sheap}_{funcstart_{724,1}.p2} \land (0 < \text{Sheap}_{funcstart_{724,1}.p3})) \&\&
(\text{sheap}_{funcstart\_724,1}.\text{p3} < \text{asType} < \text{integer} > (\text{asType} < \text{short})
int > ((int)30323)))
\rightarrow [simplify]
[5.40] \; (-30323 < -\$ heap_{funcstart\_724,1}.p3) \; \wedge \; (-30307 < -30307) \; \wedge \; (-30307 < -30307) \; \wedge \; (-30307) \; \wedge \; (-3030
 -\$heap_{funcstart\_724,1}.p2) \land (-30269 < -\$heap_{funcstart\_724,1}.p1) \land (0 < -\$heap_{funcstart\_724,1}.p1)
\text{Sheap}_{funcstart\_724,1}.\text{p1}) \land (0 < \text{Sheap}_{funcstart\_724,1}.\text{p2}) \land (0 <
heap_{funcstart_{-724,1}.p3}
[Work on sub-term 4 of conjunction in term 5.40]
[8.0] 0 < $\text{heap}_{funcstart_724.1}.p1
[Take given term]
[11.0] \operatorname{div1} == \operatorname{div}(\mathbf{heapIs} \ \text{$heap}_{funcstart\_724.1},
asType < int > (\$heap_{funcstart\_724.1}.p1),
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{a1}))
\rightarrow [simplify]
[11.1] \ \mathrm{div1} == \mathrm{div}(\mathbf{heapIs} \ \$ \mathrm{heap}_{funcstart\_724,1}, \ \$ \mathrm{heap}_{funcstart\_724,1}.\mathrm{p1},
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\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{a1}))
\rightarrow [const static or extern object]
[11.2] \operatorname{div1} == \operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724,1}, \$ \operatorname{heap}_{funcstart\_724,1}.p1,
asType < int > (\$heap_{init}.a1))
\rightarrow [expand definition of constant 'a1' at prang.c (16,20)]
[11.3] \ \mathrm{div1} == \mathrm{div}(\mathbf{heapIs} \ \$ \mathrm{heap}_{funcstart\_724,1}, \ \$ \mathrm{heap}_{funcstart\_724,1}.\mathrm{p1},
asType < int > (asType < short int > ((int)177)))
\rightarrow [simplify]
[11.6] div1 == div(heapIs $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}.p1, 177)
[Take goal term]
[1.0] minof(int) \leq (asType\leqint>(asType\leqshort int>(div1.quot)) *
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{b1}))
\rightarrow [simplify]
[1.1] -32768 \leq (asType<int>(asType<short int>(div1.quot)) *
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{b1}))
\rightarrow [from term 11.6, div1 is equal to div(heapIs $heap_{funcstart\_724,1},
heap_{funcstart_{-724,1}}.p1, 177
[1.2] -32768 \leq (asType<int>(asType<short int>(div(heapIs
\text{Sheap}_{funcstart_{-724,1}}, \text{Sheap}_{funcstart_{-724,1}}.p1, 177).quot)) *
asType < int > (\$heap_{funcstart\_724,1}.b1))
\rightarrow [simplify]
 [1.4] -32768 \leq (\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.\operatorname{p1}, 
177).quot * asType < int > (\$heap_{funcstart\_724,1}.b1))
\rightarrow [const static or extern object]
[1.5] -32768 \leq (div(heapIs $heap_{tuncstart\_724.1}, $heap_{tuncstart\_724.1}.p1,
177).quot * asType<int>($heap<sub>init</sub>.b1))
\rightarrow [expand definition of constant 'b1' at prang.c (17,20)]
[1.6] -32768 \leq (div(heapIs $heap<sub>funcstart_724,1</sub>, $heap<sub>funcstart_724,1</sub>.p1,
177).quot * asType<int>(asType<short int>((int)2)))
\rightarrow [simplify]
[1.11] -32769 < (2 * div(heapIs heapIs = f_{uncstart_{-724,1}}, heap_{funcstart_{-724,1}}.p1,
177).quot)
\rightarrow [literal comparison of product]
[1.12] ([2 < 0]: (-32769 / -2) < -\text{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1}.\text{p1}, 177).\text{quot}, [0 < 2]: (-32769 / 2) < \text{div}(\text{heapIs})
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.\text{p1}, 177).\text{quot}, [0 == 2]: -32769 < 0)
```

```
→ [explicitly assert falsehood of skipped guards in subsequent guards]
[1.13] ([2 < 0]: (-32769 / -2) < -\text{div}(\mathbf{heapIs} \ \text{$heap}_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724.1.p1}, 177).\text{quot}, [(0 < 2) \land !(2 < 0)]: (-32769 / 2) < 0
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.\text{p1}, \ 177).\text{quot}, \ [(0 == 2)]
\land !(0 < 2) \land !(2 < 0)]: -32769 < 0
\rightarrow [simplify]
[1.21] -16385 < div(heapIs $heap<sub>funcstart_724,1</sub>, $heap<sub>funcstart_724,1</sub>.p1,
177).quot
→ [negate goal and search for contradiction]
[1.22] ! (-16385 < \operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724,1}, \$ \operatorname{heap}_{funcstart\_724,1}.p1,
177).quot)
\rightarrow [simplify]
[1.24] \ 16384 < -{\rm div}(\mathbf{heapIs} \ \$ \mathrm{heap}_{funcstart\_724,1}, \ \$ \mathrm{heap}_{funcstart\_724,1}.\mathrm{p1},
177).quot
[Assume known post-assertion, class invariant or type constraint for term 11.6]
[14.0] (asType<integer>($heap_{funcstart\_724,1}.p1) /
asType<integer>(177)) == asType<integer>(div(heapIs
\$ \mathrm{heap}_{funcstart\_724,1},\,\$ \mathrm{heap}_{funcstart\_724,1}.\mathrm{p1},\,177).\mathrm{quot})
\rightarrow [simplify]
[14.2] ($heap_{funcstart\_724,1}.p1 / 177) == asType < integer > (div(heapIs
heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p1, 177).quot
→ [expand definition of operator './' in class 'int' at built in declaration]
[14.3] ([asType<integer>(heap_{funcstart\_724,1}.p1) < 0]:
-(-asType < integer > (\$heap_{funcstart\_724,1}.p1) / 177), []:
asType < integer > (\$heap_{funcstart\_724,1}.p1) / 177) ==
asType<integer>(div(heapIs heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p1,
177).quot)
→ [explicitly assert falsehood of skipped guards in subsequent guards]
[14.4] ([asType<integer>($heap_{funcstart\_724,1}.p1) < 0]:
-(-asType < integer > (\$heap_{funcstart\_724,1}.p1) / 177),
[!(\mathbf{asType} < \mathbf{integer} > (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p1}) < 0)]:
asType < integer > (\$heap_{funcstart\_724,1}.p1) / 177) ==
asType<integer>(div(heapIs $heap_{tuncstart\_724.1}, $heap_{tuncstart\_724.1}.p1,
177).quot)
\rightarrow [simplify]
[14.7] ([0 < -\$heap_{funcstart\_724,1}.p1]:
-(-asType < integer > (\$heap_{funcstart\_724,1}.p1) / 177),
[!(\mathbf{asType} < \mathbf{integer} > (\$ heap_{funcstart\_724,1}.p1) < 0)]:
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asType < integer > (\$heap_{funcstart\_724,1}.p1) / 177) ==
asType<integer>(div(heapIs heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p1,
177).quot)
\rightarrow [from term 8.0, literala < -$heap<sub>funcstart_724,1.</sub>p1 is false whenever -2 < (0
+ literala)]
    Proof of rule precondition:
    [14.7.0] - 2 < (0 + 0)
    \rightarrow [simplify]
    [14.7.2] true
[14.8] ([false]: -(-asType < integer > (\$heap_{funcstart\_724,1}.p1) / 177),
[!(asType < integer > (\$heap_{funcstart\_724,1}.p1) < 0)]:
asType < integer > (\$heap_{funcstart\_724,1}.p1) / 177) ==
\mathbf{asType} < \mathbf{integer} > (\mathbf{div}(\mathbf{heapIs} \ \$ \mathbf{heap}_{funcstart\_724,1}, \ \$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p1}, \\
177).quot)
\rightarrow [simplify]
[14.11] ([false]: -(-asType < integer > (\$heap_{funcstart\_724,1}.p1) / 177), [!(0 < integer) / (\$heap_{funcstart\_724,1}.p1) / 177)
-\$heap_{funcstart\_724,1}.p1)]: \ \mathbf{asType} < \mathbf{integer} > (\$heap_{funcstart\_724,1}.p1) \ / \ 177)
== asType < integer > (div(heapIs $heap_{funcstart\_724,1},
heap_{funcstart\_724,1}.p1, 177).quot
\rightarrow [from term 8.0, literala < -$heap<sub>funcstart_724,1</sub>.p1 is false whenever -2 < (0
+ literala)
    Proof of rule precondition:
    [14.11.0] - 2 < (0 + 0)
    \rightarrow [simplify]
    [14.11.2] true
[14.12] ([\mathbf{false}]: -(-\mathbf{asType} < \mathbf{integer} > (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p1}) \ / \ 177),
[!false]: asType<integer>($heap<sub>funcstart_724,1.</sub>p1) / 177) ==
\mathbf{asType} {<} \mathbf{integer} {>} ( \mathrm{div}(\mathbf{heapIs} \ \$ \mathrm{heap}_{funcstart\_724,1}, \ \$ \mathrm{heap}_{funcstart\_724,1}.\mathrm{p1}, \\
177).quot)
\rightarrow [simplify]
[14.17] \ 0 == (-\text{div}(\mathbf{heapIs} \ \$ \text{heap}_{funcstart\_724,1}, \ \$ \text{heap}_{funcstart\_724,1}.\text{p1},
177).quot + ({\rm \$heap}_{funcstart\_724,1}.{\rm p1}\ /\ 177))
[Create new term from terms 1.24, 14.17 using rule: transitivity 15]
[55.0] (0 + 16384) < -($heap_{funcstart\_724,1}.p1 / 177)
\rightarrow [simplify]
[55.7] \ 2899968 < -\$ heap_{funcstart\_724,1}.p1
\rightarrow [from term 8.0, literala < -$heap<sub>funcstart_724,1</sub>.p1 is false whenever -2 < (0
```

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+ literala)]
   Proof of rule precondition:
   [55.7.0] - 2 < (0 + 2899968)
   \rightarrow [simplify]
   [55.7.2] true
[55.8] false
Proof of verification condition: Arithmetic result of operator '*' is within
limit of type 'int'
Condition generated at: C:\Escher\Customers\prang\prang.c (56,38)
Condition defined at:
To prove: (asType<int>(asType<short int>(div1.quot)) *
asType < int > (\$heap_{funcstart\_724,1}.b1)) \le maxof(int)
Given:
heap_{init}.LIMIT == (int)80
heap_{init}.M1 == asType < short int > ((int)30269)
\theta
heap_{init}.a1 == asType < short int > ((int)177)
\theta
heap_{init}.M2 == asType < short int > ((int)30307)
heap_{init}.r2 == asType < short int > ((int)172)
heap_{init}.a2 == asType < short int > ((int)176)
\theta = asType < short int > ((int)35)
\theta = asType < short int > ((int)30323)
heap_{init}.r3 == asType < short int > ((int)170)
heap_{init}.a3 == asType < short int > ((int)178)
\theta = asType < short int > ((int)63)
\theta = asType < short int > ((int)1)
\theta
\theta = asType < short int > ((int)3)
invariant1(heapIs heap_{funcstart_{724,1}})
\operatorname{div1} == \operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724,1},
asType < int > (\$heap_{funcstart\_724.1}.p1),
```

 $asType < int > (\$heap_{funcstart\_724,1}.a1))$ 

```
(\mathbf{asType}{<}\mathbf{int}{>}(\mathbf{asType}{<}\mathbf{int}{>}(\mathbf{\$}\mathbf{heap}_{funcstart\_724,1}.\mathbf{p1})) \ / \\
\mathbf{asType} < \mathbf{integer} > (\mathbf{asType} < \mathbf{int} > (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{a1}))) = =
asType < integer > (div1.quot)
(asType<integer>(asType<int>($heap_{tuncstart\_724.1}.p1)) %
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a1))) = =
asType<integer>(div1.rem)
!(0 == asType < integer > (div1.rem)) || !(0 ==
asType<integer>(div1.quot))
div2 == div(\mathbf{heapIs} \$ heap_{funcstart\_724,1},
asType < int > (\$heap_{funcstart\_724,1}.p2),
asType < int > (\$heap_{funcstart_{-724,1}}.a2))
(asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.p2)) /
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a2))) = =
asType<integer>(div2.quot)
(asType<int>(sheap<sub>funcstart_724,1.</sub>p2)) %
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a2))) = =
asType<integer>(div2.rem)
!(0 == asType < integer > (div2.rem)) || !(0 ==
asType<integer>(div2.quot))
div3 == div(\mathbf{heapIs} \$ heap_{funcstart\_724,1},
asType < int > (\$heap_{funcstart\_724,1}.p3),
asType < int > (\$heap_{funcstart\_724.1}.a3))
(asType<int>(asType<int>($heap_{tuncstart}, 724.1.p3)) /
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a3))) = =
asType<integer>(div3.quot)
(asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.p3)) \%
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a3))) = =
asType<integer>(div3.rem)
!(0 == asType < integer > (div3.rem)) || !(0 ==
asType<integer>(div3.quot))
Proof:
[Take given term]
[5.0] invariant
1(heapIs \rho_{funcstart\_724,1}
\rightarrow [expand definition of function 'invariant1' at prang.c (34,1)]
 \texttt{[5.1]} \; (((((0 < \mathbf{asType} < \mathbf{integer} > (\$ heap_{funcstart\_724,1}.p1)) \; \&\& \\
(asType < integer > ($heap_{funcstart\_724,1}.p1) < 
asType < integer > (\$heap_{funcstart\_724,1}.M1))) \&\& (0 <
asType < integer > (\$heap_{funcstart\_724,1}.p2))) \&\&
(\mathbf{asType} {<} \mathbf{integer} {>} (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p2}) <
```

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asType < integer > (\$heap_{funcstart\_724,1}.M2))) \&\& (0 <
asType < integer > (\$heap_{funcstart\_724,1}.p3))) \&\&
(\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{p3}) <
asType < integer > (\$heap_{funcstart\_724,1}.M3))
\rightarrow [simplify]
[5.3] (((((0 < $heap_{funcstart_{724,1}}.p1) && ($heap_{funcstart_{724,1}}.p1 < 
asType < integer > (\$heap_{funcstart\_724,1}.M1))) \&\& (0 <
asType < integer > (\$heap_{funcstart\_724,1}.p2))) \&\&
(\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{p2}) <
asType < integer > (\$heap_{funcstart\_724,1}.M2))) \&\& (0 <
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{p3})))\ \&\&
(asType<integer>($heap_{tuncstart\_724,1}.p3) <
asType < integer > (\$heap_{funcstart\_724,1}.M3))
\rightarrow [const static or extern object]
[5.4] \ (((((0 < \$heap_{funcstart\_724,1}.p1) \&\& \ (\$heap_{funcstart\_724,1}.p1 < 
asType<integer>($heap<sub>init</sub>.M1))) && (0 <
asType < integer > (\$heap_{funcstart\_724,1}.p2))) \&\&
(\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{p2}) <
asType < integer > (\$heap_{funcstart\_724,1}.M2))) \&\& (0 <
asType < integer > (\$heap_{funcstart\_724,1}.p3))) \&\&
(\mathbf{asType} < \mathbf{integer} > (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p3}) <
\mathbf{asType} < \mathbf{integer} > (\$ \mathrm{heap}_{funcstart\_724,1}.\mathrm{M3}))
\rightarrow [expand definition of constant 'M1' at prang.c (14,20)]
[5.5] (((((0 < $heap_{funcstart_724,1}.p1) && ($heap_{funcstart_724,1}.p1 < 
asType<integer>(asType<short int>((int)30269)))) && (0 <
\mathbf{asType} {<} \mathbf{integer} {>} (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p2}))) \ \&\& \\
(asType < integer > (\$heap_{funcstart\_724,1}.p2) <
as
Type<integer>(\rho_{funcstart\_724,1}.M2))) & (0 <
asType < integer > (\$heap_{funcstart\_724,1}.p3))) \&\&
(\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{p3}) <
asType < integer > (\$heap_{funcstart\_724,1}.M3))
\rightarrow [simplify]
[5.16] \; ((((-30269 < -\$heap_{funcstart\_724,1}.p1) \; \land \; (0 < \$heap_{funcstart\_724,1}.p1) \; \land 
(0 < \text{$heap}_{funcstart_{724,1}.p2})) \&\& (\text{$heap}_{funcstart_{724,1}.p2} <
asType<integer>(heap_{funcstart\_724,1}.M2))) && (0 <
\mathbf{asType} < \mathbf{integer} > (\$ heap_{funcstart\_724,1}.p3))) \&\&
(\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{p3}) <
asType < integer > (\$heap_{funcstart\_724,1}.M3))
\rightarrow [const static or extern object]
\label{eq:final_start_724,1.p1} [(((-30269 < -\$heap_{funcstart\_724,1}.p1) \land (0 < \$heap_{funcstart\_724,1}.p1) \land (0 < \$he
(0 < \text{\$heap}_{funcstart\_724,1}.p2)) \&\& (\text{\$heap}_{funcstart\_724,1}.p2 <
```

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asType < integer > (\$heap_{init}.M2))) \&\& (0 <
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{p3})))\ \&\&
(\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{p3}) <
asType < integer > (\$heap_{funcstart\_724,1}.M3))
\rightarrow [expand definition of constant 'M2' at prang.c (19,20)]
[5.18] \left( \left( \left( \left( -30269 < -\$ \text{heap}_{funcstart\_724,1}.\text{p1} \right) \right. \wedge \left. \left( 0 < \$ \text{heap}_{funcstart\_724,1}.\text{p1} \right) \right. \wedge \right. \right)
(0 < \text{\$heap}_{funcstart\_724,1}.p2)) \&\& (\text{\$heap}_{funcstart\_724,1}.p2 <
asType < integer > (asType < short int > ((int)30307)))) && (0 < footnote{integer})
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{p3})))\ \&\&
(asType < integer > (\$heap_{funcstart\_724,1}.p3) < 
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{M3}))
\rightarrow [simplify]
[5.30] ((-30307 < -\$heap_{funcstart\_724,1}.p2) \land (-30269 <
-\$heap_{funcstart\_724,1}.p1) \land (0 < \$heap_{funcstart\_724,1}.p1) \land (0 < \$heap_{funcstart\_724,1}.p1)
\text{Sheap}_{funcstart_{724,1}.p2} \land (0 < \text{Sheap}_{funcstart_{724,1}.p3})) \&\&
(\text{\$heap}_{funcstart\_724,1}.\text{p3} < \text{asType} < \text{integer} > (\text{\$heap}_{funcstart\_724,1}.\text{M3}))
\rightarrow [const static or extern object]
[5.31] ((-30307 < -$heap<sub>funcstart_724,1.</sub>p2) \land (-30269 <
-\$heap_{funcstart\_724,1}.p1) \land (0 < \$heap_{funcstart\_724,1}.p1) \land (0 < \$heap_{funcstart\_724,1}.p1)
\text{Sheap}_{funcstart_{724,1}.p2} \land (0 < \text{Sheap}_{funcstart_{724,1}.p3})) \&\&
(\text{\$heap}_{funcstart\_724,1}.p3 < asType < integer > (\text{\$heap}_{init}.M3))
\rightarrow [expand definition of constant 'M3' at prang.c (24,20)]
[5.32] ((-30307 < -$heap<sub>funcstart_724,1.</sub>p2) \land (-30269 <
-\$heap_{funcstart\_724,1}.p1) \land (0 < \$heap_{funcstart\_724,1}.p1) \land (0 < \$heap_{funcstart\_724,1}.p1)
\text{Sheap}_{funcstart_{724,1}.p2} \land (0 < \text{Sheap}_{funcstart_{724,1}.p3})) \&\&
(\text{sheap}_{funcstart\_724,1}.p3 < asType < integer > (asType < short)
int > ((int)30323)))
\rightarrow [simplify]
[5.40] (-30323 < -\$heap_{funcstart\_724,1}.p3) \land (-30307 <
-\$heap_{funcstart\_724,1}.p2) \land (-30269 < -\$heap_{funcstart\_724,1}.p1) \land (0 < -\$heap_{funcstart\_724,1}.p1)
\text{Sheap}_{funcstart\_724,1}.\text{p1}) \land (0 < \text{Sheap}_{funcstart\_724,1}.\text{p2}) \land (0 <
heap_{funcstart_{-724,1}.p3}
[Work on sub-term 3 of conjunction in term 5.40]
[7.0] -30269 < -\$heap_{funcstart\_724,1}.p1
[Work on sub-term 4 of conjunction in term 5.40]
[8.0] 0 < $heap_{funcstart_724,1}.p1
[Take given term]
[11.0] \operatorname{div1} == \operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724,1},
asType < int > (\$heap_{funcstart\_724,1}.p1),
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\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{a1}))
\rightarrow [simplify]
[11.1] \operatorname{div1} == \operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724,1}, \$ \operatorname{heap}_{funcstart\_724,1}.p1,
asType < int > (\$heap_{funcstart\_724,1}.a1))
\rightarrow [const static or extern object]
[11.2] \operatorname{div1} == \operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724,1}, \$ \operatorname{heap}_{funcstart\_724,1}.p1,
asType < int > (\$heap_{init}.a1))
\rightarrow [expand definition of constant 'a1' at prang.c (16,20)]
[11.3] \operatorname{div1} == \operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724,1}, \$ \operatorname{heap}_{funcstart\_724,1}.p1,
asType<int>(asType<short int>((int)177)))
\rightarrow [simplify]
[11.6] \text{ div1} == \text{div}(\mathbf{heapIs} \$ heap_{funcstart\_724,1}, \$ heap_{funcstart\_724,1}.p1, 177)
[Take goal term]
[1.0] (asType<int>(asType<short int>(div1.quot)) *
asType < int > (\$heap_{funcstart\_724,1}.b1)) \le maxof(int)
\rightarrow [from term 11.6, div1 is equal to div(heapIs $heap_{funcstart\_724,1},
heap_{funcstart_{-724,1}}.p1, 177
[1.1] (asType<int>(asType<short int>(div(heapIs $heap_{tuncstart\_724,1},))
\text{Sheap}_{funcstart\_724,1}.\text{p1}, 177).\text{quot}) * asType<int>(\text{Sheap}_{funcstart\_724,1}.\text{b1}))
\leq \max of(int)
\rightarrow [simplify]
[1.3] (div(heapIs heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p1, 177).quot *
asType < int > (\$heap_{funcstart\_724,1}.b1)) \le maxof(int)
\rightarrow [const static or extern object]
[1.4] (div(heapIs $heap_{tuncstart_724.1}, $heap_{tuncstart_724.1}.p1, 177).quot *
asType < int > (\$heap_{init}.b1)) \le maxof(int)
\rightarrow [expand definition of constant 'b1' at prang.c (17,20)]
[1.5] (div(heapIs heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p1, 177).quot *
asType < int > (asType < short int > ((int)2))) \le maxof(int)
\rightarrow [simplify]
[1.18] -32768 < (-2 * div(\mathbf{heapIs} \$ heap_{funcstart\_724,1}, \$ heap_{funcstart\_724,1}.p1,
177).quot)
\rightarrow [literal comparison of product]
[1.19] ([-2 < 0]: (-32768 / 2) < -\text{div}(\mathbf{heapIs} \$ \text{heap}_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1}.\text{p1}, 177).\text{quot}, [0 < -2]: (-32768 / -2) < \text{div}(\text{heapIs})
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.\text{p1}, 177).\text{quot}, [-2 == 0]: -32768 < 0)
```

```
→ [explicitly assert falsehood of skipped guards in subsequent guards]
[1.20] ([-2 < 0]: (-32768 / 2) < -\text{div}(\mathbf{heapIs} \ \text{$heap}_{funcstart\_724,1},
\text{Sheap}_{funcstart_{-724,1}}, p1, 177).quot, [(0 < -2) \land !(-2 < 0)]: (-32768 / -2) < -2
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}, \ [(-2 == 0)]
\wedge !(-2 < 0) \wedge !(0 < -2)]: -32768 < 0)
\rightarrow [simplify]
[1.24] -16384 < -\text{div}(\mathbf{heapIs} \$ \text{heap}_{funcstart\_724,1}, \$ \text{heap}_{funcstart\_724,1}.\text{p1},
177).quot
→ [negate goal and search for contradiction]
[1.25] ! (-16384 < -\text{div}(\textbf{heapIs} \$ \text{heap}_{funcstart\_724,1}, \$ \text{heap}_{funcstart\_724,1}.\text{p1},
177).quot)
\rightarrow [simplify]
[1.28] 16383 < div(heapIs heap_{funcstart_{-724,1}}, heap_{funcstart_{-724,1}}.p1,
177).quot
[Assume known post-assertion, class invariant or type constraint for term 11.6]
[14.0] (asType<integer>($heap_{funcstart\_724,1}.p1) /
asType<integer>(177)) == asType<integer>(div(heapIs
\$ \mathrm{heap}_{funcstart\_724,1},\,\$ \mathrm{heap}_{funcstart\_724,1}.\mathrm{p1},\,177).\mathrm{quot})
\rightarrow [simplify]
[14.2] ($heap_{funcstart\_724,1}.p1 / 177) == asType < integer > (div(heapIs
heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p1, 177).quot
→ [expand definition of operator './' in class 'int' at built in declaration]
[14.3] ([asType<integer>(heap_{funcstart\_724,1}.p1) < 0]:
-(-asType < integer > (\$heap_{funcstart\_724,1}.p1) / 177), []:
asType < integer > (\$heap_{funcstart\_724,1}.p1) / 177) ==
asType<integer>(div(heapIs heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p1,
177).quot)
→ [explicitly assert falsehood of skipped guards in subsequent guards]
[14.4] ([asType<integer>($heap_{funcstart\_724,1}.p1) < 0]:
-(-asType < integer > (\$heap_{funcstart\_724,1}.p1) / 177),
[!(\mathbf{asType} < \mathbf{integer} > (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p1}) < 0)]:
asType < integer > (\$heap_{funcstart\_724,1}.p1) / 177) ==
asType<integer>(div(heapIs $heap_{tuncstart\_724.1}, $heap_{tuncstart\_724.1}.p1,
177).quot)
\rightarrow [simplify]
[14.7] ([0 < -\$heap_{funcstart\_724,1}.p1]:
-(-asType < integer > (\$heap_{funcstart\_724,1}.p1) / 177),
[!(\mathbf{asType} < \mathbf{integer} > (\$ heap_{funcstart\_724,1}.p1) < 0)]:
```

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asType < integer > (\$heap_{funcstart\_724,1}.p1) / 177) ==
\mathbf{asType} {<} \mathbf{integer} {>} ( \mathrm{div}(\mathbf{heapIs} \ \$ \mathrm{heap}_{funcstart\_724,1}, \ \$ \mathrm{heap}_{funcstart\_724,1}. \mathrm{p1}, \\
177).quot)
\rightarrow [from term 8.0, literala < -$heap<sub>funcstart_724,1.</sub>p1 is false whenever -2 < (0
+ literala)]
    Proof of rule precondition:
    [14.7.0] - 2 < (0 + 0)
    \rightarrow [simplify]
    [14.7.2] true
[14.8] ([false]: -(-asType < integer > (\$heap_{funcstart\_724,1}.p1) / 177),
[!(asType < integer > (\$heap_{funcstart\_724,1}.p1) < 0)]:
asType < integer > (\$heap_{funcstart\_724,1}.p1) / 177) ==
\mathbf{asType} < \mathbf{integer} > (\mathbf{div}(\mathbf{heapIs} \ \$ \mathbf{heap}_{funcstart\_724,1}, \ \$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p1}, \\
177).quot)
\rightarrow [simplify]
[14.11] ([false]: -(-asType < integer > (\$heap_{funcstart\_724,1}.p1) / 177), [!(0 < integer) / (\$heap_{funcstart\_724,1}.p1) / 177)
-\$heap_{funcstart\_724,1}.p1)]: \ \mathbf{asType} < \mathbf{integer} > (\$heap_{funcstart\_724,1}.p1) \ / \ 177)
== asType < integer > (div(heapIs $heap_{funcstart\_724,1},
heap_{funcstart\_724,1}.p1, 177).quot
\rightarrow [from term 8.0, literala < -$heap<sub>funcstart_724,1</sub>.p1 is false whenever -2 < (0
+ literala)
    Proof of rule precondition:
    [14.11.0] - 2 < (0 + 0)
    \rightarrow [simplify]
    [14.11.2] true
[14.12] ([\mathbf{false}]: -(-\mathbf{asType} < \mathbf{integer} > (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p1}) \ / \ 177),
[!false]: asType<integer>($heap<sub>funcstart_724,1.</sub>p1) / 177) ==
\mathbf{asType} {<} \mathbf{integer} {>} ( \mathrm{div}(\mathbf{heapIs} \ \$ \mathrm{heap}_{funcstart\_724,1}, \ \$ \mathrm{heap}_{funcstart\_724,1}.\mathrm{p1}, \\
177).quot)
\rightarrow [simplify]
[14.17] \ 0 == (-\text{div}(\mathbf{heapIs} \ \$ \text{heap}_{funcstart\_724,1}, \ \$ \text{heap}_{funcstart\_724,1}.\text{p1},
177).quot + ({\rm sheap}_{funcstart\_724,1.p1} / 177)
[Create new term from terms 1.28, 14.17 using rule: transitivity 16]
[55.0] (0 + 16383) < (\text{$heap_{funcstart\_724,1.p1} / 177})
\rightarrow [simplify]
[55.8] 2899967 < heap_{funcstart\_724,1}.p1
\rightarrow [from term 7.0, literala < $heap_{funcstart\_724,1}.p1 is false whenever -2 <
```

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(-30269 + literala)
       Proof of rule precondition:
       [55.8.0] - 2 < (-30269 + 2899967)
       \rightarrow [simplify]
       [55.8.2] true
[55.9] false
Proof of verification condition: Type constraint satisfied in implicit
conversion from 'int' to 'short int'
Condition generated at: C:\Escher\Customers\prang\prang.c (56,33)
Condition defined at:
To prove: minof(short\ int) \le ((asType < int > (asType < short\ int) < (asTy
\mathbf{int}{>}(\mathbf{div1.rem})) * \mathbf{asType}{<}\mathbf{int}{>}(\$\mathbf{heap}_{funcstart\_724,1}.\mathbf{r1})) - \\
(asType<int>(asType<short int>(div1.quot)) *
asType < int > (\$heap_{funcstart\_724,1}.b1)))
Given:
heap_{init}.LIMIT == (int)80
\theta sheap<sub>init</sub>.M1 == asType<short int>((int)30269)
\theta_{init}.r1 == asType < short int > ((int)171)
heap_{init}.a1 == asType < short int > ((int)177)
\theta = asType < short int > ((int)2)
\theta sheap<sub>init</sub>.M2 == asType<short int>((int)30307)
\theta_{init}.r2 == asType < short int > ((int)172)
heap_{init}.a2 == asType < short int > ((int)176)
heap_{init}.b2 == asType<short int>((int)35)
\theta = asType < short int > ((int)30323)
\theta_{init}.r3 == asType<short int>((int)170)
heap_{init}.a3 == asType < short int > ((int)178)
heap_{init}.b3 == asType < short int > ((int)63)
\theta
\theta
\theta = asType < short int > ((int)3)
invariant1(heapIs heap_{funcstart\_724,1})
```

 $div1 == div(\mathbf{heapIs} \$heap_{funcstart\_724,1},$ 

```
asType < int > (\$heap_{funcstart\_724,1}.p1),
asType < int > (\$heap_{funcstart\_724,1}.a1))
(\mathbf{asType}{<}\mathbf{integer}{>}(\mathbf{asType}{<}\mathbf{int}{>}(\$\mathbf{heap}_{funcstart\_724,1}.\mathbf{p1})) \ / \\
\mathbf{asType}{<}\mathbf{integer}{>}(\mathbf{asType}{<}\mathbf{int}{>}(\$\mathbf{heap}_{funcstart\_724,1}.\mathbf{a1}))) = =
asType<integer>(div1.quot)
(asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.p1)) \%
\mathbf{asType}{<}\mathbf{int}{>}(\mathbf{\$heap}_{funcstart\_724,1}.\mathbf{a1}))) ==
asType<integer>(div1.rem)
!(0 == asType < integer > (div1.rem)) || !(0 ==
asType<integer>(div1.quot))
div2 == div(\mathbf{heapIs} \$ heap_{funcstart_{-724.1}},
asType < int > (\$heap_{funcstart\_724.1}.p2),
asType < int > (\$heap_{funcstart\_724,1}.a2))
(\mathbf{asType}{<}\mathbf{int}{>}(\mathbf{asType}{<}\mathbf{int}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{p2}))\ /
\mathbf{asType}{<}\mathbf{integer}{>}(\mathbf{asType}{<}\mathbf{int}{>}(\$\mathbf{heap}_{funcstart\_724,1}.\mathbf{a2}))) = =
asType<integer>(div2.quot)
(asType < int > (asType < int > (\$heap_{funcstart\_724,1}.p2)) \%
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a2))) = =
asType<integer>(div2.rem)
!(0 == asType < integer > (div2.rem)) || !(0 ==
asType<integer>(div2.quot))
div3 == div(\mathbf{heapIs} \$ heap_{funcstart\_724,1},
asType < int > (\$heap_{funcstart\_724,1}.p3),
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{a3}))
(\mathbf{asType}{<}\mathbf{integer}{>}(\mathbf{asType}{<}\mathbf{int}{>}(\$\mathbf{heap}_{funcstart\_724,1}.\mathbf{p3})) \ / \\
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a3))) = =
asType<integer>(div3.quot)
(asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.p3)) \%
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a3))) = =
asType<integer>(div3.rem)
!(0 == asType < integer > (div3.rem)) || !(0 ==
asType<integer>(div3.quot))
Proof:
[Take given term]
[5.0] invariant1(heapIs $heap_{tuncstart_724.1})
\rightarrow [expand definition of function 'invariant1' at prang.c (34,1)]
[5.1] (((((0 < asType < integer > ($heap_{funcstart_724,1}.p1)) &&
(asType<integer>($heap_funcstart_724.1.p1) <
asType < integer > (\$heap_{funcstart\_724,1}.M1))) \&\& (0 <
```

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asType < integer > (\$heap_{funcstart\_724,1}.p2))) \&\&
(asType < integer > (\$heap_{funcstart\_724,1}.p2) < 
\mathbf{asType} {<} \mathbf{integer} {>} (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{M2}))) \ \&\& \ (0 <
asType < integer > (\$heap_{funcstart\_724,1}.p3))) \&\&
(\mathbf{asType} < \mathbf{integer} > (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p3}) <
asType<integer>($heap_funcstart_724,1.M3))
\rightarrow [simplify]
[5.3] (((((0 < \theta_{funcstart\_724,1.p1) && (\theta_{funcstart\_724,1.p1)
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{M1})))~\&\&~(0<
asType < integer > (\$heap_{funcstart\_724,1}.p2))) \&\&
(\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p2}) <
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{M2})))~\&\&~(0<
asType < integer > (\$heap_{funcstart\_724,1}.p3))) \&\&
(\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{p3}) <
asType < integer > (\$heap_{funcstart\_724,1}.M3))
\rightarrow [const static or extern object]
[5.4] (((((0 < $heap_{funcstart\_724,1}.p1) && ($heap_{funcstart\_724,1}.p1 < ])
asType < integer > (\$heap_{init}.M1))) \&\& (0 <
asType < integer > (\$heap_{funcstart\_724,1}.p2))) \&\&
(\mathbf{asType} < \mathbf{integer} > (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p2}) <
as
Type<integer>($heap_{funcstart\_724,1}.M2))) && (0 <
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p3})))\ \&\&
(asType < integer > (\$heap_{funcstart_{-724.1}}.p3) < 
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{M3}))
\rightarrow [expand definition of constant 'M1' at prang.c (14,20)]
[5.5] (((((0 < \text{$heap_{funcstart\_724,1.p1}$}) \&\& (\text{$heap_{funcstart\_724,1.p1}$})
asType<integer>(asType<short int>((int)30269)))) && (0 <
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p2})))\ \&\&
(asType < integer > (\$heap_{funcstart\_724,1}.p2) <
asType<integer>(heap_{funcstart\_724,1}.M2))) && (0 <
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p3})))\ \&\&
(asType < integer > (\$heap_{funcstart\_724,1}.p3) < 
asType < integer > (\$heap_{funcstart\_724.1}.M3))
\rightarrow [simplify]
[5.16] \; ((((-30269 < -\$heap_{funcstart\_724,1}.p1) \; \land \; (0 < \$heap_{funcstart\_724,1}.p1) \; \land 
(0 < \text{\$heap}_{funcstart\_724,1}.p2)) \&\& (\text{\$heap}_{funcstart\_724,1}.p2 <
as
Type<integer>($heap_{funcstart\_724,1}.M2))) && (0 <
asType < integer > (\$heap_{funcstart\_724.1}.p3))) \&\&
(\mathbf{asType} < \mathbf{integer} > (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p3}) <
\mathbf{asType} < \mathbf{integer} > (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{M3}))
\rightarrow [const static or extern object]
```

```
[5.17] ((((-30269 < -\$heap_{funcstart\_724,1}.p1) \land (0 < \$heap_{funcstart\_724,1}.p1) 
(0 < \text{\$heap}_{funcstart\_724,1}.p2)) \&\& (\text{\$heap}_{funcstart\_724,1}.p2 <
asType < integer > (\$heap_{init}.M2))) \&\& (0 <
asType < integer > (\$heap_{funcstart\_724,1}.p3))) \&\&
(\mathbf{asType} < \mathbf{integer} > (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p3}) <
asType<integer>($heap_funcstart_724,1.M3))
\rightarrow [expand definition of constant 'M2' at prang.c (19,20)]
[5.18] ((((-30269 < -\$heap_{funcstart\_724,1}.p1) \land (0 < \$heap_{funcstart\_724,1}.p1) 
(0 < \text{$heap}_{funcstart\_724,1}.p2)) \&\& (\text{$heap}_{funcstart\_724,1}.p2 <
asType<integer>(asType<short int>((int)30307)))) && (0 <
asType < integer > (\$heap_{funcstart\_724,1}.p3))) \&\&
(\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{p3}) <
asType < integer > (\$heap_{funcstart\_724,1}.M3))
\rightarrow [simplify]
[5.30] ((-30307 < -$heap_{tuncstart_724,1}.p2) \land (-30269 <
-\$heap_{funcstart\_724,1}.p1) \land (0 < \$heap_{funcstart\_724,1}.p1) \land (0 < \$heap_{funcstart\_724,1}.p1)
\text{Sheap}_{funcstart\_724,1.p2}) \land (0 < \text{Sheap}_{funcstart\_724,1.p3})) \&\&
(\text{\$heap}_{funcstart\_724,1}.\text{p3} < \text{asType} < \text{integer} > (\text{\$heap}_{funcstart\_724,1}.\text{M3}))
\rightarrow [const static or extern object]
[5.31] ((-30307 < -$heap<sub>funcstart_724,1.</sub>p2) \wedge (-30269 <
-\$heap_{funcstart\_724,1}.p1) \land (0 < \$heap_{funcstart\_724,1}.p1) \land (0 < \$heap_{funcstart\_724,1}.p1)
\text{Sheap}_{funcstart_{-724,1}.p2} \land (0 < \text{Sheap}_{funcstart_{-724,1}.p3})) \&\&
(\$heap_{funcstart\_724,1}.p3 < \mathbf{asType} < \mathbf{integer} > (\$heap_{init}.M3))
\rightarrow [expand definition of constant 'M3' at prang.c (24,20)]
[5.32] ((-30307 < -$heap<sub>funcstart_724,1.</sub>p2) \land (-30269 <
-\$heap_{funcstart\_724,1}.p1) \land (0 < \$heap_{funcstart\_724,1}.p1) \land (0 < \$heap_{funcstart\_724,1}.p1)
\text{Sheap}_{funcstart\_724,1}.p2) \land (0 < \text{Sheap}_{funcstart\_724,1}.p3)) \&\&
(\text{sheap}_{funcstart\_724,1}.p3 < asType < integer > (asType < short)
int > ((int)30323))
\rightarrow [simplify]
[5.40] (-30323 < -\$heap_{funcstart\_724,1}.p3) \land (-30307 < -30307)
-\$heap_{funcstart\_724,1}.p2) \wedge (-30269 < -\$heap_{funcstart\_724,1}.p1) \wedge (0 <
\text{Sheap}_{funcstart\_724,1}.\text{p1}) \land (0 < \text{Sheap}_{funcstart\_724,1}.\text{p2}) \land (0 <
heap_{funcstart_{-724,1}.p3}
[Work on sub-term 3 of conjunction in term 5.40]
\label{eq:condition} \mbox{[7.0] -30269} < -\$ heap_{funcstart\_724,1}.p1
[Work on sub-term 4 of conjunction in term 5.40]
\textit{[8.0]} \ 0 < \$ heap_{funcstart\_724,1}.p1
[Take given term]
```

```
[11.0] \operatorname{div1} == \operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724,1},
asType < int > (\$heap_{funcstart\_724,1}.p1),
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{a1}))
\rightarrow [simplify]
[11.1] \operatorname{div1} == \operatorname{div}(\mathbf{heapIs} \operatorname{\$heap}_{funcstart\_724,1}, \operatorname{\$heap}_{funcstart\_724,1}.p1,
asType < int > (\$heap_{funcstart\_724,1}.a1))
\rightarrow [const static or extern object]
[11.2] div1 == div(heapIs heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p1,
asType < int > (\$heap_{init}.a1))
\rightarrow [expand definition of constant 'a1' at prang.c (16,20)]
[11.3] \ \mathrm{div1} == \mathrm{div}(\mathbf{heapIs} \ \$ \mathrm{heap}_{funcstart\_724,1}, \ \$ \mathrm{heap}_{funcstart\_724,1}.\mathrm{p1},
asType<int>(asType<short int>((int)177)))
\rightarrow [simplify]
[11.6] div1 == div(heapIs heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p1, 177)
[Take goal term]
[1.0] minof(short int) \le ((asType<int>(asType<short int>(div1.rem)) *
asType < int > (\$heap_{funcstart\_724,1}.r1)) - (asType < int > (asType < short)
int>(div1.quot)) * asType<int>($heap_{funcstart\_724,1}.b1)))
\rightarrow [simplify]
[1.1] -32768 \leq ((asType<int>(asType<short int>(div1.rem)) *
\mathbf{asType} \hspace{-0.1em}<\hspace{-0.1em} \mathbf{int} \hspace{-0.1em}> \hspace{-0.1em} (\$ heap_{funcstart\_724,1}.r1)) - (\mathbf{asType} \hspace{-0.1em}<\hspace{-0.1em} \mathbf{int} \hspace{-0.1em}> \hspace{-0.1em} (\mathbf{asType} \hspace{-0.1em}<\hspace{-0.1em} \mathbf{short})
\mathbf{int}{>}(\mathbf{div1}.\mathbf{quot})) \ * \ \mathbf{asType}{<} \mathbf{int}{>}(\$\mathbf{heap}_{funcstart\_724,1}.\mathbf{b1})))
\rightarrow [from term 11.6, div1 is equal to div(heapIs $heap_{funcstart\_724,1},
heap_{funcstart_{-724,1}.p1, 177}
[1.2] -32768 \leq ((asType<int>(asType<short int>(div(heapIs))
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.p1, 177).rem)) *
asType < int > (\$heap_{funcstart\_724,1}.r1)) - (asType < int > (asType < short)
int>(div1.quot)) * asType< int>($heap_{funcstart\_724,1}.b1)))
\rightarrow [simplify]
[1.4] -32768 \le ((\text{div}(\mathbf{heapIs} \$ \text{heap}_{funcstart\_724,1}, \$ \text{heap}_{funcstart\_724,1}.\text{p1},
177).rem * asType < int > (\$heap_{funcstart\_724,1}.r1)) –
(asType<int>(asType<short int>(div1.quot)) *
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{b1})))
\rightarrow [const static or extern object]
[1.5] - 32768 \leq ((\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.\operatorname{p1},
177).rem * asType < int > (\$heap_{init}.r1)) - (asType < int > (asType < short)
int>(div1.quot)) * asType< int>($heap_{funcstart\_724,1}.b1)))
\rightarrow [expand definition of constant 'r1' at prang.c (15,20)]
```

```
[1.6] -32768 \leq ((div(heapIs $heap_{funcstart\_724,1}, $heap_{funcstart\_724,1}.p1,
177).rem * asType < int > (asType < short int > ((int)171))) -
(asType<int>(asType<short int>(div1.quot)) *
asType < int > (\$heap_{funcstart\_724,1}.b1)))
\rightarrow [simplify]
[1.9] -32768 \leq ((div(heapIs $heap_{funcstart\_724,1}, $heap_{funcstart\_724,1}.p1,
177).rem * 171) - (asType<int>(asType<short int>(div1.quot)) *
\mathbf{asType} < \mathbf{int} > (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{b1})))
\rightarrow [from term 11.6, div1 is equal to div(heapIs $heap_{funcstart\_724,1},
heap_{funcstart_{724,1}}.p1, 177
[1.10] -32768 \leq ((171 * div(heapIs $heap_{funcstart_724.1}),
\theta_{funcstart-724,1}, p1, 177).rem) - (asType<int>(asType<short)
int>(div(heapIs \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1, 177).quot))*
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{b1})))
\rightarrow [simplify]
[1.12] -32768 \leq ((171 * div(heapIs $heap_{funcstart\_724,1},
heap_{funcstart\_724,1}.p1, 177).rem – (div(heapIs heap_{funcstart\_724,1}).
\theta_{funcstart_{724,1}.p1, 177}.quot * asType < int > (\theta_{funcstart_{724,1}.b1}))
\rightarrow [const static or extern object]
[1.13] -32768 \leq ((171 * div(heapIs $heap_{funcstart\_724,1},)
\rho_{tuncstart} $\text{-724.1.p1, 177}.rem \) - (\div(\text{heapIs} \prescript{heap}_{tuncstart} \prescript{-724.1},
\rho_{tuncstart=724.1}.p1, 177).quot * asType<int>(\rho_{tuncstart=724.1}.p1, 177).quot * asType
\rightarrow [expand definition of constant 'b1' at prang.c (17,20)]
[1.14] -32768 \leq ((171 * div(heapIs $heap_{funcstart\_724,1}, $heap_{funcstart\_724,1}.p1,
177).rem) - (div(heapIs heap_{funcstart\_724.1}, heap_{funcstart\_724.1}.p1,
177).quot * asType<int>(asType<short int>((int)2))))
\rightarrow [simplify]
 \label{eq:local_local} \mbox{$[1.21]$ -32769} < ((-2 * \mbox{div}(\mathbf{heapIs} \ \$ \mbox{$heap}_{funcstart\_724,1}, \ \$ \mbox{$heap}_{funcstart\_724,1}.p1, 
177).quot) + (171 * div(heapIs heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p1,
177).rem))
\rightarrow [negate goal and search for contradiction]
[1.22] !(-32769 < ((-2 * div(heapIs $heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1}.\text{p1}, 177).\text{quot} + (171 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
\theta_{funcstart\_724,1}.p1, 177).rem)))
\rightarrow [simplify]
\label{eq:loss_loss} \mbox{[1.27] $32768} < ((2*\mbox{div}(\mbox{\bf heapIs} \mbox{\$heap}_{funcstart\_724,1}, \mbox{\$heap}_{funcstart\_724,1}.p1,
177).quot) + (-171 * div(heapIs heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p1,
177).rem))
```

```
[Assume known post-assertion, class invariant or type constraint for term 11.6]
[14.0] (asType<integer>($heap_{funcstart\_724,1}.p1) /
asType<integer>(177)) == asType<integer>(div(heapIs
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.p1, 177).quot)
\rightarrow [simplify]
[14.2] ($heap<sub>funcstart_724,1.</sub>p1 / 177) == asType<integer>(div(heapIs)
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.p1, 177).quot
→ [expand definition of operator './' in class 'int' at built in declaration]
[14.3] \; ([\mathbf{asType} < \mathbf{integer} > (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p1}) < 0] :
-(-asType < integer > (\$heap_{funcstart\_724,1}.p1) / 177), []:
\mathbf{asType} < \mathbf{integer} > (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p1}) \ / \ 177) = =
asType<integer>(div(heapIs $heap_{funcstart\_724,1}, $heap_{funcstart\_724,1}.p1,
177).quot)
→ [explicitly assert falsehood of skipped guards in subsequent guards]
[14.4] ([asType<integer>(heap_{funcstart\_724,1}.p1) < 0]:
-(-asType < integer > (\$heap_{funcstart\_724,1}.p1) / 177),
[!(asType < integer > (\$heap_{funcstart\_724,1}.p1) < 0)]:
\mathbf{asType} < \mathbf{integer} > (\$ \mathrm{heap}_{funcstart\_724,1}.\mathrm{p1}) \ / \ 177) = =
\mathbf{asType} {<} \mathbf{integer} {>} ( \mathrm{div}(\mathbf{heapIs} \ \$ \mathrm{heap}_{funcstart\_724,1}, \ \$ \mathrm{heap}_{funcstart\_724,1}.\mathrm{p1}, \\
177).quot)
\rightarrow [simplify]
[14.7] ([0 < -$heap<sub>funcstart_724,1.</sub>p1]:
-(-asType < integer > (\$heap_{funcstart\_724,1}.p1) / 177),
[!(asType < integer > (\$heap_{funcstart\_724,1}.p1) < 0)]:
asType < integer > (\$heap_{funcstart\_724,1}.p1) / 177) ==
asType<integer>(div(heapIs $heap_{funcstart\_724,1}, $heap_{funcstart\_724,1}.p1,
177).quot)
\rightarrow [from term 8.0, literala < -$heap<sub>funcstart_724.1</sub>.p1 is false whenever -2 < (0
+ literala)
    Proof of rule precondition:
    [14.7.0] - 2 < (0 + 0)
    \rightarrow [simplify]
    [14.7.2] true
[14.8] \; ([\mathbf{false}]: \; -(-\mathbf{asType} < \mathbf{integer} > (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p1}) \; / \; 177),
[!(\mathbf{asType} < \mathbf{integer} > (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p1}) < 0)]:
asType < integer > (\$heap_{funcstart\_724,1}.p1) / 177) ==
asType<integer>(div(heapIs heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p1,
177).quot)
\rightarrow [simplify]
```

```
[14.11] \; ([{\bf false}]: \; -({\bf -asType}{<} {\bf integer}{>} (\$ {\rm heap}_{funcstart\_724,1}.{\rm p1}) \; / \; 177), \; [!(0 < {\rm parter})] \; ([{\bf false}]: \; -({\bf -asType}{<} {\bf integer}{>} (\$ {\rm heap}_{funcstart\_724,1}.{\rm p1}) \; / \; 177), \; [!(0 < {\bf -asType}{<} {\bf integer}{>} (\$ {\bf -asType}{<} {\bf
-\$heap_{funcstart\_724,1}.p1)]: asType < integer > (\$heap_{funcstart\_724,1}.p1) / 177)
== asType < integer > (div(heapIs $heap_{funcstart\_724,1},
heap_{funcstart_{-724,1}}.p1, 177).quot
\rightarrow [from term 8.0, literala < -$heap<sub>funcstart_724.1</sub>.p1 is false whenever -2 < (0
+ literala)]
           Proof of rule precondition:
           [14.11.0] - 2 < (0 + 0)
           \rightarrow [simplify]
           [14.11.2] true
 \lceil 14.12 \rceil \; (\lceil \mathbf{false} \rceil \colon -(-\mathbf{asType} < \mathbf{integer} > (\$ \mathrm{heap}_{funcstart\_724,1}.\mathrm{p1}) \; / \; 177), 
[!false]: asType<integer>(\ensuremath{\text{heap}}_{funcstart\_724,1}.\text{p1}) / 177) ==
asType<integer>(div(heapIs $heap_{tuncstart\_724.1}, $heap_{tuncstart\_724.1}.p1,
177).quot)
\rightarrow [simplify]
[14.17] \ 0 == (-\text{div}(\mathbf{heapIs} \ \$ \text{heap}_{funcstart\_724,1}, \ \$ \text{heap}_{funcstart\_724,1}.\text{p1},
177).quot + (\text{$heap}_{funcstart\_724,1}.p1 / 177))
[Assume known post-assertion, class invariant or type constraint for term 11.6]
[15.0] (asType<integer>(heap_{funcstart\_724,1}.p1) %
asType < integer > (177)) == asType < integer > (div(heapIs))
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.\text{p1}, 177).\text{rem}
\rightarrow [simplify]
[15.2] (\text{heap}_{funcstart\_724,1}.p1 % 177) == asType<integer>(div(heapIs
\$ \mathrm{heap}_{funcstart\_724,1}, \$ \mathrm{heap}_{funcstart\_724,1}.\mathrm{p1}, \ 177).\mathrm{rem})
→ [expand definition of operator '.%' in class 'int' at built in declaration]
[15.3] ([asType<integer>(peq_{tanget}) (peq_{tanget}) ([asType<integer)) (peq_{tanget}) ([asType<integer)) (peq_{tanget}) (peq_{tange}) (peq_{tanget}) (peq_{tange}) (peq_{tange}) (peq_{tange}) (peq_{tange}) (peq_{tange}) (peq_{tange}) (peq_{tange}) (peq_{tange}) (peq_{tange}) (pe
-(-asType < integer > (\$heap_{funcstart\_724,1}.p1) \% 177), []:
asType < integer > (\$heap_{funcstart\_724,1}.p1) \% 177) = =
asType<integer>(div(heapIs heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p1,
177).\text{rem}
→ [explicitly assert falsehood of skipped guards in subsequent guards]
\textit{[15.4]} \; ([\mathbf{asType} < \mathbf{integer} > (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p1}) < 0]:
 -(-asType < integer > (\$heap_{funcstart\_724,1}.p1) \% 177),
[!(asType < integer > (\$heap_{funcstart\_724,1}.p1) < 0)]:
asType < integer > (\$heap_{funcstart\_724,1}.p1) \% 177) ==
\mathbf{asType} {<} \mathbf{integer} {>} ( \mathrm{div}(\mathbf{heapIs} \ \$ \mathrm{heap}_{funcstart\_724,1}, \ \$ \mathrm{heap}_{funcstart\_724,1}.\mathrm{p1}, \\
177).rem)
\rightarrow [simplify]
```

```
[15.7] ([0 < -$heap<sub>funcstart_724,1.</sub>p1]:
-(-asType < integer > (\$heap_{funcstart\_724,1}.p1) \% 177),
[!(\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{p1}) < 0)]:
asType < integer > (\$heap_{funcstart\_724,1}.p1) \% 177) ==
asType < integer > (div(heapIs \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1,
177).rem)
\rightarrow [from term 8.0, literala < -$heap<sub>funcstart_724,1</sub>.p1 is false whenever -2 < (0
+ literala)]
    Proof of rule precondition:
    [15.7.0] - 2 < (0 + 0)
    \rightarrow [simplify]
    [15.7.2] true
[15.8] ([false]: -(-asType < integer > (\$heap_{tuncstart\_724.1}.p1) \% 177),
[!(asType < integer > (\$heap_{funcstart\_724.1}.p1) < 0)]:
asType < integer > (\$heap_{funcstart\_724,1}.p1) \% 177) ==
asType<integer>(div(heapIs heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p1,
177).\text{rem}
\rightarrow [simplify]
[15.11] ([false]: -(-asType < integer > (\$heap_{funcstart\_724,1}.p1) \% 177), [!(0
<-$heap_{funcstart\_724,1}.p1)]: asType<integer>($heap_{funcstart\_724,1}.p1)]%
177) == asType < integer > (div(heapIs \$heap_{funcstart\_724.1},
heap_{funcstart_{-724,1}}.p1, 177).rem
\rightarrow [from term 8.0, literala < -$heap_{funcstart\_724,1}.p1 is false whenever -2 < (0
+ literala)
    Proof of rule precondition:
    [15.11.0] - 2 < (0 + 0)
    \rightarrow [simplify]
    [15.11.2] true
\textit{[15.12]} \; ([\mathbf{false}]: \; -(\mathbf{-asType} < \mathbf{integer} > (\$ \mathrm{heap}_{funcstart\_724,1}.\mathrm{p1}) \; \% \; 177),
[!false]: asType<integer>($heap_{funcstart\_724,1}.p1) % 177) ==
\mathbf{asType} < \mathbf{integer} > (\mathbf{div}(\mathbf{heapIs} \ \$ \mathbf{heap}_{funcstart\_724,1}, \ \$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p1}, \\
177).\text{rem}
\rightarrow [simplify]
[15.17] \ 0 == (-\text{div}(\mathbf{heapIs} \ \$ \text{heap}_{funcstart\_724,1}, \ \$ \text{heap}_{funcstart\_724,1}.\text{p1},
177).rem + (\text{$heap}_{funcstart\_724,1}.p1 \% 177))
[Copy term 1.27]
[58.0] 32768 < ((-171 * div(heap
Is $heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1}.\text{p1}, 177).\text{rem} + (2 * \text{div}(\text{heapIs} \text{Sheap}_{funcstart\_724,1},
```

```
\theta_{funcstart_{-724,1},p1, 177}, quot))
\rightarrow [from\ term\ 15.17,\ div(\textbf{heapIs}\ \$heap_{funcstart\_724,1},\ \$heap_{funcstart\_724,1}.p1,
177).rem is equal to heap_{funcstart_{-724,1}}.p1 \% 177
[58.1] 32768 < ((-171 * ($heap_{funcstart\_724,1}.p1 % 177)) + (2 * div(heapIs)
\text{Sheap}_{funcstart_{-724,1}}, \text{Sheap}_{funcstart_{-724,1}}.p1, 177).quot)
[Create new term from term 14.17 using rule: condition for equality of division]
[62.0] ((177 * (0 + -(-\text{div}(\mathbf{heapIs} \$ \text{heap}_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1}.\text{p1}, 177).\text{quot}))) < (1 + \text{Sheap}_{funcstart\_724,1}.\text{p1})) \land
(\text{\$heap}_{funcstart\_724,1}.\text{p1} < (177 * (0 + 1 + -(-\text{div}(\textbf{heapIs}))))
heap_{funcstart_{724,1}}, heap_{funcstart_{724,1}}, 177).quot))))
\rightarrow [simplify]
[62.15] \; (-1 < ((-177 * \mathrm{div}(\mathbf{heapIs} \; \$ \mathrm{heap}_{funcstart\_724,1}, \; \$ \mathrm{heap}_{funcstart\_724,1}.\mathrm{p1}, \; \$))))
(-177).quot) + \text{heap}_{funcstart\_724,1}.p1)) \land (-177 < (-\text{heap}_{funcstart\_724,1}.p1 +
(177 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_724,1}, \text{\$heap}_{funcstart\_724,1}.\text{p1}, 177).\text{quot})))
[Work on sub-term 2 of conjunction in term 62.15]
\textit{[63.0]} \ -1 < ((-177 \ ^* \ \mathrm{div}(\mathbf{heapIs} \ \$ \mathrm{heap}_{funcstart\_724,1}, \ \$ \mathrm{heap}_{funcstart\_724,1}.\mathrm{p1},
177).quot) + $heap<sub>funcstart_724,1</sub>.p1)
[Create new term from terms 63.0, 7.0 using rule: transitivity 2]
[77.0] (-30269 + -1 + 1) < (-177 * div(heapIs $heap_{funcstart\_724,1},
heap_{funcstart_{-724,1}}.p1, 177).quot
\rightarrow [simplify]
[77.1] -30269 < (-177 * div(heapIs $heap_{funcstart\_724,1},
heap_{funcstart_{-724,1}}.p1, 177).quot
\rightarrow [literal comparison of product]
[77.2] ([-177 < 0]: (-30269 / 177) < -\text{div}(\mathbf{heapIs} \$ \text{heap}_{funcstart\_724,1},
\theta_{tuncstart_{-724,1},p1,177}, quot, [0 < -177]: (-30269 / -177) < \text{div}(\mathbf{heapIs})
\text{Sheap}_{funcstart_{724,1}}, \text{Sheap}_{funcstart_{724,1}}, p1, 177).quot, [-177 == 0]: -30269 <
→ [explicitly assert falsehood of skipped guards in subsequent guards]
[77.3] ([-177 < 0]: (-30269 / 177) < -\text{div}(\mathbf{heapIs} \$ heap_{funcstart\_724,1},
\rho_{uncstart\_724,1.p1,\ 177).quot,\ [(0<-177)\land !(-177<0)]:\ (-30269\ /\ -177)
< div(heapIs heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p1, 177).quot, [(-177)]
==0) \land !(-177 < 0) \land !(0 < -177)]: -30269 < 0)
\rightarrow [simplify]
[77.7] - 172 < -\text{div}(\text{heapIs } \text{$heap}_{funcstart\_724,1}, \text{$heap}_{funcstart\_724,1}.\text{p1},
177).quot
[Create new term from terms 77.7, 58.1 using rule: transitivity 5]
```

```
 [81.0] \ 32768 < ((-171 * (\$heap_{funcstart\_724,1}.p1 \% 177)) + (2 * -(-172 + 1))) \\ \rightarrow [simplify] \\ [81.5] \ 32426 < (-171 * (\$heap_{funcstart\_724,1}.p1 \% 177)) \\ \rightarrow [literal\ comparison\ of\ product] \\ [81.6] \ ([-171 < 0]:\ (32426 / 171) < -(\$heap_{funcstart\_724,1}.p1 \% 177),\ [-171 == 0]:\ 32426 < -171]:\ (32426 / -171) < (\$heap_{funcstart\_724,1}.p1 \% 177),\ [-171 == 0]:\ 32426 < 0) \\ \rightarrow [explicitly\ assert\ falsehood\ of\ skipped\ guards\ in\ subsequent\ guards] \\ [81.7] \ ([-171 < 0]:\ (32426 / 171) < -(\$heap_{funcstart\_724,1}.p1 \% 177),\ [(0 < -171) \land !(-171 < 0)]:\ (32426 / -171) < (\$heap_{funcstart\_724,1}.p1 \% 177),\ [(-171 == 0) \land !(-171 < 0) \land !(0 < -171)]:\ 32426 < 0) \\ \rightarrow [simplify] \\ [81.12] \ \mathbf{false}
```

**Proof of verification condition:** Type constraint satisfied in implicit conversion from 'int' to 'short int'

Condition generated at: C:\Escher\Customers\prang\prang.c (56,33)

## Condition defined at:

To prove:  $((asType < int > (asType < short int > (div1.rem)) * asType < int > (\$heap_{funcstart\_724,1}.r1)) - (asType < int > (asType < short int > (div1.quot)) * asType < int > (\$heap_{funcstart\_724,1}.b1))) \le maxof(short int)$ 

## Given:

```
\label{eq:sheap} $$ \end{sheap}_{init}. LIMIT == (int)80 $$ \end{sheap}_{init}. M1 == asType < short int > ((int)30269) $$ \end{sheap}_{init}. r1 == asType < short int > ((int)171) $$ \end{sheap}_{init}. a1 == asType < short int > ((int)177) $$ \end{sheap}_{init}. b1 == asType < short int > ((int)2) $$ \end{sheap}_{init}. M2 == asType < short int > ((int)30307) $$ \end{sheap}_{init}. r2 == asType < short int > ((int)172) $$ \end{sheap}_{init}. a2 == asType < short int > ((int)176) $$ \end{sheap}_{init}. b2 == asType < short int > ((int)35) $$ \end{sheap}_{init}. M3 == asType < short int > ((int)170) $$ \end{sheap}_{init}. r3 == asType < short int > ((int)170) $$ \end{sheap}_{init}. a3 == asType < short int > ((int)178) $$
```

```
\theta = asType < short int > ((int)63)
\theta = asType < short int > ((int)1)
\theta
heap_{init}.p3 == asType < short int > ((int)3)
invariant1(heapIs heap_{funcstart\_724,1})
\operatorname{div1} == \operatorname{div}(\mathbf{heapIs} \ \operatorname{\$heap}_{funcstart\_724,1},
asType < int > (\$heap_{funcstart\_724,1}.p1),
asType < int > (\$heap_{funcstart\_724,1}.a1))
(asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.p1)) /
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a1))) = =
asType<integer>(div1.quot)
(\mathbf{asType}{<}\mathbf{int}{>}(\mathbf{asType}{<}\mathbf{int}{>}(\$\mathbf{heap}_{funcstart\_724,1}.\mathbf{p1}))~\%
\mathbf{asType}{<}\mathbf{integer}{>}(\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{a1}))) = =
asType<integer>(div1.rem)
!(0 == asType < integer > (div1.rem)) || !(0 ==
asType<integer>(div1.quot))
div2 == div(\mathbf{heapIs} \$heap_{funcstart\_724,1},
asType < int > (\$heap_{funcstart\_724,1}.p2),
asType < int > (\$heap_{funcstart\_724,1}.a2))
(asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.p2)) /
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a2))) = =
asType<integer>(div2.quot)
(\mathbf{asType}{<}\mathbf{integer}{>}(\mathbf{asType}{<}\mathbf{int}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{p2}))~\%
\mathbf{asType}{<}\mathbf{integer}{>}(\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{a2}))) ==
asType<integer>(div2.rem)
!(0 == asType < integer > (div2.rem)) || !(0 ==
asType<integer>(div2.quot))
div3 == div(\mathbf{heapIs} \$ heap_{funcstart\_724,1},
asType < int > (\$heap_{funcstart\_724,1}.p3),
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{a3}))
(asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.p3)) /
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a3))) = =
asType<integer>(div3.quot)
(\mathbf{asType} < \mathbf{int} > (\mathbf{asType} < \mathbf{int} > (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p3})) \ \%
\mathbf{asType} < \mathbf{integer} > (\mathbf{asType} < \mathbf{int} > (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{a3}))) = =
asType<integer>(div3.rem)
!(0 == asType < integer > (div3.rem)) || !(0 ==
asType<integer>(div3.quot))
```

## **Proof:**

```
[Take given term]
[5.0] invariant1(heapIs heap_{funcstart\_724,1})
\rightarrow [expand definition of function 'invariant1' at prang.c (34.1)]
[5.1] ((((((0 < asType < integer > ($heap_{funcstart\_724,1}.p1)) &&
(asType < integer > ($heap_{funcstart\_724,1}.p1) < 
asType < integer > (\$heap_{funcstart\_724,1}.M1))) \&\& (0 <
asType < integer > (\$heap_{funcstart\_724,1}.p2))) \&\&
(asType < integer > (\$heap_{funcstart\_724,1}.p2) <
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{M2})))~\&\&~(0<
asType < integer > (\$heap_{funcstart\_724,1}.p3))) \&\&
(asType<integer>($heap_{tuncstart_724.1}.p3) <
\mathbf{asType} < \mathbf{integer} > (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{M3}))
\rightarrow [simplify]
[5.3] \ (((((0 < \$heap_{funcstart\_724,1}.p1) \&\& \ (\$heap_{funcstart\_724,1}.p1 < (((((((1.5) + (1.5) + (1.5) + ((1.5) + (1.5) + (1.5) + ((1.5) + (1.5) + (1.5) + ((1.5) + (1.5) + (1.5) + ((1.5) + (1.5) + ((1.5) + (1.5) + ((1.5) + (1.5) + ((1.5) + (1.5) + ((1.5) + (1.5) + ((1.5) + (1.5) + ((1.5) + (1.5) + ((1.5) + (1.5) + ((1.5) + (1.5) + ((1.5) + (1.5) + ((1.5) + (1.5) + ((1.5) + (1.5) + ((1.5) + (1.5) + ((1.5) + (1.5) + ((1.5) + (1.5) + ((1.5) + ((1.5) + (1.5) + ((1.5) + ((1.5) + (1.5) + ((1.5) + ((1.5) + (1.5) + ((1.5) + ((1.5) + ((1.5) + ((1.5) + ((1.5) + ((1.5) + ((1.5) + ((1.5) + ((1.5) + ((1.5) + ((1.5) + ((1.5) + ((1.5) + ((1.5) + ((1.5) + ((1.5) + ((1.5) + ((1.5) + ((1.5) + ((1.5) + ((1.5) + ((1.5) + ((1.5) + ((1.5) + ((1.5) + ((1.5) + ((1.5) + ((1.5) + ((1.5) + ((1.5) + ((1.5) + ((1.5) + ((1.5) + ((1.5) + ((1.5) + ((1.5) + ((1.5) + ((1.5) + ((1.5) + ((1.5) + ((1.5) + ((1.5) + ((1.5) + ((1.5) + ((1.5) + ((1.5) + ((1.5) + ((1.5) + ((1.5) + ((1.5) + ((1.5) + ((1.5) + ((1.5) + ((1.5) + ((1.5) + ((1.5) + ((1.5) + ((1.5) + ((1.5) + ((1.5) + ((1.5) + ((1.5) + ((1.5) + ((1.5) + ((1.5) + ((1.5) + ((1.5) + ((1.5) + ((1.5) + ((1.5) + ((1.5) + ((1.5) + ((1.5) + ((1.5) + ((1.5) + ((1.5) + ((1.5) + ((1.5) + ((1.5) + ((1.5) + ((1.5) + ((1.5) + ((1.5) + ((1.5) + ((1.5) + ((1.5) + ((1.5) + ((1.5) + ((1.5) + ((1.5) + ((1.5) + ((1.5) + ((1.5) + ((1.5) + ((1.5) + ((1.5) + ((1.5) + ((1.5) + ((1.5) + ((1.5) + ((1.5) + ((1.5) + ((1.5) + ((1.5) + ((1.5) + ((1.5) + ((1.5) + ((1.5) + ((1.5) + ((1.5) + ((1.5) + ((1.5) + ((1.5) + ((1.5) + ((1.5) + ((1.5) + ((1.5) + ((1.5) + ((1.5) + ((1.5) + ((1.5) + ((1.5) + ((1.5) + ((1.5) + ((1.5) + ((1.5) + ((1.5) + ((1.5) + ((1.5) + ((1.5) + ((1.5) + ((1.5) + ((1.5) + ((1.5) + ((1.5) + ((1.5) + ((1.5) + ((1.5) + ((1.5) + ((1.5) + ((1.5) + ((1.5) + ((1.5) + ((1.5) + ((1.5) + ((1.5) + ((1.5) + ((1.5) + ((1.5) + ((1.5) + ((1.5) + ((1.5) + ((1.5) + ((1.5) + ((1.5) + ((1.5) + ((1.5) + ((1.5) + ((1.5) + ((1.5) + ((1.5) + ((1.5) + ((1.5) + ((1.5) + ((1.5) + ((1.5) + ((1.5) + ((1.5) + ((1.5) + ((1.5
\mathbf{asType} \small{<} \mathbf{integer} \small{>} (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{M1}))) \ \&\& \ (0 <
asType < integer > (\$heap_{funcstart\_724,1}.p2))) \&\&
(\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{p2}) <
asType < integer > (\$heap_{funcstart\_724,1}.M2))) \&\& (0 <
asType < integer > (\$heap_{funcstart\_724,1}.p3))) \&\&
(asType<integer>($heap_{tuncstart}, 724.1.p3) <
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{M3}))
\rightarrow [const static or extern object]
[5.4] (((((0 < \theta_{funcstart\_724,1.p1) && (\theta_{funcstart\_724,1.p1)
asType < integer > (\$heap_{init}.M1))) \&\& (0 <
asType < integer > (\$heap_{funcstart\_724,1}.p2))) \&\&
(\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{p2}) <
asType < integer > (\$heap_{funcstart\_724,1}.M2))) \&\& (0 <
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{p3})))\ \&\&
(asType < integer > ($heap_{funcstart\_724,1}.p3) < 
asType < integer > (\$heap_{funcstart\_724,1}.M3))
\rightarrow [expand definition of constant 'M1' at prang.c (14,20)]
[5.5] (((((0 < $heap_{funcstart_724,1}.p1) && ($heap_{funcstart_724,1}.p1 < function for the content of the 
asType<integer>(asType<short int>((int)30269)))) && (0 <
asType < integer > (\$heap_{funcstart\_724,1}.p2))) \&\&
(asType < integer > (\$heap_{funcstart\_724,1}.p2) <
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{M2})))~\&\&~(0<
asType < integer > (\$heap_{funcstart\_724,1}.p3))) \&\&
(\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{p3}) <
asType < integer > (\$heap_{funcstart_{-724.1}}.M3))
\rightarrow [simplify]
```

```
[5.16] ((((-30269 < -\$heap_{funcstart\_724,1}.p1) \land (0 < \$heap_{funcstart\_724,1}.p1) 
(0 < \text{\$heap}_{funcstart\_724,1}.p2)) \&\& (\text{\$heap}_{funcstart\_724,1}.p2 <
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{M2})))~\&\&~(0<
asType < integer > (\$heap_{funcstart\_724,1}.p3))) \&\&
(\mathbf{asType} {<} \mathbf{integer} {>} (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p3}) <
asType<integer>($heap_funcstart_724,1.M3))
\rightarrow [const static or extern object]
[5.17] \; ((((-30269 < -\$heap_{funcstart\_724,1}.p1) \; \land \; (0 < \$heap_{funcstart\_724,1}.p1) \; \land 
(0 < \text{$heap}_{funcstart\_724,1}.p2)) \&\& (\text{$heap}_{funcstart\_724,1}.p2 <
asType < integer > (\$heap_{init}.M2))) \&\& (0 <
asType < integer > (\$heap_{funcstart\_724,1}.p3))) \&\&
(asType<integer>($heap_{tuncstart\_724,1}.p3) <
asType < integer > (\$heap_{funcstart\_724,1}.M3))
\rightarrow [expand definition of constant 'M2' at prang.c (19,20)]
[5.18] \; ((((-30269 < -\$heap_{funcstart\_724,1}.p1) \; \land \; (0 < \$heap_{funcstart\_724,1}.p1) \; \land 
(0 < \text{\$heap}_{funcstart\_724,1}.p2)) \&\& (\text{\$heap}_{funcstart\_724,1}.p2 <
asType<integer>(asType<short int>((int)30307)))) && (0 <
asType < integer > (\$heap_{funcstart\_724,1}.p3))) \&\&
(asType < integer > (\$heap_{funcstart_{-724,1}}.p3) < 
asType < integer > (\$heap_{funcstart\_724,1}.M3))
\rightarrow [simplify]
[5.30] ((-30307 < -\$heap_{funcstart\_724,1}.p2) \land (-30269 <
-\$heap_{funcstart\_724,1}.p1) \land (0 < \$heap_{funcstart\_724,1}.p1) \land (0 < \$heap_{funcstart\_724,1}.p1)
\text{Sheap}_{funcstart_{724,1}.p2} \land (0 < \text{Sheap}_{funcstart_{724,1}.p3})) \&\&
(\text{\$heap}_{funcstart\_724,1}.p3 < asType < integer > (\text{\$heap}_{funcstart\_724,1}.M3))
\rightarrow [const static or extern object]
[5.31] ((-30307 < -$heap<sub>funcstart_724,1.</sub>p2) \land (-30269 <
-\$heap_{funcstart\_724,1}.p1) \land (0 < \$heap_{funcstart\_724,1}.p1) \land (0 < \$heap_{funcstart\_724,1}.p1)
\text{Sheap}_{funcstart\_724,1.p2}) \land (0 < \text{Sheap}_{funcstart\_724,1.p3})) \&\&
(\text{\$heap}_{funcstart\_724,1}.\text{p3} < \mathbf{asType} < \mathbf{integer} > (\text{\$heap}_{init}.\text{M3}))
\rightarrow [expand definition of constant 'M3' at prang.c (24,20)]
[5.32] ((-30307 < -$heap<sub>funcstart_724,1.</sub>p2) \wedge (-30269 <
-\$heap_{funcstart\_724,1}.p1) \land (0 < \$heap_{funcstart\_724,1}.p1) \land (0 < \$heap_{funcstart\_724,1}.p1)
\text{Sheap}_{funcstart\_724,1.p2} \land (0 < \text{Sheap}_{funcstart\_724,1.p3})) \&\&
(\$heap_{funcstart\_724,1}.p3 < \mathbf{asType} < \mathbf{integer} > (\mathbf{asType} < \mathbf{short}
int > ((int)30323)))
\rightarrow [simplify]
[5.40] (-30323 < -\$heap_{funcstart\_724,1}.p3) \land (-30307 < -30307)
-\$heap_{funcstart\_724,1}.p2) \land (-30269 < -\$heap_{funcstart\_724,1}.p1) \land (0 < -\$heap_{funcstart\_724,1}.p1)
\text{Sheap}_{funcstart\_724,1}.\text{p1}) \land (0 < \text{Sheap}_{funcstart\_724,1}.\text{p2}) \land (0 <
heap_{funcstart_{-724,1}.p3}
```

```
[Work on sub-term 4 of conjunction in term 5.40]
\textit{[8.0]} \ 0 < \$ heap_{funcstart\_724,1}.p1
[Take given term]
[11.0] \operatorname{div1} == \operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724,1},
asType < int > (\$heap_{funcstart\_724,1}.p1),
asType < int > (\$heap_{funcstart\_724,1}.a1))
\rightarrow [simplify]
[11.1] \operatorname{div1} == \operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1,
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{a1}))
\rightarrow [const static or extern object]
[11.2] \ \mathrm{div1} == \mathrm{div}(\mathbf{heapIs} \ \$ \mathrm{heap}_{funcstart\_724,1}, \ \$ \mathrm{heap}_{funcstart\_724,1}.\mathrm{p1},
asType < int > (\$heap_{init}.a1))
\rightarrow [expand definition of constant 'a1' at prang.c (16,20)]
[11.3] \operatorname{div1} == \operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.p1,
asType < int > (asType < short int > ((int)177)))
\rightarrow [simplify]
[11.6] div1 == div(heapIs heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p1, 177)
[Take goal term]
[1.0] ((asType<int>(asType<short int>(div1.rem)) *
asType < int > (\$heap_{tuncstart\_724.1}.r1)) - (asType < int > (asType < short)
int>(div1.quot)) * asType< int>($heap_{funcstart\_724,1}.b1))) \le maxof(short)
int)
\rightarrow [from term 11.6, div1 is equal to div(heapIs $heap_{funcstart\_724,1},
heap_{funcstart_{-724,1}}.p1, 177
[1.1] ((asType<int>(asType<short int>(div(heapIs $heap_{funcstart\_724,1},))
\theta_{funcstart\_724,1.p1, 177).rem} * asType<int>($\text{heap}_{funcstart\_724,1.r1}) -
(asType<int>(asType<short int>(div1.quot)) *
asType < int > (\$heap_{funcstart\_724,1}.b1))) \le maxof(short int)
\rightarrow [simplify]
[1.3] ((div(heapIs heap_{funcstart_{724,1}}, heap_{funcstart_{724,1}}, 177).rem *
asType < int > (\$heap_{tuncstart\_724.1}.r1)) - (asType < int > (asType < short)
int>(div1.quot)) * asType< int>($heap_{tuncstart\_724.1}.b1))) \le maxof(short)
int)
\rightarrow [const static or extern object]
[1.4] ((div(heapIs heap_{funcstart\_724,1}, heap_{funcstart\_724,1.pl}, 177).rem *
asType < int > (\$heap_{init}.r1)) - (asType < int > (asType < short)
int>(div1.quot)) * asType< int>($heap_{funcstart\_724,1}.b1))) \le maxof(short)
int)
```

```
\rightarrow [expand definition of constant 'r1' at prang.c (15,20)]
[1.5] ((div(heapIs heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p1, 177).rem *
asType<int>(asType<short int>((int)171))) -
(asType<int>(asType<short int>(div1.quot)) *
asType < int > (\$heap_{tuncstart\_724.1}.b1))) \le maxof(short int)
\rightarrow [simplify]
[1.8] ((div(heapIs heap_{funcstart_{-724,1}}, heap_{funcstart_{-724,1}}.p1, 177).rem * 171)
- (asType<int>(asType<short int>(div1.quot)) *
asType < int > (\$heap_{funcstart\_724,1}.b1))) \le maxof(short int)
\rightarrow [from term 11.6, div1 is equal to div(heapIs $heap_{funcstart\_724,1},
heap_{funcstart_{-724,1}}.p1, 177
[1.9] ((171 * div(heapIs $heap_{funcstart\_724,1}, $heap_{funcstart\_724,1}.p1, 177).rem)
- (asType<int>(asType<short int>(div(heapIs $heap_{funcstart\_724,1},
\theta_{funcstart\_724,1}.p1, 177).quot) * asType<int>($heap_{funcstart\_724,1}.b1)))
< maxof(short int)
\rightarrow [simplify]
[1.11] ((171 * div(heapIs $heap_{funcstart\_724,1}, $heap_{funcstart\_724,1}.p1,
177).rem) – (\text{div}(\mathbf{heapIs} \$ \text{heap}_{funcstart\_724,1}, \$ \text{heap}_{funcstart\_724,1}.\text{p1},
177).quot * asType<int>($heap<sub>funcstart_724,1</sub>.b1))) \leq maxof(short int)
\rightarrow [const static or extern object]
[1.12] ((171 * div(heapIs $heap_{funcstart\_724,1}, $heap_{funcstart\_724,1}.p1,
177).rem) – (\operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724,1}, \$ \operatorname{heap}_{funcstart\_724,1}.p1,
177).quot * asType < int > (\$heap_{init}.b1)) \le maxof(short int)
\rightarrow [expand definition of constant 'b1' at prang.c (17,20)]
[1.13] ((171 * div(heapIs heap_{funcstart_{-724,1}}, heap_{funcstart_{-724,1},p1})
177).rem) – (\text{div}(\mathbf{heapIs} \$ \text{heap}_{funcstart\_724,1}, \$ \text{heap}_{funcstart\_724,1}.p1,
177).quot * asType<int>(asType<short int>((int)2)))) \( \le \text{maxof(short)} \)
int)
\rightarrow [simplify]
[1.32] -32768 < ((-171 * div(heapIs $heap_{funcstart\_724.1},
\text{Sheap}_{funcstart\_724.1.p1}, 177).\text{rem} + (2 * \text{div}(\text{heapIs} \text{Sheap}_{funcstart\_724.1},
\$ \mathrm{heap}_{funcstart\_724,1}.\mathrm{p1},\ 177).\mathrm{quot}))
→ [negate goal and search for contradiction]
[1.33] !(-32768 < ((-171 * div(heapIs $heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1}.\text{p1}, 177).\text{rem} + (2 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
heap_{funcstart_{-724,1}}.p1, 177).quot))
\rightarrow [simplify]
[1.38] 32767 < ((171 * div(heapIs $heap_{funcstart\_724,1}, $heap_{funcstart\_724,1}.p1,
```

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177).rem) + (-2 * \text{div}(\text{heapIs } \text{heap}_{funcstart\_724,1}, \text{heap}_{funcstart\_724,1}.p1,
177).quot))
[Assume known post-assertion, class invariant or type constraint for term 11.6]
[14.0] (asType<integer>(heap_{funcstart\_724,1}.p1) /
asType < integer > (177)) == asType < integer > (div(heapIs))
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.p1, 177).quot)
\rightarrow [simplify]
[14.2] ($heap<sub>funcstart_724,1.</sub>p1 / 177) == asType<integer>(div(heapIs)
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.p1, 177).quot
→ [expand definition of operator './' in class 'int' at built in declaration]
[14.3] ([asType<integer>(heap_{funcstart\_724,1}.p1) < 0]:
-(-asType < integer > (\$heap_{funcstart\_724,1}.p1) / 177), []:
asType < integer > (\$heap_{funcstart\_724,1}.p1) / 177) = =
asType<integer>(div(heapIs heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p1,
177).quot)
→ [explicitly assert falsehood of skipped guards in subsequent guards]
[14.4] \; ([\mathbf{asType} < \mathbf{integer} > (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p1}) < 0] :
-(-asType < integer > (\$heap_{funcstart\_724,1}.p1) / 177),
[!(asType < integer > (\$heap_{funcstart\_724,1}.p1) < 0)]:
\mathbf{asType} < \mathbf{integer} > (\$ \mathrm{heap}_{funcstart\_724,1}.\mathrm{p1}) \ / \ 177) = =
\mathbf{asType} < \mathbf{integer} > (\mathbf{div}(\mathbf{heapIs} \ \$ \mathbf{heap}_{funcstart\_724,1}, \ \$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p1}, \\
177).quot)
\rightarrow [simplify]
[14.7] ([0 < -$heap<sub>funcstart_724,1.</sub>p1]:
-(-asType < integer > (\$heap_{funcstart\_724,1}.p1) / 177),
[!(asType < integer > (\$heap_{funcstart\_724,1}.p1) < 0)]:
asType < integer > (\$heap_{funcstart\_724,1}.p1) / 177) = =
asType<integer>(div(heapIs heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p1,
177).quot)
\rightarrow [from term 8.0, literala < -$heap<sub>funcstart_724,1</sub>.p1 is false whenever -2 < (0
+ literala)]
    Proof of rule precondition:
    [14.7.0] - 2 < (0 + 0)
    \rightarrow [simplify]
    [14.7.2] true
[14.8] \; ([\mathbf{false}]: \; -(-\mathbf{asType} < \mathbf{integer} > (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p1}) \; / \; 177),
[!(asType < integer > (\$heap_{funcstart\_724.1}.p1) < 0)]:
asType < integer > (\$heap_{funcstart\_724.1}.p1) / 177) = =
asType<integer>(div(heapIs heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p1,
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177).quot)
\rightarrow [simplify]
[14.11] ([false]: -(-asType < integer > (\$heap_{funcstart\_724,1}.p1) / 177), [!(0 < integer > (\$heap_{funcstart\_724,1}.p1) / 177)]
-\$heap_{funcstart\_724,1}.p1): asType<integer>(\$heap_{funcstart\_724,1}.p1) / 177)
== asType < integer > (div(heapIs $heap_{funcstart\_724,1},
heap_{funcstart_{-724,1}}.p1, 177).quot
\rightarrow [from term 8.0, literala < -$heap<sub>funcstart_724,1</sub>.p1 is false whenever -2 < (0
+ literala)]
    Proof of rule precondition:
    [14.11.0] - 2 < (0 + 0)
    \rightarrow [simplify]
    [14.11.2] true
[14.12] ([false]: -(-asType < integer > (\$heap_{funcstart\_724,1}.p1) / 177),
[!false]: asType<integer>(\ensuremath{$^{\circ}$heap}_{funcstart\_724,1}.p1) / 177) ==
asType<integer>(div(heapIs $heap_{tuncstart\_724.1}, $heap_{tuncstart\_724.1}.p1,
177).quot)
\rightarrow [simplify]
 [14.17] \ 0 == (-\text{div}(\mathbf{heapIs} \ \$ \text{heap}_{funcstart\_724,1}, \ \$ \text{heap}_{funcstart\_724,1}.\text{p1},
177).quot + (\text{$heap}_{funcstart\_724,1.p1} / 177))
[Assume known post-assertion, class invariant or type constraint for term 11.6]
[15.0] (asType<integer>(sheap_{funcstart\_724,1}.p1) %
asType<integer>(177)) == asType<integer>(div(heapIs
\text{Sheap}_{funcstart_{-724,1}}, \text{Sheap}_{funcstart_{-724,1}}.\text{p1}, 177).\text{rem}
\rightarrow [simplify]
[15.2] (\text{heap}_{funcstart\_724,1}.p1 % 177) == asType<integer>(div(heapIs
\theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}.p1, 177).rem
→ [expand definition of operator '.%' in class 'int' at built in declaration]
[15.3] ([asType<integer>(sheap_{funcstart\_724.1}.p1) < 0]:
-(-asType < integer > (\$heap_{funcstart\_724,1}.p1) \% 177), []:
asType < integer > (\$heap_{funcstart\_724,1}.p1) \% 177) = =
\mathbf{asType} \small{<} \mathbf{integer} \small{>} ( \mathrm{div}(\mathbf{heapIs} \ \$ \mathrm{heap}_{funcstart\_724,1}, \ \$ \mathrm{heap}_{funcstart\_724,1}.\mathrm{p1}, \\
177).\text{rem}
\rightarrow [explicitly assert falsehood of skipped guards in subsequent guards]
[15.4] ([asType<integer>($heap_{funcstart\_724,1}.p1) < 0]:
-(-asType < integer > (\$heap_{funcstart\_724,1}.p1) \% 177),
[!(asType < integer > (\$heap_{funcstart\_724,1}.p1) < 0)]:
asType < integer > (\$heap_{funcstart\_724,1}.p1) \% 177) ==
\mathbf{asType} {<} \mathbf{integer} {>} ( \mathrm{div}(\mathbf{heapIs} \ \$ \mathrm{heap}_{funcstart\_724,1}, \ \$ \mathrm{heap}_{funcstart\_724,1}. \mathrm{p1}, \\
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177).rem)
\rightarrow [simplify]
[15.7] ([0 < -$heap<sub>funcstart_724,1</sub>.p1]:
-(-asType < integer > (\$heap_{funcstart\_724,1}.p1) \% 177),
[!(asType < integer > (\$heap_{funcstart\_724,1}.p1) < 0)]:
asType < integer > (\$heap_{funcstart-724,1}.p1) \% 177) ==
asType<integer>(div(heapIs $heap_{tuncstart\_724.1}, $heap_{tuncstart\_724.1}.p1,
177).rem)
\rightarrow [from term 8.0, literala < -$heap<sub>funcstart_724,1.</sub>p1 is false whenever -2 < (0
+ literala)]
    Proof of rule precondition:
    [15.7.0] - 2 < (0 + 0)
    \rightarrow [simplify]
    [15.7.2] true
[15.8] ([false]: -(-asType < integer > (\$heap_{funcstart\_724,1}.p1) \% 177),
[!(asType < integer > (\$heap_{funcstart\_724,1}.p1) < 0)]:
asType < integer > (\$heap_{funcstart\_724,1}.p1) \% 177) ==
asType<integer>(div(heapIs heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p1,
177).rem)
\rightarrow [simplify]
[15.11] ([false]: -(-asType < integer > (\$heap_{funcstart\_724,1}.p1) \% 177), [!(0
<-$heap<sub>funcstart_724,1.</sub>p1)]: asType<integer>($heap<sub>funcstart_724,1.</sub>p1) %
177) == asType < integer > (div(heapIs \$heap_{funcstart\_724.1},
heap_{funcstart_{-724,1}}.p1, 177).rem
\rightarrow [from term 8.0, literala < -$heap<sub>funcstart_724,1</sub>.p1 is false whenever -2 < (0
+ literala)]
    Proof of rule precondition:
    [15.11.0] - 2 < (0 + 0)
    \rightarrow [simplify]
    [15.11.2] true
\textit{[15.12]} \; ([\mathbf{false}]: \; -(\mathbf{-asType} < \mathbf{integer} > (\$ \mathrm{heap}_{funcstart\_724,1}.\mathrm{p1}) \; \% \; 177),
[!false]: asType<integer>($heap_{funcstart\_724,1}.p1) % 177) ==
\mathbf{asType} < \mathbf{integer} > (\mathbf{div}(\mathbf{heapIs} \ \$ \mathbf{heap}_{funcstart\_724,1}, \ \$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p1}, \\
177).rem)
\rightarrow [simplify]
[15.17] \ 0 == (-\text{div}(\mathbf{heapIs} \ \$ \text{heap}_{funcstart\_724,1}, \ \$ \text{heap}_{funcstart\_724,1}.\text{p1},
177).rem + (\text{$heap}_{funcstart\_724,1}.p1 \% 177))
[Take given term]
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[24.0]!(0 == asType < integer > (div1.rem)) || !(0 ==
asType<integer>(div1.quot))
\rightarrow [from term 11.6, div1 is equal to div(heapIs $heap_{funcstart\_724,1},
heap_{funcstart_{724,1}}.p1, 177
[24.1]!(0 == asType < integer > (div(heapIs $heap_{funcstart\_724,1},
heap_{funcstart_724,1}.p1, 177).rem) | | !(0 == asType < integer > (div1.quot))
\rightarrow [simplify]
[24.2] ! (0 == div(\mathbf{heapIs} \$heap_{funcstart\_724.1}, \$heap_{funcstart\_724.1}.p1,
177).rem) ||!(0 == asType < integer > (div1.quot))|
\rightarrow [from term 11.6, div1 is equal to div(heapIs $heap_{funcstart\_724,1},
heap_{funcstart_{-724,1}}.p1, 177)
[24.3] ! (0 == \operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}. \operatorname{p1},
177).rem) || !(0 == asType < integer) > (div(heapIs $heap_{funcstart_{724.1}}, 
\theta_{funcstart\_724,1}.p1, 177).quot)
\rightarrow [simplify]
[24.5] ! (0 == \operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724,1}, \$ \operatorname{heap}_{funcstart\_724,1}.\operatorname{p1},
177).quot) \vee !(0 == \operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724,1}, \$ \operatorname{heap}_{funcstart\_724,1}.p1,
177).rem)
[Branch on disjunction or conditional in term 24.5]
[53.0] ! (0 == \operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724,1}, \$ \operatorname{heap}_{funcstart\_724,1}.\operatorname{p1},
177).quot) \vee !(0 == \operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724,1}, \$ \operatorname{heap}_{funcstart\_724,1}.p1,
177).rem) \vee (0 == div(heapIs $heap_{funcstart\_724,1}, $heap_{funcstart\_724,1}.p1,
177).quot)
[Copy term 1.38]
[58.0] \ 32767 < ((-2 * \mathrm{div}(\mathbf{heapIs} \ \$ \mathrm{heap}_{funcstart\_724,1}, \ \$ \mathrm{heap}_{funcstart\_724,1}.\mathrm{p1},
177).quot) + (171 * div(heapIs heapIs = f_{uncstart_{-724,1}}, heap_{funcstart_{-724,1}}.p1,
177).rem))
\rightarrow [from\ term\ 15.17,\ div(\textbf{heapIs}\ \$heap_{funcstart\_724,1},\ \$heap_{funcstart\_724,1}.p1,
177).rem is equal to heap_{funcstart_{-724,1}}.p1 \% 177
[58.1] 32767 < ((-2 * div(heapIs p_{funcstart\_724,1}, p_{funcstart\_724,1}.p_{funcstart\_724,1})
177).quot) + (171 * (\text{$heap}_{funcstart\_724,1.p1 \% 177})))
[Copy term 53.0]
[59.0]!(0 == \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_724,1}, \text{\$heap}_{funcstart\_724,1}.p1,
177).quot) \vee !(0 == \operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724,1}, \$ \operatorname{heap}_{funcstart\_724,1}.p1,
177).rem) \vee (0 == div(heapIs $heap_{funcstart\_724,1}, $heap_{funcstart\_724,1}.p1,
177).quot)
\rightarrow [from term 14.17, div(heapIs $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1,
177).<br/>quot is equal to heap_{funcstart\_724,1}.p1 / 177
```

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[59.1]!(0 == (\text{$heap}_{funcstart\_724,1}.p1 / 177)) \lor ...
[Create new term from term 14.17 using rule: condition for equality of division]
[61.0] ((177 * (0 + -(-\text{div}(\mathbf{heapIs} \$heap_{funcstart\_724,1},
\text{Sheap}_{funcstart_{-724,1}}.\text{p1}, 177).\text{quot}))) < (1 + \text{Sheap}_{funcstart_{-724,1}}.\text{p1})) \land
(\text{$heap}_{funcstart\_724,1}.\text{p1} < (177 * (0 + 1 + -(-div(\textbf{heapIs}))))
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.\text{p1}, 177).\text{quot}))))
\rightarrow [simplify]
[61.15] (-1 < ((-177 * div(heapIs $heap_{funcstart\_724.1}, $heap_{funcstart\_724.1}.p1,
177).quot) + heap_{funcstart_{-724,1}.p1}) \land (-177 < (-heap_{funcstart_{-724,1}.p1} + function))
(177 * div(\mathbf{heapIs} \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1, 177).quot)))
\rightarrow [separate conjunction and work on first sub-term]
[61.16] -177 < (-$heap_{funcstart\_724,1}.p1 + (177 * div(heapIs
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.p1, 177).quot)
[Create new term from term 59.1 using rule: condition for inequality of
division]
[65.0] (!((0 * 177) < (1 + $heap_{funcstart\_724,1}.p1)) \vee !($heap_{funcstart\_724,1}.p1)
< (177 * (0 + 1))) \lor !(0 == div(heapIs \$heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1}.\text{p1}, 177).\text{rem}) \vee (0 == \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
heap_{funcstart\_724,1}.p1, 177).quot
\rightarrow [simplify]
[65.3] (!(-1 < $heap_{funcstart_724,1}.p1) \vee !($heap_{funcstart_724,1}.p1 < (177 * (0 +
1)))) ∨ ...
\rightarrow [from term 8.0, literala < $heap_{funcstart\_724,1}.p1 is true whenever (-1 +
literala) < 0
    Proof of rule precondition:
    [65.3.0](-1+-1)<0
    \rightarrow [simplify]
    [65.3.2] true
[65.4] (!true \vee !($heap_{funcstart_724,1}.p1 < (177 * (0 + 1)))) \vee ...
\rightarrow [simplify]
[65.14] (176 < \text{$heap}_{funcstart\_724,1.p1}) \lor \dots
[Create new term from terms 65.14, 61.16 using rule: transitivity 3]
[66.0] ((-177 + 1 + 176) < (177 * div(heapIs $heap_{tuncstart\_724.1},
\text{Sheap}_{funcstart\_724,1}.\text{p1}, 177).\text{quot})) \vee !(0 == \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1}.\text{p1}, 177).\text{rem}) \vee (0 == \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
heap_{funcstart_{-724,1}}.p1, 177).quot
\rightarrow [simplify]
```

```
[66.1] (0 < (177 * div(heapIs heap_{funcstart_{-724,1}}, heap_{funcstart_{-724,1}}.p1,
177).quot)) ∨ ...
\rightarrow [product is positive]
[66.2] (((0 < 177) \land (0 < div(heapIs $heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1}.\text{p1}, 177).\text{quot})) \lor ((177 < 0) \land (\text{div}(\textbf{heapIs}))
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.\text{p1}, 177).\text{quot} < 0))) \lor ...
\rightarrow [simplify]
[66.7] (0 < div(heapIs $heap_{funcstart\_724,1}, $heap_{funcstart\_724,1}.p1, 177).quot)
[Create new term from terms 66.7, 58.1 using rule: transitivity 11]
[68.0] ((1 + 32767 + (0 * 2)) < (171 * ($heap_{funcstart\_724,1}.p1 % 177))) \vee !(0
== div(heapIs heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p1, 177).rem) \vee (0
== \operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724,1}, \$ \operatorname{heap}_{funcstart\_724,1}.p1, 177).\operatorname{quot})
\rightarrow [simplify]
[68.2] (32768 < (171 * ($heap_{funcstart_724.1}.p1 % 177))) \vee \dots
\rightarrow [literal comparison of product]
[68.3] \; ([171<0]: \; (32768 \; / \; -171) < -(\$ \mathrm{heap}_{funcstart\_724,1}.\mathrm{p1} \; \% \; 177), \; [0<171]: \;
(32768 \ / \ 171) < (\$ heap_{funcstart\_724,1}.p1 \ \% \ 177), \ [0 == 171]: \ 32768 < 0) \ \lor \dots
→ [explicitly assert falsehood of skipped guards in subsequent guards]
[68.4] ([171 < 0]: (32768 / -171) < -($heap_{funcstart\_724,1}.p1 % 177), [(0 <
171) \land !(171 < 0)]: (32768 / 171) < ($heap_{funcstart\_724,1}.p1 % 177), [(0 ==
171) \land !(0 < 171) \land !(171 < 0)]: 32768 < 0) \lor ...
\rightarrow [simplify]
[68.13] false \vee ...
[Remove 'false' term 68.13 and fetch new term from containing clause]
[71.0] 0 == \text{div}(\text{heapIs } \text{$heap}_{funcstart\_724,1}, \text{$heap}_{funcstart\_724,1}.\text{p1}, 177).\text{quot}
[Copy term 1.38]
[58.1] 32767 < ((-2 * div(heapIs $heap_{funcstart\_724,1}, $heap_{funcstart\_724,1}.p1,
177).quot) + (171 * (\text{$heap}_{funcstart\_724,1}.\text{p1} \% 177)))
\rightarrow [from\ term\ 71.0,\ div(\textbf{heapIs}\ \$heap_{funcstart\_724,1},\ \$heap_{funcstart\_724,1}.p1,
177).quot is equal to 0]
[58.2] 32767 < ((-2 * 0) + (171 * (\$heap_{funcstart\_724,1}.p1 \% 177)))
\rightarrow [simplify]
[58.4] 32767 < (171 * (\$heap_{funcstart\_724,1}.p1 \% 177))
\rightarrow [literal comparison of product]
[58.5] ([171 < 0]: (32767 / -171) < -(\$heap_{funcstart\_724,1}.p1 \% 177), [0 < 171]:
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(32767 / 171) < (\text{\$heap}_{funcstart\_724,1}.\text{p1} \% 177), [0 == 171]: 32767 < 0)
\rightarrow [explicitly assert falsehood of skipped guards in subsequent guards]
[58.6] ([171 < 0]: (32767 / -171) < -($heap_{funcstart\_724,1}.p1 % 177), [(0 <
171) \land !(171 < 0)]: (32767 / 171) < ($heap_{funcstart\_724,1}.p1 % 177), [(0 ==
171) \land !(0 < 171) \land !(171 < 0)]: 32767 < 0)
\rightarrow [simplify]
[58.15] false
Proof of verification condition: Assertion valid
Condition generated at: C:\Escher\Customers\prang\prang.c (57,31)
To prove: asType < integer > (\$heap_{724,1;740,8}.p1) < 
asType<integer>($heap<sub>724,1:740,8</sub>.M1)
Given:
heap_{init}.LIMIT == (int)80
\theta sheap<sub>init</sub>.M1 == asType<short int>((int)30269)
\theta
\theta
\theta
heap_{init}.M2 == asType < short int > ((int)30307)
heap_{init}.r2 == asType < short int > ((int)172)
heap_{init}.a2 == asType < short int > ((int)176)
\theta
heap_{init}.M3 == asType < short int > ((int)30323)
\theta
heap_{init}.a3 == asType < short int > ((int)178)
\theta = asType < short int > ((int)63)
\theta = asType < short int > ((int)1)
\theta
\theta = asType < short int > ((int)3)
invariant1(heapIs heap_{funcstart_{-724,1}})
\operatorname{div1} == \operatorname{div}(\mathbf{heapIs} \ \operatorname{\$heap}_{funcstart\_724,1},
\mathbf{asType} < \mathbf{int} > (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p1}),
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{a1}))
(\mathbf{asType}{<}\mathbf{integer}{>}(\mathbf{asType}{<}\mathbf{int}{>}(\$\mathbf{heap}_{funcstart\_724,1}.\mathbf{p1})) \ / \\
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asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a1))) = =
asType<integer>(div1.quot)
(\mathbf{asType}{<}\mathbf{int}{>}(\mathbf{asType}{<}\mathbf{int}{>}(\$\mathbf{heap}_{funcstart\_724,1}.\mathbf{p1}))~\%
\mathbf{asType}{<}\mathbf{integer}{>}(\mathbf{asType}{<}\mathbf{int}{>}(\$\mathbf{heap}_{funcstart\_724,1}.\mathbf{a1}))) = =
asType<integer>(div1.rem)
!(0 == asType < integer > (div1.rem)) || !(0 ==
asType<integer>(div1.quot))
div2 == div(\mathbf{heapIs} \$heap_{funcstart\_724,1},
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p2}),
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{a2}))
(asType<integer>(asType<int>($heap_{tuncstart\_724.1}.p2)) /
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a2))) = =
asType<integer>(div2.quot)
(\mathbf{asType}{<}\mathbf{int}{>}(\mathbf{asType}{<}\mathbf{int}{>}(\$\mathbf{heap}_{funcstart\_724,1}.\mathbf{p2}))~\%
\mathbf{asType} < \mathbf{integer} > (\mathbf{asType} < \mathbf{int} > (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{a2}))) = =
asType<integer>(div2.rem)
!(0 == asType < integer > (div2.rem)) || !(0 ==
asType<integer>(div2.quot))
div3 == div(\mathbf{heapIs} \$ heap_{funcstart\_724,1},
\mathbf{asType} < \mathbf{int} > (\$ \mathrm{heap}_{funcstart\_724,1}.\mathrm{p3}),
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{a3}))
(asType<integer>(asType<int>($heap_{tuncstart\_724.1}.p3)) /
asType < integer > (asType < int > (\$heap_{funcstart, 724,1}, a3))) = =
asType<integer>(div3.quot)
(\mathbf{asType}{<}\mathbf{integer}{>}(\mathbf{asType}{<}\mathbf{int}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{p3}))\ \%
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a3))) = =
asType<integer>(div3.rem)
!(0 == asType < integer > (div3.rem)) || !(0 ==
asType<integer>(div3.quot))
$heap_{724,1;740,8} == $heap_{funcstart\_724,1}.\_replace(p1 \rightarrow asType < short)
int>((asType<int>(asType<short int>(div1.rem)) *
\mathbf{asType} \hspace{-0.1em}<\hspace{-0.1em} \mathbf{int} \hspace{-0.1em}> \hspace{-0.1em} (\$ \mathrm{heap}_{funcstart\_724,1}.\mathrm{r1})) - (\mathbf{asType} \hspace{-0.1em}<\hspace{-0.1em} \mathbf{int} \hspace{-0.1em}> \hspace{-0.1em} (\mathbf{asType} \hspace{-0.1em}<\hspace{-0.1em} \mathbf{short})
int>(div1.quot)) * asType< int>($heap_{tuncstart\_724.1}.b1))))
-asType<integer const>($heap<sub>724.1:740.8</sub>.M1) <
asType<integer>($heap<sub>724.1:740.8</sub>.p1)
!(0 == asType < integer > (\$heap_{724,1;740,8}.p1))
Proof:
[Take given term]
[5.0] invariant1(heapIs heapIs
```

```
\rightarrow [expand definition of function 'invariant1' at prang.c (34,1)]
[5.1] ((((((0 < asType < integer > ($heap_{funcstart\_724,1}.p1)) &&
(asType < integer > (\$heap_{funcstart\_724,1}.p1) <
as
Type<integer>(\rho_{funcstart\_724,1}.M1))) & (0 <
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p2})))\ \&\&
(\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{p2}) <
asType < integer > (\$heap_{funcstart\_724,1}.M2))) \&\& (0 <
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{p3}))) \ \&\&
(asType < integer > (\$heap_{funcstart\_724.1}.p3) < 
asType<integer>($heap_funcstart_724,1.M3))
\rightarrow [simplify]
[5.3] \ (((((0 < \$heap_{funcstart\_724,1}.p1) \&\& \ (\$heap_{funcstart\_724,1}.p1 < (
as
Type<integer>(\rho_{funcstart\_724,1}.M1))) & (0 <
asType < integer > (\$heap_{funcstart\_724,1}.p2))) \&\&
(\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{p2}) <
asType < integer > (\$heap_{funcstart\_724,1}.M2))) \&\& (0 < funcstart\_724,1.M2))
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p3})))\ \&\&
(asType<integer>($heap_funcstart_724.1.p3) <
asType < integer > (\$heap_{funcstart\_724,1}.M3))
\rightarrow [const static or extern object]
[5.4] (((((0 < $heap_{funcstart_{724,1}}.p1) && ($heap_{funcstart_{724,1}}.p1 < 
asType < integer > (\$heap_{init}.M1))) \&\& (0 <
asType < integer > (\$heap_{funcstart\_724,1}.p2))) \&\&
(asType < integer > (\$heap_{funcstart\_724,1}.p2) <
asType < integer > (\$heap_{funcstart\_724,1}.M2))) \&\& (0 <
asType < integer > (\$heap_{funcstart\_724,1}.p3))) \&\&
(\mathbf{asType} < \mathbf{integer} > (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p3}) <
asType < integer > (\$heap_{funcstart\_724,1}.M3))
\rightarrow [expand definition of constant 'M1' at prang.c (14,20)]
[5.5] (((((0 < \text{heap}_{funcstart\_724,1}.p1) && (\text{heap}_{funcstart\_724,1}.p1 <
asType<integer>(asType<short int>((int)30269)))) && (0 <
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{p2})))\ \&\&
(asType < integer > ($heap_{funcstart\_724,1}.p2) < 
asType < integer > (\$heap_{funcstart\_724,1}.M2))) \&\& (0 <
asType < integer > (\$heap_{funcstart\_724,1}.p3))) \&\&
(\mathbf{asType} < \mathbf{integer} > (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p3}) <
asType < integer > (\$heap_{tuncstart_{-724.1}}.M3))
\rightarrow [simplify]
|5.16| \; ((((-30269 < -\$heap_{funcstart\_724,1}.p1) \; \land \; (0 < \$heap_{funcstart\_724,1}.p1) \; \land 
(0 < \text{\$heap}_{funcstart\_724,1}.p2)) \&\& (\text{\$heap}_{funcstart\_724,1}.p2 <
\mathbf{asType} \small{<} \mathbf{integer} \small{>} (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{M2}))) \ \&\& \ (0 <
asType < integer > (\$heap_{funcstart\_724,1}.p3))) \&\&
```

```
(\mathbf{asType} {<} \mathbf{integer} {>} (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p3}) <
asType < integer > (\$heap_{funcstart\_724,1}.M3))
\rightarrow [const static or extern object]
[5.17] \; ((((-30269 < -\$heap_{funcstart\_724,1}.p1) \; \land \; (0 < \$heap_{funcstart\_724,1}.p1) \; \land 
(0 < \text{\$heap}_{funcstart\_724,1}.\text{p2})) && (\text{\$heap}_{funcstart\_724,1}.\text{p2} <
asType < integer > ($heap_{init}.M2))) \&\& (0 <
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p3})))\ \&\&
(asType<integer>($heap_{tuncstart\_724,1}.p3) <
asType < integer > (\$heap_{funcstart\_724,1}.M3))
\rightarrow [expand definition of constant 'M2' at prang.c (19,20)]
[5.18] ((((-30269 < -\$heap_{tuncstart\_724.1}.p1) \land (0 < \$heap_{tuncstart\_724.1}.p1) 
(0 < \mathrm{\$heap}_{funcstart\_724,1}.\mathrm{p2})) && ( \mathrm{\$heap}_{funcstart\_724,1}.\mathrm{p2} <
asType<integer>(asType<short int>((int)30307)))) && (0 <
asType < integer > (\$heap_{funcstart\_724,1}.p3))) \&\&
(asType < integer > ($heap_{funcstart\_724,1}.p3) < 
asType < integer > (\$heap_{funcstart\_724,1}.M3))
\rightarrow [simplify]
[5.30] ((-30307 < -$heap<sub>funcstart_724,1.</sub>p2) \land (-30269 <
-\$heap_{funcstart\_724,1}.p1) \land (0 < \$heap_{funcstart\_724,1}.p1) \land (0 < \$heap_{funcstart\_724,1}.p1)
\text{Sheap}_{funcstart_{724,1}.p2} \land (0 < \text{Sheap}_{funcstart_{724,1}.p3})) \&\&
(\text{\$heap}_{funcstart\_724,1}.p3 < asType < integer > (\text{\$heap}_{funcstart\_724,1}.M3))
\rightarrow [const static or extern object]
[5.31] ((-30307 < -$heap<sub>funcstart_724,1.</sub>p2) \land (-30269 <
-\$heap_{funcstart\_724,1}.p1) \land (0 < \$heap_{funcstart\_724,1}.p1) \land (0 < \$heap_{funcstart\_724,1}.p1)
\theta_{funcstart\_724,1}.p2) \land (0 < \theta_{funcstart\_724,1}.p3)) \&\&
(\text{\$heap}_{funcstart\_724,1}.\text{p3} < \text{asType} < \text{integer} > (\text{\$heap}_{init}.\text{M3}))
\rightarrow [expand definition of constant 'M3' at prang.c (24,20)]
[5.32] ((-30307 < -$heap<sub>funcstart_724,1.</sub>p2) \land (-30269 <
 -\$heap_{funcstart\_724,1}.p1) \land (0 < \$heap_{funcstart\_724,1}.p1) \land (0 < \$heap_{funcstart\_724,1}.p1)
\text{Sheap}_{funcstart\_724,1.p2}) \land (0 < \text{Sheap}_{funcstart\_724,1.p3})) \&\&
(\$heap_{funcstart\_724,1}.p3 < \mathbf{asType} < \mathbf{integer} > (\mathbf{asType} < \mathbf{short}
int > ((int)30323))
\rightarrow [simplify]
[5.40] (-30323 < -\$heap_{funcstart\_724,1.p3}) \land (-30307 <
-\$heap_{funcstart\_724,1}.p2) \wedge (-30269 < -\$heap_{funcstart\_724,1}.p1) \wedge (0 <
\text{Sheap}_{funcstart\_724,1}.\text{p1}) \land (0 < \text{Sheap}_{funcstart\_724,1}.\text{p2}) \land (0 <
heap_{funcstart_{724,1}.p3}
[Work on sub-term 4 of conjunction in term 5.40]
[8.0] 0 < \text{$heap}_{funcstart\_724,1}.p1
```

```
[Take given term]
[11.0] \operatorname{div1} == \operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724,1},
asType < int > (\$heap_{funcstart\_724,1}.p1),
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{a1}))
\rightarrow [simplify]
[11.1] \operatorname{div1} == \operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724,1}, \$ \operatorname{heap}_{funcstart\_724,1}.p1,
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{a1}))
\rightarrow [const static or extern object]
[11.2] \operatorname{div1} == \operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724,1}, \$ \operatorname{heap}_{funcstart\_724,1}.p1,
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{init}.\mathrm{a1}))
\rightarrow [expand definition of constant 'a1' at prang.c (16,20)]
[11.3] \ \mathrm{div1} == \mathrm{div}(\mathbf{heapIs} \ \$ \mathrm{heap}_{funcstart\_724,1}, \ \$ \mathrm{heap}_{funcstart\_724,1}.\mathrm{p1},
asType<int>(asType<short int>((int)177)))
\rightarrow [simplify]
[11.6] \text{ div1} == \text{div}(\text{heapIs } \text{$heap}_{funcstart\_724,1}, \text{$heap}_{funcstart\_724,1}.\text{p1}, 177)
[Assume known post-assertion, class invariant or type constraint for term 11.6]
[14.0] (asType<integer>($heap_{tuncstart\_724.1}.p1) /
asType<integer>(177)) == asType<integer>(div(heapIs
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.p1, 177).quot
\rightarrow [simplify]
[14.2] ($heap_{funcstart\_724,1}.p1 / 177) == asType < integer > (div(heapIs
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.p1, 177).quot
→ [expand definition of operator './' in class 'int' at built in declaration]
[14.3] ([asType<integer>(heap_{funcstart\_724,1}.p1) < 0]:
-(-asType < integer > (\$heap_{funcstart\_724.1}.p1) / 177), []:
asType < integer > (\$heap_{funcstart\_724,1}.p1) / 177) ==
asType<integer>(div(heapIs heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p1,
177).quot)
→ [explicitly assert falsehood of skipped guards in subsequent guards]
[14.4] ([asType<integer>($heap_{funcstart\_724,1}.p1) < 0]:
-(-asType < integer > (\$heap_{funcstart\_724,1}.p1) / 177),
[!(\mathbf{asType} < \mathbf{integer} > (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p1}) < 0)]:
asType < integer > (\$heap_{funcstart\_724,1}.p1) / 177) ==
\mathbf{asType} {<} \mathbf{integer} {>} ( \mathbf{div} (\mathbf{heapIs} \ \$ \mathbf{heap}_{funcstart\_724,1}, \ \$ \mathbf{heap}_{funcstart\_724,1}. \mathbf{p1}, \\
177).quot)
\rightarrow [simplify]
[14.7] ([0 < -$heap<sub>funcstart_724,1</sub>.p1]:
-(-asType < integer > (\$heap_{funcstart\_724,1}.p1) / 177),
```

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[!(\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathbf{heap}_{funcstart\_724,1}.\mathbf{p1})<0)]:
asType < integer > (\$heap_{funcstart\_724,1}.p1) / 177) ==
\mathbf{asType} {<} \mathbf{integer} {>} ( \mathbf{div} (\mathbf{heapIs} \ \$ \mathbf{heap}_{funcstart\_724,1}, \ \$ \mathbf{heap}_{funcstart\_724,1}. \mathbf{p1}, \\
177).quot)
\rightarrow [from term 8.0, literala < -$heap<sub>funcstart_724.1</sub>.p1 is false whenever -2 < (0
+ literala)]
        Proof of rule precondition:
        [14.7.0] - 2 < (0 + 0)
        \rightarrow [simplify]
        [14.7.2] true
[14.8] ([false]: -(-asType < integer > (\$heap_{funcstart\_724,1}.p1) / 177),
[!(\mathbf{asType} < \mathbf{integer} > (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p1}) < 0)]:
asType < integer > (\$heap_{funcstart\_724.1}.p1) / 177) = =
asType<integer>(div(heapIs heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p1,
177).quot)
\rightarrow [simplify]
[14.11] \; ([{\bf false}]: \; -({\bf -asType}{<} {\bf integer}{>} (\$ {\rm heap}_{funcstart\_724,1}.{\rm p1}) \; / \; 177), \; [!(0 < {\rm parter})] \; ([{\bf false}]: \; -({\bf -asType}{<} {\bf integer}{>} (\$ {\rm heap}_{funcstart\_724,1}.{\rm p1}) \; / \; 177), \; [!(0 < {\bf -asType}{<} {\bf integer}{>} (\$ {\bf -asType}{<} {\bf
-\$heap_{funcstart\_724,1}.p1): asType<integer>(\$heap_{funcstart\_724,1}.p1) / 177)
== asType < integer > (div(heapIs $heap_{funcstart\_724,1},
heap_{funcstart_{-724,1}}.p1, 177).quot
\rightarrow [from term 8.0, literala < -$heap<sub>funcstart_724,1</sub>.p1 is false whenever -2 < (0
+ literala)]
        Proof of rule precondition:
        [14.11.0] - 2 < (0 + 0)
        \rightarrow [simplify]
        [14.11.2] true
[14.12] ([false]: -(-asType < integer > (\$heap_{funcstart\_724,1}.p1) / 177),
[!false]: asType<integer>($heap<sub>funcstart_724,1.</sub>p1) / 177) ==
asType<integer>(div(heapIs heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p1,
177).quot)
\rightarrow [simplify]
 [14.17] \ 0 == (-\mathrm{div}(\mathbf{heapIs} \ \$ \mathrm{heap}_{funcstart\_724,1}, \ \$ \mathrm{heap}_{funcstart\_724,1}.\mathrm{p1},
177).quot + (\text{$heap}_{funcstart\_724,1}.p1 / 177))
[Assume known post-assertion, class invariant or type constraint for term 11.6]
[15.0] (asType<integer>(sheap_{funcstart\_724,1}.p1) %
asType<integer>(177)) == asType<integer>(div(heapIs
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.\text{p1}, 177).\text{rem}
\rightarrow [simplify]
```

```
[15.2] (\text{heap}_{tuncstart-724.1}.p1 % 177) == asType<integer>(div(heapIs)
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.\text{p1}, 177).\text{rem}
→ [expand definition of operator '.%' in class 'int' at built in declaration]
[15.3] ([asType<integer>(sheap_{funcstart\_724,1}.p1) < 0]:
-(-asType < integer > (\$heap_{funcstart\_724,1}.p1) \% 177), []:
asType < integer > (\$heap_{funcstart\_724.1}.p1) \% 177) ==
asType<integer>(div(heapIs $heap_{tuncstart\_724,1}, $heap_{tuncstart\_724,1}.p1,
177).rem)
→ [explicitly assert falsehood of skipped guards in subsequent guards]
[15.4] ([asType<integer>($heap_{funcstart\_724,1}.p1) < 0]:
-(-asType < integer > (\$heap_{funcstart\_724.1}.p1) \% 177),
[!(asType < integer > (\$heap_{funcstart\_724,1}.p1) < 0)]:
asType < integer > (\$heap_{funcstart\_724,1}.p1) \% 177) ==
asType<integer>(div(heapIs p_{funcstart\_724,1}, p_{funcstart\_724,1}),
177).\text{rem}
\rightarrow [simplify]
[15.7] ([0 < -$heap<sub>funcstart_724,1.</sub>p1]:
-(-asType < integer > (\$heap_{funcstart\_724,1}.p1) \% 177),
[!(asType < integer > (\$heap_{funcstart\_724,1}.p1) < 0)]:
asType<integer>($heap_{funcstart\_724,1}.p1) \% 177) ==
asType<integer>(div(heapIs p_{funcstart\_724,1}, p_{funcstart\_724,1}),
177).rem)
\rightarrow [from term 8.0, literala < -$heap<sub>funcstart_724,1</sub>.p1 is false whenever -2 < (0
+ literala)]
   Proof of rule precondition:
   [15.7.0] - 2 < (0 + 0)
   \rightarrow [simplify]
   [15.7.2] true
[15.8] ([false]: -(-asType < integer > (\$heap_{funcstart\_724,1}.p1) \% 177),
[!(asType < integer > (\$heap_{funcstart\_724.1}.p1) < 0)]:
asType < integer > (\$heap_{funcstart\_724,1}.p1) \% 177) ==
asType<integer>(div(heapIs $heap_{funcstart\_724,1}, $heap_{funcstart\_724,1}.p1,
177).rem)
\rightarrow [simplify]
[15.11] ([false]: -(-asType < integer > (\$heap_{funcstart\_724,1}.p1) \% 177), [!(0
< -$heap<sub>funcstart_724.1</sub>.p1)]: asType<integer>($heap<sub>funcstart_724.1</sub>.p1) %
177) == asType<integer>(div(heapIs heap_{funcstart\_724,1},
heap_{funcstart_{-724,1}.p1, 177}.rem
\rightarrow [from term 8.0, literala < -$heap<sub>funcstart_724,1</sub>.p1 is false whenever -2 < (0
```

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+ literala)]
                Proof of rule precondition:
                [15.11.0] - 2 < (0 + 0)
                \rightarrow [simplify]
                [15.11.2] true
[15.12] ([false]: -(-asType < integer > (\$heap_{funcstart\_724,1}.p1) \% 177),
[!false]: asType<integer>(sheap_{funcstart\_724,1.p1}) \% 177 ==
asType<integer>(div(heapIs $heap_{tuncstart\_724.1}, $heap_{tuncstart\_724.1}.p1,
177).rem)
\rightarrow [simplify]
[15.17] \ 0 == (-\text{div}(\mathbf{heapIs} \ \$ \text{heap}_{funcstart\_724,1}, \ \$ \text{heap}_{funcstart\_724,1}.\text{p1},
177).rem + (\text{$heap}_{funcstart\_724,1}.p1 \% 177))
[Take given term]
[24.0]!(0 == asType < integer > (div1.rem)) || !(0 ==
asType<integer>(div1.quot))
\rightarrow [from term 11.6, div1 is equal to div(heapIs $heap_{funcstart_724,1},
heap_{funcstart_{-724,1}}.p1, 177)
[24.1] !(0 == asType < integer) (div(heapIs $heap_{funcstart\_724,1}, 
\label{eq:linear_funcstart_724,1.p1,177).rem} ) \mid \mid ! (0 == \mathbf{asType} < \mathbf{integer} > (\mathbf{div1.quot})) \\
\rightarrow [simplify]
[24.2] ! (0 == \operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724,1}, \$ \operatorname{heap}_{funcstart\_724,1}. \operatorname{p1},
177).rem) ||!(0 == asType < integer > (div1.quot))|
\rightarrow [from term 11.6, div1 is equal to div(heapIs $heap_{funcstart\_724,1},
heap_{funcstart_{-724,1}}.p1, 177
\label{eq:constant_724,1} \cite{24.3} \c
177).rem) || !(0 == asType < integer) = (div(heapIs \$heap_{funcstart\_724,1}, 
heap_{funcstart_{-724,1}}.p1, 177).quot)
\rightarrow [simplify]
\label{eq:constant_724,1} \cite{24.5} \c
177).quot) \vee!(0 == div(heapIs $heap_{funcstart\_724,1}, $heap_{funcstart\_724,1}.p1,
177).rem)
[Take given term]
[53.0] \rho_{1740,8} == \rho_{1740,8} == \rho_{1740,8} == \rho_{1740,8} - \rho_{1740,8} == \rho_{1740,8} == \rho_{1740,8} - \rho_{1740,8} == \rho_{1740,8} 
int>((asType<int>(asType<short int>(div1.rem)) *
\mathbf{asType} {<} \mathbf{int} {>} (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{r1})) - (\mathbf{asType} {<} \mathbf{int} {>} (\mathbf{asType} {<} \mathbf{short}
\mathbf{int}{>}(\mathbf{div1.quot})) \ * \ \mathbf{asType}{<} \mathbf{int}{>} (\$\mathbf{heap}_{funcstart\_724,1}.\mathbf{b1}))))
\rightarrow [from term 11.6, div1 is equal to div(heapIs $heap_{funcstart\_724,1},
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heap_{funcstart_{-724,1}}.p1, 177
[53.1] heap_{724,1:740,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow asType<short
int>((asType<int>(asType<short int>(div(heapIs $heap_{funcstart\_724,1},
\theta_{funcstart\_724,1.p1, 177).rem} * asType<int>($\text{heap}_{funcstart\_724,1.r1}) - 3\text{r1}
(asType<int>(asType<short int>(div1.quot)) *
asType < int > (\$heap_{funcstart\_724.1}.b1))))
\rightarrow [simplify]
[53.3] \text{heap}_{724,1;740,8} == \text{heap}_{funcstart\_724,1}._replace(p1 \rightarrow asType<short
int>((div(heapIs \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1, 177).rem *
asType < int > (\$heap_{funcstart\_724,1}.r1)) - (asType < int > (asType < short)
int>(div1.quot)) * asType< int>($heap_{funcstart\_724,1}.b1))))
\rightarrow [const static or extern object]
[53.4] \rho_{13,1;740,8} == \rho_{13,1;740,8} == \rho_{13,1;740,8} =- \rho_{
int>((div(heapIs \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1, 177).rem *
asType < int > (\$heap_{init}.r1)) - (asType < int > (asType < short)
\mathbf{int}{>}(\mathbf{div1.quot})) * \mathbf{asType}{<} \mathbf{int}{>} (\$\mathbf{heap}_{funcstart\_724,1}.\mathbf{b1}))))
\rightarrow [expand definition of constant 'r1' at prang.c (15,20)]
[53.5] heap_{724,1:740,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow asType<short
int>((div(heapIs \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1, 177).rem *
asType < int > (asType < short int > ((int)171))) -
(asType < int > (asType < short int > (div1.quot)) *
asType < int > (\$heap_{funcstart\_724,1}.b1)))
\rightarrow [simplify]
[53.8] heap_{724,1;740,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow asType<short
int>((div(heapIs \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1, 177).rem * 171)
- (asType<int>(asType<short int>(div1.quot)) *
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{b1}))))
\rightarrow [from term 11.6, div1 is equal to div(heapIs $heap_{funcstart\_724,1},
heap_{funcstart_{-724,1}}.p1, 177
[53.9] \text{sheap}_{724,1;740,8} == \text{sheap}_{funcstart\_724,1}._replace(p1 \rightarrow asType<short
int>((171 * div(heapIs $heap_{funcstart\_724,1}, $heap_{funcstart\_724,1}.p1, 177).rem)
- (asType<int>(asType<short int>(div(heapIs $heap_{funcstart_724.1},
heap_{funcstart_{724,1},p1, 177}, quot)) *
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{b1}))))
\rightarrow [simplify]
[53.11] heap_{724,1;740,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow asType<short
\mathbf{int} > ((171 * \operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724,1}, \$ \operatorname{heap}_{funcstart\_724,1}.\operatorname{p1}, 177).\operatorname{rem})
- (\text{div}(\mathbf{heapIs} \$ \text{heap}_{funcstart\_724,1}, \$ \text{heap}_{funcstart\_724,1}.\text{p1}, 177).\text{quot} *
asType < int > (\$heap_{funcstart\_724,1}.b1))))
\rightarrow [const static or extern object]
```

```
[53.12] heap_{724,1;740,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow asType<short
int>((171 * div(heapIs $heap_{funcstart\_724,1}, $heap_{funcstart\_724,1}.p1, 177).rem)
 - (\text{div}(\mathbf{heapIs} \$ \text{heap}_{funcstart\_724,1}, \$ \text{heap}_{funcstart\_724,1}.\text{p1}, 177).\text{quot} *
asType < int > (\$heap_{init}.b1)))
\rightarrow [expand definition of constant 'b1' at prang.c (17,20)]
[53.13] \theta_{13} = \theta_
int>((171 * div(heapIs $heap_{funcstart_724,1}, $heap_{funcstart_724,1}.p1, 177).rem)
- (\text{div}(\mathbf{heapIs} \$ \text{heap}_{funcstart\_724,1}, \$ \text{heap}_{funcstart\_724,1}.\text{p1}, 177).\text{quot} *
asType<int>(asType<short int>((int)2))))
\rightarrow [simplify]
[53.19] $heap<sub>724,1;740,8</sub> == $heap<sub>funcstart_724,1</sub>._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.p1, \ 177).rem)))
[Take goal term]
[1.0] asType<integer>($heap_{724,1;740,8}.p1) <
asType<integer>($heap<sub>724.1:740.8</sub>.M1)
\rightarrow [from term 53.19, $heap<sub>724,1;740.8</sub> is equal to
heap_{funcstart\_724.1}._replace(p1 \rightarrow (-2 * div(heapIs $heap_{funcstart\_724.1},
heap_{funcstart_{724,1},p1, 177}, quot) + (171 * div(heapIs p_{funcstart_{724,1},p1, 177}).
heap_{funcstart_{-724,1}}.p1, 177).rem)
[1.1] asType<integer>(heap_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 *
div(\mathbf{heapIs} \ \$heap_{funcstart\_724.1}, \ \$heap_{funcstart\_724.1}.p1, \ 177).quot) + (171 *
div(\mathbf{heapIs} \ \$heap_{funcstart\_724,1}, \ \$heap_{funcstart\_724,1}.p1, \ 177).rem))).p1) <
asType<integer>($heap<sub>724.1:740.8</sub>.M1)
\rightarrow [simplify]
[1.3] ((-2 * div(heapIs heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p1, 177).quot)
+ (171 * div(\mathbf{heapIs} \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1, 177).rem)) < 
asType<integer>($heap<sub>724.1:740.8</sub>.M1)
\rightarrow [from term 53.19, $heap<sub>724,1;740,8</sub> is equal to
heap_{funcstart\_724.1}._replace(p1 \rightarrow (-2 * div(heapIs $heap_{funcstart\_724.1},
heap_{funcstart_{-724,1},p1, 177}, quot) + (171 * div(heapIs heap_{funcstart_{-724,1},p1, 177})
heap_{funcstart_{-724,1}}.p1, 177).rem)
[1.4] ((-2 * div(heapIs $heap_{funcstart\_724,1}, $heap_{funcstart\_724,1}.p1, 177).quot)
+ (171 * div(\mathbf{heapIs} \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1, 177).rem)) <
asType<integer>(p1 \rightarrow (-2 * div(heapIs))
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.p1, 177).quot) + (171 * div(heapIs)
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.p1, 177).rem))).M1)
\rightarrow [const member of object with modified fields]
[1.5] ((-2 * div(heapIs $heap_{tuncstart_{-724.1}}, $heap_{tuncstart_{-724.1}}.p1, 177).quot)
+ (171 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_724,1}, \text{\$heap}_{funcstart\_724,1}.\text{p1}, 177).\text{rem})) <
```

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\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{M1})
\rightarrow [const static or extern object]
[1.6] ((-2 * div(heapIs $heap_{funcstart_{-724,1}}, $heap_{funcstart_{-724,1}}.p1, 177).quot)
+ (171 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_724,1}, \text{\$heap}_{funcstart\_724,1}.\text{p1}, 177).\text{rem})) <
asType < integer > (\$heap_{init}.M1)
\rightarrow [expand definition of constant 'M1' at prang.c (14,20)]
[1.7] ((-2*\operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724,1}, \$ \operatorname{heap}_{funcstart\_724,1}.p1, 177).\operatorname{quot})
+ (171 * div(\mathbf{heapIs} \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1, 177).rem)) <
asType<integer>(asType<short int>((int)30269))
\rightarrow [simplify]
[1.17] -30269 < ((-171 * div(heapIs $heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1}.\text{p1}, 177).\text{rem} + (2 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
heap_{funcstart_{724,1}}.p1, 177).quot)
\rightarrow [negate goal and search for contradiction]
[1.18]!(-30269 < ((-171 * div(heapIs $heap_{funcstart\_724.1},
\text{Sheap}_{funcstart\_724,1}.\text{p1}, 177).\text{rem} + (2 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
heap_{funcstart_{-724,1}}.p1, 177).quot)
\rightarrow [simplify]
 \label{eq:continuous}  \mbox{$[1.23]$ } 30268 < ((171 * \mbox{div}(\mathbf{heapIs} \; \$ \mbox{$heap}_{funcstart\_724,1}, \; \$ \mbox{$heap}_{funcstart\_724,1}.p1, \\
177).rem) + (-2 * \text{div}(\mathbf{heapIs} \$ \text{heap}_{funcstart\_724,1}, \$ \text{heap}_{funcstart\_724,1}.\text{p1},
177).quot))
[Branch on disjunction or conditional in term 24.5]
[56.0]!(0 == \text{div}(\text{heapIs } \text{$heap}_{funcstart\_724,1}, \text{$heap}_{funcstart\_724,1}.p1,
177).quot) \vee !(0 == \text{div}(\mathbf{heapIs} \$ \text{heap}_{funcstart\_724,1}, \$ \text{heap}_{funcstart\_724,1}.\text{p1},
177).rem) \vee (0 == div(heapIs heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p1,
177).quot)
[Copy term 1.23]
[61.0] 30268 < ((-2 * div(heapIs p_{funcstart_{-724,1}}, p_{funcstart_{-724,1}}, p_{funcstart_{-724,1}})
177).quot) + (171 * div(heapIs $heap_{funcstart\_724,1}, $heap_{funcstart\_724,1}.p1,
177).rem))
\rightarrow [from\ term\ 15.17,\ div(\textbf{heapIs}\ \$heap_{funcstart\_724,1},\ \$heap_{funcstart\_724,1}.p1,
177).rem is equal to heap_{funcstart-724.1}.p1 \% 177
\label{eq:condition} \mbox{\it [61.1] } 30268 < ((-2 * \mbox{\it div}(\textbf{heapIs} \mbox{\it \$heap}_{funcstart\_724,1}, \mbox{\it \$heap}_{funcstart\_724,1}.p1,
(177).quot + (171 * (\$heap_{funcstart\_724,1}.p1 \% 177)))
[Copy term 56.0]
[62.0] ! (0 == \operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.p1,
177).quot) \vee !(0 == \text{div}(\mathbf{heapIs} \$ \text{heap}_{funcstart\_724,1}, \$ \text{heap}_{funcstart\_724,1}.\text{p1},
177).rem) \vee (0 == div(heapIs $heap_{funcstart\_724,1}, $heap_{funcstart\_724,1}.p1,
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177).quot)
\rightarrow [from\ term\ 14.17,\ div(\mathbf{heapIs}\ \$heap_{funcstart\_724,1},\ \$heap_{funcstart\_724,1}.p1,
177).quot is equal to heap_{funcstart\_724,1}.p1 / 177
[62.1]!(0 == (\text{$heap}_{funcstart\_724,1}.p1 / 177)) \vee ...
[Create new term from term 14.17 using rule: condition for equality of division]
[64.0] ((177 * (0 + -(-\text{div}(\mathbf{heapIs} \$ \text{heap}_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1.p1}, 177).\text{quot}))) < (1 + \text{Sheap}_{funcstart\_724,1.p1})) \land
(\text{\$heap}_{funcstart\_724.1}.\text{p1} < (177 * (0 + 1 + -(-\text{div}(\text{heapIs}))))
heap_{funcstart_{724,1}}, heap_{funcstart_{724,1}}, 177).quot))))
\rightarrow [simplify]
[64.15] (-1 < ((-177 * div(heapIs $heap_{funcstart\_724,1}, $heap_{funcstart\_724,1}.p1,
177).quot) + heap_{funcstart_{-724,1}.p1}) \land (-177 < (-heap_{funcstart_{-724,1}.p1} + function)
(177 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_724,1}, \text{\$heap}_{funcstart\_724,1}.\text{p1}, 177).\text{quot})))
\rightarrow [separate conjunction and work on first sub-term]
[64.16] -177 < (-\$heap_{funcstart\_724.1}.p1 + (177 * div(heapIs))
\$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1, 177).quot))
[Create new term from term 62.1 using rule: condition for inequality of
division]
[68.0] \; (!((0*177) < (1 + \$ heap_{funcstart\_724,1}.p1)) \; \lor \; !(\$ heap_{funcstart\_724,1}.p1) \; \lor \; !(\$ heap_{funcstart\_724,1}.p1)) \; \lor \; !(\$ heap_{funcstart\_724,1}.p1) \; \lor \; !(\$ heap_{funcst
< (177 * (0 + 1))) \lor !(0 == div(heapIs $heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1}.\text{p1}, 177).\text{rem}) \vee (0 == \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
heap_{funcstart_{-724,1}}.p1, 177).quot
\rightarrow [simplify]
[68.3] (!(-1 < $heap_{funcstart_724,1}.p1) \vee !($heap_{funcstart_724,1}.p1 < (177 * (0 +
1)))) ∨ ...
\rightarrow [from term 8.0, literala < $heap_{funcstart\_724,1}.p1 is true whenever (-1 +
literala) < 0
        Proof of rule precondition:
        [68.3.0](-1+-1)<0
        \rightarrow [simplify]
        [68.3.2] true
[68.4] (!true \vee !($heap_funcstart_724,1.p1 < (177 * (0 + 1)))) \vee ...
\rightarrow [simplify]
[68.14] (176 < $\text{heap}_{funcstart_724,1}.p1) \quad \dots
[Create new term from terms 68.14, 64.16 using rule: transitivity 3]
[69.0] ((-177 + 1 + 176) < (177 * div(heapIs $heap_{funcstart\_724,1},
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\text{Sheap}_{funcstart\_724,1}.\text{p1}, 177).\text{quot})) \vee !(0 == \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1}.\text{p1}, 177).\text{rem}) \lor (0 == \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
heap_{funcstart_{-724,1}}.p1, 177).quot
\rightarrow [simplify]
[69.1] (0 < (177 * div(heapIs heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p1,
177).quot)) \vee ...
\rightarrow [product is positive]
[69.2] (((0 < 177) \land (0 < div(heapIs $heap_{funcstart\_724.1},
\theta_{funcstart\_724,1}.p1, 177).quot) \lor ((177 < 0) \land (div(heapIs))
\$ \mathrm{heap}_{funcstart\_724,1},\, \$ \mathrm{heap}_{funcstart\_724,1}.\mathrm{p1},\, 177).\mathrm{quot} < 0))) \,\vee\, \dots
\rightarrow [simplify]
[69.7] (0 < div(heapIs heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p1, 177).quot)
[Create new term from terms 69.7, 61.1 using rule: transitivity 11]
[71.0] ((1 + 30268 + (0 * 2)) < (171 * ($heap_{tuncstart_724.1}.p1 % 177))) \vee !(0
== \operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.\operatorname{p1}, \ 177).\operatorname{rem}) \lor (0)
== \operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724,1}, \$ \operatorname{heap}_{funcstart\_724,1}.p1, 177).\operatorname{quot})
\rightarrow [simplify]
[71.2] (30269 < (171 * ($heap_{funcstart\_724,1}.p1 % 177))) \vee \dots
\rightarrow [literal comparison of product]
[71.3] ([171 < 0]: (30269 / -171) < -(\$heap_{funcstart\_724,1}.p1 \% 177), [0 < 171]:
(30269 / 171) < (\text{$heap}_{funcstart\_724,1}.\text{p1} \% 177), [0 == 171]: 30269 < 0) \lor \dots
→ [explicitly assert falsehood of skipped guards in subsequent guards]
[71.4] ([171 < 0]: (30269 / -171) < -($heap_{tuncstart, 724,1}.p1 % 177), [(0 <
171) \wedge !(171 < 0)]: (30269 / 171) < ($heap_{funcstart\_724,1}.p1 % 177), [(0 ==
171) \land !(0 < 171) \land !(171 < 0)]: 30269 < 0) \lor ...
\rightarrow [simplify]
[71.13] false \vee ...
[Remove 'false' term 71.13 and fetch new term from containing clause]
[74.0] 0 == \text{div}(\text{heapIs } \text{$heap}_{funcstart\_724,1}, \text{$heap}_{funcstart\_724,1}.\text{p1}, 177).\text{quot}
[Copy term 1.23]
 [61.1] \ 30268 < ((-2 * \mathrm{div}(\mathbf{heapIs} \ \$ \mathrm{heap}_{funcstart\_724,1}, \ \$ \mathrm{heap}_{funcstart\_724,1}.\mathrm{p1}, 
177).quot) + (171 * (\$heap_{funcstart\_724,1}.p1 \% 177)))
\rightarrow [from term 74.0, div(heapIs $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}.p1,
177).quot is equal to 0
[61.2] 30268 < ((-2 * 0) + (171 * (p_{tuncstart\_724,1}.p_{tuncstart\_724,1}))
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\rightarrow [simplify]
[61.4] 30268 < (171 * (\$heap_{funcstart\_724,1}.p1 \% 177))
\rightarrow [literal comparison of product]
[61.5] \; ([171<0] \colon (30268 \; / \; \text{-}171) < -(\$ \mathrm{heap}_{funcstart\_724,1}.\mathrm{p1} \; \% \; 177), \, [0<171] \colon
(30268 \ / \ 171) < (\$ heap_{funcstart\_724,1}.p1 \ \% \ 177), \ [0 == 171]: \ 30268 < 0)
→ [explicitly assert falsehood of skipped guards in subsequent guards]
[61.6] ([171 < 0]: (30268 / -171) < -($heap_{funcstart\_724.1}.p1 % 177), [(0 <
171) \land !(171 < 0)]: (30268 / 171) < (\$heap_{funcstart\_724,1}.p1 \% 177), [(0 ==
171) \land !(0 < 171) \land !(171 < 0)]: 30268 < 0)
\rightarrow [simplify]
[61.15] false
Proof of verification condition: Assertion valid
Condition generated at: C:\Escher\Customers\prang\prang.c (57,12)
To prove: -asType<integer const>($heap<sub>724,1:740.8</sub>.M1) <
asType<integer>($heap<sub>724,1;740,8</sub>.p1)
Given:
heap_{init}.LIMIT == (int)80
heap_{init}.M1 == asType < short int > ((int)30269)
\theta_{init}.r1 == asType < short int > ((int)171)
\theta_{init}.a1 == asType<short int>((int)177)
heap_{init}.M2 == asType < short int > ((int)30307)
\theta_{init}.r2 == asType<short int>((int)172)
\theta_{init}.a2 == asType<short int>((int)176)
\theta = asType < short int > ((int)35)
\theta = asType < short int > ((int)30323)
heap_{init}.r3 == asType < short int > ((int)170)
heap_{init}.a3 == asType < short int > ((int)178)
heap_{init}.b3 == asType < short int > ((int)63)
\theta = asType < short int > ((int)1)
\theta
\theta = asType < short int > ((int)3)
invariant1(heapIs heap_{funcstart\_724,1})
```

```
div1 == div(\mathbf{heapIs} \$heap_{funcstart\_724,1},
asType < int > (\$heap_{funcstart\_724,1}.p1),
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{a1}))
(asType<int>(asType<int>($heap_{tuncstart\_724.1}.p1)) /
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a1))) = =
asType<integer>(div1.quot)
(\mathbf{asType} {<} \mathbf{integer} {>} (\mathbf{asType} {<} \mathbf{int} {>} (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p1})) \ \%
\mathbf{asType}{<}\mathbf{integer}{>}(\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{a1}))) ==
asType<integer>(div1.rem)
!(0 == asType < integer > (div1.rem)) || !(0 ==
asType<integer>(div1.quot))
div2 == div(\mathbf{heapIs} \$heap_{funcstart\_724,1},
asType < int > (\$heap_{funcstart\_724,1}.p2),
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{a2}))
(asType<integer>(asType<int>($heap_{tuncstart\_724.1}.p2)) /
asType < integer > (asType < int > (\$heap_{funcstart\_724.1}.a2))) = =
asType<integer>(div2.quot)
(\mathbf{asType}{<}\mathbf{int}{>}(\mathbf{asType}{<}\mathbf{int}{>}(\$\mathbf{heap}_{funcstart\_724,1}.\mathbf{p2}))~\%
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a2))) = =
asType<integer>(div2.rem)
!(0 == asType < integer > (div2.rem)) || !(0 ==
asType<integer>(div2.quot))
div3 == div(\mathbf{heapIs} \$heap_{funcstart\_724,1},
asType < int > (\$heap_{funcstart\_724,1}.p3),
asType < int > (\$heap_{funcstart\_724,1}.a3))
(asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.p3)) /
asType < integer > (asType < int > (\$heap_{funcstart\_724.1}.a3))) = =
asType<integer>(div3.quot)
(asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.p3)) \%
\mathbf{asType}{<}\mathbf{integer}{>}(\mathbf{asType}{<}\mathbf{int}{>}(\$\mathbf{heap}_{funcstart\_724,1}.\mathbf{a3}))) = =
asType<integer>(div3.rem)
!(0 == asType < integer > (div3.rem)) || !(0 ==
asType<integer>(div3.quot))
heap_{724,1:740,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow asType<short
int>((asType<int>(asType<short int>(div1.rem)) *
\mathbf{asType} \small{<} \mathbf{int} \small{>} (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{r1})) \\ - (\mathbf{asType} \small{<} \mathbf{int} \small{>} (\mathbf{asType} \small{<} \mathbf{short}
int>(div1.quot)) * asType< int>($heap_{funcstart\_724,1}.b1))))
Proof:
[Take given term]
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[5.0] invariant1(heapIs heap_{funcstart_{-724,1}})
\rightarrow [expand definition of function 'invariant1' at prang.c (34,1)]
\texttt{[5.1]} \; (((((0 < \mathbf{asType} < \mathbf{integer} > (\$ heap_{funcstart\_724,1}.p1)) \; \&\& \\
(asType < integer > ($heap_{funcstart\_724,1}.p1) < 
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{M1})))~\&\&~(0<
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{p2})))\ \&\&
(\mathbf{asType} < \mathbf{integer} > (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p2}) <
asType < integer > (\$heap_{funcstart\_724,1}.M2))) \&\& (0 <
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p3})))\ \&\&
(asType < integer > (\$heap_{funcstart\_724,1}.p3) < 
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{M3}))
\rightarrow [simplify]
[5.3] (((((0 < \theta_{funcstart\_724,1.p1) && (\theta_{funcstart\_724,1.p1)
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{M1})))~\&\&~(0<
asType < integer > (\$heap_{funcstart\_724,1}.p2))) \&\&
(\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{p2}) <
asType < integer > (\$heap_{funcstart\_724,1}.M2))) \&\& (0 <
asType < integer > (\$heap_{funcstart\_724,1}.p3))) \&\&
(asType < integer > (\$heap_{funcstart_{-724,1}}.p3) < 
asType < integer > (\$heap_{funcstart\_724,1}.M3))
\rightarrow [const static or extern object]
[5.4] (((((0 < \text{heap}_{funcstart\_724,1}.p1) && (\text{heap}_{funcstart\_724,1}.p1 <
asType < integer > (\$heap_{init}.M1))) \&\& (0 <
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p2})))\ \&\&
(\mathbf{asType} < \mathbf{integer} > (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p2}) <
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{M2})))~\&\&~(0<
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{p3})))\ \&\&
(\mathbf{asType} < \mathbf{integer} > (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p3}) <
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{M3}))
\rightarrow [expand definition of constant 'M1' at prang.c (14,20)]
[5.5] (((((0 < $heap_{funcstart_724,1}.p1) && ($heap_{funcstart_724,1}.p1 < 
asType<integer>(asType<short int>((int)30269)))) && (0 <
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p2})))\ \&\&
(\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{p2}) <
asType < integer > (\$heap_{funcstart\_724,1}.M2))) \&\& (0 <
asType < integer > (\$heap_{funcstart\_724,1}.p3))) \&\&
(\mathbf{asType} {<} \mathbf{integer} {>} (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p3}) <
asType < integer > (\$heap_{funcstart\_724.1}.M3))
\rightarrow [simplify]
[5.16] ((((-30269 < -\$heap_{funcstart\_724,1}.p1) \land (0 < \$heap_{funcstart\_724,1}.p1) 
(0 < \text{\$heap}_{funcstart\_724,1}.p2)) \&\& (\text{\$heap}_{funcstart\_724,1}.p2 <
```

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asType<integer>(heap_{funcstart\_724,1}.M2))) && (0 <
asType < integer > (\$heap_{funcstart\_724,1}.p3))) \&\&
(\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{p3}) <
asType < integer > (\$heap_{funcstart\_724,1}.M3))
\rightarrow [const static or extern object]
[5.17] \left( \left( \left( \left( -30269 < -\$ \text{heap}_{funcstart\_724,1}.\text{p1} \right) \right. \wedge \left. \left( 0 < \$ \text{heap}_{funcstart\_724,1}.\text{p1} \right) \right. \wedge \right. \right)
(0 < \text{$heap}_{funcstart\_724,1}.p2)) \&\& (\text{$heap}_{funcstart\_724,1}.p2 <
asType < integer > (\$heap_{init}.M2))) \&\& (0 <
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{p3})))\ \&\&
(asType < integer > ($heap_{funcstart\_724,1}.p3) < 
asType < integer > (\$heap_{funcstart\_724,1}.M3))
\rightarrow [expand definition of constant 'M2' at prang.c (19,20)]
[5.18] ((((-30269 < -\$heap_{funcstart\_724,1}.p1) \land (0 < \$heap_{funcstart\_724,1}.p1) 
(0 < \text{\$heap}_{funcstart\_724,1}.p2)) \&\& (\text{\$heap}_{funcstart\_724,1}.p2 <
asType<integer>(asType<short int>((int)30307)))) && (0 <
asType < integer > (\$heap_{funcstart\_724,1}.p3))) \&\&
(asType < integer > (\$heap_{funcstart\_724,1}.p3) < 
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{M3}))
\rightarrow [simplify]
[5.30] ((-30307 < -$heap_funcstart_724,1.p2) \land (-30269 <
-\$heap_{funcstart\_724,1}.p1) \land (0 < \$heap_{funcstart\_724,1}.p1) \land (0 < \$heap_{funcstart\_724,1}.p1)
\text{heap}_{funcstart\_724,1.p2} \land (0 < \text{heap}_{funcstart\_724,1.p3})) \&\&
(\text{\$heap}_{funcstart\_724,1}.p3 < asType < integer > (\text{\$heap}_{funcstart\_724,1}.M3))
\rightarrow [const static or extern object]
[5.31] ((-30307 < -\$heap_{funcstart\_724,1}.p2) \land (-30269 <
-\$heap_{funcstart\_724,1}.p1) \land (0 < \$heap_{funcstart\_724,1}.p1) \land (0 < \$heap_{funcstart\_724,1}.p1)
\text{Sheap}_{funcstart_{724,1}.p2} \land (0 < \text{Sheap}_{funcstart_{724,1}.p3})) \&\&
(\text{\$heap}_{funcstart\_724,1}.\text{p3} < \mathbf{asType} < \mathbf{integer} > (\text{\$heap}_{init}.\text{M3}))
\rightarrow [expand definition of constant 'M3' at prang.c (24,20)]
[5.32] ((-30307 < -$heap<sub>funcstart_724,1.</sub>p2) \land (-30269 <
-\$heap_{funcstart\_724,1}.p1) \land (0 < \$heap_{funcstart\_724,1}.p1) \land (0 < \$heap_{funcstart\_724,1}.p1)
\text{Sheap}_{funcstart_{724,1}.p2} \land (0 < \text{Sheap}_{funcstart_{724,1}.p3})) \&\&
(\$heap_{funcstart\_724,1}.p3 < \mathbf{asType} < \mathbf{integer} > (\mathbf{asType} < \mathbf{short}
int > ((int)30323)))
\rightarrow [simplify]
[5.40] (-30323 < -$heap_{funcstart\_724,1}.p3) \land (-30307 <
-\$heap_{funcstart\_724,1}.p2) \land (-30269 < -\$heap_{funcstart\_724,1}.p1) \land (0 < -\$heap_{funcstart\_724,1}.p1)
\text{Sheap}_{funcstart\_724,1}.\text{p1}) \land (0 < \text{Sheap}_{funcstart\_724,1}.\text{p2}) \land (0 <
heap_{funcstart_{-724,1}.p3}
[Work on sub-term 3 of conjunction in term 5.40]
```

```
[7.0] -30269 < -$heap<sub>funcstart_724,1</sub>.p1
[Work on sub-term 4 of conjunction in term 5.40]
[8.0] 0 < \text{$heap}_{funcstart\_724,1}.p1
[Take given term]
[11.0] div1 == div(heapIs heap_{funcstart\_724,1},
asType < int > (\$heap_{funcstart\_724,1}.p1),
asType < int > (\$heap_{funcstart\_724,1}.a1))
\rightarrow [simplify]
[11.1] \operatorname{div1} == \operatorname{div}(\mathbf{heapIs} \operatorname{\$heap}_{funcstart\_724,1}, \operatorname{\$heap}_{funcstart\_724,1}.p1,
asType < int > (\$heap_{funcstart\_724.1}.a1))
\rightarrow [const static or extern object]
[11.2] \operatorname{div1} == \operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724,1}, \$ \operatorname{heap}_{funcstart\_724,1}.p1,
asType < int > (\$heap_{init}.a1))
\rightarrow [expand definition of constant 'a1' at prang.c (16,20)]
\label{eq:linear_start_724,1} \text{ div1} == \text{div}(\mathbf{heapIs} \ \$ \text{heap}_{funcstart\_724,1}, \ \$ \text{heap}_{funcstart\_724,1}.\text{p1},
\mathbf{asType}{<}\mathbf{int}{>}(\mathbf{asType}{<}\mathbf{short}\ \mathbf{int}{>}((\mathbf{int})177)))
\rightarrow [simplify]
[11.6] div1 == div(heapIs \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}.p1, 177)
[Assume known post-assertion, class invariant or type constraint for term 11.6]
[14.0] (asType<integer>($heap<sub>funcstart_724,1.</sub>p1) /
asType < integer > (177)) == asType < integer > (div(heapIs))
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.p1, 177).quot
\rightarrow [simplify]
[14.2] ($heap<sub>funcstart_724,1.</sub>p1 / 177) == asType<integer>(div(heapIs)
heap_{funcstart_{724,1}}, heap_{funcstart_{724,1}}, 177).quot
→ [expand definition of operator './' in class 'int' at built in declaration]
[14.3] ([asType<integer>(heap_{funcstart\_724.1}.p1) < 0]:
-(-asType < integer > (\$heap_{funcstart\_724,1}.p1) / 177), []:
asType < integer > (\$heap_{funcstart\_724,1}.p1) / 177) ==
\mathbf{asType} < \mathbf{integer} > (\mathbf{div}(\mathbf{heapIs} \ \$ \mathbf{heap}_{funcstart\_724,1}, \ \$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p1},
177).quot)
→ [explicitly assert falsehood of skipped guards in subsequent guards]
[14.4] ([asType<integer>($heap_{funcstart\_724,1}.p1) < 0]:
-(-asType < integer > (\$heap_{funcstart\_724,1}.p1) / 177),
[!(asType < integer > (\$heap_{funcstart\_724,1}.p1) < 0)]:
asType < integer > (\$heap_{funcstart\_724,1}.p1) / 177) = =
\mathbf{asType} < \mathbf{integer} > (\mathbf{div}(\mathbf{heapIs} \ \$ \mathbf{heap}_{funcstart\_724,1}, \ \$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p1}, \\
```

```
177).quot)
\rightarrow [simplify]
[14.7] ([0 < -$heap<sub>funcstart_724,1.</sub>p1]:
-(-asType < integer > (\$heap_{funcstart\_724,1}.p1) / 177),
[!(asType < integer > (\$heap_{funcstart\_724,1}.p1) < 0)]:
asType < integer > (\$heap_{funcstart\_724,1}.p1) / 177) ==
asType<integer>(div(heapIs $heap_{tuncstart\_724.1}, $heap_{tuncstart\_724.1}.p1,
177).quot)
\rightarrow [from term 8.0, literala < -$heap<sub>funcstart_724,1</sub>.p1 is false whenever -2 < (0
+ literala)]
    Proof of rule precondition:
    [14.7.0] - 2 < (0 + 0)
    \rightarrow [simplify]
    [14.7.2] true
[14.8] ([false]: -(-asType < integer > (\$heap_{funcstart\_724,1}.p1) / 177),
[!(\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{p1}) < 0)]:
asType < integer > (\$heap_{funcstart\_724,1}.p1) / 177) ==
asType<integer>(div(heapIs heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p1,
177).quot)
\rightarrow [simplify]
[14.11] ([false]: -(-asType < integer > (\$heap_{funcstart\_724,1}.p1) / 177), [!(0 < integer)]
-\$heap_{funcstart\_724,1}.p1)]: asType<integer>(\$heap_{funcstart\_724,1}.p1) / 177)
== asType<integer>(div(heapIs $heap_{tuncstart_724.1},
heap_{funcstart_{-724.1}}.p1, 177).quot
\rightarrow [from term 8.0, literala < -$heap<sub>funcstart_724,1</sub>.p1 is false whenever -2 < (0
+ literala)]
    Proof of rule precondition:
    [14.11.0] - 2 < (0 + 0)
    \rightarrow [simplify]
    [14.11.2] true
\label{eq:continuous_flat_self_lambda} $$[14.12]$ ([false]: -(-asType<integer>($heap_{funcstart\_724,1}.p1) \ / \ 177),
[!false]: asType<integer>(\theta_{funcstart\_724,1}.p1) / 177) ==
\mathbf{asType} < \mathbf{integer} > (\mathbf{div}(\mathbf{heapIs} \ \$ \mathbf{heap}_{funcstart\_724,1}, \ \$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p1}, \\
177).quot)
\rightarrow [simplify]
[14.17] \ 0 == (-\text{div}(\mathbf{heapIs} \ \$ \text{heap}_{funcstart\_724,1}, \ \$ \text{heap}_{funcstart\_724,1}.\text{p1},
177).quot + (\text{$heap}_{funcstart\_724,1}.p1 / 177))
[Assume known post-assertion, class invariant or type constraint for term 11.6]
```

```
[15.0] (asType<integer>(sheap_{funcstart=724,1}.p1) %
asType<integer>(177)) == asType<integer>(div(heapIs
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.\text{p1}, 177).\text{rem}
\rightarrow [simplify]
[15.2] (\text{heap}_{funcstart\_724,1}.\text{p1} \% 177) == asType<integer>(div(heapIs)
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.\text{p1}, 177).\text{rem}
→ [expand definition of operator '.%' in class 'int' at built in declaration]
[15.3] ([asType<integer>(heap_{funcstart\_724,1}.p1) < 0]:
-(-asType < integer > (\$heap_{funcstart\_724,1}.p1) \% 177), []:
asType < integer > (\$heap_{funcstart\_724,1}.p1) \% 177) ==
asType<integer>(div(heapIs $heap_{tuncstart\_724.1}, $heap_{tuncstart\_724.1}.p1,
→ [explicitly assert falsehood of skipped guards in subsequent guards]
[15.4] ([asType<integer>(heap_{funcstart\_724,1}.p1) < 0]:
-(-asType < integer > (\$heap_{funcstart\_724,1}.p1) \% 177),
[!(\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathbf{heap}_{funcstart\_724,1}.\mathbf{p1})<0)]:
asType < integer > (\$heap_{funcstart\_724,1}.p1) \% 177) ==
asType<integer>(div(heapIs heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p1,
177).rem)
\rightarrow [simplify]
[15.7] ([0 < -$heap<sub>funcstart_724,1.</sub>p1]:
-(-asType < integer > (\$heap_{funcstart\_724,1}.p1) \% 177),
[!(asType < integer > (\$heap_{funcstart\_724,1}.p1) < 0)]:
asType < integer > (\$heap_{funcstart\_724,1}.p1) \% 177) ==
asType<integer>(div(heapIs $heap_{tuncstart\_724.1}, $heap_{tuncstart\_724.1}.p1,
177).rem)
\rightarrow [from term 8.0, literala < -$heap<sub>funcstart_724.1</sub>.p1 is false whenever -2 < (0
+ literala)]
   Proof of rule precondition:
   [15.7.0] - 2 < (0 + 0)
   \rightarrow [simplify]
   [15.7.2] true
[15.8] ([false]: -(-asType < integer > (\$heap_{funcstart\_724,1}.p1) \% 177),
[!(\mathbf{asType} < \mathbf{integer} > (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p1}) < 0)]:
asType < integer > (\$heap_{funcstart\_724,1}.p1) \% 177) = =
asType<integer>(div(heapIs $heap_{tuncstart_724.1}, $heap_{tuncstart_724.1.p1},
177).rem)
\rightarrow [simplify]
[15.11] ([false]: -(-asType < integer > (\$heap_{funcstart\_724,1}.p1) \% 177), [!(0
```

```
<-$heap<sub>funcstart_724,1.</sub>p1)]: asType<integer>($heap<sub>funcstart_724,1.</sub>p1) %
177) == asType < integer > (div(heapIs \$heap_{funcstart\_724,1},
heap_{funcstart_{-724,1}.p1, 177}.rem
\rightarrow [from term 8.0, literala < -$heap<sub>funcstart_724,1.</sub>p1 is false whenever -2 < (0
+ literala)]
            Proof of rule precondition:
            [15.11.0] - 2 < (0 + 0)
            \rightarrow [simplify]
            [15.11.2] true
 [15.12] ([false]: -(-asType < integer > (\$heap_{funcstart\_724,1}.p1) \% 177),
[!false]: asType<integer>(p_{funcstart\_724,1}.p_{1}) \% 177) ==
\mathbf{asType} < \mathbf{integer} > (\mathbf{div}(\mathbf{heapIs} \ \$ \mathbf{heap}_{funcstart\_724,1}, \ \$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p1},
177).rem)
\rightarrow [simplify]
 [15.17] \ 0 == (-\text{div}(\mathbf{heapIs} \ \$ \text{heap}_{funcstart\_724,1}, \ \$ \text{heap}_{funcstart\_724,1}.\text{p1},
177).rem + (\text{$heap}_{funcstart\_724,1}.p1 \% 177))
[Take given term]
[53.0] heap_{724,1;740,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow asType<short
int>((asType<int>(asType<short int>(div1.rem)) *
\mathbf{asType} \small{<} \mathbf{int} \small{>} (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{r1})) \\ - (\mathbf{asType} \small{<} \mathbf{int} \small{>} (\mathbf{asType} \small{<} \mathbf{short}) \\
\mathbf{int}{>}(\mathbf{div1.quot})) \ * \ \mathbf{asType}{<} \mathbf{int}{>} (\$\mathbf{heap}_{funcstart\_724,1}.\mathbf{b1}))))
\rightarrow [from term 11.6, div1 is equal to div(heapIs $heap_{funcstart_724,1},
heap_{funcstart_{724,1}}.p1, 177
[53.1] \theta == 
int>((asType<int>(asType<short int>(div(heapIs $heap_{tuncstart\_724.1},
\text{sheap}_{funcstart,724,1}.\text{p1}, 177).\text{rem}) * asType < int > (\text{sheap}_{funcstart,724,1}.\text{r1})) -
(asType<int>(asType<short int>(div1.quot)) *
asType < int > (\$heap_{funcstart\_724,1}.b1))))
\rightarrow [simplify]
[53.3] heap_{724,1;740,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow asType<short
int>((div(heapIs \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1, 177).rem *
asType < int > (\$heap_{funcstart\_724,1}.r1)) - (asType < int > (asType < short)
int>(div1.quot)) * asType< int>($heap_{funcstart\_724,1}.b1))))
\rightarrow [const static or extern object]
[53.4] \rho_{13,1;740,8} == \rho_{13,1;740,8} == \rho_{13,1;740,8} =- \rho_{
int>((div(heapIs \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1, 177).rem *
asType < int > (\$heap_{init}.r1)) - (asType < int > (asType < short)
int>(div1.quot)) * asType< int>($heap_{tuncstart\_724.1}.b1))))
```

```
\rightarrow [expand definition of constant 'r1' at prang.c (15,20)]
[53.5] heap_{724,1:740,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow asType<short
int>((div(heapIs \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1, 177).rem *
asType<int>(asType<short int>((int)171))) -
(asType < int > (asType < short int > (div1.quot)) *
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{b1}))))
\rightarrow [simplify]
[53.8] heap_{724,1;740,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow asType<short
int>((div(heapIs \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1, 177).rem * 171)
- (asType<int>(asType<short int>(div1.quot)) *
asType < int > (\$heap_{funcstart\_724,1}.b1))))
\rightarrow [from term 11.6, div1 is equal to div(heapIs $heap_{tuncstart_724.1},
heap_{funcstart_{-724,1}}.p1, 177
[53.9] heap_{724,1:740,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow asType<short
int>((171 * div(heapIs $heap_{funcstart\_724,1}, $heap_{funcstart\_724,1}.p1, 177).rem)
- (asType<int>(asType<short int>(div(heapIs $heap_{funcstart_724.1},
heap_{funcstart_{724,1}}.p1, 177).quot) *
asType < int > (\$heap_{funcstart\_724,1}.b1))))
\rightarrow [simplify]
[53.11] heap_{724,1;740,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow asType<short
int>((171 * div(heapIs $heap_{funcstart\_724,1}, $heap_{funcstart\_724,1}.p1, 177).rem)
- (div(heapIs heap_{funcstart_{724,1}}, heap_{funcstart_{724,1}}, 177).quot *
asType < int > (\$heap_{funcstart\_724,1}.b1))))
\rightarrow [const static or extern object]
[53.12] \theta_{12} = \theta_{124,1;740,8} = \theta_{124,1;74
int>((171 * div(heapIs $heap_{funcstart\_724,1}, $heap_{funcstart\_724,1}.p1, 177).rem)
- (\text{div}(\mathbf{heapIs} \$ \text{heap}_{funcstart\_724,1}, \$ \text{heap}_{funcstart\_724,1}.\text{p1}, 177).\text{quot} *
asType < int > (\$heap_{init}.b1)))
\rightarrow [expand definition of constant 'b1' at prang.c (17,20)]
[53.13] \theta_{13} = \theta_
int>((171 * div(heapIs $heap_{funcstart\_724,1}, $heap_{funcstart\_724,1}.p1, 177).rem)
- (\text{div}(\mathbf{heapIs} \$ \text{heap}_{funcstart\_724,1}, \$ \text{heap}_{funcstart\_724,1}.\text{p1}, 177).\text{quot} *
asType<int>(asType<short int>((int)2))))
\rightarrow [simplify]
[53.19] \text{Sheap}_{724,1;740,8} == \text{Sheap}_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).quot) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.\operatorname{p1}, \ 177).\operatorname{rem})))
[Take goal term]
[1.0] -asType<integer const>($heap_{724,1:740,8}.M1) <
```

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asType<integer>($heap<sub>724,1.740,8.</sub>p1)
\rightarrow [from term 53.19, $heap<sub>724.1:740.8</sub> is equal to
heap_{funcstart\_724,1}._replace(p1 \rightarrow (-2 * div(heapIs $heap_{funcstart\_724,1},
heap_{funcstart\_724,1}.p1, 177).quot) + (171 * div(heapIs $heap_{funcstart\_724,1}, 1
heap_{funcstart_{-724,1}}.p1, 177).rem)
[1.1] -asType < integer const > (\$heap_{funcstart\_724,1}.\_replace(p1 \rightarrow ((-2 * funcstart\_724,1)))))
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).quot) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724.1}, \ \text{\$heap}_{funcstart\_724.1}. p1, \ 177).rem))).M1) <
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathrm{heap}_{724,1;740,8}.\mathrm{p1})
\rightarrow [const member of object with modified fields]
[1.2] -asType<integer const>(\theta_{tuncstart}) <
asType<integer>($heap<sub>724,1;740,8</sub>.p1)
\rightarrow [const static or extern object]
[1.3] -asType<integer const>($heap_{init}.M1) <
asType<integer>($heap<sub>724,1;740,8</sub>.p1)
\rightarrow [expand definition of constant 'M1' at prang.c (14.20)]
[1.4] -asType<integer const>(asType<short int>((int)30269)) <
asType<integer>($heap<sub>724,1;740,8</sub>.p1)
\rightarrow [simplify]
[1.8] -30269 < asType<integer>($heap<sub>724.1:740.8</sub>.p1)
\rightarrow [from term 53.19, $heap<sub>724.1:740.8</sub> is equal to
heap_{funcstart\_724,1}._replace(p1 \rightarrow (-2 * div(heapIs heap_{funcstart\_724,1}),
heap_{funcstart\_724,1}.p1, 177).quot + (171 * div(heapIs $heap_{funcstart\_724,1}, 177).quot) + (171 * div(heapIs $heap_{funcstart\_724,1}, 17
heap_{funcstart_{-724,1}.p1, 177).rem}
[1.9] -30269 < asType<integer>($heap_funcstart_724,1._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.p1, \ 177).rem))).p1)
\rightarrow [simplify]
[1.11] -30269 < ((-2 * div(heapIs $heap_{funcstart_{-724,1}}, $heap_{funcstart_{-724,1}}.p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_724,1}, \text{\$heap}_{funcstart\_724,1}.p1,
177).rem))
\rightarrow [negate goal and search for contradiction]
[1.12]!(-30269 < ((-2 * div(heapIs $heap_{funcstart\_724,1},))
heap_{funcstart\_724,1}.p1, 177).quot + (171 * div(heapIs p_{funcstart\_724,1})
\operatorname{\$heap}_{funcstart\_724,1}.\operatorname{p1},\ 177).\operatorname{rem})))
\rightarrow [simplify]
[1.17] 30268 < ((2 * div(\mathbf{heapIs} \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1,
177).quot) + (-171 * div(heapIs heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p1,
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177).rem))
[Copy term 1.17]
[59.0] 30268 < ((-171 * div(heapIs $heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1}.\text{p1}, 177).\text{rem} + (2 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
heap_{funcstart_{-724,1}}.p1, 177).quot)
\rightarrow [from term 15.17, div(heapIs $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p1,
177).rem is equal to heap_{funcstart\_724,1}.p1 \% 177
[59.1] 30268 < ((-171 * ($heap_{funcstart\_724,1}.p1 % 177)) + (2 * div(heapIs)
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.p1, 177).quot)
[Create new term from term 14.17 using rule: condition for equality of division]
[63.0] ((177 * (0 + -(\text{div}(\mathbf{heapIs} \$ \text{heap}_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724.1.p1}, 177).\text{quot}))) < (1 + \text{Sheap}_{funcstart\_724.1.p1})) \land
(\text{\$heap}_{funcstart\_724.1}.\text{p1} < (177 * (0 + 1 + -(-\text{div}(\text{heapIs}))))
\text{Sheap}_{funcstart_{-724,1}}, \text{Sheap}_{funcstart_{-724,1}}.p1, 177).quot))))
\rightarrow [simplify]
[63.15] (-1 < ((-177 * div(heapIs $heap_{funcstart\_724,1}, $heap_{funcstart\_724,1}.p1,
(-177).quot) + \text{heap}_{funcstart\_724,1}.p1)) \land (-177 < (-\text{heap}_{funcstart\_724,1}.p1 +
(177 * \operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724,1}, \$ \operatorname{heap}_{funcstart\_724,1}.\operatorname{p1}, 177).\operatorname{quot})))
[Work on sub-term 2 of conjunction in term 63.15]
[64.0] -1 < ((-177 * div(heapIs $heap<sub>funcstart_724,1</sub>, $heap<sub>funcstart_724,1</sub>.p1,
177).quot) + $heap<sub>funcstart_724,1</sub>.p1)
[Create new term from terms 64.0, 7.0 using rule: transitivity 2]
[78.0] (-30269 + -1 + 1) < (-177 * div(heapIs \rho_{funcstart_{-724,1}},
heap_{funcstart_{-724,1}}.p1, 177).quot
\rightarrow [simplify]
[78.1] -30269 < (-177 * div(heapIs $heap_{funcstart\_724,1},
heap_{funcstart_{-724,1}}.p1, 177).quot
\rightarrow [literal comparison of product]
[78.2] ([-177 < 0]: (-30269 / 177) < -\text{div}(\mathbf{heapIs} \ \$ \text{heap}_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1}.\text{p1}, 177).\text{quot}, [0 < -177]: (-30269 / -177) < \text{div}(\textbf{heapIs})
0)
→ [explicitly assert falsehood of skipped guards in subsequent guards]
[78.3] ([-177 < 0]: (-30269 / 177) < -\text{div}(\text{heapIs } \text{$heap}_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1.p1}, 177).\text{quot}, [(0 < -177) \land !(-177 < 0)]: (-30269 / -177)
< \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_724,1}, \text{\$heap}_{funcstart\_724,1}.\text{p1}, 177).\text{quot}, [(-177)]
==0) \land !(-177 < 0) \land !(0 < -177)]: -30269 < 0)
\rightarrow [simplify]
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[78.7] -172 < -\text{div}(\text{heapIs } \text{$heap}_{funcstart\_724,1}, \text{$heap}_{funcstart\_724,1}.\text{p1},
177).quot
[Create new term from terms 78.7, 59.1 using rule: transitivity 5]
[82.0] 30268 < ((-171 * (\$heap_{funcstart\_724,1}.p1 \% 177)) + (2 * -(-172 + 1)))
\rightarrow [simplify]
[82.5] 29926 < (-171 * ($heap_{funcstart\_724,1}.p1 % 177))
\rightarrow [literal comparison of product]
[82.6] ([-171 < 0]: (29926 / 171) < -(\text{$heap_{funcstart\_724,1.p1} \% 177}), [0 <
-171]: (29926 / -171) < ($heap_{funcstart\_724,1}.p1 % 177), [-171 == 0]: 29926 <
→ [explicitly assert falsehood of skipped guards in subsequent guards]
[82.7] ([-171 < 0]: (29926 / 171) < –($heap _funcstart_724,1.p1 % 177), [(0 <
-171) \wedge!(-171 < 0)]: (29926 / -171) < ($heap_{tuncstart_724,1}.p1 % 177), [(-171)]
==0) \land !(-171 < 0) \land !(0 < -171)]: 29926 < 0)
\rightarrow [simplify]
[82.12] false
Proof of verification condition: Type constraint satisfied in explicit
conversion from 'int' to 'short int'
Condition generated at: C:\Escher\Customers\prang\prang.c (58,15)
Condition defined at:
To prove: minof(short int) \le div2.rem
Given:
heap_{init}.LIMIT == (int)80
\theta sheap<sub>init</sub>.M1 == asType<short int>((int)30269)
\theta_{init}.r1 == asType < short int > ((int)171)
\theta
\theta
heap_{init}.M2 == asType < short int > ((int)30307)
heap_{init}.r2 == asType < short int > ((int)172)
heap_{init}.a2 == asType < short int > ((int)176)
\theta
\theta sheap<sub>init</sub>.M3 == asType<short int>((int)30323)
heap_{init}.r3 == asType < short int > ((int)170)
```

```
\theta sheap<sub>init</sub>.a3 == asType<short int>((int)178)
heap_{init}.b3 == asType < short int > ((int)63)
\theta = asType < short int > ((int)1)
\theta
\theta = asType < short int > ((int)3)
invariant1(heapIs heap_{funcstart\_724,1})
\mathrm{div1} == \mathrm{div}(\mathbf{heapIs} \ \$ \mathrm{heap}_{funcstart\_724,1},
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p1}),
asType < int > (\$heap_{funcstart\_724,1}.a1))
(asType<int>(asType<int>($heap_{tuncstart\_724.1}.p1)) /
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a1))) = =
asType<integer>(div1.quot)
(asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.p1)) \%
\mathbf{asType}{<}\mathbf{integer}{>}(\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{a1}))) ==
asType<integer>(div1.rem)
!(0 == asType < integer > (div1.rem)) || !(0 ==
asType<integer>(div1.quot))
div2 == div(\mathbf{heapIs} \$heap_{funcstart\_724,1},
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p2}),
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{a2}))
(asType<integer>(asType<int>($heap_{tuncstart\_724.1}.p2)) /
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a2))) = =
asType<integer>(div2.quot)
(\mathbf{asType} {<} \mathbf{integer} {>} (\mathbf{asType} {<} \mathbf{int} {>} (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p2})) \ \%
\mathbf{asType}{<}\mathbf{integer}{>}(\mathbf{asType}{<}\mathbf{int}{>}(\$\mathbf{heap}_{funcstart\_724,1}.\mathbf{a2}))) = =
asType<integer>(div2.rem)
!(0 == asType < integer > (div2.rem)) || !(0 ==
asType<integer>(div2.quot))
div3 == div(\mathbf{heapIs} \$ heap_{funcstart\_724,1},
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p3}),
asType < int > (\$heap_{funcstart\_724,1}.a3))
(asType<int>(asType<int>($heap_{tuncstart\_724.1}.p3)) /
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a3))) = =
asType<integer>(div3.quot)
(\mathbf{asType} {<} \mathbf{integer} {>} (\mathbf{asType} {<} \mathbf{int} {>} (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p3})) \ \%
\mathbf{asType} < \mathbf{integer} > (\mathbf{asType} < \mathbf{int} > (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{a3}))) = =
asType<integer>(div3.rem)
!(0 == asType < integer > (div3.rem)) || !(0 ==
```

```
asType<integer>(div3.quot))
heap_{724,1;740,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow asType<short
int>((asType<int>(asType<short\ int>(div1.rem))*
asType < int > (\$heap_{funcstart\_724,1}.r1)) - (asType < int > (asType < short)
int>(div1.quot)) * asType<int>($heap_{funcstart\_724,1}.b1)))
-asType < integer\ const > (\$heap_{724,1;740,8}.M1) < 
asType<integer>($heap<sub>724,1:740,8</sub>.p1)
!(0 == asType < integer > (\$heap_{724,1;740,8}.p1))
asType<integer>($heap<sub>724,1:740,8:p1</sub>) <
asType<integer>($heap<sub>724.1:740.8</sub>.M1)
Proof:
[Take given term]
[5.0] invariant1(heapIs heap_{funcstart\_724,1})
\rightarrow [expand definition of function 'invariant1' at prang.c (34,1)]
 \texttt{[5.1]} \left( \left( \left( \left( \left( 0 < \mathbf{asType} < \mathbf{integer} > \left( \$ \mathsf{heap}_{funcstart\_724,1}.\mathsf{p1} \right) \right) \right. \&\& \right. \right. 
(asType<integer>($heap_funcstart_724.1.p1) <
asType < integer > (\$heap_{funcstart\_724,1}.M1))) \&\& (0 <
asType < integer > (\$heap_{funcstart\_724,1}.p2))) \&\&
(\mathbf{asType} {<} \mathbf{integer} {>} (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p2}) <
asType < integer > (\$heap_{funcstart\_724,1}.M2))) \&\& (0 <
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p3})))\ \&\&
(asType<integer>($heap_{tuncstart\_724,1}.p3) <
asType < integer > (\$heap_{funcstart\_724,1}.M3))
\rightarrow [simplify]
[5.3] (((((0 < \text{\$heap}_{funcstart\_724,1}.p1) \&\& (\text{\$heap}_{funcstart\_724,1}.p1 <
asType < integer > (\$heap_{funcstart\_724,1}.M1))) \&\& (0 <
asType < integer > (\$heap_{funcstart\_724,1}.p2))) \&\&
(\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{p2}) <
asType < integer > (\$heap_{funcstart\_724,1}.M2))) \&\& (0 <
asType < integer > (\$heap_{funcstart\_724,1}.p3))) \&\&
(\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{p3}) <
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{M3}))
\rightarrow [const static or extern object]
[5.4] (((((0 < $heap_{funcstart_{724,1}}.p1) && ($heap_{funcstart_{724,1}}.p1 < ]
asType < integer > (\$heap_{init}.M1))) \&\& (0 <
asType < integer > (\$heap_{funcstart\_724,1}.p2))) \&\&
(\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{p2}) <
asType < integer > (\$heap_{funcstart\_724,1}.M2))) \&\& (0 <
asType < integer > (\$heap_{funcstart\_724,1}.p3))) \&\&
(asType<integer>($heap_{tuncstart\_724.1}.p3) <
```

```
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{M3}))
\rightarrow [expand definition of constant 'M1' at prang.c (14,20)]
[5.5] (((((0 < $heap_{funcstart_{724,1}}.p1) && ($heap_{funcstart_{724,1}}.p1 < 
asType<integer>(asType<short int>((int)30269)))) && (0 <
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{p2})))\ \&\&
(asType < integer > (\$heap_{funcstart\_724,1}.p2) <
asType < integer > (\$heap_{funcstart\_724,1}.M2))) \&\& (0 <
asType < integer > (\$heap_{funcstart\_724,1}.p3))) \&\&
(asType < integer > ($heap_{funcstart\_724,1}.p3) < 
asType < integer > (\$heap_{funcstart\_724,1}.M3))
\rightarrow [simplify]
[5.16] ((((-30269 < -\$heap_{funcstart\_724,1}.p1) \land (0 < \$heap_{funcstart\_724,1}.p1) 
(0 < \text{\$heap}_{funcstart\_724,1}.p2)) \&\& (\text{\$heap}_{funcstart\_724,1}.p2 <
\mathbf{asType} \small{<} \mathbf{integer} \small{>} (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{M2}))) \ \&\& \ (0 <
asType < integer > (\$heap_{funcstart\_724,1}.p3))) \&\&
(\mathbf{asType} < \mathbf{integer} > (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p3}) <
asType < integer > (\$heap_{funcstart\_724,1}.M3))
\rightarrow [const static or extern object]
[5.17] \; ((((-30269 < -\$heap_{funcstart\_724,1}.p1) \; \land \; (0 < \$heap_{funcstart\_724,1}.p1) \; \land 
(0 < \text{$heap}_{funcstart\_724,1}.p2)) \&\& (\text{$heap}_{funcstart\_724,1}.p2 <
asType < integer > (\$heap_{init}.M2))) \&\& (0 <
asType < integer > (\$heap_{funcstart\_724,1}.p3))) \&\&
(asType<integer>($heap_{tuncstart\_724,1}.p3) <
asType < integer > (\$heap_{funcstart\_724,1}.M3))
\rightarrow [expand definition of constant 'M2' at prang.c (19,20)]
|5.18| \left( \left( \left( \left( -30269 < -\$ \text{heap}_{funcstart\_724,1}.\text{p1} \right) \right. \wedge \left. \left( 0 < \$ \text{heap}_{funcstart\_724,1}.\text{p1} \right) \right. \wedge \right. |
(0 < \text{$heap}_{funcstart\_724,1}.p2)) \&\& (\text{$heap}_{funcstart\_724,1}.p2 <
asType < integer > (asType < short int > ((int)30307)))) && (0 < int) && (0 < int
asType < integer > (\$heap_{funcstart\_724,1}.p3))) \&\&
(asType < integer > ($heap_{funcstart\_724,1}.p3) < 
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{M3}))
\rightarrow [simplify]
[5.30] ((-30307 < -$heap_{funcstart\_724,1}.p2) \land (-30269 <
-\$heap_{funcstart\_724,1}.p1) \land (0 < \$heap_{funcstart\_724,1}.p1) \land (0 < \$heap_{funcstart\_724,1}.p1)
\text{Sheap}_{funcstart_{-724,1}.p2} \land (0 < \text{Sheap}_{funcstart_{-724,1}.p3})) \&\&
(\text{\$heap}_{funcstart\_724,1}.\text{p3} < \text{asType} < \text{integer} > (\text{\$heap}_{funcstart\_724,1}.\text{M3}))
\rightarrow [const static or extern object]
[5.31] ((-30307 < -$heap_{funcstart\_724,1}.p2) \land (-30269 <
-\$heap_{funcstart\_724,1}.p1) \land (0 < \$heap_{funcstart\_724,1}.p1) \land (0 < \$heap_{funcstart\_724,1}.p1)
\text{Sheap}_{funcstart\_724,1.p2}) \land (0 < \text{Sheap}_{funcstart\_724,1.p3})) \&\&
(\text{\$heap}_{funcstart\_724,1}.p3 < asType < integer > (\text{\$heap}_{init}.M3))
```

```
\rightarrow [expand definition of constant 'M3' at prang.c (24,20)]
[5.32] ((-30307 < -$heap<sub>funcstart_724,1.</sub>p2) \wedge (-30269 <
-\$heap_{funcstart\_724,1}.p1) \land (0 < \$heap_{funcstart\_724,1}.p1) \land (0 < \$heap_{funcstart\_724,1}.p1)
\text{Sheap}_{funcstart\_724,1.p2} \land (0 < \text{Sheap}_{funcstart\_724,1.p3})) \&\&
(\text{sheap}_{funcstart\_724.1}.p3 < asType < integer > (asType < short)
int > ((int)30323)))
\rightarrow [simplify]
[5.40] (-30323 < -$heap_{funcstart\_724,1}.p3) \land (-30307 <
-\$heap_{funcstart_{-724,1}.p2}) \land (-30269 < -\$heap_{funcstart_{-724,1}.p1}) \land (0 < -\$heap_{funcstart_{-724,1}.p2})
\text{Sheap}_{funcstart\_724,1}.\text{p1}) \land (0 < \text{Sheap}_{funcstart\_724,1}.\text{p2}) \land (0 <
heap_{funcstart_{724,1}.p3}
[Work on sub-term 5 of conjunction in term 5.40]
[9.0] 0 < \text{$heap}_{funcstart\_724,1}.p2
[Take given term]
[25.0] div2 == div(heapIs $heap_{funcstart\_724,1},
asType < int > (\$heap_{funcstart\_724,1}.p2),
asType < int > (\$heap_{funcstart\_724,1}.a2))
\rightarrow [simplify]
[25.1] \ \mathrm{div2} == \mathrm{div}(\mathbf{heapIs} \ \$ \mathrm{heap}_{funcstart\_724,1}, \ \$ \mathrm{heap}_{funcstart\_724,1}.\mathrm{p2},
asType < int > (\$heap_{funcstart\_724,1}.a2))
\rightarrow [const static or extern object]
[25.2] div2 == div(heapIs $heap_{funcstart\_724.1}, $heap_{funcstart\_724.1}.p2,
asType < int > (\$heap_{init}.a2))
\rightarrow [expand definition of constant 'a2' at prang.c (21,20)]
[25.3] \operatorname{div2} == \operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.p2,
asType<int>(asType<short int>((int)176)))
\rightarrow [simplify]
[25.6] div2 == div(heapIs \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, p2, 176)
[Assume known post-assertion, class invariant or type constraint for term 25.6]
[29.0] (asType<integer>(sheap_{funcstart\_724,1}.p2) %
asType<integer>(176)) == asType<integer>(div(heapIs
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.p2, 176).rem
\rightarrow [simplify]
[29.2] ($heap<sub>funcstart_724,1.</sub>p2 % 176) == asType<integer>(div(heapIs)
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.p2, 176).rem
→ [expand definition of operator '.%' in class 'int' at built in declaration]
[29.3] ([asType<integer>(sheap_{funcstart\_724.1}.p2) < 0]:
```

```
-(-asType < integer > (\$heap_{funcstart\_724,1}.p2) \% 176), []:
asType < integer > (\$heap_{funcstart\_724,1}.p2) \% 176) ==
\mathbf{asType} {<} \mathbf{integer} {>} ( \mathbf{div} (\mathbf{heapIs} \ \$ \mathbf{heap}_{funcstart\_724,1}, \ \$ \mathbf{heap}_{funcstart\_724,1}. \mathbf{p2}, \\
176).rem)
\rightarrow [explicitly assert falsehood of skipped guards in subsequent guards]
[29.4] ([asType<integer>(heap_{funcstart\_724,1}.p2) < 0]:
-(-asType < integer > (\$heap_{funcstart\_724,1}.p2) \% 176),
[!(asType < integer > (\$heap_{funcstart\_724,1}.p2) < 0)]:
asType < integer > (\$heap_{funcstart\_724,1}.p2) \% 176) ==
asType<integer>(div(heapIs $heap_funcstart_724,1, $heap_funcstart_724,1.p2,
176).rem)
\rightarrow [simplify]
[29.7] ([0 < -$heap<sub>funcstart_724,1</sub>.p2]:
-(-\mathbf{asType} < \mathbf{integer} > (\$ \mathrm{heap}_{funcstart\_724,1}.\mathrm{p2}) \% \ 176),
[!(asType < integer > (\$heap_{funcstart\_724,1}.p2) < 0)]:
asType < integer > (\$heap_{funcstart\_724,1}.p2) \% 176) ==
asType<integer>(div(heapIs heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p2,
176).rem)
\rightarrow [from term 9.0, literala < –$heap_{uncstart\_724,1}.p2 is false whenever -2 < (0
+ literala)]
    Proof of rule precondition:
    [29.7.0] - 2 < (0 + 0)
    \rightarrow [simplify]
    [29.7.2] true
[29.8] ([false]: -(-asType < integer > (\$heap_{funcstart\_724,1}.p2) \% 176),
[!(asType < integer > (\$heap_{funcstart\_724,1}.p2) < 0)]:
asType < integer > (\$heap_{funcstart\_724,1}.p2) \% 176) ==
\mathbf{asType} < \mathbf{integer} > (\mathbf{div}(\mathbf{heapIs} \ \$ \mathbf{heap}_{funcstart\_724,1}, \ \$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p2}, \\
176).rem)
\rightarrow [simplify]
[29.11] ([false]: -(-asType < integer > ($heap_{funcstart\_724,1}.p2) \% 176), [!(0
<-$heap<sub>funcstart_724,1.</sub>p2)]: asType<integer>($heap<sub>funcstart_724,1.</sub>p2) %
176) == asType<integer>(div(heapIs heap_{funcstart\_724,1},
heap_{funcstart_{724,1},p2,176}.rem)
\rightarrow [from term 9.0, literala < -$heap<sub>funcstart_724,1</sub>.p2 is false whenever -2 < (0
+ literala)]
    Proof of rule precondition:
    [29.11.0] - 2 < (0 + 0)
    \rightarrow [simplify]
```

```
[29.11.2] true
[29.12] ([false]: -(-asType < integer > (\$heap_{funcstart\_724,1}.p2) \% 176),
[!false]: asType<integer>(\ensuremath{$^{\circ}$}(\ensuremath{$^{\circ}$}) ===
\mathbf{asType} < \mathbf{integer} > (\mathbf{div}(\mathbf{heapIs} \ \$ \mathbf{heap}_{funcstart\_724,1}, \ \$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p2}, \\
176).rem)
\rightarrow [simplify]
[29.17] \ 0 == (-\text{div}(\mathbf{heapIs} \ \$ \text{heap}_{funcstart\_724,1}, \ \$ \text{heap}_{funcstart\_724,1}.\text{p2},
176).rem + (heap_{funcstart\_724,1}.p2 \% 176)
[Assume known post-assertion, class invariant or type constraint for term
29.17]
[36.0] \ \mathbf{minof(int)} \leq \mathrm{div}(\mathbf{heapIs} \ \$ \mathrm{heap}_{funcstart\_724,1}, \ \$ \mathrm{heap}_{funcstart\_724,1}.\mathrm{p2},
176).rem
\rightarrow [simplify]
[36.3] -32769 < div(heapIs $heap_{funcstart\_724,1}, $heap_{funcstart\_724,1}.p2,
176).rem
[Take goal term]
[1.0] minof(short int) \leq div2.rem
\rightarrow [simplify]
[1.1] -32768 < div2.rem
\rightarrow [from term 25.6, div2 is equal to div(heapIs $heap_{funcstart\_724,1},
heap_{funcstart_{-724,1}}.p2, 176
[1.2] - 32768 \leq \operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.\operatorname{p2},
176).rem
\rightarrow [simplify]
[1.4] -32769 < div(heapIs $heap_{funcstart_724,1}$, $heap_{funcstart_724,1}.p2$,
176).rem
\rightarrow [from term 36.3, literala < div(heapIs $heap_{funcstart\_724,1},
heap_{funcstart_{724,1}.p2, 176}.rem is true whenever (-1 + literala) < -32769
    Proof of rule precondition:
    [1.4.0](-32769 + -1) < -32769
    \rightarrow [simplify]
    [1.4.2] true
[1.5] true
```

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

```
Condition generated at: C:\Escher\Customers\prang\prang.c (58,15)
Condition defined at:
To prove: div2.rem < maxof(short int)
Given:
heap_{init}.LIMIT == (int)80
\theta
\theta_{init}.r1 == asType < short int > ((int)171)
heap_{init}.a1 == asType < short int > ((int)177)
\theta
heap_{init}.M2 == asType < short int > ((int)30307)
\theta
heap_{init}.a2 == asType < short int > ((int)176)
\theta = asType < short int > ((int)35)
\theta = asType < short int > ((int)30323)
heap_{init}.r3 == asType < short int > ((int)170)
heap_{init}.a3 == asType < short int > ((int)178)
\theta = asType < short int > ((int)63)
\theta = asType < short int > ((int)1)
\theta
\theta = asType < short int > ((int)3)
invariant1(heapIs heap_{funcstart\_724,1})
div1 == div(\mathbf{heapIs} \$ heap_{funcstart\_724.1},
\mathbf{asType} < \mathbf{int} > (\$ \mathrm{heap}_{funcstart\_724,1}.\mathrm{p1}),
asType < int > (\$heap_{funcstart\_724,1}.a1))
(\mathbf{asType}{<}\mathbf{int}{>}(\mathbf{asType}{<}\mathbf{int}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{p1}))\ /
\mathbf{asType}{<}\mathbf{integer}{>}(\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{a1}))) = =
asType<integer>(div1.quot)
(asType<integer>(asType<int>($heap_{tuncstart\_724.1}.p1)) %
\mathbf{asType}{<}\mathbf{integer}{>}(\mathbf{asType}{<}\mathbf{int}{>}(\$\mathbf{heap}_{funcstart\_724,1}.\mathbf{a1}))) = =
asType<integer>(div1.rem)
!(0 == asType < integer > (div1.rem)) || !(0 ==
asType<integer>(div1.quot))
div2 == div(\mathbf{heapIs} \$ heap_{funcstart\_724,1},
asType < int > (\$heap_{funcstart\_724,1}.p2),
asType < int > (\$heap_{funcstart\_724,1}.a2))
```

```
(\mathbf{asType}{<}\mathbf{integer}{>}(\mathbf{asType}{<}\mathbf{int}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{p2}))\ /
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a2))) = =
asType<integer>(div2.quot)
(asType<int>(asType<int>($heap_{funcstart\_724,1}.p2)) %
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a2))) = =
asType<integer>(div2.rem)
!(0 == asType < integer > (div2.rem)) || !(0 ==
asType<integer>(div2.quot))
div3 == div(\mathbf{heapIs} \$ heap_{funcstart\_724,1},
asType < int > (\$heap_{funcstart\_724,1}.p3),
asType < int > (\$heap_{funcstart_{-724,1}}.a3))
(asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.p3)) /
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a3))) = =
asType<integer>(div3.quot)
(asType<int>(asType<int>($heap_{tuncstart\_724.1}.p3)) %
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a3))) = =
asType<integer>(div3.rem)
!(0 == asType < integer > (div3.rem)) || !(0 ==
asType<integer>(div3.quot))
\$heap_{724,1;740,8} == \$heap_{funcstart\_724,1}.\_\textbf{replace}(p1 \rightarrow \textbf{asType} < \textbf{short}
int>((asType<int>(asType<short int>(div1.rem)) *
asType < int > (\$heap_{tuncstart\_724.1}.r1)) - (asType < int > (asType < short)
int>(div1.quot)) * asType<int>($heap_{funcstart\_724,1}.b1)))
-{\bf asType}{<} {\bf integer~const}{>} (\${\rm heap}_{724,1;740,8}.{\rm M1}) <
asType<integer>($heap<sub>724,1:740.8</sub>.p1)
!(0 == asType < integer > (\$heap_{724,1;740,8}.p1))
asType<integer>($heap<sub>724.1:740.8</sub>.p1) <
asType<integer>($heap<sub>724.1:740.8</sub>.M1)
Proof:
[Take given term]
[5.0] invariant1(heapIs heap_{funcstart\_724,1})
\rightarrow [expand definition of function 'invariant1' at prang.c (34,1)]
[5.1] ((((((0 < asType < integer > ($heap_{funcstart\_724,1}.p1)) &&
(\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{p1}) <
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{M1})))~\&\&~(0<
asType < integer > (\$heap_{funcstart\_724,1}.p2))) \&\&
(asType < integer > ($heap_{funcstart\_724,1}.p2) < 
asType < integer > (\$heap_{funcstart\_724,1}.M2))) \&\& (0 < function 0)
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{p3})))\ \&\&
```

```
(\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{p3}) <
asType < integer > (\$heap_{funcstart\_724,1}.M3))
\rightarrow [simplify]
[5.3] (((((0 < $heap_{funcstart\_724,1}.p1) && ($heap_{funcstart\_724,1}.p1 < 
asType<integer>(heap_{funcstart\_724,1}.M1))) && (0 <
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{p2})))\ \&\&
(\mathbf{asType} < \mathbf{integer} > (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p2}) <
asType < integer > (\$heap_{funcstart\_724,1}.M2))) \&\& (0 <
\mathbf{asType} {<} \mathbf{integer} {>} (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p3}))) \ \&\& \\
(asType < integer > (\$heap_{funcstart\_724,1}.p3) < 
\mathbf{asType} < \mathbf{integer} > (\$ heap_{funcstart\_724,1}.M3))
\rightarrow [const static or extern object]
[5.4] \; (((((0 < \mathrm{\$heap}_{funcstart\_724,1}.\mathrm{p1}) \; \&\& \; (\mathrm{\$heap}_{funcstart\_724,1}.\mathrm{p1} <
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathrm{heap}_{init}.\mathrm{M1})))~\&\&~(0<
asType < integer > (\$heap_{funcstart\_724,1}.p2))) \&\&
(\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{p2}) <
asType < integer > (\$heap_{funcstart\_724,1}.M2))) \&\& (0 <
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p3})))\ \&\&
(asType < integer > (\$heap_{funcstart_{-724,1}}.p3) < 
asType < integer > (\$heap_{funcstart\_724,1}.M3))
\rightarrow [expand definition of constant 'M1' at prang.c (14,20)]
[5.5] (((((0 < \text{heap}_{funcstart\_724,1}.p1) && (\text{heap}_{funcstart\_724,1}.p1 <
asType<integer>(asType<short int>((int)30269)))) && (0 <
asType < integer > (\$heap_{funcstart\_724,1}.p2))) \&\&
(asType < integer > ($heap_{funcstart\_724,1}.p2) < 
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{M2})))~\&\&~(0<
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathtt{heap}_{funcstart\_724,1}.\mathtt{p3})))\ \&\&
(asType < integer > ($heap_{funcstart\_724,1}.p3) < 
asType < integer > (\$heap_{funcstart\_724,1}.M3))
\rightarrow [simplify]
[5.16] ((((-30269 < -$heap_{funcstart\_724,1}.p1) \lambda (0 < $heap_{funcstart\_724,1}.p1) \lambda
(0 < \text{$heap}_{funcstart\_724,1}.p2)) \&\& (\text{$heap}_{funcstart\_724,1}.p2 <
asType<integer>($heap_{funcstart\_724,1}.M2))) && (0 <
asType < integer > (\$heap_{funcstart\_724,1}.p3))) \&\&
(\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{p3}) <
asType < integer > (\$heap_{funcstart\_724,1}.M3))
\rightarrow [const static or extern object]
[5.17] \; ((((-30269 < -\$heap_{funcstart\_724,1}.p1) \; \land \; (0 < \$heap_{funcstart\_724,1}.p1) \; \land 
(0 < \text{\$heap}_{funcstart\_724,1}.p2)) \&\& (\text{\$heap}_{funcstart\_724,1}.p2 <
asType < integer > (\$heap_{init}.M2))) \&\& (0 <
asType < integer > (\$heap_{funcstart\_724,1}.p3))) \&\&
```

```
(\mathbf{asType} {<} \mathbf{integer} {>} (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p3}) <
asType < integer > (\$heap_{funcstart\_724,1}.M3))
\rightarrow [expand definition of constant 'M2' at prang.c (19,20)]
[5.18] ((((-30269 < -\$heap_{funcstart\_724,1}.p1) \land (0 < \$heap_{funcstart\_724,1}.p1) 
(0 < \mathrm{\$heap}_{funcstart\_724,1}.\mathrm{p2})) && (\mathrm{\$heap}_{funcstart\_724,1}.\mathrm{p2} <
asType<integer>(asType<short int>((int)30307)))) && (0 <
asType < integer > ($heap_{funcstart\_724,1}.p3))) &&
(asType<integer>($heap_{tuncstart\_724,1}.p3) <
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{M3}))
\rightarrow [simplify]
[5.30] ((-30307 < -$heap<sub>funcstart_724.1.</sub>p2) \wedge (-30269 <
-\$heap_{funcstart_{-724,1}.p1}) \land (0 < \$heap_{funcstart_{-724,1}.p1}) \land (0 <
\text{Sheap}_{funcstart\_724,1}.\text{p2}) \land (0 < \text{Sheap}_{funcstart\_724,1}.\text{p3})) \&\&
(\$heap_{funcstart\_724,1}.p3 < \mathbf{asType} < \mathbf{integer} > (\$heap_{funcstart\_724,1}.M3))
\rightarrow [const static or extern object]
[5.31] ((-30307 < -$heap<sub>funcstart_724,1.</sub>p2) \land (-30269 <
-\$heap_{funcstart\_724,1}.p1) \land (0 < \$heap_{funcstart\_724,1}.p1) \land (0 < \$heap_{funcstart\_724,1}.p1)
\text{Sheap}_{funcstart\_724,1.p2}) \land (0 < \text{Sheap}_{funcstart\_724,1.p3})) \&\&
(\text{\$heap}_{funcstart\_724,1}.p3 < asType < integer > (\text{\$heap}_{init}.M3))
\rightarrow [expand definition of constant 'M3' at prang.c (24,20)]
[5.32] ((-30307 < -$heap_{funcstart\_724,1}.p2) \land (-30269 <
-\$heap_{funcstart_{724,1}.p1}) \land (0 < \$heap_{funcstart_{724,1}.p1}) \land (0 <
\text{Sheap}_{funcstart_{724,1},p2} \land (0 < \text{Sheap}_{funcstart_{724,1},p3})) \&\&
(\$heap_{funcstart\_724,1}.p3 < \textbf{asType} < \textbf{integer} > (\textbf{asType} < \textbf{short}
int > ((int)30323))
\rightarrow [simplify]
[5.40] \; (-30323 < -\$ heap_{funcstart\_724,1}.p3) \; \wedge \; (-30307 < -30307) \; \wedge \; (-30307 < -30307) \; \wedge \; (-30307) \; \wedge \; (-3030
  -\$heap_{funcstart\_724,1}.p2) \land (-30269 < -\$heap_{funcstart\_724,1}.p1) \land (0 < -\$heap_{funcstart\_724,1}.p1)
\text{Sheap}_{funcstart_{724,1}.p1} \land (0 < \text{Sheap}_{funcstart_{724,1}.p2}) \land (0 <
\$ heap_{funcstart\_724,1}.p3)
[Work on sub-term 5 of conjunction in term 5.40]
[9.0] 0 < $heap_{funcstart_724,1}.p2
[Take given term]
[25.0] \operatorname{div2} == \operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724,1},
asType < int > (\$heap_{funcstart\_724,1}.p2),
asType < int > (\$heap_{funcstart\_724,1}.a2))
\rightarrow [simplify]
[25.1] \operatorname{div2} == \operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.p2,
asType < int > (\$heap_{funcstart\_724,1}.a2))
```

```
\rightarrow [const static or extern object]
[25.2] div2 == div(heapIs $heap_{funcstart\_724.1}, $heap_{funcstart\_724.1}.p2,
asType < int > (\$heap_{init}.a2))
\rightarrow [expand definition of constant 'a2' at prang.c (21,20)]
[25.3]~{\rm div2} == {\rm div}(\mathbf{heapIs}~\$ \mathrm{heap}_{funcstart\_724,1},\,\$ \mathrm{heap}_{funcstart\_724,1}.\mathrm{p2},
asType<int>(asType<short int>((int)176)))
\rightarrow [simplify]
[25.6] \text{ div2} == \text{div}(\text{heapIs } \text{$heap}_{funcstart\_724,1}, \text{$heap}_{funcstart\_724,1}.p2, 176)
[Assume known post-assertion, class invariant or type constraint for term 25.6]
[29.0] (asType<integer>(heap_{funcstart\_724,1}.p2) %
asType<integer>(176)) == asType<integer>(div(heapIs
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.p2, 176).rem
\rightarrow [simplify]
[29.2] ($heap<sub>funcstart_724,1.</sub>p2 % 176) == asType<integer>(div(heapIs)
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.p2, 176).rem
→ [expand definition of operator '.%' in class 'int' at built in declaration]
[29.3] ([asType<integer>(heap_{funcstart}_{724.1}.p2) < 0]:
-(-asType < integer > (\$heap_{tuncstart\_724,1}.p2) \% 176), []:
asType < integer > (\$heap_{funcstart\_724,1}.p2) \% 176) ==
asType<integer>(div(heapIs $heap_{funcstart_724,1}, $heap_{funcstart_724,1}.p2,
176).rem)
→ [explicitly assert falsehood of skipped guards in subsequent guards]
[29.4] ([asType<integer>(heap_{funcstart\_724,1}.p2) < 0]:
-(-asType < integer > (\$heap_{funcstart\_724,1}.p2) \% 176),
[!(\mathbf{asType} < \mathbf{integer} > (\$ heap_{funcstart\_724,1}.p2) < 0)]:
asType < integer > (\$heap_{funcstart\_724,1}.p2) \% 176) ==
asType<integer>(div(heapIs heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p2,
176).rem)
\rightarrow [simplify]
[29.7] ([0 < -\$heap_{funcstart\_724,1}.p2]:
-(-asType < integer > (\$heap_{funcstart\_724,1}.p2) \% 176),
[!(\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathbf{heap}_{funcstart\_724,1}.\mathbf{p2})<0)]:
asType < integer > (\$heap_{funcstart\_724,1}.p2) \% 176) = =
asType<integer>(div(heapIs p_{funcstart\_724,1}, p_{funcstart\_724,1}, p_{funcstart\_724,1})
176).rem)
\rightarrow [from term 9.0, literala < -$heap<sub>funcstart_724.1</sub>.p2 is false whenever -2 < (0
+ literala)]
```

## Proof of rule precondition:

```
[29.7.0] - 2 < (0 + 0)
   \rightarrow [simplify]
   [29.7.2] true
[29.8] ([false]: -(-asType < integer > (\$heap_{funcstart\_724,1}.p2) \% 176),
[!(asType<integer>(peq_{funcstart_{-724,1}}.p2) < 0)]:
asType < integer > (\$heap_{funcstart\_724,1}.p2) \% 176) ==
asType<integer>(div(heapIs heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p2,
176).rem)
\rightarrow [simplify]
[29.11] ([false]: -(-asType < integer > (\$heap_{funcstart\_724,1}.p2) \% 176), [!(0
<-$heap<sub>funcstart_724,1.</sub>p2)]: asType<integer>($heap<sub>funcstart_724,1.</sub>p2) %
176) == asType<integer>(div(heapIs $heap_{funcstart\_724,1},)
heap_{funcstart_{-724,1}.p2, 176}.rem
\rightarrow [from term 9.0, literala < -$heap<sub>funcstart_724.1</sub>.p2 is false whenever -2 < (0
+ literala)]
   Proof of rule precondition:
   [29.11.0] - 2 < (0 + 0)
   \rightarrow [simplify]
   [29.11.2] true
[29.12] ([false]: -(-asType < integer > (\$heap_{funcstart\_724,1}.p2) \% 176),
[!false]: asType<integer>(sheap_{funcstart_{-724,1},p2}) \% 176) ==
asType<integer>(div(heapIs heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p2,
176).rem)
\rightarrow [simplify]
[29.17] \ 0 == (-\text{div}(\mathbf{heapIs} \ \$ \text{heap}_{funcstart\_724,1}, \ \$ \text{heap}_{funcstart\_724,1}.\text{p2},
176).rem + (\text{$heap}_{funcstart\_724,1}.p2 \% 176))
[Assume known post-assertion, class invariant or type constraint for term
29.17
[37.0] div(heapIs heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p2, 176).rem \leq
maxof(int)
\rightarrow [simplify]
\label{eq:continuous} \textit{[37.9] -32768} < -\text{div}(\mathbf{heapIs} \ \$ \text{heap}_{funcstart\_724,1}, \ \$ \text{heap}_{funcstart\_724,1}.\text{p2},
176).rem
[Take goal term]
[1.0] div2.rem \leq maxof(short int)
\rightarrow [from term 25.6, div2 is equal to div(heapIs $heap_{funcstart\_724,1},
heap_{funcstart_{724,1}}.p2, 176
```

```
[1.1] div(heapIs heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p2, 176).rem \leq
maxof(short int)
\rightarrow [simplify]
 [1.10] \ -32768 < -\mathrm{div}(\mathbf{heapIs} \ \$ \mathrm{heap}_{funcstart\_724,1}, \ \$ \mathrm{heap}_{funcstart\_724,1}.\mathrm{p2}, 
176).rem
\rightarrow [from term 37.9, literala < -div(heapIs $heap_{funcstart\_724.1},
\text{Sheap}_{funcstart\_724,1}.p2, 176).\text{rem} is true whenever (-1 + \text{literala}) < -32768]
   Proof of rule precondition:
   [1.10.0](-32768 + -1) < -32768
   \rightarrow [simplify]
   [1.10.2] true
[1.11] true
Proof of verification condition: Type constraint satisfied in implicit
conversion from 'short int' to 'int'
Condition generated at: C:\Escher\Customers\prang\prang.c (58,15)
Condition defined at:
To prove: minof(int) \le asType < short int > (div2.rem)
Given:
heap_{init}.LIMIT == (int)80
heap_{init}.M1 == asType < short int > ((int)30269)
\theta_{init}.r1 == asType < short int > ((int)171)
heap_{init}.a1 == asType < short int > ((int)177)
\theta
\theta sheap<sub>init</sub>.M2 == asType<short int>((int)30307)
\theta_{init}.r2 == asType < short int > ((int)172)
\theta_{init}.a2 == asType<short int>((int)176)
heap_{init}.b2 == asType<short int>((int)35)
\theta = asType < short int > ((int)30323)
heap_{init}.r3 == asType < short int > ((int)170)
heap_{init}.a3 == asType < short int > ((int)178)
\theta = asType < short int > ((int)63)
\theta = asType < short int > ((int)1)
\theta
```

```
\theta = asType < short int > ((int)3)
invariant1(heapIs $heap_{tuncstart_724.1})
\operatorname{div1} == \operatorname{div}(\mathbf{heapIs} \ \operatorname{\$heap}_{funcstart\_724,1},
asType < int > (\$heap_{funcstart\_724,1}.p1),
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{a1}))
(\mathbf{asType}{<}\mathbf{integer}{>}(\mathbf{asType}{<}\mathbf{int}{>}(\$\mathbf{heap}_{funcstart\_724,1}.\mathbf{p1})) \ / \\
\mathbf{asType}{<}\mathbf{integer}{>}(\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{a1}))) = =
asType<integer>(div1.quot)
(\mathbf{asType} < \mathbf{integer} > (\mathbf{asType} < \mathbf{int} > (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p1})) \ \%
asType<integer>(asType<int>($heap_{tuncstart\_724.1}.a1))) ==
asType<integer>(div1.rem)
!(0 == asType < integer > (div1.rem)) || !(0 ==
asType<integer>(div1.quot))
div2 == div(\mathbf{heapIs} \$heap_{funcstart\_724,1},
asType < int > (\$heap_{funcstart\_724,1}.p2),
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{a2}))
(\mathbf{asType}{<}\mathbf{integer}{>}(\mathbf{asType}{<}\mathbf{int}{>}(\$\mathbf{heap}_{funcstart\_724,1}.\mathbf{p2})) \ / \\
asType < integer > (asType < int > (\$heap_{funcstart_{-724,1}}.a2))) = =
asType<integer>(div2.quot)
(\mathbf{asType} < \mathbf{integer} > (\mathbf{asType} < \mathbf{int} > (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p2})) \ \%
\mathbf{asType}{<}\mathbf{integer}{>}(\mathbf{asType}{<}\mathbf{int}{>}(\$\mathbf{heap}_{funcstart\_724,1}.\mathbf{a2}))) = =
asType<integer>(div2.rem)
!(0 == asType < integer > (div2.rem)) || !(0 ==
asType<integer>(div2.quot))
div3 == div(\mathbf{heapIs} \$heap_{funcstart\_724,1},
asType < int > (\$heap_{funcstart\_724,1}.p3),
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{a3}))
(asType < int > (sheap_{funcstart\_724,1}.p3)) / 
asType < integer > (asType < int > (\$heap_{funcstart_{-724,1}}.a3))) = =
asType<integer>(div3.quot)
(\mathbf{asType} < \mathbf{integer} > (\mathbf{asType} < \mathbf{int} > (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p3})) \%
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a3))) = =
asType<integer>(div3.rem)
!(0 == asType < integer > (div3.rem)) || !(0 ==
asType<integer>(div3.quot))
$heap_{724,1;740,8} == $heap_{funcstart\_724,1}.\_replace(p1 \rightarrow asType < short)
int>((asType<int>(asType<short int>(div1.rem)) *
asType < int > (\$heap_{funcstart\_724,1}.r1)) - (asType < int > (asType < short)
int>(div1.quot)) * asType< int>($heap_{tuncstart\_724.1}.b1))))
```

```
-asType<integer const>($heap<sub>724.1:740.8</sub>.M1) <
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathrm{heap}_{724,1;740,8}.\mathrm{p1})
!(0 == asType < integer > (\$heap_{724,1:740.8}.p1))
asType<integer>($heap<sub>724,1;740,8</sub>.p1) <
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathrm{heap}_{724,1;740,8}.\mathrm{M1})
Proof:
[Take given term]
[5.0] invariant1(heapIs heap_{funcstart\_724,1})
\rightarrow [expand definition of function 'invariant1' at prang.c (34,1)]
[5.1] ((((((0 < asType<integer>(sheap_{funcstart\_724.1}.p1)) &&
(asType < integer > (\$heap_{funcstart\_724,1}.p1) < 
asType < integer > (\$heap_{funcstart\_724,1}.M1))) \&\& (0 < funcstart\_724,1)
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p2})))\ \&\&
(asType < integer > (\$heap_{funcstart\_724,1}.p2) <
asType < integer > (\$heap_{funcstart\_724,1}.M2))) \&\& (0 <
asType < integer > (\$heap_{funcstart\_724,1}.p3))) \&\&
(\mathbf{asType} < \mathbf{integer} > (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p3}) <
asType < integer > (\$heap_{funcstart\_724,1}.M3))
\rightarrow [simplify]
[5.3] \ (((((0 < \$heap_{funcstart\_724,1}.p1) \&\& \ (\$heap_{funcstart\_724,1}.p1 < 
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{M1})))~\&\&~(0<
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{p2})))\ \&\&
(asType < integer > ($heap_{funcstart\_724,1}.p2) < 
asType < integer > (\$heap_{funcstart\_724,1}.M2))) \&\& (0 <
asType < integer > (\$heap_{funcstart\_724,1}.p3))) \&\&
(\mathbf{asType} {<} \mathbf{integer} {>} (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p3}) <
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{M3}))
\rightarrow [const static or extern object]
[5.4] (((((0 < \text{\$heap}_{funcstart\_724,1}.p1) \&\& (\text{\$heap}_{funcstart\_724,1}.p1 <
asType<integer>(\theta_{init}.M1))) && (0 <
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p2})))\ \&\&
(\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{p2}) <
asType < integer > (\$heap_{funcstart\_724,1}.M2))) \&\& (0 <
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p3})))\ \&\&
(\mathbf{asType} {<} \mathbf{integer} {>} (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p3}) <
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{M3}))
\rightarrow [expand definition of constant 'M1' at prang.c (14,20)]
[5.5] \ (((((0 < \text{\$heap}_{funcstart\_724,1}.\text{p1}) \&\& \ (\text{\$heap}_{funcstart\_724,1}.\text{p1} <
asType<integer>(asType<short int>((int)30269)))) && (0 <
asType < integer > (\$heap_{funcstart\_724,1}.p2))) \&\&
```

```
(\mathbf{asType} {<} \mathbf{integer} {>} (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p2}) <
asType < integer > (\$heap_{funcstart\_724,1}.M2))) \&\& (0 <
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{p3})))\ \&\&
(asType < integer > ($heap_{funcstart\_724,1}.p3) < 
asType<integer>($heap_funcstart_724,1.M3))
\rightarrow [simplify]
[5.16] ((((-30269 < -$heap_{funcstart\_724,1}.p1) \lambda (0 < $heap_{funcstart\_724,1}.p1) \lambda
(0 < \text{\$heap}_{funcstart\_724,1}.p2)) \&\& (\text{\$heap}_{funcstart\_724,1}.p2 <
asType<integer>(heap_{funcstart\_724,1}.M2))) && (0 <
asType < integer > (\$heap_{funcstart\_724,1}.p3))) \&\&
(\mathbf{asType} < \mathbf{integer} > (\$ heap_{funcstart\_724,1}.p3) <
asType < integer > (\$heap_{funcstart\_724,1}.M3))
\rightarrow [const static or extern object]
[5.17] \; ((((-30269 < -\$heap_{funcstart\_724,1}.p1) \; \land \; (0 < \$heap_{funcstart\_724,1}.p1) \; \land 
(0 < \text{Sheap}_{funcstart_{724,1}.p2})) \&\& (\text{Sheap}_{funcstart_{724,1}.p2} <
asType < integer > (\$heap_{init}.M2))) \&\& (0 <
asType < integer > (\$heap_{funcstart\_724,1}.p3))) \&\&
(asType < integer > (\$heap_{funcstart\_724,1}.p3) <
asType < integer > (\$heap_{tuncstart_{-724.1}}.M3))
\rightarrow [expand definition of constant 'M2' at prang.c (19,20)]
[5.18] ((((-30269 < -\$heap_{funcstart\_724,1}.p1) \land (0 < \$heap_{funcstart\_724,1}.p1) 
(0 < \text{$heap}_{funcstart\_724,1}.p2)) \&\& (\text{$heap}_{funcstart\_724,1}.p2 <
asType < integer > (asType < short int > ((int)30307)))) && (0 < integer) && (0 < integer
asType < integer > (\$heap_{funcstart\_724,1}.p3))) \&\&
(\mathbf{asType} < \mathbf{integer} > (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p3}) <
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{M3}))
\rightarrow [simplify]
[5.30] ((-30307 < -$heap<sub>funcstart_724,1</sub>.p2) \wedge (-30269 <
  -\$heap_{funcstart\_724,1}.p1) \land (0 < \$heap_{funcstart\_724,1}.p1) \land (0 < \$heap_{funcstart\_724,1}.p1)
\text{Sheap}_{funcstart_{724,1}.p2} \land (0 < \text{Sheap}_{funcstart_{724,1}.p3})) \&\&
(\text{\$heap}_{funcstart\_724,1}.\text{p3} < \text{asType} < \text{integer} > (\text{\$heap}_{funcstart\_724,1}.\text{M3}))
\rightarrow [const static or extern object]
[5.31] ((-30307 < -$heap_funcstart_724,1.p2) \land (-30269 <
-$heap_{funcstart\_724,1}.p1) \land (0 < $heap_{funcstart\_724,1}.p1) \land (0 <
\text{Sheap}_{funcstart\_724,1.p2} \land (0 < \text{Sheap}_{funcstart\_724,1.p3})) \&\&
(\$heap_{funcstart\_724,1}.p3 < \textbf{asType} < \textbf{integer} > (\$heap_{init}.M3))
\rightarrow [expand definition of constant 'M3' at prang.c (24,20)]
[5.32] ((-30307 < -$heap_{tuncstart\_724,1}.p2) \land (-30269 <
-\$heap_{funcstart\_724,1}.p1) \land (0 < \$heap_{funcstart\_724,1}.p1) \land (0 < \$heap_{funcstart\_724,1}.p1)
\text{Sheap}_{funcstart\_724,1.p2}) \land (0 < \text{Sheap}_{funcstart\_724,1.p3})) \&\&
(\text{sheap}_{funcstart\_724,1}.\text{p3} < \text{asType} < \text{integer} > (\text{asType} < \text{short})
```

```
int > ((int)30323)))
\rightarrow [simplify]
[5.40] (-30323 < -\$heap_{funcstart\_724,1}.p3) \land (-30307 < -30307)
-\$heap_{funcstart\_724,1}.p2) \land (-30269 < -\$heap_{funcstart\_724,1}.p1) \land (0 < -\$heap_{funcstart\_724,1}.p1)
\text{Sheap}_{funcstart\_724,1}.\text{p1}) \land (0 < \text{Sheap}_{funcstart\_724,1}.\text{p2}) \land (0 <
heap_{funcstart_{-724,1}.p3}
[Work on sub-term 5 of conjunction in term 5.40]
[9.0] 0 < \text{$heap}_{funcstart\_724,1}.p2
[Take given term]
[25.0] div2 == div(heapIs $heap_{funcstart\_724,1},
asType < int > (\$heap_{funcstart\_724,1}.p2),
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{a2}))
\rightarrow [simplify]
[25.1] div2 == div(heapIs heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p2,
asType < int > (\$heap_{funcstart\_724.1}.a2))
\rightarrow [const static or extern object]
\label{eq:continuous} \textit{[25.2]} \ \text{div2} == \ \text{div} (\mathbf{heapIs} \ \$ \text{heap}_{funcstart\_724,1}, \ \$ \text{heap}_{funcstart\_724,1}.\text{p2},
asType < int > (\$heap_{init}.a2))
\rightarrow [expand definition of constant 'a2' at prang.c (21,20)]
\label{eq:continuous} \textit{[25.3]} \ \text{div2} == \ \text{div}(\mathbf{heapIs} \ \$ \text{heap}_{funcstart\_724,1}, \ \$ \text{heap}_{funcstart\_724,1}.\text{p2},
asType<int>(asType<short int>((int)176)))
\rightarrow [simplify]
[25.6] div2 == div(heapIs \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}.p2, 176)
[Assume known post-assertion, class invariant or type constraint for term 25.6]
[29.0] (asType<integer>(sheap_{funcstart\_724,1}.p2) %
asType<integer>(176)) == asType<integer>(div(heapIs
\$heap_{funcstart\_724,1},\,\$heap_{funcstart\_724,1}.p2,\,176).rem)
\rightarrow [simplify]
[29.2] ($heap<sub>funcstart_724,1.</sub>p2 % 176) == asType<integer>(div(heapIs)
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.p2, 176).rem
→ [expand definition of operator '.%' in class 'int' at built in declaration]
[29.3] ([asType<integer>(peq: funcstart_{-724,1}.p2) < 0]:
-(-asType < integer > (\$heap_{funcstart\_724,1}.p2) \% 176), []:
asType < integer > (\$heap_{funcstart\_724,1}.p2) \% 176) ==
asType < integer > (div(heapIs \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p2,
176).rem)
→ [explicitly assert falsehood of skipped guards in subsequent guards]
```

```
\label{eq:continuous_section} \textit{[29.4]} \; ([\textbf{asType} < \textbf{integer} > (\$ \text{heap}_{funcstart\_724,1}.\text{p2}) < 0]:
-(-asType < integer > ($heap_{funcstart\_724,1}.p2) \% 176),
[!(\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{p2}) < 0)]:
asType < integer > (\$heap_{funcstart\_724,1}.p2) \% 176) = =
asType<integer>(div(heapIs p_{funcstart\_724,1}, p_{funcstart\_724,1}, p_{funcstart\_724,1})
176).rem)
\rightarrow [simplify]
[29.7] ([0 < -$heap<sub>funcstart_724,1.</sub>p2]:
-(-asType < integer > (\$heap_{funcstart\_724,1}.p2) \% 176),
[!(asType < integer > (\$heap_{funcstart\_724,1}.p2) < 0)]:
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p2})~\%~176) ==
asType<integer>(div(heapIs p_{funcstart\_724,1}, p_{funcstart\_724,1}, p_{funcstart\_724,1})
176).rem)
\rightarrow [from term 9.0, literala < -$heap<sub>funcstart_724.1</sub>.p2 is false whenever -2 < (0
+ literala)]
    Proof of rule precondition:
    [29.7.0] - 2 < (0 + 0)
    \rightarrow [simplify]
    [29.7.2] true
[29.8] ([false]: -(-asType < integer > (\$heap_{funcstart\_724,1}.p2) \% 176),
[!(asType < integer > (\$heap_{funcstart\_724,1}.p2) < 0)]:
asType < integer > (\$heap_{funcstart\_724,1}.p2) \% 176) ==
asType<integer>(div(heapIs $heap_funcstart_724,1, $heap_funcstart_724,1.p2,
176).rem)
\rightarrow [simplify]
[29.11] \; ([\mathbf{false}]: \; -(-\mathbf{asType} < \mathbf{integer} > (\$ heap_{funcstart\_724,1}.p2) \; \% \; 176), \; [!(0.12)] \; ((1.12)) \; \% \; 176), \; [!(0.12)] \; ((1.12)) \; \% \; 176), \; [!(0.12)] \; ((1.12)) \; \% \; 176)
<-$heap_{funcstart\_724,1}.p2)]: asType<integer>($heap_{funcstart\_724,1}.p2) %
176) == asType < integer > (div(heapIs $heap_{funcstart\_724,1},
heap_{funcstart_{-724,1}.p2, 176}.rem
\rightarrow [from term 9.0, literala < -$heap<sub>funcstart_724,1</sub>.p2 is false whenever -2 < (0
+ literala)]
    Proof of rule precondition:
    [29.11.0] - 2 < (0 + 0)
    \rightarrow [simplify]
    [29.11.2] true
[29.12] ([false]: -(-asType < integer > (\$heap_{funcstart\_724,1}.p2) \% 176),
[!false]: asType<integer>($heap<sub>funcstart_724.1.</sub>p2) % 176) ==
asType<integer>(div(heapIs $heap_{tuncstart\_724.1}, $heap_{tuncstart\_724.1}.p2,
176).rem)
```

```
\rightarrow [simplify]
[29.17] 0 == (-\text{div}(\mathbf{heapIs} \$ \text{heap}_{funcstart\_724,1}, \$ \text{heap}_{funcstart\_724,1}.\text{p2},
176).rem + (\text{$heap}_{funcstart\_724,1}.p2 % 176))
[Assume known post-assertion, class invariant or type constraint for term
29.17
[36.0] minof(int) \leq div(heapIs \text{$heap}_{funcstart\_724,1}, \text{$heap}_{funcstart\_724,1}.p2,
176).rem
\rightarrow [simplify]
[36.3] \ -32769 < {\rm div}(\mathbf{heapIs} \ \$ \mathrm{heap}_{funcstart\_724,1}, \ \$ \mathrm{heap}_{funcstart\_724,1}.\mathrm{p2},
176).rem
[Take goal term]
[1.0] minof(int) \leq asType<short int>(div2.rem)
\rightarrow [simplify]
[1.1] -32768 \leq asType<short int>(div2.rem)
\rightarrow [from term 25.6, div2 is equal to div(heapIs $heap_{funcstart\_724,1},
heap_{funcstart_{-724,1}}.p2, 176
[1.2] -32768 \leq asType<short int>(div(heapIs $heap_{tuncstart\_724.1},
heap_{funcstart_{-724,1}.p2, 176}.rem
\rightarrow [simplify]
[1.5] -32769 < \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_724,1}, \text{\$heap}_{funcstart\_724,1}.p2,
176).rem
\rightarrow [from term 36.3, literala < div(heapIs $heap<sub>funcstart_724,1</sub>,
heap_{funcstart_{-724,1}}.p2, 176).rem is true whenever (-1 + literala) < -32769
   Proof of rule precondition:
   [1.5.0](-32769 + -1) < -32769
   \rightarrow [simplify]
   [1.5.2] true
[1.6] true
Proof of verification condition: Type constraint satisfied in implicit
conversion from 'short int' to 'int'
Condition generated at: C:\Escher\Customers\prang\prang.c (58,15)
Condition defined at:
```

To prove:  $asType < short int > (div2.rem) \le maxof(int)$ 

Given:

```
heap_{init}.LIMIT == (int)80
heap_{init}.M1 == asType < short int > ((int)30269)
\theta_{init}.r1 == asType < short int > ((int)171)
heap_{init}.a1 == asType < short int > ((int)177)
heap_{init}.M2 == asType < short int > ((int)30307)
\theta_{init}.r2 == asType < short int > ((int)172)
heap_{init}.a2 == asType < short int > ((int)176)
\theta = asType < short int > ((int)35)
heap_{init}.M3 == asType < short int > ((int)30323)
heap_{init}.r3 == asType < short int > ((int)170)
heap_{init}.a3 == asType < short int > ((int)178)
\theta = asType < short int > ((int)63)
\theta = asType < short int > ((int)1)
\theta
\theta = asType < short int > ((int)3)
invariant1(heapIs heap_{funcstart\_724,1})
\operatorname{div1} == \operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724,1},
asType < int > (\$heap_{funcstart\_724,1}.p1),
asType < int > (\$heap_{funcstart\_724,1}.a1))
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a1))) = =
asType<integer>(div1.quot)
(asType<integer>(asType<int>($heap_{tuncstart\_724.1}.p1)) %
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a1))) = =
asType<integer>(div1.rem)
!(0 == asType < integer > (div1.rem)) || !(0 ==
asType<integer>(div1.quot))
div2 == div(\mathbf{heapIs} \$heap_{funcstart\_724,1},
asType < int > (\$heap_{funcstart\_724,1}.p2),
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{a2}))
(\mathbf{asType} < \mathbf{integer} > (\mathbf{asType} < \mathbf{int} > (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p2})) \ / \ 
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a2))) = =
asType<integer>(div2.quot)
(asType<int>(asType<int>($heap_{funcstart\_724,1}.p2)) %
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a2))) = =
```

```
asType<integer>(div2.rem)
!(0 == asType < integer > (div2.rem)) || !(0 ==
asType<integer>(div2.quot))
div3 == div(\mathbf{heapIs} \$heap_{funcstart\_724,1},
asType < int > (\$heap_{funcstart\_724,1}.p3),
asType < int > (\$heap_{funcstart\_724,1}.a3))
(\mathbf{asType}{<}\mathbf{integer}{>}(\mathbf{asType}{<}\mathbf{int}{>}(\$\mathbf{heap}_{funcstart\_724,1}.\mathbf{p3})) \ / \\
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a3))) = =
asType<integer>(div3.quot)
(asType<int>(asType<int>($heap_{funcstart\_724.1}.p3)) %
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a3))) = =
asType<integer>(div3.rem)
!(0 == asType < integer > (div3.rem)) || !(0 ==
asType<integer>(div3.quot))
heap_{724,1;740,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow asType<short
int>((asType<int>(asType<short int>(div1.rem)) *
asType < int > (\$heap_{tuncstart\_724.1}.r1)) - (asType < int > (asType < short)
int>(div1.quot)) * asType< int>($heap_{funcstart\_724,1}.b1))))
-{\bf asType}{<}{\bf integer~const}{>}(\${\rm heap}_{724,1;740,8}.{\rm M1})<
asType<integer>($heap<sub>724,1:740,8</sub>.p1)
!(0 == asType < integer > (\$heap_{724,1;740,8}.p1))
asType<integer>($heap<sub>724,1:740,8</sub>.p1) <
asType<integer>($heap<sub>724,1;740,8</sub>.M1)
Proof:
[Take given term]
[5.0] invariant1(heapIs heap_{funcstart_{-724.1}})
\rightarrow [expand definition of function 'invariant1' at prang.c (34,1)]
[5.1] \; (((((0 < \mathbf{asType} < \mathbf{integer} > (\$ heap_{funcstart\_724,1}.p1)) \; \&\& \\
(asType < integer > (\$heap_{funcstart\_724,1}.p1) < 
asType < integer > (\$heap_{funcstart\_724,1}.M1))) \&\& (0 <
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{p2})))\ \&\&
(asType < integer > ($heap_{funcstart\_724,1}.p2) < 
asType < integer > (\$heap_{funcstart\_724,1}.M2))) \&\& (0 <
asType < integer > (\$heap_{funcstart\_724,1}.p3))) \&\&
(\mathbf{asType} < \mathbf{integer} > (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p3}) <
\mathbf{asType} < \mathbf{integer} > (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{M3}))
\rightarrow [simplify]
[5.3] (((((0 < $heap_{funcstart_724,1}.p1) && ($heap_{funcstart_724,1}.p1 < footnote{in the content of the c
asType < integer > (\$heap_{funcstart\_724,1}.M1))) \&\& (0 <
```

```
asType < integer > (\$heap_{funcstart\_724,1}.p2))) \&\&
(asType < integer > (\$heap_{funcstart\_724,1}.p2) < 
\mathbf{asType} {<} \mathbf{integer} {>} (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{M2}))) \ \&\& \ (0 <
asType < integer > (\$heap_{funcstart\_724,1}.p3))) \&\&
(\mathbf{asType} < \mathbf{integer} > (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p3}) <
asType<integer>($heap_funcstart_724,1.M3))
\rightarrow [const static or extern object]
[5.4] (((((0 < \theta_{funcstart\_724,1.p1}) && (\theta_{funcstart\_724,1.p1})
asType<integer>(heap_{init}.M1))) && (0 <
asType < integer > (\$heap_{funcstart\_724,1}.p2))) \&\&
(\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{p2}) <
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{M2})))~\&\&~(0<
asType < integer > (\$heap_{funcstart\_724,1}.p3))) \&\&
(\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{p3}) <
asType < integer > (\$heap_{funcstart\_724,1}.M3))
\rightarrow [expand definition of constant 'M1' at prang.c (14,20)]
[5.5] (((((0 < $heap_{funcstart\_724,1}.p1) && ($heap_{funcstart\_724,1}.p1 < ])
asType<integer>(asType<short int>((int)30269)))) && (0 <
asType < integer > (\$heap_{funcstart\_724,1}.p2))) \&\&
(\mathbf{asType} < \mathbf{integer} > (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p2}) <
as
Type<integer>($heap_{funcstart\_724,1}.M2))) && (0 <
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p3})))\ \&\&
(asType < integer > (\$heap_{funcstart_{-724.1}}.p3) < 
asType < integer > (\$heap_{funcstart_{-724.1}}.M3))
\rightarrow [simplify]
[5.16] \; ((((-30269 < -\$heap_{funcstart\_724,1}.p1) \; \land \; (0 < \$heap_{funcstart\_724,1}.p1) \; \land 
(0 < \mathrm{\$heap}_{funcstart\_724,1}.\mathrm{p2})) && (\mathrm{\$heap}_{funcstart\_724,1}.\mathrm{p2} <
asType < integer > (\$heap_{funcstart\_724,1}.M2))) \&\& (0 < 1)
asType < integer > (\$heap_{funcstart\_724,1}.p3))) \&\&
(\mathbf{asType} < \mathbf{integer} > (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p3}) <
\mathbf{asType} {<} \mathbf{integer} {>} (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{M3}))
\rightarrow [const static or extern object]
\label{eq:final_start_724,1.p1} [(((-30269 < -\$heap_{funcstart\_724,1}.p1) \land (0 < \$heap_{funcstart\_724,1}.p1) \land (0 < \$he
(0 < \text{\$heap}_{funcstart_{724,1},p2})) \&\& (\text{\$heap}_{funcstart_{724,1},p2} <
asType < integer > (\$heap_{init}.M2))) \&\& (0 <
asType < integer > (\$heap_{funcstart\_724,1}.p3))) \&\&
(asType < integer > (\$heap_{funcstart\_724,1}.p3) < 
asType < integer > (\$heap_{funcstart\_724,1}.M3))
\rightarrow [expand definition of constant 'M2' at prang.c (19,20)]
[5.18] ((((-30269 < -\$heap_{funcstart\_724,1}.p1) \land (0 < \$heap_{funcstart\_724,1}.p1) 
(0 < \text{\$heap}_{funcstart\_724,1}.p2)) \&\& (\text{\$heap}_{funcstart\_724,1}.p2 <
```

```
asType<integer>(asType<short int>((int)30307)))) && (0 <
asType < integer > (\$heap_{funcstart\_724,1}.p3))) \&\&
(\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{p3}) <
asType < integer > (\$heap_{funcstart\_724,1}.M3))
\rightarrow [simplify]
[5.30] ((-30307 < -$heap<sub>funcstart_724,1</sub>.p2) \wedge (-30269 <
-\text{\$heap}_{funcstart\_724,1}.\text{p1}) \land (0 < \text{\$heap}_{funcstart\_724,1}.\text{p1}) \land (0 <
\text{Sheap}_{funcstart_{724,1}.p2} \land (0 < \text{Sheap}_{funcstart_{724,1}.p3})) \&\&
(\text{\$heap}_{funcstart\_724,1}.p3 < asType < integer > (\text{\$heap}_{funcstart\_724,1}.M3))
\rightarrow [const static or extern object]
[5.31] ((-30307 < -$heap<sub>funcstart_724.1.</sub>p2) \wedge (-30269 <
-\$heap_{funcstart\_724,1}.p1) \land (0 < \$heap_{funcstart\_724,1}.p1) \land (0 < \$heap_{funcstart\_724,1}.p1)
\text{Sheap}_{funcstart\_724,1}.p2) \land (0 < \text{Sheap}_{funcstart\_724,1}.p3)) \&\&
(\$heap_{funcstart\_724,1}.p3 < \textbf{asType} < \textbf{integer} > (\$heap_{init}.M3))
\rightarrow [expand definition of constant 'M3' at prang.c (24,20)]
[5.32] ((-30307 < -$heap<sub>funcstart_724,1.</sub>p2) \land (-30269 <
-\$heap_{funcstart\_724,1}.p1) \land (0 < \$heap_{funcstart\_724,1}.p1) \land (0 < \$heap_{funcstart\_724,1}.p1)
\text{Sheap}_{funcstart\_724,1.p2}) \land (0 < \text{Sheap}_{funcstart\_724,1.p3})) \&\&
(\text{sheap}_{funcstart\_724,1}.\text{p3} < \text{asType} < \text{integer} > (\text{asType} < \text{short})
int > ((int)30323)))
\rightarrow [simplify]
[5.40] (-30323 < -$heap<sub>funcstart_724,1.</sub>p3) \land (-30307 <
-\$heap_{funcstart\_724,1}.p2) \land (-30269 < -\$heap_{funcstart\_724,1}.p1) \land (0 <
\text{Sheap}_{funcstart\_724,1}.\text{p1}) \land (0 < \text{Sheap}_{funcstart\_724,1}.\text{p2}) \land (0 <
heap_{funcstart_{-724,1}.p3}
[Work on sub-term 5 of conjunction in term 5.40]
\textit{[9.0] 0} < \$ heap_{funcstart\_724,1}.p2
[Take given term]
[25.0] div2 == div(heapIs $heap_{funcstart\_724,1},
asType < int > (\$heap_{funcstart\_724,1}.p2),
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{a2}))
\rightarrow [simplify]
[25.1]~{\rm div2} == {\rm div}(\mathbf{heapIs}~\$ \mathrm{heap}_{funcstart\_724,1},\,\$ \mathrm{heap}_{funcstart\_724,1}.\mathrm{p2},
asType < int > (\$heap_{funcstart\_724,1}.a2))
\rightarrow [const static or extern object]
[25.2]~{\rm div2} == {\rm div}(\mathbf{heapIs}~\$ \mathrm{heap}_{funcstart\_724,1},\,\$ \mathrm{heap}_{funcstart\_724,1}.\mathrm{p2},
asType < int > (\$heap_{init}.a2))
\rightarrow [expand definition of constant 'a2' at prang.c (21,20)]
```

```
[25.3] \operatorname{div2} == \operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.p2,
asType < int > (asType < short int > ((int)176)))
\rightarrow [simplify]
[25.6] div2 == div(heapIs $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}.p2, 176)
[Assume known post-assertion, class invariant or type constraint for term 25.6]
[29.0] (as
Type<integer>($heap_{funcstart\_724,1}.p2) \%
asType < integer > (176)) == asType < integer > (div(heapIs))
heap_{funcstart_{724,1}}, heap_{funcstart_{724,1},p2,176}.rem)
\rightarrow [simplify]
[29.2] (heap_{funcstart\_724,1}.p2 \% 176) == asType<integer>(div(heapIs
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.p2, 176).rem
→ [expand definition of operator '.%' in class 'int' at built in declaration]
[29.3] \; ([\mathbf{asType} < \mathbf{integer} > (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p2}) < 0] :
-(-asType < integer > (\$heap_{funcstart\_724,1}.p2) \% 176), []:
asType < integer > (\$heap_{funcstart\_724,1}.p2) \% 176) ==
asType<integer>(div(heapIs heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p2,
176).rem)
→ [explicitly assert falsehood of skipped guards in subsequent guards]
[29.4] ([asType<integer>($heap_{funcstart\_724,1}.p2) < 0]:
-(-asType < integer > (\$heap_{funcstart\_724,1}.p2) \% 176),
[!(asType < integer > (\$heap_{funcstart\_724,1}.p2) < 0)]:
asType < integer > (\$heap_{funcstart\_724,1}.p2) \% 176) ==
\mathbf{asType} {<} \mathbf{integer} {>} ( \mathrm{div}(\mathbf{heapIs} \ \$ \mathrm{heap}_{funcstart\_724,1}, \ \$ \mathrm{heap}_{funcstart\_724,1}.\mathrm{p2}, \\
176).rem)
\rightarrow [simplify]
[29.7] ([0 < -\$heap_{funcstart\_724,1}.p2]:
-(-asType < integer > (\$heap_{funcstart\_724,1}.p2) \% 176),
[!(\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathbf{heap}_{funcstart\_724,1}.\mathbf{p2})<0)]:
\mathbf{asType} < \mathbf{integer} > (\$ \mathrm{heap}_{funcstart\_724,1}.\mathrm{p2}) \% 176) = =
\mathbf{asType} < \mathbf{integer} > (\mathbf{div}(\mathbf{heapIs} \ \$ \mathbf{heap}_{funcstart\_724,1}, \ \$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p2}, \\
176).rem)
\rightarrow [from term 9.0, literala < -$heap<sub>funcstart_724,1</sub>.p2 is false whenever -2 < (0
+ literala)]
    Proof of rule precondition:
    [29.7.0] - 2 < (0 + 0)
    \rightarrow [simplify]
    [29.7.2] true
[29.8] ([false]: -(-asType < integer > (\$heap_{funcstart\_724,1}.p2) \% 176),
```

```
[!(asType < integer > (\$heap_{funcstart\_724,1}.p2) < 0)]:
asType < integer > (\$heap_{funcstart\_724,1}.p2) \% 176) ==
\mathbf{asType} {<} \mathbf{integer} {>} ( \mathbf{div} (\mathbf{heapIs} \ \$ \mathbf{heap}_{funcstart\_724,1}, \ \$ \mathbf{heap}_{funcstart\_724,1}. \mathbf{p2}, \\
176).rem)
\rightarrow [simplify]
[29.11] ([false]: -(-asType < integer > (\$heap_{funcstart\_724,1}.p2) \% 176), [!(0
<-$heap_{funcstart\_724,1}.p2)]: asType<integer>($heap_{funcstart\_724,1}.p2) %
176) == asType<integer>(div(heapIs heap_{funcstart\_724,1},
heap_{funcstart_{-724,1}.p2, 176}.rem
\rightarrow [from term 9.0, literala < -$heap<sub>funcstart_724,1</sub>.p2 is false whenever -2 < (0
+ literala)
    Proof of rule precondition:
    [29.11.0] - 2 < (0 + 0)
    \rightarrow [simplify]
    [29.11.2] true
[29.12] ([false]: -(-asType < integer > (\$heap_{funcstart\_724,1}.p2) \% 176),
[!false]: asType<integer>(sheap_{funcstart\_724,1.p2}) \% 176 ==
\mathbf{asType} < \mathbf{integer} > (\mathbf{div}(\mathbf{heapIs} \ \$ \mathbf{heap}_{funcstart\_724,1}, \ \$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p2}, \\
176).rem)
\rightarrow [simplify]
\label{eq:continuous} \textit{[29.17] } 0 == (-\text{div}(\mathbf{heapIs} \ \$ \text{heap}_{funcstart\_724,1}, \ \$ \text{heap}_{funcstart\_724,1}.\text{p2},
176).rem + (\text{$heap}_{funcstart\_724,1}.p2 \% 176))
[Assume known post-assertion, class invariant or type constraint for term
29.17
[37.0] div(heapIs heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p2, 176).rem \leq
maxof(int)
\rightarrow [simplify]
[37.9] - 32768 < -\text{div}(\text{heapIs } \text{$heap}_{funcstart\_724,1}, \text{$heap}_{funcstart\_724,1}.p2,
176).rem
[Take goal term]
[1.0] asType<short int>(div2.rem) \le maxof(int)
\rightarrow [from term 25.6, div2 is equal to div(heapIs $heap_{funcstart\_724,1},
heap_{funcstart_{-724,1}}.p2, 176
[1.1] asType<short int>(div(heapIs heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1}.\text{p2}, 176).\text{rem} \leq \text{maxof(int)}
\rightarrow [simplify]
[1.11] - 32768 < -{\rm div}(\mathbf{heapIs} \ \$ \mathrm{heap}_{funcstart\_724,1}, \ \$ \mathrm{heap}_{funcstart\_724,1}.\mathrm{p2},
```

```
176).rem
\rightarrow [from term 37.9, literala < -div(heapIs $heap_{funcstart\_724,1},
\rho_{funcstart_{-724,1},p2,176}.rem is true whenever (-1 + literala) < -32768
   Proof of rule precondition:
   [1.11.0](-32768 + -1) < -32768
   \rightarrow [simplify]
   [1.11.2] true
[1.12] true
Proof of verification condition: Type constraint satisfied in implicit
conversion from 'short int const' to 'int'
Condition generated at: C:\Escher\Customers\prang\prang.c (58,10)
Condition defined at:
To prove: minof(int) \le \$heap_{724,1:740.8}.r2
Given:
heap_{init}.LIMIT == (int)80
\theta sheap<sub>init</sub>.M1 == asType<short int>((int)30269)
\theta_{init}.r1 == asType < short int > ((int)171)
heap_{init}.a1 == asType < short int > ((int)177)
\theta
\theta sheap<sub>init</sub>.M2 == asType<short int>((int)30307)
\theta
heap_{init}.a2 == asType < short int > ((int)176)
\theta = asType < short int > ((int)35)
heap_{init}.M3 == asType < short int > ((int)30323)
\theta_{init}.r3 == asType<short int>((int)170)
heap_{init}.a3 == asType<short int>((int)178)
\theta = asType < short int > ((int)63)
\theta = asType < short int > ((int)1)
\theta
\theta = asType < short int > ((int)3)
invariant1(heapIs heap_{funcstart_{-724.1}})
div1 == div(\mathbf{heapIs} \$heap_{funcstart\_724,1},
```

```
asType < int > (\$heap_{funcstart\_724,1}.p1),
asType < int > (\$heap_{funcstart\_724,1}.a1))
(\mathbf{asType}{<}\mathbf{integer}{>}(\mathbf{asType}{<}\mathbf{int}{>}(\$\mathbf{heap}_{funcstart\_724,1}.\mathbf{p1})) \ / \\
asType<integer>(asType<int>($heap_{tuncstart\_724.1}.a1))) ==
asType<integer>(div1.quot)
(\mathbf{asType} < \mathbf{integer} > (\mathbf{asType} < \mathbf{int} > (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p1})) \ \%
\mathbf{asType}{<}\mathbf{int}{>}(\mathbf{\$heap}_{funcstart\_724,1}.\mathbf{a1}))) ==
asType < integer > (div1.rem)
!(0 == asType < integer > (div1.rem)) || !(0 ==
asType<integer>(div1.quot))
div2 == div(\mathbf{heapIs} \$ heap_{funcstart_{-724.1}},
asType < int > (\$heap_{funcstart\_724.1}.p2),
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{a2}))
(\mathbf{asType}{<}\mathbf{integer}{>}(\mathbf{asType}{<}\mathbf{int}{>}(\$\mathbf{heap}_{funcstart\_724,1}.\mathbf{p2})) \ / \\
asType<integer>(asType<int>($heap_{tuncstart\_724.1}.a2))) ==
asType<integer>(div2.quot)
(asType < int > (asType < int > (\$heap_{funcstart\_724,1}.p2)) \%
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a2))) = =
asType<integer>(div2.rem)
!(0 == asType < integer > (div2.rem)) || !(0 ==
asType<integer>(div2.quot))
div3 == div(\mathbf{heapIs} \$ heap_{funcstart\_724,1},
asType < int > (\$heap_{funcstart\_724,1}.p3),
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{a3}))
(\mathbf{asType}{<}\mathbf{integer}{>}(\mathbf{asType}{<}\mathbf{int}{>}(\$\mathbf{heap}_{funcstart\_724,1}.\mathbf{p3})) \ / \\
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a3))) = =
asType<integer>(div3.quot)
(asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.p3)) \%
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a3))) = =
asType<integer>(div3.rem)
!(0 == asType < integer > (div3.rem)) || !(0 ==
asType<integer>(div3.quot))
heap_{724,1:740.8} == heap_{funcstart_{724,1}}._replace(p1 \rightarrow asType<short
int>((asType<int>(asType<short int>(div1.rem)) *
asType < int > (\$heap_{funcstart\_724,1}.r1)) - (asType < int > (asType < short)
int>(div1.quot)) * asType< int>($heap_{funcstart\_724,1}.b1))))
-asType < integer const > (\$heap_{724,1;740,8}.M1) < 1
asType < integer > ($heap_{724,1;740,8}.p1)
!(0 == asType < integer > (\$heap_{724,1;740,8}.p1))
```

```
asType < integer > (\$heap_{724,1;740,8}.p1) <
asType<integer>($heap<sub>724,1;740,8</sub>.M1)
Proof:
[Take given term]
[11.0] \operatorname{div1} == \operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724,1},
asType < int > (\$heap_{funcstart\_724,1}.p1),
asType < int > (\$heap_{funcstart\_724,1}.a1))
\rightarrow [simplify]
[11.1] \ \mathrm{div1} == \mathrm{div}(\mathbf{heapIs} \ \$ \mathrm{heap}_{funcstart\_724,1}, \ \$ \mathrm{heap}_{funcstart\_724,1}.\mathrm{p1},
asType < int > (\$heap_{funcstart\_724,1}.a1))
\rightarrow [const static or extern object]
[11.2] \ \mathrm{div1} == \mathrm{div}(\mathbf{heapIs} \ \$ \mathrm{heap}_{funcstart\_724,1}, \ \$ \mathrm{heap}_{funcstart\_724,1}.\mathrm{p1},
asType < int > (\$heap_{init}.a1))
\rightarrow [expand definition of constant 'a1' at prang.c (16,20)]
[11.3] div1 == div(heapIs \theta_{funcstart_{-724,1}}, \theta_{funcstart_{-724,1}}, p1,
asType<int>(asType<short int>((int)177)))
\rightarrow [simplify]
[11.6] \text{ div1} == \text{div}(\text{heapIs } \text{heap}_{funcstart\_724.1}, \text{heap}_{funcstart\_724.1}, \text{p1}, 177)
[Take given term]
[53.0] \rho_{13,1;740,8} == \rho_{13,1;740,8} == \rho_{13,1;740,8} =- \rho_{
int>((asType<int>(asType<short int>(div1.rem)) *
\mathbf{asType} \small{<} \mathbf{int} \small{>} (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{r1})) - (\mathbf{asType} \small{<} \mathbf{int} \small{>} (\mathbf{asType} \small{<} \mathbf{short}
\mathbf{int}{>}(\mathbf{div1.quot})) * \mathbf{asType}{<} \mathbf{int}{>} (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{b1}))))
\rightarrow [from term 11.6, div1 is equal to div(heapIs $heap_{funcstart\_724,1},
heap_{funcstart_{-724,1}}.p1, 177
[53.1] \theta == 
int>((asType<int>(asType<short int>(div(heapIs $heap_{funcstart\_724,1},))
\rho_{funcstart\_724,1.p1, 177}.rem) * asType < int > (\rho_{funcstart\_724,1.r1}) - (\rho_{funcstart\_724,1.r1}
(asType<int>(asType<short int>(div1.quot)) *
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{b1}))))
\rightarrow [simplify]
[53.3] \text{heap}_{724,1;740,8} == \text{heap}_{funcstart\_724,1}._replace(p1 \rightarrow asType<short
int>((div(heapIs \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1, 177).rem *
asType < int > (\$heap_{tuncstart\_724.1}.r1)) - (asType < int > (asType < short)
int>(div1.quot)) * asType<int>($heap_{funcstart\_724,1}.b1)))
\rightarrow [const static or extern object]
[53.4] \rho_{724,1;740,8} == \rho_{funcstart\_724,1}.\_replace(p1 \rightarrow asType < short)
int>((div(heapIs \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1, 177).rem *
```

```
asType < int > (\$heap_{init}.r1)) - (asType < int > (asType < short)
int>(div1.quot)) * asType< int>($heap_{funcstart\_724,1}.b1))))
\rightarrow [expand definition of constant 'r1' at prang.c (15,20)]
[53.5] heap_{724,1;740,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow asType<short
int>((div(heapIs \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1, 177).rem *
asType<int>(asType<short int>((int)171))) -
(asType<int>(asType<short int>(div1.quot)) *
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{b1}))))
\rightarrow [simplify]
[53.8] heap_{724,1;740,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow asType<short
int > ((div(heapIs \$heap_{funcstart\_724.1}, \$heap_{funcstart\_724.1}, p1, 177).rem * 171)
- (asType<int>(asType<short int>(div1.quot)) *
asType < int > (\$heap_{funcstart\_724,1}.b1))))
\rightarrow [from term 11.6, div1 is equal to div(heapIs $heap_{funcstart\_724,1},
heap_{funcstart_{-724,1},p1,177}
[53.9] heap_{724,1;740,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow asType<short
int>((171 * div(heapIs \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1, 177).rem)
- (asType<int>(asType<short int>(div(heapIs $heap_{funcstart_724,1},))
heap_{funcstart_{724,1}}.p1, 177).quot) *
asType < int > (\$heap_{funcstart\_724,1}.b1))))
\rightarrow [simplify]
[53.11] \theta_{124.1:740.8} = \theta_
int>((171 * div(heapIs \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1, 177).rem)
- (div(heapIs heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p1, 177).quot *
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{b1}))))
\rightarrow [const static or extern object]
[53.12] heap_{724,1;740,8} == heap_{funcstart\_724,1}. replace(p1 \rightarrow asType<short
int>((171 * div(heapIs $heap_{funcstart\_724,1}, $heap_{funcstart\_724,1}.p1, 177).rem)
- (\text{div}(\textbf{heapIs} \$ \text{heap}_{funcstart\_724,1}, \$ \text{heap}_{funcstart\_724,1}.\text{p1}, 177).\text{quot} *
asType < int > (\$heap_{init}.b1)))
\rightarrow [expand definition of constant 'b1' at prang.c (17,20)]
[53.13] \$ heap_{724,1;740,8} == \$ heap_{funcstart\_724,1}.\_\mathbf{replace} (p1 \to \mathbf{asType} < \mathbf{short})
int>((171 * div(heapIs \$heap_{tuncstart\_724.1}, \$heap_{tuncstart\_724.1}, p1, 177).rem)
- (\text{div}(\mathbf{heapIs} \$ \text{heap}_{funcstart\_724,1}, \$ \text{heap}_{funcstart\_724,1}.\text{p1}, 177).\text{quot} *
asType<int>(asType<short int>((int)2))))
\rightarrow [simplify]
[53.19] $\text{heap}_{724,1;740,8} == \text{$heap}_{funcstart\_724,1}._\text{$replace}(p1 \to ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 \ *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.p1, \ 177).rem)))
```

```
[Take goal term]
[1.0] minof(int) \leq $heap<sub>724.1:740.8</sub>.r2
\rightarrow [simplify]
[1.1] -32768 \leq $heap<sub>724,1:740,8</sub>.r2
\rightarrow [from term 53.19, $heap_{724,1;740,8}$ is equal to
\text{Sheap}_{funcstart\_724,1}._replace(p1 \rightarrow (-2 * div(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
heap_{funcstart\_724,1}.p1, 177).quot + (171 * div(heapIs p_{funcstart\_724,1}),
heap_{funcstart_{-724,1}.p1, 177).rem}
[1.2] -32768 \leq $heap<sub>funcstart_724,1</sub>._replace(p1 \rightarrow ((-2 * div(heapIs)
\theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}.p1, 177).quot) + (171 * div(heapIs
heap_{funcstart_{-724,1}}, heap_{funcstart_{-724,1}}, 177).rem)).r2
\rightarrow [const member of object with modified fields]
[1.3] -32768 \le \text{$heap}_{funcstart\_724,1}.r2
\rightarrow [const static or extern object]
[1.4] -32768 \le \text{$heap}_{init}.r2
\rightarrow [expand definition of constant 'r2' at prang.c (20,20)]
[1.5] -32768 \leq asType<short int>((int)172)
\rightarrow \textit{[simplify]}
[1.8] true
Proof of verification condition: Type constraint satisfied in implicit
conversion from 'short int const' to 'int'
Condition generated at: C:\Escher\Customers\prang\prang.c (58,10)
Condition defined at:
To prove: heap_{724,1:740,8}.r2 \le maxof(int)
Given:
heap_{init}.LIMIT == (int)80
heap_{init}.M1 == asType < short int > ((int)30269)
\theta_{init}.r1 == asType < short int > ((int)171)
heap_{init}.a1 == asType < short int > ((int)177)
\theta
heap_{init}.M2 == asType < short int > ((int)30307)
\theta_{init}.r2 == asType < short int > ((int)172)
heap_{init}.a2 == asType < short int > ((int)176)
```

```
\theta sheap<sub>init</sub>.b2 == asType<short int>((int)35)
heap_{init}.M3 == asType < short int > ((int)30323)
\theta_{init}.r3 == asType<short int>((int)170)
heap_{init}.a3 == asType < short int > ((int)178)
heap_{init}.b3 == asType < short int > ((int)63)
\theta
\theta
\theta = asType < short int > ((int)3)
invariant
1(heap<br/>Is \theta_{funcstart\_724,1}
div1 == div(\mathbf{heapIs} \$heap_{funcstart\_724,1},
asType < int > (\$heap_{funcstart\_724,1}.p1),
asType < int > (\$heap_{funcstart\_724,1}.a1))
(\mathbf{asType} {<} \mathbf{integer} {>} (\mathbf{asType} {<} \mathbf{int} {>} (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p1})) \ / \\
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a1))) = =
asType<integer>(div1.quot)
(\mathbf{asType} < \mathbf{integer} > (\mathbf{asType} < \mathbf{int} > (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p1})) \%
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a1))) = =
asType<integer>(div1.rem)
!(0 == asType < integer > (div1.rem)) || !(0 ==
asType<integer>(div1.quot))
div2 == div(\mathbf{heapIs} \$heap_{funcstart\_724,1},
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p2}),
asType < int > (\$heap_{funcstart\_724,1}.a2))
(asType<int>(sheap<sub>funcstart 724.1</sub>.p2)) /
\mathbf{asType}{<}\mathbf{integer}{>}(\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{a2}))) ==
asType<integer>(div2.quot)
(asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.p2)) \%
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a2))) = =
asType<integer>(div2.rem)
!(0 == asType < integer > (div2.rem)) || !(0 ==
asType<integer>(div2.quot))
div3 == div(\mathbf{heapIs} \$heap_{funcstart\_724,1},
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p3}),
asType < int > (\$heap_{funcstart\_724,1}.a3))
(asType<integer>(asType<int>($heap_{tuncstart\_724.1}.p3)) /
\mathbf{asType}{<}\mathbf{integer}{>}(\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{a3}))) ==
asType<integer>(div3.quot)
(\mathbf{asType} < \mathbf{integer} > (\mathbf{asType} < \mathbf{int} > (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p3})) \%
```

```
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a3))) = =
asType<integer>(div3.rem)
!(0 == asType < integer > (div3.rem)) || !(0 ==
asType<integer>(div3.quot))
\$heap_{724,1;740,8} == \$heap_{funcstart\_724,1}.\_\mathbf{replace}(p1 \to \mathbf{asType} < \mathbf{short}
int>((asType<int>(asType<short int>(div1.rem)) *
asType < int > (\$heap_{funcstart\_724.1}.r1)) - (asType < int > (asType < short)
int>(div1.quot)) * asType< int>($heap_{funcstart\_724,1}.b1))))
-asType<integer const>($heap<sub>724,1:740,8</sub>.M1) <
asType<integer>($heap<sub>724.1:740.8</sub>.p1)
!(0 == asType < integer > (\$heap_{724,1:740.8}.p1))
asType<integer>($heap<sub>724,1;740,8</sub>.p1) <
asType<integer>($heap<sub>724,1:740,8</sub>.M1)
Proof:
[Take given term]
[11.0] \operatorname{div1} == \operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724,1},
asType < int > (\$heap_{funcstart\_724,1}.p1),
asType < int > (\$heap_{funcstart\_724,1}.a1))
\rightarrow [simplify]
[11.1] div1 == div(heapIs heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p1,
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{a1}))
\rightarrow [const static or extern object]
[11.2] \operatorname{div1} == \operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724,1}, \$ \operatorname{heap}_{funcstart\_724,1}.p1,
asType < int > (\$heap_{init}.a1))
\rightarrow [expand definition of constant 'a1' at prang.c (16,20)]
[11.3] \ \mathrm{div1} == \mathrm{div}(\mathbf{heapIs} \ \$ \mathrm{heap}_{funcstart\_724,1}, \ \$ \mathrm{heap}_{funcstart\_724,1}.\mathrm{p1},
asType<int>(asType<short int>((int)177)))
\rightarrow [simplify]
[11.6] \ \mathrm{div1} == \mathrm{div}(\mathbf{heapIs} \ \$ \mathrm{heap}_{funcstart\_724,1}, \ \$ \mathrm{heap}_{funcstart\_724,1}.\mathrm{p1}, \ 177)
[Take given term]
[53.0] heap_{724,1;740,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow asType<short
int>((asType<int>(asType<short int>(div1.rem)) *
asType < int > (\$heap_{funcstart\_724,1}.r1)) - (asType < int > (asType < short)
\mathbf{int}{>}(\mathbf{div1}.\mathbf{quot})) * \mathbf{asType}{<} \mathbf{int}{>}(\$\mathbf{heap}_{funcstart\_724,1}.\mathbf{b1}))))
\rightarrow [from term 11.6, div1 is equal to div(heapIs $heap_{funcstart\_724.1},
heap_{funcstart_{-724,1}}.p1, 177
[53.1] \; \$ heap_{724,1;740,8} == \$ heap_{funcstart\_724,1}.\_\mathbf{replace} (p1 \to \mathbf{asType} < \mathbf{short}
```

```
int>((asType < int) < (asType < short int) < (div(heapIs $heap_{funcstart\_724,1}, 
\theta_{tuncstart\_724,1.p1, 177}.rem) * asType < int > (\theta_{tuncstart\_724,1.r1}) - (\theta_{tuncstart\_724,1.r1}
(asType<int>(asType<short int>(div1.quot)) *
asType < int > (\$heap_{funcstart\_724,1}.b1))))
\rightarrow [simplify]
[53.3] \text{heap}_{724,1;740,8} == \text{heap}_{funcstart\_724,1}._replace(p1 \rightarrow asType<short
int>((div(heapIs \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1, 177).rem *
asType < int > (\$heap_{funcstart\_724,1}.r1)) - (asType < int > (asType < short)
int>(div1.quot)) * asType< int>($heap_{funcstart\_724,1}.b1))))
\rightarrow [const static or extern object]
[53.4] heap_{724,1:740.8} == heap_{funcstart\_724,1}-replace(p1 \rightarrow asType<short
int>((div(heapIs \$heap_{funcstart\_724.1}, \$heap_{funcstart\_724.1}.p1, 177).rem *
asType < int > (\$heap_{init}.r1)) - (asType < int > (asType < short)
int>(div1.quot)) * asType< int>($heap_{funcstart\_724,1}.b1))))
\rightarrow [expand definition of constant 'r1' at prang.c (15,20)]
[53.5] heap_{724,1;740,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow asType<short
int>((div(heapIs \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1, 177).rem *
asType<int>(asType<short int>((int)171))) -
(asType<int>(asType<short int>(div1.quot)) *
asType < int > (\$heap_{funcstart\_724,1}.b1))))
\rightarrow [simplify]
[53.8] heap_{724,1:740.8} == heap_{funcstart\_724,1}-replace(p1 \rightarrow asType<short
int>((div(heapIs \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1, 177).rem * 171)
- (asType<int>(asType<short int>(div1.quot)) *
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{b1}))))
\rightarrow [from term 11.6, div1 is equal to div(heapIs $heap_{funcstart\_724,1},
heap_{funcstart_{-724,1}}.p1, 177
[53.9] heap_{724,1;740,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow asType<short
int>((171 * div(heapIs \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1, 177).rem)
- (asType<int>(asType<short int>(div(heapIs $heap_{funcstart\_724,1},
heap_{funcstart_{724,1},p1,177}, quot)) *
asType < int > (\$heap_{funcstart\_724,1}.b1))))
\rightarrow [simplify]
[53.11] \theta_{13} = \theta_
int>((171 * div(heapIs $heap_{funcstart\_724,1}, $heap_{funcstart\_724,1}.p1, 177).rem)
- (\text{div}(\mathbf{heapIs} \$ \text{heap}_{funcstart\_724,1}, \$ \text{heap}_{funcstart\_724,1}.\text{p1}, 177).\text{quot} *
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{b1}))))
\rightarrow [const static or extern object]
[53.12] heap_{724,1;740,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow asType<short
int>((171 * div(heapIs \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1, 177).rem)
```

```
- (\text{div}(\mathbf{heapIs} \$ \text{heap}_{funcstart\_724,1}, \$ \text{heap}_{funcstart\_724,1}.\text{p1}, 177).\text{quot} *
asType < int > (\$heap_{init}.b1))))
\rightarrow [expand definition of constant 'b1' at prang.c (17,20)]
[53.13] heap_{724,1;740,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow asType<short
int>((171 * div(heapIs \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1, 177).rem)
- (\text{div}(\mathbf{heapIs} \$ \text{heap}_{funcstart\_724,1}, \$ \text{heap}_{funcstart\_724,1}.\text{p1}, 177).\text{quot} *
asType < int > (asType < short int > ((int)2))))
\rightarrow [simplify]
[53.19] $heap<sub>724,1;740,8</sub> == $heap<sub>funcstart_724,1</sub>._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724.1}, \ \text{\$heap}_{funcstart\_724.1}, 177).rem)))
[Take goal term]
[1.0] $heap<sub>724.1:740.8</sub>.r2 \leq maxof(int)
\rightarrow [from term 53.19, $heap<sub>724,1:740.8</sub> is equal to
heap_{funcstart\_724,1}._replace(p1 \rightarrow (-2 * div(heapIs heap_{funcstart\_724,1}),
heap_{funcstart\_724,1}.p1, 177).quot + (171 * div(heapIs p_{funcstart\_724,1})
heap_{funcstart_{-724,1}}.p1, 177).rem)
[1.1] \text{sheap}_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 * div(heapIs)
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.\text{p1}, 177).\text{quot}) + (171 * \text{div}(\text{heapIs}))
\$ heap_{funcstart\_724,1}, \$ heap_{funcstart\_724,1}.p1, \ 177).rem))).r2 \leq \textbf{maxof(int)}
\rightarrow [const member of object with modified fields]
[1.2] $heap<sub>funcstart_724.1</sub>.r2 \leq maxof(int)
\rightarrow [const static or extern object]
[1.3] $heap<sub>init</sub>.r2 \leq maxof(int)
\rightarrow [expand definition of constant 'r2' at prang.c (20,20)]
[1.4] asType<short int>((int)172) \le maxof(int)
\rightarrow [simplify]
[1.8] true
Proof of verification condition: Arithmetic result of operator '*' is within
limit of type 'int'
Condition generated at: C:\Escher\Customers\prang\prang.c (58,13)
Condition defined at:
```

To prove: minof(int) \le (asType<int>(asType<short int>(div2.rem)) \*

 $asType < int > (\$heap_{724,1;740,8}.r2))$ 

Given:

```
heap_{init}.LIMIT == (int)80
heap_{init}.M1 == asType < short int > ((int)30269)
\theta_{init}.r1 == asType < short int > ((int)171)
heap_{init}.a1 == asType < short int > ((int)177)
heap_{init}.M2 == asType < short int > ((int)30307)
\theta_{init}.r2 == asType < short int > ((int)172)
heap_{init}.a2 == asType < short int > ((int)176)
\theta = asType < short int > ((int)35)
heap_{init}.M3 == asType < short int > ((int)30323)
\theta_{init}.r3 == asType<short int>((int)170)
heap_{init}.a3 == asType < short int > ((int)178)
\theta = asType < short int > ((int)63)
\theta = asType < short int > ((int)1)
\theta
\theta = asType < short int > ((int)3)
invariant1(heapIs heap_{funcstart\_724,1})
\operatorname{div1} == \operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724,1},
asType < int > (\$heap_{funcstart\_724,1}.p1),
asType < int > (\$heap_{funcstart\_724,1}.a1))
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a1))) = =
asType<integer>(div1.quot)
(asType<integer>(asType<int>($heap_{tuncstart\_724.1}.p1)) %
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a1))) = =
asType<integer>(div1.rem)
!(0 == asType < integer > (div1.rem)) || !(0 ==
asType<integer>(div1.quot))
div2 == div(\mathbf{heapIs} \$heap_{funcstart\_724,1},
asType < int > (\$heap_{funcstart\_724,1}.p2),
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{a2}))
(\mathbf{asType} < \mathbf{integer} > (\mathbf{asType} < \mathbf{int} > (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p2})) \ / \ 
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a2))) = =
asType<integer>(div2.quot)
(asType<int>(asType<int>($heap_{funcstart\_724,1}.p2)) %
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a2))) = =
```

```
asType<integer>(div2.rem)
!(0 == asType < integer > (div2.rem)) || !(0 ==
asType<integer>(div2.quot))
div3 == div(\mathbf{heapIs} \$heap_{funcstart\_724,1},
asType < int > (\$heap_{funcstart\_724,1}.p3),
asType < int > (\$heap_{funcstart\_724,1}.a3))
(\mathbf{asType}{<}\mathbf{integer}{>}(\mathbf{asType}{<}\mathbf{int}{>}(\$\mathbf{heap}_{funcstart\_724,1}.\mathbf{p3})) \ / \\
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a3))) = =
asType<integer>(div3.quot)
(asType<int>(asType<int>($heap_{funcstart\_724.1}.p3)) %
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a3))) = =
asType<integer>(div3.rem)
!(0 == asType < integer > (div3.rem)) || !(0 ==
asType<integer>(div3.quot))
heap_{724,1;740,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow asType<short
int>((asType<int>(asType<short int>(div1.rem)) *
asType < int > (\$heap_{tuncstart\_724.1}.r1)) - (asType < int > (asType < short)
int>(div1.quot)) * asType< int>($heap_{funcstart\_724,1}.b1))))
-{\bf asType}{<}{\bf integer~const}{>}(\${\rm heap}_{724,1;740,8}.{\rm M1})<
asType<integer>($heap<sub>724,1:740,8</sub>.p1)
!(0 == asType < integer > (\$heap_{724,1;740,8}.p1))
asType<integer>($heap<sub>724,1:740,8</sub>.p1) <
asType<integer>($heap<sub>724,1;740,8</sub>.M1)
Proof:
[Take given term]
[5.0] invariant1(heapIs heap_{funcstart_{-724.1}})
\rightarrow [expand definition of function 'invariant1' at prang.c (34,1)]
[5.1] \; (((((0 < \mathbf{asType} < \mathbf{integer} > (\$ heap_{funcstart\_724,1}.p1)) \; \&\& \\
(asType < integer > (\$heap_{funcstart\_724,1}.p1) < 
asType < integer > (\$heap_{funcstart\_724,1}.M1))) \&\& (0 <
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{p2})))\ \&\&
(asType < integer > ($heap_{funcstart\_724,1}.p2) < 
asType < integer > (\$heap_{funcstart\_724,1}.M2))) \&\& (0 <
asType < integer > (\$heap_{funcstart\_724,1}.p3))) \&\&
(\mathbf{asType} {<} \mathbf{integer} {>} (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p3}) <
\mathbf{asType} < \mathbf{integer} > (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{M3}))
\rightarrow [simplify]
[5.3] (((((0 < $heap_{funcstart_724,1}.p1) && ($heap_{funcstart_724,1}.p1 < footnote{in the content of the c
asType < integer > (\$heap_{funcstart\_724,1}.M1))) \&\& (0 <
```

```
asType < integer > (\$heap_{funcstart\_724,1}.p2))) \&\&
(asType < integer > (\$heap_{funcstart\_724,1}.p2) < 
\mathbf{asType} {<} \mathbf{integer} {>} (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{M2}))) \ \&\& \ (0 <
asType < integer > (\$heap_{funcstart\_724,1}.p3))) \&\&
(\mathbf{asType} < \mathbf{integer} > (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p3}) <
asType<integer>($heap_funcstart_724,1.M3))
\rightarrow [const static or extern object]
[5.4] (((((0 < \theta_{funcstart\_724,1.p1}) && (\theta_{funcstart\_724,1.p1})
asType<integer>(heap_{init}.M1))) && (0 <
asType < integer > (\$heap_{funcstart\_724,1}.p2))) \&\&
(\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{p2}) <
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{M2})))~\&\&~(0<
asType < integer > (\$heap_{funcstart\_724,1}.p3))) \&\&
(\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{p3}) <
asType < integer > (\$heap_{funcstart\_724,1}.M3))
\rightarrow [expand definition of constant 'M1' at prang.c (14,20)]
[5.5] (((((0 < $heap_{funcstart\_724,1}.p1) && ($heap_{funcstart\_724,1}.p1 < ])
asType<integer>(asType<short int>((int)30269)))) && (0 <
asType < integer > (\$heap_{funcstart\_724,1}.p2))) \&\&
(\mathbf{asType} < \mathbf{integer} > (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p2}) <
as
Type<integer>($heap_{funcstart\_724,1}.M2))) && (0 <
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p3})))\ \&\&
(asType < integer > (\$heap_{funcstart_{-724.1}}.p3) < 
asType < integer > (\$heap_{funcstart_{-724.1}}.M3))
\rightarrow [simplify]
[5.16] \; ((((-30269 < -\$heap_{funcstart\_724,1}.p1) \; \land \; (0 < \$heap_{funcstart\_724,1}.p1) \; \land 
(0 < \mathrm{\$heap}_{funcstart\_724,1}.\mathrm{p2})) && (\mathrm{\$heap}_{funcstart\_724,1}.\mathrm{p2} <
asType < integer > (\$heap_{funcstart\_724,1}.M2))) \&\& (0 < 1)
asType < integer > (\$heap_{funcstart\_724,1}.p3))) \&\&
(\mathbf{asType} < \mathbf{integer} > (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p3}) <
\mathbf{asType} {<} \mathbf{integer} {>} (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{M3}))
\rightarrow [const static or extern object]
\label{eq:final_start_724,1.p1} [(((-30269 < -\$heap_{funcstart\_724,1}.p1) \land (0 < \$heap_{funcstart\_724,1}.p1) \land (0 < \$he
(0 < \text{\$heap}_{funcstart_{724,1},p2})) \&\& (\text{\$heap}_{funcstart_{724,1},p2} <
asType < integer > (\$heap_{init}.M2))) \&\& (0 <
asType < integer > (\$heap_{funcstart\_724,1}.p3))) \&\&
(asType < integer > (\$heap_{funcstart\_724,1}.p3) < 
asType < integer > (\$heap_{funcstart\_724,1}.M3))
\rightarrow [expand definition of constant 'M2' at prang.c (19,20)]
[5.18] ((((-30269 < -\$heap_{funcstart\_724,1}.p1) \land (0 < \$heap_{funcstart\_724,1}.p1) 
(0 < \text{\$heap}_{funcstart\_724,1}.p2)) \&\& (\text{\$heap}_{funcstart\_724,1}.p2 <
```

```
asType<integer>(asType<short int>((int)30307)))) && (0 <
asType < integer > (\$heap_{funcstart\_724,1}.p3))) \&\&
(\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{p3}) <
asType < integer > (\$heap_{funcstart\_724,1}.M3))
\rightarrow [simplify]
[5.30] ((-30307 < -$heap<sub>funcstart_724,1</sub>.p2) \wedge (-30269 <
-\text{\$heap}_{funcstart\_724,1}.\text{p1}) \land (0 < \text{\$heap}_{funcstart\_724,1}.\text{p1}) \land (0 <
\text{Sheap}_{funcstart_{724,1}.p2} \land (0 < \text{Sheap}_{funcstart_{724,1}.p3})) \&\&
(\text{\$heap}_{funcstart\_724,1}.p3 < asType < integer > (\text{\$heap}_{funcstart\_724,1}.M3))
\rightarrow [const static or extern object]
[5.31] ((-30307 < -$heap<sub>funcstart_724.1.</sub>p2) \wedge (-30269 <
-\$heap_{funcstart\_724,1}.p1) \land (0 < \$heap_{funcstart\_724,1}.p1) \land (0 < \$heap_{funcstart\_724,1}.p1)
\text{Sheap}_{funcstart\_724,1}.p2) \land (0 < \text{Sheap}_{funcstart\_724,1}.p3)) \&\&
(\$heap_{funcstart\_724,1}.p3 < \textbf{asType} < \textbf{integer} > (\$heap_{init}.M3))
\rightarrow [expand definition of constant 'M3' at prang.c (24,20)]
[5.32] ((-30307 < -$heap<sub>funcstart_724,1.</sub>p2) \land (-30269 <
-\$heap_{funcstart\_724,1}.p1) \land (0 < \$heap_{funcstart\_724,1}.p1) \land (0 < \$heap_{funcstart\_724,1}.p1)
\text{Sheap}_{funcstart\_724,1.p2}) \land (0 < \text{Sheap}_{funcstart\_724,1.p3})) \&\&
(\text{sheap}_{funcstart\_724,1}.\text{p3} < \text{asType} < \text{integer} > (\text{asType} < \text{short})
int > ((int)30323)))
\rightarrow [simplify]
[5.40] (-30323 < -$heap<sub>funcstart_724.1</sub>.p3) \land (-30307 <
-\$heap_{funcstart\_724,1}.p2) \land (-30269 < -\$heap_{funcstart\_724,1}.p1) \land (0 <
\text{Sheap}_{funcstart\_724,1}.\text{p1}) \land (0 < \text{Sheap}_{funcstart\_724,1}.\text{p2}) \land (0 <
heap_{funcstart_{-724,1}.p3}
[Work on sub-term 5 of conjunction in term 5.40]
[9.0] 0 < $heap_{funcstart_724,1}.p2
[Take given term]
[11.0] \operatorname{div1} == \operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724,1},
asType < int > (\$heap_{funcstart\_724,1}.p1),
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{a1}))
\rightarrow [simplify]
[11.1] \ \mathrm{div1} == \mathrm{div}(\mathbf{heapIs} \ \$ \mathrm{heap}_{funcstart\_724,1}, \ \$ \mathrm{heap}_{funcstart\_724,1}.\mathrm{p1},
asType < int > (\$heap_{funcstart\_724,1}.a1))
\rightarrow [const static or extern object]
[11.2] \ \mathrm{div1} == \mathrm{div}(\mathbf{heapIs} \ \$ \mathrm{heap}_{funcstart\_724,1}, \ \$ \mathrm{heap}_{funcstart\_724,1}.\mathrm{p1},
asType < int > (\$heap_{init}.a1))
\rightarrow [expand definition of constant 'a1' at prang.c (16,20)]
```

```
[11.3] \operatorname{div1} == \operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724,1}, \$ \operatorname{heap}_{funcstart\_724,1}.p1,
asType<int>(asType<short int>((int)177)))
\rightarrow [simplify]
[11.6] div1 == div(heapIs heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p1, 177)
[Take given term]
[25.0] div2 == div(heapIs $heap_{funcstart\_724,1},
asType < int > (\$heap_{funcstart\_724,1}.p2),
asType < int > (\$heap_{funcstart\_724.1}.a2))
\rightarrow [simplify]
[25.1]~{\rm div2} == {\rm div}(\mathbf{heapIs}~\$ \mathrm{heap}_{funcstart\_724,1},\,\$ \mathrm{heap}_{funcstart\_724,1}.\mathrm{p2},
asType < int > (\$heap_{funcstart\_724,1}.a2))
\rightarrow [const static or extern object]
\label{eq:continuous} \mbox{\sc [25.2] div2} == \mbox{\sc div}(\mathbf{heapIs} \ \$\mbox{\sc heap}_{funcstart\_724,1}, \ \$\mbox{\sc heap}_{funcstart\_724,1}.\mbox{\sc p2},
asType < int > (\$heap_{init}.a2))
\rightarrow [expand definition of constant 'a2' at prang.c (21,20)]
[25.3] div2 == div(heapIs $heap_{funcstart\_724.1}, $heap_{funcstart\_724.1}.p2,
asType<int>(asType<short int>((int)176)))
\rightarrow [simplify]
[25.6] div2 == div(heapIs \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}.p2, 176)
[Assume known post-assertion, class invariant or type constraint for term 25.6]
[29.0] (asType<integer>(peq:temp_{funcstart\_724,1}.p2) %
asType<integer>(176)) == asType<integer>(div(heapIs
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.p2, 176).rem
\rightarrow [simplify]
[29.2] ($heap<sub>funcstart_724.1</sub>.p2 % 176) == asType<integer>(div(heapIs)
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.p2, 176).rem
→ [expand definition of operator '.%' in class 'int' at built in declaration]
[29.3] ([asType<integer>(heap_{funcstart\_724,1}.p2) < 0]:
-(-asType < integer > (\$heap_{funcstart\_724,1}.p2) \% 176), []:
asType < integer > (\$heap_{funcstart\_724,1}.p2) \% 176) ==
\mathbf{asType} < \mathbf{integer} > (\mathbf{div}(\mathbf{heapIs} \ \$ \mathbf{heap}_{funcstart\_724,1}, \ \$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p2}, \\
176).rem)
→ [explicitly assert falsehood of skipped guards in subsequent guards]
\label{eq:continuous_section} \textit{[29.4]} \; ([\textbf{asType} < \textbf{integer} > (\$ \text{heap}_{funcstart\_724,1}.\text{p2}) < 0] :
-(-asType < integer > (\$heap_{funcstart\_724,1}.p2) \% 176),
[!(asType<integer>(peq_{funcstart_{-724,1}}.p2) < 0)]:
asType < integer > (\$heap_{funcstart\_724,1}.p2) \% 176) ==
```

```
asType<integer>(div(heapIs heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p2,
176).rem)
\rightarrow [simplify]
[29.7] ([0 < -\$ {\rm heap}_{funcstart\_724,1}.{\rm p2}]:
-(-asType < integer > (\$heap_{funcstart\_724,1}.p2) \% 176),
[!(asType < integer > (\$heap_{funcstart\_724,1}.p2) < 0)]:
asType < integer > (\$heap_{funcstart\_724,1}.p2) \% 176) ==
asType<integer>(div(heapIs $heap_{funcstart\_724.1}, $heap_{funcstart\_724.1}.p2,
176).rem)
\rightarrow [from term 9.0, literala < -$heap<sub>funcstart_724,1</sub>.p2 is false whenever -2 < (0
+ literala)
   Proof of rule precondition:
   [29.7.0] - 2 < (0 + 0)
   \rightarrow [simplify]
   [29.7.2] true
[29.8] ([false]: -(-asType < integer > (\$heap_{funcstart\_724,1}.p2) \% 176),
[!(\mathbf{asType} < \mathbf{integer} > (\$ heap_{funcstart\_724,1}.p2) < 0)]:
asType<integer>($heap<sub>funcstart_724,1.</sub>p2) % 176) ==
asType<integer>(div(heapIs heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p2,
176).rem)
\rightarrow [simplify]
[29.11] ([false]: -(-asType < integer > ($heap_{funcstart\_724,1}.p2) \% 176), [!(0
<-$heap<sub>funcstart_724,1.</sub>p2)]: asType<integer>($heap<sub>funcstart_724,1.</sub>p2) %
176) == asType<integer>(div(heapIs $heap_{tuncstart\_724.1},)
heap_{funcstart_{-724,1}.p2, 176}.rem
\rightarrow [from term 9.0, literala < -$heap<sub>funcstart_724,1</sub>.p2 is false whenever -2 < (0
+ literala)]
   Proof of rule precondition:
   [29.11.0] - 2 < (0 + 0)
   \rightarrow [simplify]
   [29.11.2] true
[29.12] ([false]: -(-asType < integer > (\$heap_{funcstart\_724,1}.p2) \% 176),
[!false]: asType<integer>(sheap_{funcstart\_724,1}.p2) \% 176 ==
asType < integer > (div(heapIs \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p2,
176).rem)
\rightarrow [simplify]
[29.17] \ 0 == (-\text{div}(\mathbf{heapIs} \ \$ \text{heap}_{funcstart\_724,1}, \ \$ \text{heap}_{funcstart\_724,1}.\text{p2},
176).rem + (\text{$heap}_{funcstart\_724,1}.p2 \% 176))
```

```
[Take given term]
[53.0] \rho_{1740,8} == \rho_{1740,8} == \rho_{1740,8} == \rho_{1740,8} - \rho_{1740,8} == \rho_{1740,8} == \rho_{1740,8} - \rho_{1740,8} == \rho_{1740,8} 
int>((asType<int>(asType<short int>(div1.rem)) *
\mathbf{asType} \small{<} \mathbf{int} \small{>} (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{r1})) \\ - (\mathbf{asType} \small{<} \mathbf{int} \small{>} (\mathbf{asType} \small{<} \mathbf{short}) \\
int>(div1.quot)) * asType<int>($heap_{funcstart\_724.1}.b1)))
\rightarrow [from term 11.6, div1 is equal to div(heapIs $heap_{funcstart\_724,1},
heap_{funcstart_{-724,1}}.p1, 177
[53.1] \text{heap}_{724,1;740,8} == \text{heap}_{funcstart\_724,1}._replace(p1 \rightarrow asType<short
int>((asType<int>(asType<short int>(div(heapIs $heap_{funcstart_724,1},))
\text{Sheap}_{funcstart\_724,1}.\text{p1}, 177).\text{rem}) * asType<int>(\text{Sheap}_{funcstart\_724,1}.\text{r1})) -
(asType<int>(asType<short int>(div1.quot)) *
asType < int > (\$heap_{funcstart\_724,1}.b1))))
\rightarrow [simplify]
[53.3] \theta == 
int>((div(heapIs \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1, 177).rem *
asType < int > (\$heap_{funcstart\_724.1}.r1)) - (asType < int > (asType < short)
int>(div1.quot)) * asType< int>($heap_{tuncstart\_724.1}.b1))))
\rightarrow [const static or extern object]
[53.4] \rho_{13,1;740,8} == \rho_{13,1;740,8} == \rho_{13,1;740,8} =- \rho_{
int>((div(heapIs \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1, 177).rem *
asType < int > (\$heap_{init}.r1)) - (asType < int > (asType < short)
int>(div1.quot)) * asType< int>($heap_{tuncstart\_724.1}.b1))))
\rightarrow [expand definition of constant 'r1' at prang.c (15,20)]
[53.5] heap_{724,1;740,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow asType<short
int>((div(heapIs \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1, 177).rem *
asType < int > (asType < short int > ((int)171))) -
(asType<int>(asType<short int>(div1.quot)) *
asType < int > (\$heap_{funcstart\_724.1}.b1))))
\rightarrow [simplify]
[53.8] \text{sheap}_{724,1;740,8} == \text{sheap}_{funcstart\_724,1}._replace(p1 \rightarrow asType<short
int>((div(heapIs \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1, 177).rem * 171)
- (asType<int>(asType<short int>(div1.quot)) *
asType < int > (\$heap_{funcstart_{724.1}}.b1))))
\rightarrow [from term 11.6, div1 is equal to div(heapIs $heap_{funcstart\_724,1},
heap_{funcstart_{-724,1}}.p1, 177
[53.9] heap_{724,1;740,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow asType<short
\mathbf{int} > ((171 * \operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724,1}, \$ \operatorname{heap}_{funcstart\_724,1}.\operatorname{p1}, 177).\operatorname{rem})
 - (asType < int > (asType < short int > (div(heapIs $heap_{funcstart\_724,1}, 
heap_{funcstart_{724,1}}.p1, 177).quot) *
asType < int > (\$heap_{funcstart\_724.1}.b1))))
```

```
\rightarrow [simplify]
[53.11] \theta_{13} = \theta_
int>((171 * div(heapIs $heap_{funcstart_724,1}, $heap_{funcstart_724,1}.p1, 177).rem)
- (\text{div}(\mathbf{heapIs} \$ \text{heap}_{funcstart\_724,1}, \$ \text{heap}_{funcstart\_724,1}.\text{p1}, 177).\text{quot} *
asType < int > (\$heap_{funcstart\_724.1}.b1)))
\rightarrow [const static or extern object]
[53.12] \$ heap_{724,1;740,8} == \$ heap_{funcstart\_724,1}.\_\mathbf{replace} (p1 \to \mathbf{asType} < \mathbf{short})
\mathbf{int} > ((171 * \operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724,1}, \$ \operatorname{heap}_{funcstart\_724,1}.\operatorname{p1}, 177).\operatorname{rem})
 — (div(heapIs $heap_{funcstart\_724,1}, $heap_{funcstart\_724,1}.p1, 177).quot *
asType < int > (\$heap_{init}.b1)))
\rightarrow [expand definition of constant 'b1' at prang.c (17,20)]
[53.13] heap_{724,1;740,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow asType<short
int>((171 * div(heapIs $heap_{funcstart\_724,1}, $heap_{funcstart\_724,1}.p1, 177).rem)
- (\text{div}(\mathbf{heapIs} \$ \text{heap}_{funcstart\_724,1}, \$ \text{heap}_{funcstart\_724,1}.\text{p1}, 177).\text{quot} *
asType<int>(asType<short int>((int)2))))
\rightarrow [simplify]
[53.19] $\text{heap}_{724,1:740,8} == $\text{heap}_{funcstart\_724,1}._\text{replace}(p1 \to ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).rem)))
[Take goal term]
[1.0] minof(int) \le (asType<int>(asType<short int>(div2.rem)) *
asType<int>($heap<sub>724,1;740,8</sub>.r2))
\rightarrow [simplify]
[1.1] -32768 \leq (asType<int>(asType<short int>(div2.rem)) *
asType < int > (\$heap_{724,1;740,8}.r2))
\rightarrow [from term 25.6, div2 is equal to div(heapIs $heap_{tuncstart_{724.1}},
heap_{funcstart_{-724,1}}.p2, 176
[1.2] -32768 \leq (asType<int>(asType<short int>(div(heapIs
\text{Sheap}_{funcstart_{-724,1}}, \text{Sheap}_{funcstart_{-724,1}}.p2, 176).rem)) *
asType<int>($heap<sub>724,1;740,8</sub>.r2))
\rightarrow [simplify]
[1.4] -32768 \leq (div(heapIs $heap<sub>funcstart_724,1</sub>, $heap<sub>funcstart_724,1</sub>.p2,
176).rem * asType < int > (\$heap_{724,1;740,8}.r2))
\rightarrow [from term 53.19, $heap<sub>724,1:740,8</sub> is equal to
heap_{funcstart\_724,1}._replace(p1 \rightarrow (-2 * div(heapIs $heap_{funcstart\_724,1},
heap_{funcstart_{-724,1},p1, 177}, quot) + (171 * div(heapIs heap_{funcstart_{-724,1}})
heap_{funcstart_{-724,1}}.p1, 177).rem)
[1.5] -32768 \leq (div(heapIs $heap_{funcstart\_724,1}, $heap_{funcstart\_724,1}.p2,
```

```
176).rem * asType<int>(heap_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).rem))).r2))
→ [const member of object with modified fields]
[1.6] -32768 \leq (div(heapIs $heap_{funcstart\_724,1}, $heap_{funcstart\_724,1}.p2,
176).rem * asType < int > (\$heap_{funcstart\_724,1}.r2))
\rightarrow [const static or extern object]
[1.7] -32768 \leq (div(heapIs $heap<sub>funcstart_724,1</sub>, $heap<sub>funcstart_724,1</sub>.p2,
176).rem * asType < int > (\$heap_{init}.r2))
\rightarrow [expand definition of constant 'r2' at prang.c (20,20)]
[1.8] \ -32768 \leq (\mathrm{div}(\mathbf{heapIs} \ \$ \mathrm{heap}_{funcstart\_724,1}, \ \$ \mathrm{heap}_{funcstart\_724,1}.\mathrm{p2},
176).rem * asType<int>(asType<short int>((int)172)))
\rightarrow [simplify]
[1.13] -32769 < (172 * div(heapIs heapIs = f_{uncstart_{724,1}}, heap_{funcstart_{724,1}}, p_{2,1}
176).rem)
\rightarrow [literal comparison of product]
[1.14] ([172 < 0]: (-32769 / -172) < -\text{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1.p2}, 176).\text{rem}, [0 < 172]: (-32769 / 172) < \text{div}(\text{heapIs})
\$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p2, 176).rem, [0 == 172]: -32769 < 0)
→ [explicitly assert falsehood of skipped guards in subsequent guards]
[1.15] ([172 < 0]: (-32769 / -172) < -\text{div}(\mathbf{heapIs} \$ \mathbf{heap}_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1}.\text{p2}, 176).\text{rem}, [(0 < 172) \land !(172 < 0)]: (-32769 / 172) < 0
div(\mathbf{heapIs} \ \text{$heap}_{funcstart\_724,1}, \ \text{$heap}_{funcstart\_724,1}.p2, \ 176).rem, \ [(0 == 172)]
\land !(0 < 172) \land !(172 < 0)]: -32769 < 0)
\rightarrow [simplify]
\textit{[1.23]} - 191 < \mathrm{div}(\mathbf{heapIs} \ \$ \mathrm{heap}_{funcstart\_724,1}, \ \$ \mathrm{heap}_{funcstart\_724,1}.\mathrm{p2}, \ 176).\mathrm{rem}
\rightarrow [negate goal and search for contradiction]
\label{eq:continuous} \mbox{[1.24] !(-191 < div(\bf heapIs \ \$heap_{funcstart\_724,1}, \ \$heap_{funcstart\_724,1}.p2,}}
176).rem)
\rightarrow [simplify]
[1.26] 190 < -\text{div}(\mathbf{heapIs} \$ \text{heap}_{funcstart\_724,1}, \$ \text{heap}_{funcstart\_724,1}.\text{p2},
[Create new term from terms 1.26, 29.17 using rule: transitivity 15]
[59.0] (0 + 190) < -(\$heap_{funcstart\_724.1}.p2 \% 176)
\rightarrow [simplify]
[59.2] false
```

```
limit of type 'int'
Condition generated at: C:\Escher\Customers\prang\prang.c (58,13)
Condition defined at:
To prove: (asType<int>(asType<short int>(div2.rem)) *
asType < int > (\$heap_{724,1:740,8}.r2)) \le maxof(int)
Given:
heap_{init}.LIMIT == (int)80
\theta
\theta_{init}.r1 == asType < short int > ((int)171)
heap_{init}.a1 == asType < short int > ((int)177)
\theta
heap_{init}.M2 == asType < short int > ((int)30307)
\rho_{init}.r2 == asType < short int > ((int)172)
heap_{init}.a2 == asType < short int > ((int)176)
\theta sheap<sub>init</sub>.b2 == asType<short int>((int)35)
\theta
\theta_{init}.r3 == asType < short int > ((int)170)
\theta = asType < short int > ((int)178)
\theta = asType < short int > ((int)63)
\theta = asType < short int > ((int)1)
\theta
\theta = asType < short int > ((int)3)
invariant1(heapIs $heap_{tuncstart_724.1})
\operatorname{div1} == \operatorname{div}(\mathbf{heapIs} \ \operatorname{\$heap}_{funcstart\_724,1},
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p1}),
asType < int > (\$heap_{funcstart\_724,1}.a1))
(asType<integer>(asType<int>($heap_{tuncstart\_724.1}.p1)) /
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a1))) = =
asType<integer>(div1.quot)
(asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.p1)) \%
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a1))) = =
asType<integer>(div1.rem)
!(0 == asType < integer > (div1.rem)) || !(0 ==
asType<integer>(div1.quot))
```

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

```
div2 == div(\mathbf{heapIs} \$heap_{funcstart\_724,1},
asType < int > (\$heap_{funcstart\_724,1}.p2),
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{a2}))
(asType<int>(asType<int>($heap_{tuncstart\_724.1}.p2)) /
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a2))) = =
asType<integer>(div2.quot)
(\mathbf{asType} {<} \mathbf{integer} {>} (\mathbf{asType} {<} \mathbf{int} {>} (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p2})) \ \%
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a2))) = =
asType<integer>(div2.rem)
!(0 == asType < integer > (div2.rem)) || !(0 ==
asType<integer>(div2.quot))
div3 == div(\mathbf{heapIs} \$heap_{funcstart\_724,1},
asType < int > (\$heap_{funcstart\_724,1}.p3),
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{a3}))
(asType<integer>(asType<int>($heap_{tuncstart\_724.1}.p3)) /
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a3))) = =
asType<integer>(div3.quot)
(asType < integer > (asType < int > (\$heap_{tuncstart\_724,1}.p3)) \%
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a3))) = =
asType<integer>(div3.rem)
!(0 == asType < integer > (div3.rem)) || !(0 ==
asType<integer>(div3.quot))
heap_{724,1:740,8} == heap_{funcstart\_724,1}.replace(p1 \rightarrow asType<short
int>((asType<int>(asType<short int>(div1.rem)) *
asType < int > (\$heap_{funcstart\_724,1}.r1)) - (asType < int > (asType < short)
int>(div1.quot)) * asType< int>($heap_{funcstart\_724,1}.b1))))
-asType < integer\ const > (\$heap_{724,1;740,8}.M1) < 
asType<integer>($heap<sub>724.1:740.8</sub>.p1)
!(0 == asType < integer > (\$heap_{724,1:740.8}.p1))
asType<integer>($heap<sub>724.1:740.8</sub>.p1) <
asType<integer>($heap<sub>724,1:740,8</sub>.M1)
Proof:
[Take given term]
[5.0] invariant1(heapIs heapIs 
\rightarrow [expand definition of function 'invariant1' at prang.c (34,1)]
\texttt{[5.1]} \; (((((0 < \mathbf{asType} < \mathbf{integer} > (\$ heap_{funcstart\_724,1}.p1)) \; \&\& \;
(asType<integer>($heap_funcstart_724.1.p1) <
asType < integer > (\$heap_{funcstart\_724.1}.M1))) \&\& (0 <
asType < integer > (\$heap_{funcstart\_724,1}.p2))) \&\&
```

```
(\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{p2}) <
asType < integer > (\$heap_{funcstart\_724,1}.M2))) \&\& (0 < funcstart\_724,1)
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{p3})))\ \&\&
(asType < integer > ($heap_{funcstart\_724,1}.p3) < 
\mathbf{asType} < \mathbf{integer} > (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{M3}))
\rightarrow [simplify]
[5.3] (((((0 < $heap_{funcstart_724,1}.p1) && ($heap_{funcstart_724,1}.p1 < function for the content of the 
asType < integer > (\$heap_{funcstart\_724,1}.M1))) \&\& (0 <
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p2})))\ \&\&
(asType < integer > ($heap_{funcstart\_724,1}.p2) < 
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{M2})))~\&\&~(0<
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{p3})))\ \&\&
(asType < integer > (\$heap_{funcstart\_724,1}.p3) < 
asType < integer > (\$heap_{funcstart\_724,1}.M3))
\rightarrow [const static or extern object]
[5.4] (((((0 < $heap_{funcstart\_724,1}.p1) && ($heap_{funcstart\_724,1}.p1 < ])
asType < integer > (\$heap_{init}.M1))) \&\& (0 <
asType < integer > (\$heap_{funcstart\_724,1}.p2))) \&\&
(asType < integer > (\$heap_{funcstart_{-724,1}}.p2) < 
asType < integer > (\$heap_{funcstart\_724,1}.M2))) \&\& (0 <
asType < integer > (\$heap_{funcstart\_724,1}.p3))) \&\&
(\mathbf{asType} {<} \mathbf{integer} {>} (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p3}) <
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{M3}))
\rightarrow [expand definition of constant 'M1' at prang.c (14,20)]
[5.5] (((((0 < $heap_{funcstart_{724,1}}.p1) && ($heap_{funcstart_{724,1}}.p1 < ]
\mathbf{asType} \small{<} \mathbf{integer} \small{>} (\mathbf{asType} \small{<} \mathbf{short} \ \mathbf{int} \small{>} ((\mathbf{int})30269)))) \ \&\& \ (0 <
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{p2})))\ \&\&
(asType < integer > ($heap_{funcstart\_724,1}.p2) < 
asType < integer > (\$heap_{funcstart\_724,1}.M2))) \&\& (0 <
asType < integer > (\$heap_{funcstart\_724,1}.p3))) \&\&
(asType<integer>($heap_{tuncstart\_724.1}.p3) <
asType < integer > (\$heap_{funcstart\_724.1}.M3))
\rightarrow [simplify]
[5.16] \left( \left( \left( \left( -30269 < -\$ \text{heap}_{funcstart\_724,1}.\text{p1} \right) \right. \wedge \left. \left( 0 < \$ \text{heap}_{funcstart\_724,1}.\text{p1} \right) \right. \wedge \right. \right)
(0 < \mathrm{\$heap}_{funcstart\_724,1}.\mathrm{p2})) && (\mathrm{\$heap}_{funcstart\_724,1}.\mathrm{p2} <
asType < integer > (\$heap_{funcstart\_724,1}.M2))) \&\& (0 <
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p3})))\ \&\&
(asType < integer > (\$heap_{funcstart\_724.1}.p3) < 
asType < integer > (\$heap_{funcstart\_724,1}.M3))
\rightarrow [const static or extern object]
[5.17] ((((-30269 < -$heap_{funcstart\_724,1}.p1) \lambda (0 < $heap_{funcstart\_724,1}.p1) \lambda
```

```
(0 < \text{$heap}_{funcstart\_724,1}.p2)) \&\& (\text{$heap}_{funcstart\_724,1}.p2 <
asType < integer > (\$heap_{init}.M2))) \&\& (0 <
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{p3})))\ \&\&
(asType < integer > ($heap_{funcstart\_724,1}.p3) < 
asType < integer > (\$heap_{funcstart\_724,1}.M3))
\rightarrow [expand definition of constant 'M2' at prang.c (19,20)]
[5.18] ((((-30269 < -\$heap_{funcstart\_724,1}.p1) \land (0 < \$heap_{funcstart\_724,1}.p1) 
(0 < \text{\$heap}_{funcstart\_724,1}.p2)) \&\& (\text{\$heap}_{funcstart\_724,1}.p2 <
asType < integer > (asType < short int > ((int)30307)))) && (0 < integer) && (0 < integer
asType < integer > (\$heap_{funcstart\_724,1}.p3))) \&\&
(asType < integer > (\$heap_{funcstart\_724,1}.p3) < 
asType < integer > (\$heap_{funcstart\_724,1}.M3))
\rightarrow [simplify]
[5.30] ((-30307 < -\$heap_{funcstart\_724,1}.p2) \land (-30269 <
-\$heap_{funcstart\_724,1}.p1) \land (0 < \$heap_{funcstart\_724,1}.p1) \land (0 < \$heap_{funcstart\_724,1}.p1)
\text{Sheap}_{funcstart\_724,1.p2}) \land (0 < \text{Sheap}_{funcstart\_724,1.p3})) \&\&
(\text{\$heap}_{funcstart\_724,1}.\text{p3} < \text{asType} < \text{integer} > (\text{\$heap}_{funcstart\_724,1}.\text{M3}))
\rightarrow [const static or extern object]
[5.31] ((-30307 < -$heap_funcstart_724,1.p2) \land (-30269 <
-\$heap_{funcstart\_724,1}.p1) \land (0 < \$heap_{funcstart\_724,1}.p1) \land (0 < \$heap_{funcstart\_724,1}.p1)
\text{Sheap}_{funcstart\ 724.1.p2} \land (0 < \text{Sheap}_{funcstart\ 724.1.p3})) \&\&
(\$heap_{funcstart\_724,1}.p3 < \mathbf{asType} < \mathbf{integer} > (\$heap_{init}.M3))
\rightarrow [expand definition of constant 'M3' at prang.c (24,20)]
[5.32] ((-30307 < -$heap_funcstart_724,1.p2) \land (-30269 <
-\$heap_{funcstart\_724,1}.p1) \land (0 < \$heap_{funcstart\_724,1}.p1) \land (0 < \$heap_{funcstart\_724,1}.p1)
\text{Sheap}_{funcstart_{724,1}.p2} \land (0 < \text{Sheap}_{funcstart_{724,1}.p3})) \&\&
(\text{sheap}_{funcstart\_724,1}.p3 < asType < integer > (asType < short)
int > ((int)30323)))
\rightarrow [simplify]
[5.40] (-30323 < -\$heap_{funcstart\_724,1}.p3) \land (-30307 < -30307)
 -\$heap_{funcstart\_724,1}.p2) \land (-30269 < -\$heap_{funcstart\_724,1}.p1) \land (0 < -\$heap_{funcstart\_724,1}.p1)
\text{Sheap}_{funcstart_{-724,1}.p1} \land (0 < \text{Sheap}_{funcstart_{-724,1}.p2}) \land (0 <
heap_{funcstart_{724,1}.p3}
[Work on sub-term 5 of conjunction in term 5.40]
\textit{[9.0] 0} < \$ heap_{funcstart\_724,1}.p2
[Take given term]
[11.0] \operatorname{div1} == \operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724,1},
asType < int > (\$heap_{funcstart\_724,1}.p1),
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{a1}))
```

```
\rightarrow [simplify]
[11.1] \operatorname{div1} == \operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724,1}, \$ \operatorname{heap}_{funcstart\_724,1}.p1,
asType < int > (\$heap_{funcstart\_724,1}.a1))
\rightarrow [const static or extern object]
\textit{[11.2]} \ \text{div1} == \text{div}(\mathbf{heapIs} \ \$ \text{heap}_{funcstart\_724,1}, \ \$ \text{heap}_{funcstart\_724,1}.\text{p1},
asType < int > (\$heap_{init}.a1))
\rightarrow [expand definition of constant 'a1' at prang.c (16,20)]
[11.3] \operatorname{div1} == \operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724,1}, \$ \operatorname{heap}_{funcstart\_724,1}.p1,
asType<int>(asType<short int>((int)177)))
\rightarrow [simplify]
[11.6] div1 == div(heapIs \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}.p1, 177)
[Take given term]
[25.0] \operatorname{div2} == \operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724,1},
asType < int > (\$heap_{funcstart\_724,1}.p2),
asType < int > (\$heap_{funcstart\_724,1}.a2))
\rightarrow [simplify]
[25.1] \operatorname{div2} == \operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p2,
asType < int > (\$heap_{funcstart\_724,1}.a2))
\rightarrow [const static or extern object]
[25.2] \operatorname{div2} == \operatorname{div}(\mathbf{heapIs} \operatorname{\$heap}_{funcstart\_724,1}, \operatorname{\$heap}_{funcstart\_724,1}.p2,
asType < int > (\$heap_{init}.a2))
\rightarrow [expand definition of constant 'a2' at prang.c (21,20)]
[25.3] \operatorname{div2} == \operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724,1}, \$ \operatorname{heap}_{funcstart\_724,1}.\operatorname{p2},
asType<int>(asType<short int>((int)176)))
\rightarrow [simplify]
[25.6] \operatorname{div2} == \operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724,1}, \$ \operatorname{heap}_{funcstart\_724,1}.p2, 176)
[Assume known post-assertion, class invariant or type constraint for term 25.6]
[29.0] (asType<integer>(peq:total)) %
\mathbf{asType}{<}\mathbf{integer}{>}(176)) == \mathbf{asType}{<}\mathbf{integer}{>}(\mathrm{div}(\mathbf{heapIs}
\theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}.p2, 176).rem
\rightarrow [simplify]
[29.2] ($heap<sub>funcstart_724,1.</sub>p2 % 176) == asType<integer>(div(heapIs)
heap_{funcstart_{-724,1}}, heap_{funcstart_{-724,1}}, 2, 176).rem
→ [expand definition of operator '.%' in class 'int' at built in declaration]
[29.3] ([asType<integer>(heap_{funcstart}_724.1.p2) < 0]:
-(-asType < integer > (\$heap_{tuncstart\_724,1}.p2) \% 176), []:
```

```
asType < integer > (\$heap_{funcstart-724,1}.p2) \% 176) ==
asType<integer>(div(heapIs heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p2,
176).rem)
→ [explicitly assert falsehood of skipped guards in subsequent guards]
[29.4] ([asType<integer>(heap_{funcstart\_724,1}.p2) < 0]:
-(-asType < integer > (\$heap_{funcstart\_724,1}.p2) \% 176),
[!(asType < integer > (\$heap_{funcstart\_724,1}.p2) < 0)]:
asType < integer > (\$heap_{funcstart\_724,1}.p2) \% 176) ==
\mathbf{asType} {<} \mathbf{integer} {>} ( \mathbf{div} (\mathbf{heapIs} \ \$ \mathbf{heap}_{funcstart\_724,1}, \ \$ \mathbf{heap}_{funcstart\_724,1}. \mathbf{p2}, \\
176).rem)
\rightarrow [simplify]
[29.7] ([0 < -$heap<sub>funcstart_724,1.</sub>p2]:
-(-asType < integer > ($heap_{funcstart\_724,1}.p2) \% 176),
[!(\mathbf{asType} < \mathbf{integer} > (\$ heap_{funcstart\_724,1}.p2) < 0)]:
asType < integer > (\$heap_{funcstart\_724,1}.p2) \% 176) = =
asType<integer>(div(heapIs heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p2,
176).rem)
\rightarrow [from term 9.0, literala < -$heap<sub>funcstart_724.1</sub>.p2 is false whenever -2 < (0
+ literala)]
   Proof of rule precondition:
   [29.7.0] - 2 < (0 + 0)
   \rightarrow [simplify]
   [29.7.2] true
[29.8] ([false]: -(-asType < integer > (\$heap_{funcstart\_724.1}.p2) \% 176),
[!(asType < integer > (\$heap_{funcstart\_724,1}.p2) < 0)]:
asType < integer > (\$heap_{funcstart\_724,1}.p2) \% 176) ==
asType<integer>(div(heapIs heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p2,
176).\text{rem}
\rightarrow [simplify]
[29.11] ([false]: -(-asType < integer > (\$heap_{funcstart\_724,1}.p2) \% 176), [!(0
<-\$ heap_{funcstart\_724,1}.p2)]: \ \mathbf{asType} < \mathbf{integer} > (\$ heap_{funcstart\_724,1}.p2) \ \%
176) == asType < integer > (div(heapIs $heap_{funcstart\_724,1},
heap_{funcstart_{-724,1}}.p2, 176).rem
\rightarrow [from term 9.0, literala < -$heap<sub>funcstart_724,1</sub>.p2 is false whenever -2 < (0
+ literala)]
   Proof of rule precondition:
   [29.11.0] - 2 < (0 + 0)
   \rightarrow [simplify]
```

```
[29.11.2] true
[29.12] ([false]: -(-asType < integer > (\$heap_{tuncstart_{-724,1}}.p2) \% 176),
[!false]: asType<integer>(sheap_{funcstart_{-724,1},p2}) \% 176) ==
\mathbf{asType} < \mathbf{integer} > (\mathbf{div}(\mathbf{heapIs} \ \$ \mathbf{heap}_{funcstart\_724,1}, \ \$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p2}, \\
176).rem)
\rightarrow [simplify]
[29.17] 0 == (-div(heapIs \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}.p2,
176).rem + (\text{$heap}_{funcstart\_724,1}.p2 \% 176))
[Take given term]
[53.0] \text{sheap}_{724,1;740,8} == \text{sheap}_{funcstart\_724,1}._replace(p1 \rightarrow asType<short
int>((asType<int>(asType<short int>(div1.rem)) *
asType < int > (\$heap_{funcstart\_724,1}.r1)) - (asType < int > (asType < short)
\mathbf{int}{>}(\mathbf{div1.quot})) * \mathbf{asType}{<} \mathbf{int}{>} (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{b1}))))
 \rightarrow [from term 11.6, div1 is equal to div(heapIs $heap_{funcstart_724.1},
heap_{funcstart_{-724,1}}.p1, 177
[53.1] heap_{724,1:740,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow asType<short
\mathbf{int}{>}((\mathbf{asType}{<}\mathbf{int}{>}(\mathbf{asType}{<}\mathbf{short}\ \mathbf{int}{>}(\mathbf{div}(\mathbf{heapIs}\ \$\mathbf{heap}_{funcstart\_724,1},
\theta_{funcstart\_724,1.p1, 177}.rem) * asType < int > (\theta_{funcstart\_724,1.r1}) - (\theta_{funcstart\_724,1.r1}
(asType<int>(asType<short int>(div1.quot)) *
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{b1}))))
\rightarrow [simplify]
[53.3] \text{sheap}_{724,1;740,8} == \text{sheap}_{funcstart\_724,1}._replace(p1 \rightarrow asType<short
int>((div(heapIs \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1, 177).rem *
asType < int > (\$heap_{funcstart\_724,1}.r1)) - (asType < int > (asType < short)
int>(div1.quot)) * asType< int>($heap_{funcstart\_724,1}.b1))))
\rightarrow [const static or extern object]
[53.4] heap_{724,1:740,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow asType<short
int>((\text{div}(\mathbf{heapIs} \$ \text{heap}_{funcstart\_724,1}, \$ \text{heap}_{funcstart\_724,1}.\text{p1}, 177).\text{rem} *
asType < int > (\$heap_{init}.r1)) - (asType < int > (asType < short)
\mathbf{int}{>}(\mathbf{div1}.\mathbf{quot})) \ * \ \mathbf{asType}{<} \mathbf{int}{>} (\$\mathbf{heap}_{funcstart\_724,1}.\mathbf{b1}))))
\rightarrow [expand definition of constant 'r1' at prang.c (15,20)]
[53.5] \rho_{1740,8} == \rho_{1740,8} == \rho_{1740,8} == \rho_{1740,8} - \rho_{1740,8} == \rho_{1740,8} == \rho_{1740,8} - \rho_{1740,8} == \rho_{1740,8} 
int>((div(heapIs \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1, 177).rem *
asType<int>(asType<short int>((int)171))) -
(asType<int>(asType<short int>(div1.quot)) *
asType < int > (\$heap_{funcstart\_724,1}.b1))))
\rightarrow [simplify]
[53.8] heap_{724,1;740,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow asType<short
int>((div(heapIs \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1, 177).rem * 171)
```

```
- (asType<int>(asType<short int>(div1.quot)) *
asType < int > (\$heap_{funcstart\_724,1}.b1)))
\rightarrow [from term 11.6, div1 is equal to div(heapIs $heap_{funcstart_{724,1}},
heap_{funcstart_{724,1}}.p1, 177
[53.9] heap_{724,1;740,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow asType<short
int>((171 * div(heapIs $heap_{tuncstart_724.1}, $heap_{tuncstart_724.1}.p1, 177).rem)
- (asType<int>(asType<short int>(div(heapIs $heap_{funcstart\_724,1},
heap_{funcstart_{724,1},p1,177}, quot)) *
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{b1}))))
\rightarrow [simplify]
[53.11] \theta == 
int>((171 * div(heapIs \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1, 177).rem)
- (\text{div}(\mathbf{heapIs} \$ \text{heap}_{funcstart\_724,1}, \$ \text{heap}_{funcstart\_724,1}.\text{p1}, 177).\text{quot} *
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{b1}))))
\rightarrow [const static or extern object]
[53.12] \text{heap}_{724,1;740,8} == \text{heap}_{funcstart\_724,1}._replace(p1 \rightarrow asType<short
int>((171 * div(heapIs \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1, 177).rem)
- (\text{div}(\mathbf{heapIs} \$ \text{heap}_{funcstart\_724,1}, \$ \text{heap}_{funcstart\_724,1}.\text{p1}, 177).\text{quot} *
asType < int > (\$heap_{init}.b1))))
\rightarrow [expand definition of constant 'b1' at prang.c (17,20)]
[53.13] \$ heap_{724,1;740,8} == \$ heap_{funcstart\_724,1}.\_\mathbf{replace} (p1 \to \mathbf{asType} < \mathbf{short})
int>((171 * div(heapIs \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1, 177).rem)
- (\text{div}(\mathbf{heapIs} \$ \text{heap}_{funcstart\_724,1}, \$ \text{heap}_{funcstart\_724,1}.\text{p1}, 177).\text{quot} *
asType < int > (asType < short int > ((int)2))))
\rightarrow [simplify]
[53.19] $\text{heap}_{724,1;740,8} == $\text{heap}_{funcstart\_724,1}._\text{replace}(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 \ *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}. p1, 177).rem)))
[Take goal term]
[1.0] (asType<int>(asType<short int>(div2.rem)) *
asType < int > ($heap_{724,1;740,8}.r2)) \le maxof(int)
\rightarrow [from term 25.6, div2 is equal to div(heapIs $heap_{tuncstart\_724.1},
heap_{funcstart_{-724,1},p2,176}
[1.1] (asType<int>(asType<short int>(div(heapIs $heap_{funcstart\_724,1},))
\text{sheap}_{funcstart\_724.1.p2, 176}.\text{rem}) * asType < int > (\text{sheap}_{724.1:740.8.r2})) \le
maxof(int)
\rightarrow [simplify]
[1.3] (div(heapIs heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p2, 176).rem *
asType < int > ($heap_{724,1;740,8}.r2)) \le maxof(int)
```

```
\rightarrow [from term 53.19, $heap<sub>724.1:740.8</sub> is equal to
heap_{funcstart\_724,1}._replace(p1 \rightarrow (-2 * div(heapIs heap_{funcstart\_724,1}),
heap_{funcstart\_724,1}.p1, 177).quot) + (171 * div(heapIs $heap_{funcstart\_724,1}, 1
heap_{funcstart_{-724,1}}.p1, 177).rem
[1.4] (div(heapIs heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p2, 176).rem *
asType < int > (\$heap_{funcstart\_724,1}.\_replace(p1 \rightarrow ((-2 * div(heapIs))))))
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.\text{p1}, 177).\text{quot}) + (171 * \text{div}(\text{heapIs}))
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.p1, 177).rem)).r2)) \leq \maxof(int)
\rightarrow [const member of object with modified fields]
[1.5] (div(heapIs \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, 176).rem *
asType < int > (\$heap_{funcstart\_724,1}.r2)) \le maxof(int)
\rightarrow [const static or extern object]
[1.6] (div(heapIs heap_{funcstart_{-724,1}}, heap_{funcstart_{-724,1}}.p2, 176).rem *
asType < int > (\$heap_{init}.r2)) \le maxof(int)
\rightarrow [expand definition of constant 'r2' at prang.c (20,20)]
[1.7] (div(heapIs heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p2, 176).rem *
asType < int > (asType < short int > ((int)172))) \le maxof(int)
\rightarrow [simplify]
[1.20] -32768 < (-172 * div(heapIs $heap_{funcstart\_724,1},
heap_{funcstart_{-724,1}}.p2, 176).rem
\rightarrow [literal comparison of product]
[1.21] ([-172 < 0]: (-32768 / 172) < -\text{div}(\mathbf{heapIs} \ \$ \text{heap}_{funcstart} \ 724.1,
\rho_{funcstart_{-724,1},p2,176}.rem, [0 < -172]: (-32768 / -172) < \text{div}(heapIs)
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.\text{p2}, 176).\text{rem}, [-172 == 0]: -32768 <
0)
→ [explicitly assert falsehood of skipped guards in subsequent guards]
[1.22] ([-172 < 0]: (-32768 / 172) < -\text{div}(\text{heapIs } \text{$heap}_{tuncstart\_724.1},
\rho_{tuncstart_{724,1},p2,176}.rem, [(0 < -172) \land !(-172 < 0)]: (-32768 / -172) < 0
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p2, \ 176).rem, \ [(-172 ==
0) \wedge !(-172 < 0) \wedge !(0 < -172)]: -32768 < 0)
\rightarrow [simplify]
[1.26] -191 < -\text{div}(\mathbf{heapIs} \ \text{$heap}_{funcstart\_724,1}, \ \text{$heap}_{funcstart\_724,1}.\text{p2},
176).rem
\rightarrow [negate goal and search for contradiction]
 \label{eq:constart_724,1} \ | \text{(-191} < -\text{div}(\mathbf{heapIs} \ \$ \text{heap}_{funcstart\_724,1}, \ \$ \text{heap}_{funcstart\_724,1}.\text{p2}, 
176).rem)
\rightarrow [simplify]
[1.30] 190 < div(heapIs heap_{funcstart_{-724,1}}, heap_{funcstart_{-724,1}}.p2, 176).rem
```

```
[Create new term from terms 1.30, 29.17 using rule: transitivity 16]
[59.0] (0 + 190) < ($heap_funcstart_724,1.p2 % 176)
\rightarrow [simplify]
[59.2] false
Proof of verification condition: Type constraint satisfied in explicit
conversion from 'int' to 'short int'
Condition generated at: C:\Escher\Customers\prang\prang.c (58,40)
Condition defined at:
To prove: minof(short int) \le div2.quot
Given:
heap_{init}.LIMIT == (int)80
heap_{init}.M1 == asType < short int > ((int)30269)
\theta_{init}.r1 == asType < short int > ((int)171)
heap_{init}.a1 == asType < short int > ((int)177)
\theta
heap_{init}.M2 == asType < short int > ((int)30307)
\theta_{init}.r2 == asType < short int > ((int)172)
\theta
\theta sheap<sub>init</sub>.b2 == asType<short int>((int)35)
heap_{init}.M3 == asType < short int > ((int)30323)
heap_{init}.r3 == asType < short int > ((int)170)
heap_{init}.a3 == asType < short int > ((int)178)
\theta = asType < short int > ((int)63)
\theta = asType < short int > ((int)1)
\theta
\theta = asType < short int > ((int)3)
invariant1(heapIs heap_{funcstart_{-724,1}})
\operatorname{div1} == \operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724,1},
asType < int > (\$heap_{funcstart\_724.1}.p1),
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{a1}))
(asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.p1)) /
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a1))) = =
asType<integer>(div1.quot)
```

```
(asType < int > (asType < int > (\$heap_{funcstart\_724,1}.p1)) \%
\mathbf{asType} < \mathbf{integer} > (\mathbf{asType} < \mathbf{int} > (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{a1}))) = =
asType < integer > (div1.rem)
!(0 == asType < integer > (div1.rem)) || !(0 ==
asType<integer>(div1.quot))
div2 == div(\mathbf{heapIs} \$ heap_{funcstart\_724,1},
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p2}),
asType < int > (\$heap_{funcstart\_724,1}.a2))
(\mathbf{asType} < \mathbf{integer} > (\mathbf{asType} < \mathbf{int} > (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p2})) \ / \\
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a2))) = =
asType<integer>(div2.quot)
(asType < integer > (asType < int > (\$heap_{funcstart\_724.1}.p2)) \%
\mathbf{asType}{<}\mathbf{int}{>}(\mathbf{\$heap}_{funcstart\_724,1}.\mathbf{a2}))) ==
asType<integer>(div2.rem)
!(0 == asType < integer > (div2.rem)) || !(0 ==
asType < integer > (div2.quot))
div3 == div(\mathbf{heapIs} \$ heap_{funcstart\_724,1},
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p3}),
asType < int > (\$heap_{funcstart\_724,1}.a3))
(\mathbf{asType} < \mathbf{integer} > (\mathbf{asType} < \mathbf{int} > (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p3})) \ / \\
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a3))) = =
asType<integer>(div3.quot)
(\mathbf{asType} < \mathbf{integer} > (\mathbf{asType} < \mathbf{int} > (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p3})) \%
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a3))) = =
asType<integer>(div3.rem)
!(0 == asType < integer > (div3.rem)) || !(0 ==
asType<integer>(div3.quot))
heap_{724,1:740.8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow asType<short
int>((asType<int>(asType<short int>(div1.rem)) *
asType < int > (\$heap_{funcstart\_724,1}.r1)) - (asType < int > (asType < short)
int>(div1.quot)) * asType< int>($heap_{funcstart\_724,1}.b1))))
-asType<integer const>($heap<sub>724.1:740.8</sub>.M1) <
asType<integer>($heap<sub>724.1:740.8</sub>.p1)
!(0 == asType < integer > (\$heap_{724,1:740,8}.p1))
asType<integer>($heap<sub>724,1:740,8</sub>.p1) <
asType<integer>($heap<sub>724,1;740,8</sub>.M1)
Proof:
[Take given term]
[5.0] invariant1(heapIs heap_{funcstart\_724,1})
```

```
\rightarrow [expand definition of function 'invariant1' at prang.c (34,1)]
[5.1] ((((((0 < asType < integer > ($heap_{funcstart\_724,1}.p1)) &&
(asType < integer > (\$heap_{funcstart\_724,1}.p1) <
as
Type<integer>(\rho_{funcstart\_724,1}.M1))) & (0 <
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p2})))\ \&\&
(\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{p2}) <
asType < integer > (\$heap_{funcstart\_724,1}.M2))) \&\& (0 <
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{p3})))\ \&\&
(asType < integer > (\$heap_{funcstart\_724.1}.p3) < 
asType < integer > (\$heap_{funcstart\_724,1}.M3))
\rightarrow [simplify]
[5.3] \ (((((0 < \$heap_{funcstart\_724,1}.p1) \&\& \ (\$heap_{funcstart\_724,1}.p1 < (
as
Type<integer>(\rho_{funcstart\_724,1}.M1))) & (0 <
asType < integer > (\$heap_{funcstart\_724,1}.p2))) \&\&
(\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{p2}) <
asType < integer > (\$heap_{funcstart\_724,1}.M2))) \&\& (0 < funcstart\_724,1)
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{p3})))\ \&\&
(asType<integer>($heap_funcstart_724.1.p3) <
asType < integer > (\$heap_{funcstart\_724,1}.M3))
\rightarrow [const static or extern object]
[5.4] (((((0 < $heap_{funcstart_{724,1}}.p1) && ($heap_{funcstart_{724,1}}.p1 < 
asType < integer > (\$heap_{init}.M1))) \&\& (0 <
asType < integer > (\$heap_{funcstart\_724,1}.p2))) \&\&
(asType < integer > (\$heap_{funcstart\_724,1}.p2) <
asType < integer > (\$heap_{funcstart\_724,1}.M2))) \&\& (0 <
asType < integer > (\$heap_{funcstart\_724,1}.p3))) \&\&
(\mathbf{asType} < \mathbf{integer} > (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p3}) <
asType < integer > (\$heap_{funcstart\_724,1}.M3))
\rightarrow [expand definition of constant 'M1' at prang.c (14,20)]
[5.5] (((((0 < \text{heap}_{funcstart\_724,1}.p1) && (\text{heap}_{funcstart\_724,1}.p1 <
asType<integer>(asType<short int>((int)30269)))) && (0 <
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{p2})))\ \&\&
(asType < integer > ($heap_{funcstart\_724,1}.p2) < 
asType < integer > (\$heap_{funcstart\_724,1}.M2))) \&\& (0 <
asType < integer > (\$heap_{funcstart\_724,1}.p3))) \&\&
(\mathbf{asType} < \mathbf{integer} > (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p3}) <
asType < integer > (\$heap_{tuncstart_{-724.1}}.M3))
\rightarrow [simplify]
|5.16| \; ((((-30269 < -\$heap_{funcstart\_724,1}.p1) \; \land \; (0 < \$heap_{funcstart\_724,1}.p1) \; \land 
(0 < \text{\$heap}_{funcstart\_724,1}.p2)) \&\& (\text{\$heap}_{funcstart\_724,1}.p2 <
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{M2})))~\&\&~(0<
asType < integer > (\$heap_{funcstart\_724,1}.p3))) \&\&
```

```
(\mathbf{asType} {<} \mathbf{integer} {>} (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p3}) <
asType < integer > (\$heap_{funcstart\_724,1}.M3))
\rightarrow [const static or extern object]
[5.17] \; ((((-30269 < -\$heap_{funcstart\_724,1}.p1) \; \land \; (0 < \$heap_{funcstart\_724,1}.p1) \; \land 
(0 < \text{\$heap}_{funcstart\_724,1}.\text{p2})) && (\text{\$heap}_{funcstart\_724,1}.\text{p2} <
asType < integer > ($heap_{init}.M2))) \&\& (0 <
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p3})))\ \&\&
(asType<integer>($heap_{tuncstart\_724,1}.p3) <
asType<integer>($heap_funcstart_724,1.M3))
\rightarrow [expand definition of constant 'M2' at prang.c (19,20)]
[5.18] ((((-30269 < -\$heap_{tuncstart\_724.1}.p1) \land (0 < \$heap_{tuncstart\_724.1}.p1) 
(0 < \mathrm{\$heap}_{funcstart\_724,1}.\mathrm{p2})) && ( \mathrm{\$heap}_{funcstart\_724,1}.\mathrm{p2} <
asType<integer>(asType<short int>((int)30307)))) && (0 <
asType < integer > (\$heap_{funcstart\_724,1}.p3))) \&\&
(asType < integer > ($heap_{funcstart\_724,1}.p3) < 
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{M3}))
\rightarrow [simplify]
[5.30] ((-30307 < -$heap<sub>funcstart_724,1.</sub>p2) \land (-30269 <
-\$heap_{funcstart\_724,1}.p1) \land (0 < \$heap_{funcstart\_724,1}.p1) \land (0 < \$heap_{funcstart\_724,1}.p1)
\text{Sheap}_{funcstart_{724,1}.p2} \land (0 < \text{Sheap}_{funcstart_{724,1}.p3})) \&\&
(\text{\$heap}_{funcstart\_724,1}.p3 < asType < integer > (\text{\$heap}_{funcstart\_724,1}.M3))
\rightarrow [const static or extern object]
[5.31] ((-30307 < -$heap<sub>funcstart_724,1.</sub>p2) \land (-30269 <
-\$heap_{funcstart\_724,1}.p1) \land (0 < \$heap_{funcstart\_724,1}.p1) \land (0 < \$heap_{funcstart\_724,1}.p1)
\theta_{funcstart\_724,1}.p2) \land (0 < \theta_{funcstart\_724,1}.p3)) \&\&
(\text{\$heap}_{funcstart\_724,1}.\text{p3} < \text{asType} < \text{integer} > (\text{\$heap}_{init}.\text{M3}))
\rightarrow [expand definition of constant 'M3' at prang.c (24,20)]
[5.32] ((-30307 < -$heap<sub>funcstart_724,1.</sub>p2) \wedge (-30269 <
 -\$heap_{funcstart\_724,1}.p1) \land (0 < \$heap_{funcstart\_724,1}.p1) \land (0 < \$heap_{funcstart\_724,1}.p1)
\text{Sheap}_{funcstart\_724,1.p2}) \land (0 < \text{Sheap}_{funcstart\_724,1.p3})) \&\&
(\$heap_{funcstart\_724,1}.p3 < \mathbf{asType} < \mathbf{integer} > (\mathbf{asType} < \mathbf{short}
int > ((int)30323))
\rightarrow [simplify]
[5.40] (-30323 < -\$heap_{funcstart\_724,1.p3}) \land (-30307 <
-\$heap_{funcstart\_724,1}.p2) \wedge (-30269 < -\$heap_{funcstart\_724,1}.p1) \wedge (0 <
\text{Sheap}_{funcstart\_724,1}.\text{p1}) \land (0 < \text{Sheap}_{funcstart\_724,1}.\text{p2}) \land (0 <
heap_{funcstart_{724,1}.p3}
[Work on sub-term 5 of conjunction in term 5.40]
[9.0] 0 < \text{$heap}_{funcstart\_724,1}.p2
```

```
[Take given term]
[25.0] div2 == div(heapIs $heap<sub>funcstart_724,1</sub>,
asType < int > (\$heap_{funcstart\_724,1}.p2),
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{a2}))
\rightarrow [simplify]
[25.1] div2 == div(heapIs $heap_{funcstart\_724.1}, $heap_{funcstart\_724.1}.p2,
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{a2}))
\rightarrow [const static or extern object]
[25.2] div2 == div(heapIs $heap_{funcstart\_724.1}, $heap_{funcstart\_724.1}.p2,
\mathbf{asType}{<}\mathbf{int}{>}(\$\text{heap}_{init}.\text{a2}))
\rightarrow [expand definition of constant 'a2' at prang.c (21,20)]
[25.3] div2 == div(heapIs \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}.p2,
asType<int>(asType<short int>((int)176)))
\rightarrow [simplify]
[25.6] \text{ div2} == \text{div}(\text{heapIs } \text{$heap}_{funcstart\_724,1}, \text{$heap}_{funcstart\_724,1}.p2, 176)
[Assume known post-assertion, class invariant or type constraint for term 25.6]
[28.0] (asType<integer>($heap_{funcstart\_724.1}.p2) /
asType<integer>(176)) == asType<integer>(div(heapIs
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.p2, 176).quot
\rightarrow [simplify]
[28.2] (\theta_{funcstart\_724,1}.p2 / 176) == asType<integer>(div(heapIs
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.p2, 176).quot
→ [expand definition of operator './' in class 'int' at built in declaration]
[28.3] ([asType<integer>($heap_{funcstart\_724,1}.p2) < 0]:
-(-asType < integer > (\$heap_{funcstart\_724.1}.p2) / 176), []:
asType < integer > (\$heap_{funcstart\_724,1}.p2) / 176) ==
asType<integer>(div(heapIs heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p2,
176).quot)
→ [explicitly assert falsehood of skipped guards in subsequent guards]
[28.4] ([asType<integer>(sheap_{funcstart_{-724,1}}.p2) < 0]:
-(-asType < integer > (\$heap_{funcstart\_724,1}.p2) / 176),
[!(\mathbf{asType} < \mathbf{integer} > (\$ heap_{funcstart\_724,1}.p2) < 0)]:
asType < integer > (\$heap_{funcstart\_724,1}.p2) / 176) ==
asType<integer>(div(heapIs heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p2,
176).quot)
\rightarrow [simplify]
[28.7] ([0 < -$heap<sub>funcstart_724,1</sub>.p2]:
-(-asType < integer > (\$heap_{funcstart\_724,1}.p2) / 176),
```

```
[!(\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{p2}) < 0)]:
asType < integer > (\$heap_{funcstart\_724,1}.p2) / 176) = =
\mathbf{asType} {<} \mathbf{integer} {>} ( \mathbf{div} (\mathbf{heapIs} \ \$ \mathbf{heap}_{funcstart\_724,1}, \ \$ \mathbf{heap}_{funcstart\_724,1}. \mathbf{p2}, \\
176).quot)
\rightarrow [from term 9.0, literala < -$heap<sub>funcstart_724.1</sub>.p2 is false whenever -2 < (0
+ literala)]
        Proof of rule precondition:
        [28.7.0] - 2 < (0 + 0)
        \rightarrow [simplify]
        [28.7.2] true
[28.8] ([false]: -(-asType < integer > (\$heap_{funcstart\_724,1}.p2) / 176),
[!(\mathbf{asType} < \mathbf{integer} > (\$ heap_{funcstart\_724,1}.p2) < 0)]:
asType < integer > (\$heap_{funcstart\_724.1}.p2) / 176) = =
asType<integer>(div(heapIs heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p2,
176).quot)
\rightarrow [simplify]
{\it [28.11] ([false]: -(-asType < integer > (\$heap_{funcstart\_724,1}.p2) \ / \ 176), \ [!(0 < integer) < (\$heap_{funcstart\_724,1}.p2) \ / \ 176), \ [!(0 < integer) < (\$heap_{funcstart\_724,1}.p2) \ / \ 176), \ [!(0 < integer) < (\$heap_{funcstart\_724,1}.p2) \ / \ 176), \ [!(0 < integer) < (\$heap_{funcstart\_724,1}.p2) \ / \ 176), \ [!(0 < integer) < (\$heap_{funcstart\_724,1}.p2) \ / \ 176), \ [!(0 < integer) < (\$heap_{funcstart\_724,1}.p2) \ / \ 176), \ [!(0 < integer) < (\$heap_{funcstart\_724,1}.p2) \ / \ 176), \ [!(0 < integer) < (\$heap_{funcstart\_724,1}.p2) \ / \ 176), \ [!(0 < integer) < (\Sheap_{funcstart\_724,1}.p2) \ / \ 176), \ [!(0 < integer) < (\Sheap_{funcstart\_724,1}.p2) \ / \ 176), \ [!(0 < integer) < (\Sheap_{funcstart\_724,1}.p2) \ / \ 176), \ [!(0 < integer) < (\Sheap_{funcstart\_724,1}.p2) \ / \ 176), \ [!(0 < integer) < (\Sheap_{funcstart\_724,1}.p2) \ / \ 176), \ [!(0 < integer) < (\Sheap_{funcstart\_724,1}.p2) \ / \ 176), \ [!(0 < integer) < (\Sheap_{funcstart\_724,1}.p2) \ / \ 176), \ [!(0 < integer) < (\Sheap_{funcstart\_724,1}.p2)], \ [!(0 < integer) < (\Shea
-\$heap_{funcstart\_724,1}.p2): asType<integer>(\$heap_{funcstart\_724,1}.p2) / 176)
== asType < integer > (div(heapIs $heap_{funcstart\_724,1},
heap_{funcstart_{-724,1}}.p2, 176).quot
\rightarrow [from term 9.0, literala < -$heap<sub>funcstart_724,1</sub>.p2 is false whenever -2 < (0
+ literala)]
        Proof of rule precondition:
        [28.11.0] - 2 < (0 + 0)
        \rightarrow [simplify]
        [28.11.2] true
[28.12] ([false]: -(-asType < integer > (\$heap_{funcstart\_724,1}.p2) / 176),
[!false]: asType<integer>($heap<sub>funcstart_724,1.</sub>p2) / 176) ==
asType<integer>(div(heapIs heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p2,
176).quot)
\rightarrow [simplify]
\label{eq:continuous} \textit{[28.17] 0} == (-\text{div}(\mathbf{heapIs} \ \$ \text{heap}_{funcstart\_724,1}, \ \$ \text{heap}_{funcstart\_724,1}.\text{p2},
176).quot + (\text{$heap}_{funcstart\_724,1}.p2 / 176))
[Assume known post-assertion, class invariant or type constraint for term
28.17
[34.0] minof(int) \leq div(heapIs \text{$heap}_{funcstart\_724,1}, \text{$heap}_{funcstart\_724,1}.p2,
176).quot
\rightarrow [simplify]
```

```
[34.3] -32769 < div(heapIs $heap_{funcstart_{-724,1}}, $heap_{funcstart_{-724,1}}.p2,
176).quot
[Take goal term]
[1.0] minof(short int) \leq div2.quot
\rightarrow [simplify]
[1.1] -32768 \leq div2.quot
\rightarrow [from term 25.6, div2 is equal to div(heapIs $heap_{funcstart\_724,1},
$heap_{funcstart\_724,1}.p2, 176)]
[1.2] \ -32768 \leq \mathrm{div}(\mathbf{heapIs} \ \$ \mathrm{heap}_{funcstart\_724,1}, \ \$ \mathrm{heap}_{funcstart\_724,1}.\mathrm{p2},
176).quot
\rightarrow [simplify]
[1.4] -32769 < div(heapIs $heap_{funcstart\_724,1}, $heap_{funcstart\_724,1}.p2,
176).quot
\rightarrow [from term 34.3, literala < div(heapIs $heap_{funcstart\_724,1},
heap_{funcstart\_724,1}.p2, 176).quot is true whenever (-1 + literala) < -32769
   Proof of rule precondition:
   [1.4.0](-32769 + -1) < -32769
   \rightarrow [simplify]
   [1.4.2] true
[1.5] true
Proof of verification condition: Type constraint satisfied in explicit
conversion from 'int' to 'short int'
Condition generated at: C:\Escher\Customers\prang\prang.c (58,40)
Condition defined at:
To prove: div2.quot \leq maxof(short int)
Given:
heap_{init}.LIMIT == (int)80
\theta
\theta
heap_{init}.a1 == asType < short int > ((int)177)
\theta
\theta sheap<sub>init</sub>.M2 == asType<short int>((int)30307)
\theta_{init}.r2 == asType < short int > ((int)172)
```

```
\theta
\theta sheap<sub>init</sub>.b2 == asType<short int>((int)35)
\theta sheap<sub>init</sub>.M3 == asType<short int>((int)30323)
\theta_{init}.r3 == asType < short int > ((int)170)
heap_{init}.a3 == asType < short int > ((int)178)
heap_{init}.b3 == asType<short int>((int)63)
\theta = asType < short int > ((int)1)
\theta
\theta = asType < short int > ((int)3)
invariant
1<br/>( \mathbf{heapIs}\ \$ \mathbf{heap}_{funcstart\_724,1})
\operatorname{div1} == \operatorname{div}(\mathbf{heapIs} \ \operatorname{\$heap}_{funcstart\_724,1},
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p1}),
asType < int > (\$heap_{funcstart\_724,1}.a1))
(asType<int>(asType<int>($heap_{tuncstart\_724.1}.p1)) /
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a1))) = =
asType<integer>(div1.quot)
(asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.p1)) \%
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a1))) = =
asType<integer>(div1.rem)
!(0 == asType < integer > (div1.rem)) || !(0 ==
asType<integer>(div1.quot))
\label{eq:div2} \text{div2} == \text{div}(\mathbf{heapIs} \ \$ \text{heap}_{funcstart\_724,1},
\mathbf{asType} < \mathbf{int} > (\$ \mathrm{heap}_{funcstart\_724,1}.\mathrm{p2}),
asType < int > (\$heap_{funcstart\_724,1}.a2))
(asType<integer>(asType<int>($heap_{tuncstart\_724.1}.p2)) /
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a2))) = =
asType<integer>(div2.quot)
(asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.p2)) \%
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a2))) = =
asType<integer>(div2.rem)
!(0 == asType < integer > (div2.rem)) || !(0 ==
asType<integer>(div2.quot))
\mathrm{div3} == \mathrm{div}(\mathbf{heapIs} \ \$ \mathrm{heap}_{funcstart\_724,1},
\mathbf{asType} < \mathbf{int} > (\$ \mathrm{heap}_{funcstart\_724,1}.\mathrm{p3}),
asType < int > (\$heap_{funcstart\_724,1}.a3))
(asType<int>(asType<int>($heap_{tuncstart\_724.1}.p3)) /
\mathbf{asType}{<}\mathbf{integer}{>}(\mathbf{asType}{<}\mathbf{int}{>}(\$\mathbf{heap}_{funcstart\_724,1}.\mathbf{a3}))) = =
asType<integer>(div3.quot)
```

```
(asType<integer>(asType<int>($heap_{tuncstart\_724.1}.p3)) %
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a3))) = =
asType<integer>(div3.rem)
!(0 == asType < integer > (div3.rem)) || !(0 ==
asType<integer>(div3.quot))
heap_{724,1;740,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow asType<short
int>((asType<int>(asType<short int>(div1.rem)) *
asType < int > (\$heap_{funcstart\_724,1}.r1)) - (asType < int > (asType < short)
int>(div1.quot)) * asType< int>($heap_{funcstart\_724,1}.b1))))
-asType<integer const>($heap<sub>724,1;740,8</sub>.M1) <
asType<integer>($heap<sub>724,1:740,8</sub>.p1)
!(0 == asType < integer > (\$heap_{724.1:740.8}.p1))
asType<integer>($heap<sub>724,1:740,8</sub>.p1) <
asType<integer>($heap<sub>724,1:740,8</sub>.M1)
Proof:
[Take given term]
[5.0] invariant1(heapIs heap_{funcstart\_724,1})
\rightarrow [expand definition of function 'invariant1' at prang.c (34,1)]
[5.1] ((((((0 < asType < integer > ($heap_{funcstart\_724,1}.p1)) &&
(\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{p1}) <
asType < integer > (\$heap_{funcstart\_724,1}.M1))) \&\& (0 <
asType < integer > (\$heap_{funcstart\_724,1}.p2))) \&\&
(\mathbf{asType} {<} \mathbf{integer} {>} (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p2}) <
asType < integer > (\$heap_{funcstart\_724.1}.M2))) \&\& (0 <
asType < integer > (\$heap_{funcstart_{-724,1}}.p3))) \&\&
(asType < integer > (\$heap_{funcstart\_724,1}.p3) <
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{M3}))
\rightarrow [simplify]
asType < integer > (\$heap_{funcstart\_724,1}.M1))) \&\& (0 <
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{p2})))\ \&\&
(asType < integer > (\$heap_{funcstart\_724,1}.p2) <
as
Type<integer>(\rho_{funcstart\_724,1}.M2))) & (0 <
asType < integer > (\$heap_{funcstart\_724,1}.p3))) \&\&
(\mathbf{asType} < \mathbf{integer} > (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p3}) <
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{M3}))
\rightarrow [const static or extern object]
[5.4] \ (((((0 < \text{\$heap}_{funcstart\_724,1}.\text{p1}) \&\& \ (\text{\$heap}_{funcstart\_724,1}.\text{p1} <
asType < integer > (\$heap_{init}.M1))) \&\& (0 <
asType < integer > (\$heap_{funcstart\_724,1}.p2))) \&\&
```

```
(\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{p2}) <
asType < integer > (\$heap_{funcstart\_724,1}.M2))) \&\& (0 <
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{p3})))\ \&\&
(asType < integer > ($heap_{funcstart\_724,1}.p3) < 
\mathbf{asType} < \mathbf{integer} > (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{M3}))
\rightarrow [expand definition of constant 'M1' at prang.c (14,20)]
[5.5] (((((0 < $heap_{funcstart_724,1}.p1) && ($heap_{funcstart_724,1}.p1 < 
asType<integer>(asType<short int>((int)30269)))) && (0 <
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p2})))\ \&\&
(asType < integer > ($heap_{funcstart\_724,1}.p2) < 
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{M2})))~\&\&~(0<
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{p3})))\ \&\&
(asType < integer > ($heap_{funcstart\_724,1}.p3) < 
asType < integer > (\$heap_{funcstart\_724,1}.M3))
\rightarrow [simplify]
[5.16] ((((-30269 < -\$heap_{funcstart\_724,1}.p1) \land (0 < \$heap_{funcstart\_724,1}.p1) 
(0 < \text{\$heap}_{funcstart\_724,1}.p2)) \&\& (\text{\$heap}_{funcstart\_724,1}.p2 <
asType<integer>($heap_{funcstart\_724,1}.M2))) && (0 <
asType < integer > (\$heap_{funcstart\_724,1}.p3))) \&\&
(\mathbf{asType} {<} \mathbf{integer} {>} (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p3}) <
asType < integer > (\$heap_{funcstart\_724,1}.M3))
\rightarrow [const static or extern object]
[5.17] \; ((((-30269 < -\$heap_{funcstart\_724,1}.p1) \; \land \; (0 < \$heap_{funcstart\_724,1}.p1) \; \land 
(0 < \text{$heap}_{funcstart\_724,1}.p2)) \&\& (\text{$heap}_{funcstart\_724,1}.p2 <
asType < integer > (\$heap_{init}.M2))) \&\& (0 <
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p3})))\ \&\&
(\mathbf{asType} {<} \mathbf{integer} {>} (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p3}) <
asType < integer > (\$heap_{funcstart\_724,1}.M3))
\rightarrow [expand definition of constant 'M2' at prang.c (19,20)]
[5.18] ((((-30269 < -\$heap_{funcstart\_724,1}.p1) \land (0 < \$heap_{funcstart\_724,1}.p1) 
(0 < \text{\$heap}_{funcstart\_724,1}.p2)) \&\& (\text{\$heap}_{funcstart\_724,1}.p2 <
asType < integer > (asType < short int > ((int)30307)))) && (0 < integer) && (0 < integer
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p3})))\ \&\&
(asType < integer > (\$heap_{funcstart_{-724.1}}.p3) < 
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{M3}))
\rightarrow [simplify]
[5.30] ((-30307 < -\$heap_{funcstart\_724,1}.p2) \land (-30269 <
-\$heap_{funcstart\_724,1}.p1) \land (0 < \$heap_{funcstart\_724,1}.p1) \land (0 < \$heap_{funcstart\_724,1}.p1)
\text{Sheap}_{funcstart_{724,1}.p2} \land (0 < \text{Sheap}_{funcstart_{724,1}.p3})) \&\&
(\text{\$heap}_{funcstart\_724,1}.p3 < asType < integer > (\text{\$heap}_{funcstart\_724,1}.M3))
\rightarrow [const static or extern object]
```

```
[5.31] ((-30307 < -$heap_funcstart_724,1.p2) \land (-30269 <
-\$heap_{funcstart\_724,1}.p1) \land (0 < \$heap_{funcstart\_724,1}.p1) \land (0 < \$heap_{funcstart\_724,1}.p1)
\text{Sheap}_{funcstart\_724,1}.p2) \land (0 < \text{Sheap}_{funcstart\_724,1}.p3)) \&\&
(\text{\$heap}_{funcstart\_724,1}.\text{p3} < \mathbf{asType} < \mathbf{integer} > (\text{\$heap}_{init}.\text{M3}))
\rightarrow [expand definition of constant 'M3' at prang.c (24,20)]
[5.32] ((-30307 < -$heap<sub>funcstart_724,1</sub>.p2) \wedge (-30269 <
-\$heap_{funcstart\_724,1}.p1) \land (0 < \$heap_{funcstart\_724,1}.p1) \land (0 < \$heap_{funcstart\_724,1}.p1)
\text{Sheap}_{funcstart_{724,1}.p2} \land (0 < \text{Sheap}_{funcstart_{724,1}.p3})) \&\&
(\text{sheap}_{funcstart\_724,1}.\text{p3} < \text{asType} < \text{integer} > (\text{asType} < \text{short})
int > ((int)30323))
\rightarrow [simplify]
[5.40] (-30323 < -\$heap_{funcstart\_724,1}.p3) \land (-30307 < -30307)
-\$heap_{funcstart\_724,1}.p2) \land (-30269 < -\$heap_{funcstart\_724,1}.p1) \land (0 <
\text{Sheap}_{funcstart\_724,1}.\text{p1}) \land (0 < \text{Sheap}_{funcstart\_724,1}.\text{p2}) \land (0 <
heap_{funcstart_{724,1}.p3}
[Work on sub-term 5 of conjunction in term 5.40]
[9.0] 0 < $heap_{funcstart_724,1}.p2
[Take given term]
[25.0] div2 == div(heapIs $heap_{funcstart\_724,1},
asType < int > (\$heap_{funcstart\_724,1}.p2),
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{a2}))
\rightarrow [simplify]
[25.1]~{\rm div2} == {\rm div}(\mathbf{heapIs}~\$ \mathrm{heap}_{funcstart\_724,1},\,\$ \mathrm{heap}_{funcstart\_724,1}.\mathrm{p2},
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{a2}))
\rightarrow [const static or extern object]
[25.2] \ \mathrm{div2} == \mathrm{div}(\mathbf{heapIs} \ \$ \mathrm{heap}_{funcstart\_724,1}, \ \$ \mathrm{heap}_{funcstart\_724,1}.\mathrm{p2},
asType < int > (\$heap_{init}.a2))
\rightarrow [expand definition of constant 'a2' at prang.c (21,20)]
[25.3] div2 == div(heapIs \theta_{funcstart_{-724,1}}, \theta_{funcstart_{-724,1}}, \theta_{funcstart_{-724,1}}
asType<int>(asType<short int>((int)176)))
\rightarrow [simplify]
[25.6] \ \mathrm{div2} == \mathrm{div}(\mathbf{heapIs} \ \$ \mathrm{heap}_{funcstart\_724,1}, \ \$ \mathrm{heap}_{funcstart\_724,1}.\mathrm{p2}, \ 176)
[Assume known post-assertion, class invariant or type constraint for term 25.6]
<code>[28.0]</code> (asType<integer>($heap_{funcstart\_724,1}.p2) /
asType<integer>(176)) == asType<integer>(div(heapIs
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.p2, 176).quot)
\rightarrow [simplify]
```

```
[28.2] ($heap<sub>funcstart_724,1.</sub>p2 / 176) == asType<integer>(div(heapIs)
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.p2, 176).quot
→ [expand definition of operator './' in class 'int' at built in declaration]
[28.3] ([asType<integer>(peq: funcstart_{-724,1}.p2) < 0]:
-(-asType < integer > (\$heap_{funcstart\_724,1}.p2) / 176), []:
asType < integer > (\$heap_{funcstart\_724,1}.p2) / 176) ==
asType<integer>(div(heapIs $heap_{tuncstart\_724.1}, $heap_{tuncstart\_724.1}.p2,
176).quot)
→ [explicitly assert falsehood of skipped guards in subsequent guards]
[28.4] ([asType<integer>(heap_{funcstart\_724,1}.p2) < 0]:
-(-asType < integer > (\$heap_{funcstart\_724,1}.p2) / 176),
[!(asType < integer > (\$heap_{funcstart\_724,1}.p2) < 0)]:
asType < integer > (\$heap_{funcstart\_724,1}.p2) / 176) ==
\mathbf{asType} {<} \mathbf{integer} {>} ( \mathrm{div}(\mathbf{heapIs} \ \$ \mathrm{heap}_{funcstart\_724,1}, \ \$ \mathrm{heap}_{funcstart\_724,1}.\mathrm{p2}, \\
176).quot)
\rightarrow [simplify]
[28.7] ([0 < -$heap<sub>funcstart_724,1.</sub>p2]:
-(-asType < integer > (\$heap_{funcstart\_724,1}.p2) / 176),
[!(asType < integer > (\$heap_{funcstart\_724,1}.p2) < 0)]:
asType < integer > (\$heap_{funcstart\_724,1}.p2) / 176) ==
asType<integer>(div(heapIs $heap_funcstart_724,1, $heap_funcstart_724,1.p2,
176).quot)
\rightarrow [from term 9.0, literala < -$heap<sub>funcstart_724,1</sub>.p2 is false whenever -2 < (0
+ literala)]
    Proof of rule precondition:
    [28.7.0] - 2 < (0 + 0)
    \rightarrow [simplify]
    [28.7.2] true
[28.8] \; ([\mathbf{false}]: \; -(-\mathbf{asType} < \mathbf{integer} > (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p2}) \; / \; 176),
[!(asType < integer > (\$heap_{funcstart\_724.1}.p2) < 0)]:
asType < integer > (\$heap_{funcstart\_724,1}.p2) / 176) ==
\mathbf{asType} {<} \mathbf{integer} {>} ( \mathrm{div}(\mathbf{heapIs} \ \$ \mathrm{heap}_{funcstart\_724,1}, \ \$ \mathrm{heap}_{funcstart\_724,1}.\mathrm{p2}, \\
176).quot)
\rightarrow [simplify]
[28.11] ([false]: -(-asType < integer > (\$heap_{funcstart\_724,1}.p2) / 176), [!(0 <
-\text{$heap}_{funcstart\_724,1}.p2)]: asType<integer>($heap_{funcstart\_724,1}.p2) / 176)
== asType < integer > (div(heapIs $heap_{funcstart\_724,1},
heap_{funcstart_{-724,1}}.p2, 176).quot
\rightarrow [from term 9.0, literala < -$heap<sub>funcstart_724,1.</sub>p2 is false whenever -2 < (0
```

```
+ literala)]
    Proof of rule precondition:
    [28.11.0] - 2 < (0 + 0)
    \rightarrow [simplify]
    [28.11.2] true
[28.12] ([\mathbf{false}]: -(-\mathbf{asType} < \mathbf{integer} > (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p2}) \ / \ 176),
[!false]: asType<integer>($heap<sub>funcstart_724,1.</sub>p2) / 176) ==
\mathbf{asType} \small{<} \mathbf{integer} \small{>} ( \mathrm{div}(\mathbf{heapIs} \ \$ \mathrm{heap}_{funcstart\_724,1}, \ \$ \mathrm{heap}_{funcstart\_724,1}.\mathrm{p2}, \\
176).quot)
\rightarrow [simplify]
[28.17] \ 0 == (-\text{div}(\mathbf{heapIs} \ \$ \text{heap}_{funcstart\_724,1}, \ \$ \text{heap}_{funcstart\_724,1}.\text{p2},
176).quot + (\text{$heap}_{funcstart\_724,1}.p2 / 176))
[Assume known post-assertion, class invariant or type constraint for term
28.17
[35.0] div(heapIs heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p2, 176).quot \leq
maxof(int)
\rightarrow [simplify]
[35.9] -32768 < -\text{div}(\mathbf{heapIs} \$ \text{heap}_{funcstart\_724,1}, \$ \text{heap}_{funcstart\_724,1}.\text{p2},
176).quot
[Take goal term]
[1.0] div2.quot \leq maxof(short int)
\rightarrow [from term 25.6, div2 is equal to div(heapIs $heap_{funcstart\_724,1},
heap_{funcstart_{-724,1}}.p2, 176)
[1.1] div(heapIs heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p2, 176).quot \leq
maxof(short int)
\rightarrow [simplify]
[1.10] \ -32768 < -{\rm div}(\mathbf{heapIs} \ \$ \mathrm{heap}_{funcstart\_724,1}, \ \$ \mathrm{heap}_{funcstart\_724,1}.\mathrm{p2},
176).quot
\rightarrow [from term 35.9, literala < -\text{div}(\text{heapIs } \text{\$heap}_{funcstart\_724,1},
heap_{funcstart\_724,1}.p2, 176).quot is true whenever (-1 + literala) < -32768
    Proof of rule precondition:
    [1.10.0](-32768 + -1) < -32768
    \rightarrow [simplify]
    [1.10.2] true
[1.11] true
```

```
conversion from 'short int' to 'int'
Condition generated at: C:\Escher\Customers\prang\prang.c (58,40)
Condition defined at:
To prove: minof(int) \le asType \le short int \rangle (\div2.quot)
Given:
heap_{init}.LIMIT == (int)80
\theta
\theta_{init}.r1 == asType < short int > ((int)171)
\theta sheap<sub>init</sub>.a1 == asType<short int>((int)177)
\theta
heap_{init}.M2 == asType < short int > ((int)30307)
\theta_{init}.r2 == asType < short int > ((int)172)
heap_{init}.a2 == asType < short int > ((int)176)
\theta = asType < short int > ((int)35)
heap_{init}.M3 == asType < short int > ((int)30323)
\theta
heap_{init}.a3 == asType < short int > ((int)178)
\theta = asType < short int > ((int)63)
\theta = asType < short int > ((int)1)
\theta
\theta = asType < short int > ((int)3)
invariant1(heapIs heap_{funcstart_{-724,1}})
\operatorname{div1} == \operatorname{div}(\mathbf{heapIs} \ \operatorname{heap}_{funcstart\_724,1},
asType < int > (\$heap_{funcstart\_724,1}.p1),
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{a1}))
(\mathbf{asType}{<}\mathbf{int}{>}(\mathbf{asType}{<}\mathbf{int}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{p1})) \ / \\
asType < integer > (asType < int > (\$heap_{funcstart\_724.1}.a1))) = =
asType<integer>(div1.quot)
(\mathbf{asType} {<} \mathbf{int} {>} (\mathbf{asType} {<} \mathbf{int} {>} (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p1})) \ \%
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a1))) = =
asType<integer>(div1.rem)
!(0 == asType < integer > (div1.rem)) || !(0 ==
asType<integer>(div1.quot))
div2 == div(\mathbf{heapIs} \$heap_{funcstart\_724,1},
```

**Proof of verification condition:** Type constraint satisfied in implicit

```
asType < int > (\$heap_{funcstart\_724.1}.p2),
asType < int > (\$heap_{funcstart\_724,1}.a2))
(\mathbf{asType}{<}\mathbf{integer}{>}(\mathbf{asType}{<}\mathbf{int}{>}(\$\mathbf{heap}_{funcstart\_724,1}.\mathbf{p2})) \ / \\
\mathbf{asType}{<}\mathbf{integer}{>}(\mathbf{asType}{<}\mathbf{int}{>}(\$\mathbf{heap}_{funcstart\_724,1}.\mathbf{a2}))) = =
asType<integer>(div2.quot)
(\mathbf{asType} < \mathbf{integer} > (\mathbf{asType} < \mathbf{int} > (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p2})) \ \%
\mathbf{asType} < \mathbf{integer} > (\mathbf{asType} < \mathbf{int} > (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{a2}))) = =
asType<integer>(div2.rem)
!(0 == asType < integer > (div2.rem)) || !(0 ==
asType<integer>(div2.quot))
div3 == div(\mathbf{heapIs} \$ heap_{funcstart_{-724.1}},
asType < int > (\$heap_{funcstart\_724.1}.p3),
asType < int > (\$heap_{funcstart\_724,1}.a3))
(\mathbf{asType}{<}\mathbf{int}{>}(\mathbf{asType}{<}\mathbf{int}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{p3}))\ /
asType < integer > (asType < int > (\$heap_{funcstart\_724.1}.a3))) = =
asType<integer>(div3.quot)
(asType < int > (asType < int > (\$heap_{funcstart\_724,1}.p3)) \%
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a3))) = =
asType<integer>(div3.rem)
!(0 == asType < integer > (div3.rem)) || !(0 ==
asType<integer>(div3.quot))
heap_{724,1:740.8} == heap_{funcstart_{724,1}}._replace(p1 \rightarrow asType<short
int>((asType<int>(asType<short int>(div1.rem)) *
asType < int > (\$heap_{funcstart\_724,1}.r1)) - (asType < int > (asType < short)
\mathbf{int}{>}(\mathbf{div1.quot})) * \mathbf{asType}{<} \mathbf{int}{>} (\$\mathbf{heap}_{funcstart\_724,1}.\mathbf{b1}))))
-asType < integer\ const > (\$heap_{724,1;740,8}.M1) < 1
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathrm{heap}_{724,1;740,8}.\mathrm{p1})
!(0 == asType < integer > (\$heap_{724,1;740,8}.p1))
asType<integer>($heap<sub>724.1:740.8</sub>.p1) <
asType<integer>($heap<sub>724,1:740,8</sub>.M1)
Proof:
[Take given term]
[5.0] invariant1(heapIs heap_{funcstart\_724,1})
\rightarrow [expand definition of function 'invariant1' at prang.c (34,1)]
 \texttt{[5.1]} \; (((((0 < \mathbf{asType} < \mathbf{integer} > (\$ heap_{funcstart\_724,1}.p1)) \; \&\& \\
(asType < integer > (\$heap_{funcstart\_724,1}.p1) < 
asType < integer > (\$heap_{funcstart\_724,1}.M1))) \&\& (0 <
asType < integer > (\$heap_{funcstart\_724,1}.p2))) \&\&
(\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p2}) <
```

```
asType<integer>(heap_{funcstart\_724,1}.M2))) && (0 <
asType < integer > (\$heap_{funcstart\_724,1}.p3))) \&\&
(\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{p3}) <
asType < integer > (\$heap_{funcstart\_724,1}.M3))
\rightarrow [simplify]
[5.3] (((((0 < $heap_{funcstart_{724,1}}.p1) && ($heap_{funcstart_{724,1}}.p1 < 
asType < integer > (\$heap_{funcstart\_724,1}.M1))) \&\& (0 <
asType < integer > (\$heap_{funcstart\_724,1}.p2))) \&\&
(\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{p2}) <
asType < integer > (\$heap_{funcstart\_724,1}.M2))) \&\& (0 <
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{p3})))\ \&\&
(asType<integer>($heap_{tuncstart\_724,1}.p3) <
asType < integer > (\$heap_{funcstart\_724,1}.M3))
\rightarrow [const static or extern object]
[5.4] \ (((((0 < \$heap_{funcstart\_724,1}.p1) \&\& \ (\$heap_{funcstart\_724,1}.p1 < 
asType<integer>($heap<sub>init</sub>.M1))) && (0 <
asType < integer > (\$heap_{funcstart\_724,1}.p2))) \&\&
(\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{p2}) <
asType < integer > (\$heap_{funcstart\_724,1}.M2))) \&\& (0 <
asType < integer > (\$heap_{funcstart\_724,1}.p3))) \&\&
(\mathbf{asType} < \mathbf{integer} > (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p3}) <
asType < integer > (\$heap_{funcstart\_724,1}.M3))
\rightarrow [expand definition of constant 'M1' at prang.c (14,20)]
[5.5] (((((0 < $heap_{funcstart_724,1}.p1) && ($heap_{funcstart_724,1}.p1 < function for the content of the 
asType<integer>(asType<short int>((int)30269)))) && (0 <
asType < integer > (\$heap_{funcstart\_724,1}.p2))) \&\&
(asType < integer > (\$heap_{funcstart\_724,1}.p2) <
asType < integer > ($heap_{funcstart\_724,1}.M2))) && (0 < footnote{footnote{footnote{footnote{footnote{footnote{footnote{footnote{footnote{footnote{footnote{footnote{footnote{footnote{footnote{footnote{footnote{footnote{footnote{footnote{footnote{footnote{footnote{footnote{footnote{footnote{footnote{footnote{footnote{footnote{footnote{footnote{footnote{footnote{footnote{footnote{footnote{footnote{footnote{footnote{footnote{footnote{footnote{footnote{footnote{footnote{footnote{footnote{footnote{footnote{footnote{footnote{footnote{footnote{footnote{footnote{footnote{footnote{footnote{footnote{footnote{footnote{footnote{footnote{footnote{footnote{footnote{footnote{footnote{footnote{footnote{footnote{footnote{footnote{footnote{footnote{footnote{footnote{footnote{footnote{footnote{footnote{footnote{footnote{footnote{footnote{footnote{footnote{footnote{footnote{footnote{footnote{footnote{footnote{footnote{footnote{footnote{footnote{footnote{footnote{footnote{footnote{footnote{footnote{footnote{footnote{footnote{footnote{footnote{footnote{footnote{footnote{footnote{footnote{footnote{footnote{footnote{footnote{footnote{footnote{footnote{footnote{footnote{footnote{footnote{footnote{footnote{footnote{footnote{footnote{footnote{footnote{footnote{footnote{footnote{footnote{footnote{footnote{footnote{footnote{footnote{footnote{footnote{footnote{footnote{footnote{footnote{footnote{footnote{footnote{footnote{footnote{footnote{footnote{footnote{footnote{footnote{footnote{footnote{footnote{footnote{footnote{footnote{footnote{footnote{footnote{footnote{footnote{footnote{footnote{footnote{footnote{footnote{footnote{footnote{footnote{footnote{footnote{footnote{footnote{footnote{footnote{footnote{footnote{footnote{footnote{footnote{footnote{footnote{footnote{footnote{footnote{footnote{footnote{footnote{footnote{footnote{footnote{footnote{footnote{footnote{footnote{footnote{footnote{footnote{footnote{footnote{footnote{footnote{footnote{footnote{footnote{footnote{footnote{footnote{footnote{footnote{footnote{footnote{footnote{footno
asType < integer > (\$heap_{funcstart\_724,1}.p3))) \&\&
(\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{p3}) <
asType < integer > (\$heap_{funcstart\_724,1}.M3))
\rightarrow [simplify]
[5.16] \; ((((-30269 < -\$heap_{funcstart\_724,1}.p1) \; \land \; (0 < \$heap_{funcstart\_724,1}.p1) \; \land 
(0 < \text{$heap}_{funcstart_{724,1}.p2})) \&\& (\text{$heap}_{funcstart_{724,1}.p2} <
asType<integer>(heap_{funcstart\_724,1}.M2))) && (0 <
\mathbf{asType} {<} \mathbf{integer} {>} (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p3}))) \ \&\& \\
(\mathbf{asType} {<} \mathbf{integer} {>} (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p3}) <
asType < integer > (\$heap_{funcstart\_724,1}.M3))
\rightarrow [const static or extern object]
\label{eq:final_start_724,1.p1} [(((-30269 < -\$heap_{funcstart\_724,1}.p1) \land (0 < \$heap_{funcstart\_724,1}.p1) \land (0 < \$he
(0 < \text{\$heap}_{funcstart\_724,1}.p2)) \&\& (\text{\$heap}_{funcstart\_724,1}.p2 <
```

```
asType < integer > (\$heap_{init}.M2))) \&\& (0 <
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{p3})))\ \&\&
(\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{p3}) <
asType < integer > (\$heap_{funcstart\_724,1}.M3))
\rightarrow [expand definition of constant 'M2' at prang.c (19,20)]
[5.18] \left( \left( \left( \left( -30269 < -\$ \text{heap}_{funcstart\_724,1}.\text{p1} \right) \right. \wedge \left. \left( 0 < \$ \text{heap}_{funcstart\_724,1}.\text{p1} \right) \right. \wedge \right. \right)
(0 < \text{$heap}_{funcstart\_724,1}.p2)) \&\& (\text{$heap}_{funcstart\_724,1}.p2 <
asType < integer > (asType < short int > ((int)30307)))) && (0 < integer) && (0 < integer
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{p3})))\ \&\&
(asType < integer > (\$heap_{funcstart\_724,1}.p3) < 
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{M3}))
\rightarrow [simplify]
[5.30] ((-30307 < -\$heap_{funcstart\_724,1}.p2) \land (-30269 <
-\$heap_{funcstart\_724,1}.p1) \land (0 < \$heap_{funcstart\_724,1}.p1) \land (0 < \$heap_{funcstart\_724,1}.p1)
\text{Sheap}_{funcstart_{724,1}.p2} \land (0 < \text{Sheap}_{funcstart_{724,1}.p3})) \&\&
(\text{\$heap}_{funcstart\_724,1}.\text{p3} < \text{asType} < \text{integer} > (\text{\$heap}_{funcstart\_724,1}.\text{M3}))
\rightarrow [const static or extern object]
[5.31] ((-30307 < -$heap<sub>funcstart_724,1.</sub>p2) \land (-30269 <
-\$heap_{funcstart\_724,1}.p1) \land (0 < \$heap_{funcstart\_724,1}.p1) \land (0 < \$heap_{funcstart\_724,1}.p1)
\text{Sheap}_{funcstart_{724,1}.p2} \land (0 < \text{Sheap}_{funcstart_{724,1}.p3})) \&\&
(\text{\$heap}_{funcstart\_724,1}.p3 < asType < integer > (\text{\$heap}_{init}.M3))
\rightarrow [expand definition of constant 'M3' at prang.c (24,20)]
[5.32] ((-30307 < -$heap<sub>funcstart_724,1.</sub>p2) \land (-30269 <
-\$heap_{funcstart\_724,1}.p1) \land (0 < \$heap_{funcstart\_724,1}.p1) \land (0 < \$heap_{funcstart\_724,1}.p1)
\text{Sheap}_{funcstart_{724,1}.p2} \land (0 < \text{Sheap}_{funcstart_{724,1}.p3})) \&\&
(\text{sheap}_{funcstart\_724,1}.p3 < asType < integer > (asType < short)
int > ((int)30323)))
\rightarrow [simplify]
[5.40] (-30323 < -\$heap_{funcstart\_724,1}.p3) \land (-30307 <
-\$heap_{funcstart\_724,1}.p2) \land (-30269 < -\$heap_{funcstart\_724,1}.p1) \land (0 < -\$heap_{funcstart\_724,1}.p1)
\text{Sheap}_{funcstart\_724,1}.\text{p1}) \land (0 < \text{Sheap}_{funcstart\_724,1}.\text{p2}) \land (0 <
heap_{funcstart_{-724,1}.p3}
[Work on sub-term 5 of conjunction in term 5.40]
[9.0] 0 < \text{heap}_{funcstart\_724,1.p2}
[Take given term]
[25.0] \operatorname{div2} == \operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724,1},
asType < int > (\$heap_{funcstart\_724,1}.p2),
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{a2}))
\rightarrow [simplify]
```

```
[25.1] \ \mathrm{div2} == \ \mathrm{div}(\mathbf{heapIs} \ \$ \mathrm{heap}_{funcstart\_724,1}, \ \$ \mathrm{heap}_{funcstart\_724,1}.\mathrm{p2},
asType < int > (\$heap_{funcstart\_724,1}.a2))
\rightarrow [const static or extern object]
[25.2]~{\rm div2} == {\rm div}(\mathbf{heapIs}~\$ \mathrm{heap}_{funcstart\_724,1},\,\$ \mathrm{heap}_{funcstart\_724,1}.\mathrm{p2},
asType < int > (\$heap_{init}.a2))
\rightarrow [expand definition of constant 'a2' at prang.c (21,20)]
[25.3] \operatorname{div2} == \operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p2,
asType<int>(asType<short int>((int)176)))
\rightarrow [simplify]
[25.6] div2 == div(heapIs heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p2, 176)
[Assume known post-assertion, class invariant or type constraint for term 25.6]
[28.0] \; (\mathbf{asType} {<} \mathbf{integer} {>} (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p2}) \; / \\
asType < integer > (176)) == asType < integer > (div(heapIs))
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.p2, 176).quot)
\rightarrow [simplify]
[28.2] ($heap<sub>funcstart_724,1.</sub>p2 / 176) == asType<integer>(div(heapIs)
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.p2, 176).quot
→ [expand definition of operator './' in class 'int' at built in declaration]
[28.3] ([asType<integer>($heap<sub>funcstart_724,1.</sub>p2) < 0]:
-(-asType < integer > (\$heap_{funcstart\_724,1}.p2) / 176), []:
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p2})~/~176) ==
\mathbf{asType} \small{<} \mathbf{integer} \small{>} ( \mathrm{div}(\mathbf{heapIs} \ \$ \mathrm{heap}_{funcstart\_724,1}, \ \$ \mathrm{heap}_{funcstart\_724,1}.\mathrm{p2}, \\
176).quot)
→ [explicitly assert falsehood of skipped guards in subsequent guards]
[28.4] ([asType<integer>(heap_{funcstart\_724,1}.p2) < 0]:
-(-asType < integer > (\$heap_{funcstart\_724,1}.p2) / 176),
[!(asType < integer > (\$heap_{funcstart\_724,1}.p2) < 0)]:
asType < integer > (\$heap_{funcstart\_724,1}.p2) / 176) ==
\mathbf{asType} \small{<} \mathbf{integer} \small{>} ( \mathrm{div}(\mathbf{heapIs} \ \$ \mathrm{heap}_{funcstart\_724,1}, \ \$ \mathrm{heap}_{funcstart\_724,1}.\mathrm{p2}, \\
176).quot)
\rightarrow [simplify]
[28.7] ([0 < -$heap<sub>funcstart_724,1</sub>.p2]:
-(-asType < integer > (\$heap_{funcstart\_724,1}.p2) / 176),
[!(asType < integer > (\$heap_{funcstart\_724,1}.p2) < 0)]:
asType < integer > (\$heap_{funcstart\_724,1}.p2) / 176) ==
\mathbf{asType} < \mathbf{integer} > (\mathbf{div}(\mathbf{heapIs} \ \$ \mathbf{heap}_{funcstart\_724,1}, \ \$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p2},
176).quot)
\rightarrow [from term 9.0, literala < -$heap<sub>funcstart_724.1</sub>.p2 is false whenever -2 < (0
```

```
+ literala)]
    Proof of rule precondition:
    [28.7.0] - 2 < (0 + 0)
    \rightarrow [simplify]
    [28.7.2] true
[28.8] ([false]: -(-asType < integer > (\$heap_{funcstart\_724,1}.p2) / 176),
[!(\mathbf{asType} < \mathbf{integer} > (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p2}) < 0)]:
asType < integer > (\$heap_{funcstart\_724,1}.p2) / 176) = =
asType<integer>(div(heapIs heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p2,
176).quot)
\rightarrow [simplify]
[28.11] \; ([{\bf false}]: \; -({\bf -asType}{<} {\bf integer}{>} (\$ {\rm heap}_{funcstart\_724,1}.{\rm p2}) \; / \; 176), \; [!(0 < {\rm heap}_{funcstart\_724,1}.{\rm p2}) \; / \; 176), \; [!(0 < {\rm heap}_{funcstart\_724,1}.{\rm p2}) \; / \; 176), \; [!(0 < {\rm heap}_{funcstart\_724,1}.{\rm p2}) \; / \; 176)]
-\$heap_{funcstart\_724,1}.p2)]: asType<integer>(\$heap_{funcstart\_724,1}.p2) / 176)
== asType < integer > (div(heapIs $heap_{funcstart\_724,1},
\text{$heap}_{funcstart\_724,1}.p2, 176).quot)
\rightarrow [from term 9.0, literala < -$heap<sub>funcstart_724,1.</sub>p2 is false whenever -2 < (0
+ literala)]
    Proof of rule precondition:
    [28.11.0] - 2 < (0 + 0)
    \rightarrow [simplify]
    [28.11.2] true
[28.12] \; ([\mathbf{false}]: \; -(-\mathbf{asType} < \mathbf{integer} > (\$ \mathrm{heap}_{funcstart\_724,1}.\mathrm{p2}) \; / \; 176),
[!false]: asType<integer>(\theta_{tal} = 1.00) | 176| ==
asType<integer>(div(heapIs heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p2,
176).quot)
\rightarrow [simplify]
[28.17] \ 0 == (-\text{div}(\mathbf{heapIs} \ \$ \text{heap}_{funcstart\_724,1}, \ \$ \text{heap}_{funcstart\_724,1}.\text{p2},
176).quot + (heap_{funcstart\_724,1}.p2 / 176))
[Assume known post-assertion, class invariant or type constraint for term
28.17
[34.0] minof(int) \leq div(heapIs \text{$heap}_{funcstart\_724.1}, \text{$heap}_{funcstart\_724.1}, \text{$p2},
176).quot
\rightarrow [simplify]
\label{eq:constant_724,1} \text{-32769} < \text{div}(\mathbf{heapIs} \ \$ \text{heap}_{funcstart\_724,1}, \ \$ \text{heap}_{funcstart\_724,1}.\text{p2},
176).quot
[Take goal term]
[1.0] minof(int) \leq asType<short int>(div2.quot)
```

```
\rightarrow [simplify]
[1.1] -32768 \leq asType<short int>(div2.quot)
\rightarrow [from term 25.6, div2 is equal to div(heapIs $heap_{funcstart\_724,1},
heap_{funcstart_{-724,1}}.p2, 176)
[1.2] \text{ -}32768 \leq \mathbf{asType} < \mathbf{short int} > (\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1},
heap_{funcstart_{-724,1}}.p2, 176).quot
\rightarrow [simplify]
[1.5] -32769 < \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_724,1}, \text{\$heap}_{funcstart\_724,1}.p2,
176).quot
\rightarrow [from term 34.3, literala < div(heapIs $heap_{funcstart\_724,1},
heap_{funcstart\_724,1}.p2, 176).quot is true whenever (-1 + literala) < -32769
   Proof of rule precondition:
   [1.5.0](-32769 + -1) < -32769
   \rightarrow [simplify]
   [1.5.2] true
[1.6] true
Proof of verification condition: Type constraint satisfied in implicit
conversion from 'short int' to 'int'
Condition generated at: C:\Escher\Customers\prang\prang.c (58,40)
Condition defined at:
To prove: asType<short int>(div2.quot) \le maxof(int)
Given:
heap_{init}.LIMIT == (int)80
\theta
\theta_{init}.r1 == asType < short int > ((int)171)
\theta
\theta
\theta sheap<sub>init</sub>.M2 == asType<short int>((int)30307)
\theta_{init}.r2 == asType<short int>((int)172)
heap_{init}.a2 == asType < short int > ((int)176)
\theta = asType < short int > ((int)35)
heap_{init}.M3 == asType < short int > ((int)30323)
\theta_{init}.r3 == asType<short int>((int)170)
```

```
heap_{init}.a3 == asType < short int > ((int)178)
heap_{init}.b3 == asType<short int>((int)63)
\theta
\theta
\theta = asType < short int > ((int)3)
invariant1(heapIs heap_{funcstart\_724,1})
\mathrm{div1} == \mathrm{div}(\mathbf{heapIs} \ \$ \mathrm{heap}_{funcstart\_724,1},
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p1}),
asType < int > (\$heap_{funcstart\_724,1}.a1))
(asType<int>(asType<int>($heap_{tuncstart\_724.1}.p1)) /
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a1))) = =
asType<integer>(div1.quot)
(asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.p1)) \%
\mathbf{asType}{<}\mathbf{integer}{>}(\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{a1}))) ==
asType<integer>(div1.rem)
!(0 == asType < integer > (div1.rem)) || !(0 ==
asType<integer>(div1.quot))
div2 == div(\mathbf{heapIs} \$heap_{funcstart\_724,1},
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p2}),
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{a2}))
(asType<integer>(asType<int>($heap_{tuncstart\_724.1}.p2)) /
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a2))) = =
asType<integer>(div2.quot)
(\mathbf{asType} {<} \mathbf{integer} {>} (\mathbf{asType} {<} \mathbf{int} {>} (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p2})) \ \%
\mathbf{asType}{<}\mathbf{integer}{>}(\mathbf{asType}{<}\mathbf{int}{>}(\$\mathbf{heap}_{funcstart\_724,1}.\mathbf{a2}))) = =
asType<integer>(div2.rem)
!(0 == asType < integer > (div2.rem)) || !(0 ==
asType<integer>(div2.quot))
div3 == div(\mathbf{heapIs} \$ heap_{funcstart\_724,1},
\mathbf{asType} < \mathbf{int} > (\$ \mathrm{heap}_{funcstart\_724,1}.\mathrm{p3}),
asType < int > (\$heap_{funcstart\_724,1}.a3))
(asType<int>(asType<int>($heap_{tuncstart\_724.1}.p3)) /
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a3))) = =
asType<integer>(div3.quot)
(\mathbf{asType} {<} \mathbf{integer} {>} (\mathbf{asType} {<} \mathbf{int} {>} (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p3})) \ \%
\mathbf{asType} < \mathbf{integer} > (\mathbf{asType} < \mathbf{int} > (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{a3}))) = =
asType<integer>(div3.rem)
!(0 == asType < integer > (div3.rem)) || !(0 ==
```

```
asType<integer>(div3.quot))
heap_{724,1;740,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow asType<short
int>((asType<int>(asType<short\ int>(div1.rem))*
asType < int > (\$heap_{funcstart\_724,1}.r1)) - (asType < int > (asType < short)
int>(div1.quot)) * asType<int>($heap_{funcstart\_724,1}.b1)))
-asType < integer\ const > (\$heap_{724,1;740,8}.M1) < 
asType<integer>($heap<sub>724,1:740,8</sub>.p1)
!(0 == asType < integer > (\$heap_{724,1;740,8}.p1))
asType<integer>($heap<sub>724,1:740,8:p1</sub>) <
asType<integer>($heap<sub>724.1:740.8</sub>.M1)
Proof:
[Take given term]
[5.0] invariant1(heapIs heap_{funcstart\_724,1})
\rightarrow [expand definition of function 'invariant1' at prang.c (34,1)]
[5.1] (((((0 < asType<integer>($heap_{funcstart\_724,1}.p1)) &&
(asType<integer>($heap_funcstart_724.1.p1) <
asType < integer > (\$heap_{funcstart\_724,1}.M1))) \&\& (0 <
asType < integer > (\$heap_{funcstart\_724,1}.p2))) \&\&
(\mathbf{asType} {<} \mathbf{integer} {>} (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p2}) <
asType < integer > (\$heap_{funcstart\_724,1}.M2))) \&\& (0 <
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p3})))\ \&\&
(asType<integer>($heap_{tuncstart\_724,1}.p3) <
asType < integer > (\$heap_{funcstart\_724,1}.M3))
\rightarrow [simplify]
[5.3] (((((0 < \text{\$heap}_{funcstart\_724,1}.p1) \&\& (\text{\$heap}_{funcstart\_724,1}.p1 <
asType < integer > (\$heap_{funcstart\_724,1}.M1))) \&\& (0 <
asType < integer > (\$heap_{funcstart\_724,1}.p2))) \&\&
(\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{p2}) <
asType < integer > (\$heap_{funcstart\_724,1}.M2))) \&\& (0 <
asType < integer > (\$heap_{funcstart\_724,1}.p3))) \&\&
(\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{p3}) <
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{M3}))
\rightarrow [const static or extern object]
[5.4] (((((0 < $heap_{funcstart_{724,1}}.p1) && ($heap_{funcstart_{724,1}}.p1 < ]
asType < integer > (\$heap_{init}.M1))) \&\& (0 <
asType < integer > (\$heap_{funcstart\_724,1}.p2))) \&\&
(\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{p2}) <
asType < integer > (\$heap_{funcstart\_724,1}.M2))) \&\& (0 <
asType < integer > (\$heap_{funcstart\_724,1}.p3))) \&\&
(asType<integer>($heap_{tuncstart\_724.1}.p3) <
```

```
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{M3}))
\rightarrow [expand definition of constant 'M1' at prang.c (14,20)]
[5.5] (((((0 < $heap_{funcstart_{724,1}}.p1) && ($heap_{funcstart_{724,1}}.p1 < 
asType<integer>(asType<short int>((int)30269)))) && (0 <
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{p2})))\ \&\&
(asType < integer > (\$heap_{funcstart\_724,1}.p2) <
asType < integer > (\$heap_{funcstart\_724,1}.M2))) \&\& (0 <
asType < integer > (\$heap_{funcstart\_724,1}.p3))) \&\&
(asType < integer > ($heap_{funcstart\_724,1}.p3) < 
asType < integer > (\$heap_{funcstart\_724,1}.M3))
\rightarrow [simplify]
[5.16] ((((-30269 < -\$heap_{funcstart\_724,1}.p1) \land (0 < \$heap_{funcstart\_724,1}.p1) 
(0 < \text{\$heap}_{funcstart\_724,1}.p2)) \&\& (\text{\$heap}_{funcstart\_724,1}.p2 <
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{M2})))~\&\&~(0<
asType < integer > (\$heap_{funcstart\_724,1}.p3))) \&\&
(\mathbf{asType} < \mathbf{integer} > (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p3}) <
asType < integer > (\$heap_{funcstart\_724,1}.M3))
\rightarrow [const static or extern object]
[5.17] \; ((((-30269 < -\$heap_{funcstart\_724,1}.p1) \; \land \; (0 < \$heap_{funcstart\_724,1}.p1) \; \land 
(0 < \text{$heap}_{funcstart\_724,1}.p2)) \&\& (\text{$heap}_{funcstart\_724,1}.p2 <
asType < integer > (\$heap_{init}.M2))) \&\& (0 <
asType < integer > (\$heap_{funcstart\_724,1}.p3))) \&\&
(asType<integer>($heap_{tuncstart\_724,1}.p3) <
asType < integer > (\$heap_{funcstart\_724,1}.M3))
\rightarrow [expand definition of constant 'M2' at prang.c (19,20)]
|5.18| \left( \left( \left( \left( -30269 < -\$ \text{heap}_{funcstart\_724,1}.\text{p1} \right) \right. \wedge \left. \left( 0 < \$ \text{heap}_{funcstart\_724,1}.\text{p1} \right) \right. \wedge \right. |
(0 < \text{$heap}_{funcstart\_724,1}.p2)) \&\& (\text{$heap}_{funcstart\_724,1}.p2 <
asType < integer > (asType < short int > ((int)30307)))) && (0 < integer) && (0 < integer
asType < integer > (\$heap_{funcstart\_724,1}.p3))) \&\&
(asType < integer > ($heap_{funcstart\_724,1}.p3) < 
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{M3}))
\rightarrow [simplify]
[5.30] ((-30307 < -$heap_{funcstart\_724,1}.p2) \land (-30269 <
-\$heap_{funcstart\_724,1}.p1) \land (0 < \$heap_{funcstart\_724,1}.p1) \land (0 < \$heap_{funcstart\_724,1}.p1)
\text{Sheap}_{funcstart_{-724,1}.p2} \land (0 < \text{Sheap}_{funcstart_{-724,1}.p3})) \&\&
(\text{\$heap}_{funcstart\_724,1}.\text{p3} < \text{asType} < \text{integer} > (\text{\$heap}_{funcstart\_724,1}.\text{M3}))
\rightarrow [const static or extern object]
[5.31] ((-30307 < -$heap_{funcstart\_724,1}.p2) \land (-30269 <
-\$heap_{funcstart\_724,1}.p1) \land (0 < \$heap_{funcstart\_724,1}.p1) \land (0 < \$heap_{funcstart\_724,1}.p1)
\text{Sheap}_{funcstart\_724,1.p2}) \land (0 < \text{Sheap}_{funcstart\_724,1.p3})) \&\&
(\text{\$heap}_{funcstart\_724,1}.p3 < asType < integer > (\text{\$heap}_{init}.M3))
```

```
\rightarrow [expand definition of constant 'M3' at prang.c (24,20)]
[5.32] ((-30307 < -$heap<sub>funcstart_724,1.</sub>p2) \wedge (-30269 <
-\$heap_{funcstart\_724,1}.p1) \land (0 < \$heap_{funcstart\_724,1}.p1) \land (0 < \$heap_{funcstart\_724,1}.p1)
\text{Sheap}_{funcstart\_724,1.p2} \land (0 < \text{Sheap}_{funcstart\_724,1.p3})) \&\&
(\text{sheap}_{funcstart\_724.1}.p3 < asType < integer > (asType < short)
int > ((int)30323)))
\rightarrow [simplify]
[5.40] (-30323 < -$heap_{funcstart\_724,1}.p3) \land (-30307 <
-\$heap_{funcstart_{-724,1}.p2}) \land (-30269 < -\$heap_{funcstart_{-724,1}.p1}) \land (0 < -\$heap_{funcstart_{-724,1}.p2})
\text{Sheap}_{funcstart\_724,1}.\text{p1}) \land (0 < \text{Sheap}_{funcstart\_724,1}.\text{p2}) \land (0 <
heap_{funcstart_{724,1}.p3}
[Work on sub-term 5 of conjunction in term 5.40]
[9.0] 0 < \text{$heap}_{funcstart\_724,1}.p2
[Take given term]
[25.0] div2 == div(heapIs $heap_{funcstart\_724,1},
asType < int > (\$heap_{funcstart\_724,1}.p2),
asType < int > (\$heap_{funcstart\_724,1}.a2))
\rightarrow [simplify]
[25.1] \ \mathrm{div2} == \mathrm{div}(\mathbf{heapIs} \ \$ \mathrm{heap}_{funcstart\_724,1}, \ \$ \mathrm{heap}_{funcstart\_724,1}.\mathrm{p2},
asType < int > (\$heap_{funcstart\_724,1}.a2))
\rightarrow [const static or extern object]
[25.2] div2 == div(heapIs $heap_{funcstart\_724.1}, $heap_{funcstart\_724.1}.p2,
asType < int > (\$heap_{init}.a2))
\rightarrow [expand definition of constant 'a2' at prang.c (21,20)]
[25.3] \operatorname{div2} == \operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.p2,
asType<int>(asType<short int>((int)176)))
\rightarrow [simplify]
[25.6] div2 == div(heapIs \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, p2, 176)
[Assume known post-assertion, class invariant or type constraint for term 25.6]
[28.0] (asType<integer>($heap_{funcstart\_724,1}.p2) /
asType<integer>(176)) == asType<integer>(div(heapIs
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.p2, 176).quot
\rightarrow [simplify]
[28.2] ($heap<sub>funcstart_724,1.</sub>p2 / 176) == asType<integer>(div(heapIs)
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.p2, 176).quot)
→ [expand definition of operator './' in class 'int' at built in declaration]
[28.3] ([asType<integer>(sheap_{funcstart\_724.1}.p2) < 0]:
```

```
-(-asType < integer > (\$heap_{funcstart\_724,1}.p2) / 176), []:
asType < integer > (\$heap_{funcstart\_724,1}.p2) / 176) = =
\mathbf{asType} {<} \mathbf{integer} {>} ( \mathbf{div} (\mathbf{heapIs} \ \$ \mathbf{heap}_{funcstart\_724,1}, \ \$ \mathbf{heap}_{funcstart\_724,1}. \mathbf{p2}, \\
176).quot)
→ [explicitly assert falsehood of skipped guards in subsequent guards]
[28.4] ([asType<integer>(heap_{funcstart\_724,1}.p2) < 0]:
-(-asType < integer > (\$heap_{funcstart\_724,1}.p2) / 176),
[!(asType < integer > (\$heap_{funcstart\_724,1}.p2) < 0)]:
asType < integer > (\$heap_{funcstart\_724,1}.p2) / 176) = =
asType<integer>(div(heapIs $heap_funcstart_724,1, $heap_funcstart_724,1.p2,
176).quot)
\rightarrow [simplify]
[28.7] ([0 < -$heap<sub>funcstart_724,1</sub>.p2]:
-(-asType < integer > (\$heap_{funcstart\_724,1}.p2) / 176),
[!(asType < integer > (\$heap_{funcstart\_724,1}.p2) < 0)]:
asType < integer > (\$heap_{funcstart\_724,1}.p2) / 176) = =
asType<integer>(div(heapIs heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p2,
176).quot)
\rightarrow [from term 9.0, literala < -$heap<sub>funcstart_724,1</sub>.p2 is false whenever -2 < (0
+ literala)
   Proof of rule precondition:
   [28.7.0] - 2 < (0 + 0)
   \rightarrow [simplify]
   [28.7.2] true
[28.8] \; ([\mathbf{false}]: \; -(-\mathbf{asType} < \mathbf{integer} > (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p2}) \; / \; 176),
[!(asType < integer > (\$heap_{funcstart\_724,1}.p2) < 0)]:
asType < integer > (\$heap_{funcstart\_724,1}.p2) / 176) ==
asType < integer > (div(heapIs \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p2,
176).quot)
\rightarrow [simplify]
[28.11] ([false]: -(-asType < integer > (\$heap_{funcstart\_724,1}.p2) / 176), [!(0 <
-\$heap_{funcstart\_724,1}.p2)]: \ \mathbf{asType} < \mathbf{integer} > (\$heap_{funcstart\_724,1}.p2) \ / \ 176)
== asType < integer > (div(heapIs $heap_{funcstart\_724,1},
heap_{funcstart_{-724,1}.p2, 176}.quot)
\rightarrow [from term 9.0, literala < -$heap<sub>funcstart_724,1</sub>.p2 is false whenever -2 < (0
+ literala)]
   Proof of rule precondition:
   [28.11.0] - 2 < (0 + 0)
   \rightarrow [simplify]
```

```
[28.11.2] true
[28.12] ([false]: -(-asType < integer > (\$heap_{funcstart\_724,1}.p2) / 176),
[!false]: asType<integer>($heap<sub>funcstart_724,1.</sub>p2) / 176) ==
\mathbf{asType} < \mathbf{integer} > (\mathbf{div}(\mathbf{heapIs} \ \$ \mathbf{heap}_{funcstart\_724,1}, \ \$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p2}, \\
176).quot)
\rightarrow [simplify]
[28.17] 0 == (-div(heapIs \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}.p2,
176).quot + ({\rm \$heap}_{funcstart\_724,1}.p2 / 176))
[Assume known post-assertion, class invariant or type constraint for term
28.17]
[35.0] div(heapIs heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p2, 176).quot \leq
maxof(int)
\rightarrow [simplify]
[35.9] \ -32768 < -{\rm div}(\mathbf{heapIs} \ \$ \mathrm{heap}_{funcstart\_724,1}, \ \$ \mathrm{heap}_{funcstart\_724,1}.\mathrm{p2},
176).quot
[Take goal term]
[1.0] asType<short int>(div2.quot) \leq maxof(int)
\rightarrow [from term 25.6, div2 is equal to div(heapIs $heap_{funcstart\_724,1},
heap_{funcstart_{724,1},p2,176}
[1.1] asType<short int>(div(heapIs heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1}.\text{p2}, 176).\text{quot} \leq \text{maxof(int)}
\rightarrow [simplify]
[1.11] -32768 < -\text{div}(\text{heapIs } \text{$heap}_{funcstart\_724,1}, \text{$heap}_{funcstart\_724,1}.\text{p2},
176).quot
\rightarrow [from term 35.9, literala < -div(\mathbf{heapIs} \ \$heap_{funcstart\_724,1},
\rho_{funcstart_{-724,1},p2,176}, quot is true whenever (-1 + literala) < -32768
    Proof of rule precondition:
    [1.11.0](-32768 + -1) < -32768
    \rightarrow [simplify]
    [1.11.2] true
[1.12] true
```

**Proof of verification condition:** Type constraint satisfied in implicit conversion from 'short int const' to 'int'

Condition generated at: C:\Escher\Customers\prang\prang.c (58,35)
Condition defined at:

```
To prove: minof(int) \le \$heap_{724,1:740.8}.b2
Given:
heap_{init}.LIMIT == (int)80
heap_{init}.M1 == asType < short int > ((int)30269)
\theta_{init}.r1 == asType < short int > ((int)171)
heap_{init}.a1 == asType < short int > ((int)177)
\theta
heap_{init}.M2 == asType < short int > ((int)30307)
\theta_{init}.r2 == asType<short int>((int)172)
heap_{init}.a2 == asType < short int > ((int)176)
\theta sheap<sub>init</sub>.b2 == asType<short int>((int)35)
\theta = asType < short int > ((int)30323)
heap_{init}.r3 == asType < short int > ((int)170)
heap_{init}.a3 == asType < short int > ((int)178)
\theta = asType < short int > ((int)63)
\theta = asType < short int > ((int)1)
\theta
\theta = asType < short int > ((int)3)
invariant1(heapIs heap_{funcstart\_724,1})
\operatorname{div1} == \operatorname{div}(\mathbf{heapIs} \ \operatorname{\$heap}_{funcstart\_724,1},
asType < int > (\$heap_{funcstart\_724,1}.p1),
asType < int > (\$heap_{funcstart\_724,1}.a1))
(\mathbf{asType}{<}\mathbf{integer}{>}(\mathbf{asType}{<}\mathbf{int}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{p1})) \ / \\
\mathbf{asType}{<}\mathbf{integer}{>}(\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{a1}))) = =
asType<integer>(div1.quot)
(asType<integer>(asType<int>($heap_{tuncstart\_724.1}.p1)) %
\mathbf{asType}{<}\mathbf{integer}{>}(\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{a1}))) ==
asType<integer>(div1.rem)
!(0 == asType < integer > (div1.rem)) || !(0 ==
asType<integer>(div1.quot))
div2 == div(\mathbf{heapIs} \$ heap_{funcstart\_724,1},
asType < int > (\$heap_{funcstart\_724,1}.p2),
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{a2}))
(\mathbf{asType} < \mathbf{integer} > (\mathbf{asType} < \mathbf{int} > (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p2})) \ / \\
\mathbf{asType}{<}\mathbf{integer}{>}(\mathbf{asType}{<}\mathbf{int}{>}(\$\mathbf{heap}_{funcstart\_724,1}.\mathbf{a2}))) = =
asType<integer>(div2.quot)
```

```
(asType < integer > (asType < int > (\$heap_{funcstart\_724.1}.p2)) \%
\mathbf{asType} < \mathbf{integer} > (\mathbf{asType} < \mathbf{int} > (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{a2}))) = =
asType<integer>(div2.rem)
!(0 == asType < integer > (div2.rem)) || !(0 ==
asType<integer>(div2.quot))
div3 == div(\mathbf{heapIs} \$ heap_{funcstart\_724,1},
\mathbf{asType} < \mathbf{int} > (\$ \mathrm{heap}_{funcstart\_724,1}.\mathrm{p3}),
asType < int > (\$heap_{funcstart\_724,1}.a3))
(\mathbf{asType} < \mathbf{integer} > (\mathbf{asType} < \mathbf{int} > (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p3})) \ / \\
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a3))) = =
asType<integer>(div3.quot)
(\mathbf{asType} < \mathbf{integer} > (\mathbf{asType} < \mathbf{int} > (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p3})) \%
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a3))) = =
asType<integer>(div3.rem)
!(0 == asType < integer > (div3.rem)) || !(0 ==
asType<integer>(div3.quot))
heap_{724,1;740,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow asType<short
int>((asType<int>(asType<short int>(div1.rem)) *
asType < int > (\$heap_{funcstart\_724,1}.r1)) - (asType < int > (asType < short)
\mathbf{int}{>}(\mathbf{div1.quot})) * \mathbf{asType}{<} \mathbf{int}{>} (\$\mathbf{heap}_{funcstart\_724,1}.\mathbf{b1}))))
-asType<integer const>($heap<sub>724.1:740.8</sub>.M1) <
asType<integer>($heap<sub>724,1:740,8</sub>.p1)
!(0 == asType < integer > (\$heap_{724,1;740,8}.p1))
asType<integer>($heap<sub>724,1;740,8</sub>.p1) <
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathrm{heap}_{724,1;740,8}.\mathrm{M1})
Proof:
[Take given term]
[11.0] div1 == div(heapIs heap_{funcstart\_724,1},
asType < int > (\$heap_{funcstart\_724,1}.p1),
asType < int > (\$heap_{funcstart\_724,1}.a1))
\rightarrow [simplify]
[11.1] \operatorname{div1} == \operatorname{div}(\mathbf{heapIs} \operatorname{\$heap}_{funcstart\_724,1}, \operatorname{\$heap}_{funcstart\_724,1}.p1,
asType < int > (\$heap_{funcstart\_724,1}.a1))
\rightarrow [const static or extern object]
\label{eq:linear_lambda} \textit{[11.2]} \ \text{div1} == \text{div}(\mathbf{heapIs} \ \$ \text{heap}_{funcstart\_724,1}, \ \$ \text{heap}_{funcstart\_724,1}.\text{p1},
asType < int > (\$heap_{init}.a1))
\rightarrow [expand definition of constant 'a1' at prang.c (16,20)]
 [11.3] \ \mathrm{div1} == \mathrm{div}(\mathbf{heapIs} \ \$ \mathrm{heap}_{funcstart\_724,1}, \ \$ \mathrm{heap}_{funcstart\_724,1}.\mathrm{p1}, \\
```

```
asType<int>(asType<short int>((int)177)))
\rightarrow [simplify]
[11.6] div1 == div(heapIs $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}.p1, 177)
[Take given term]
[53.0] \rho_{13,1;740,8} == \rho_{13,1;740,8} == \rho_{13,1;740,8} =- \rho_{
int>((asType<int>(asType<short int>(div1.rem)) *
asType < int > (\$heap_{funcstart\_724,1}.r1)) - (asType < int > (asType < short)
int>(div1.quot)) * asType< int>($heap_{tuncstart\_724.1}.b1))))
\rightarrow [from term 11.6, div1 is equal to div(heapIs $heap_{funcstart_{724,1}},
heap_{funcstart_{-724,1}}.p1, 177)
[53.1] \theta == 
int>((asType<int>(asType<short int>(div(heapIs $heap_{tuncstart\_724.1},
\text{sheap}_{funcstart\_724.1}.\text{p1}, 177).\text{rem}) * asType < int > (\text{sheap}_{funcstart\_724.1}.\text{r1})) -
(asType<int>(asType<short int>(div1.quot)) *
asType < int > (\$heap_{funcstart\_724,1}.b1))))
\rightarrow [simplify]
[53.3] \theta == 
int>((div(heapIs \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1, 177).rem *
asType < int > (\$heap_{funcstart\_724,1}.r1)) - (asType < int > (asType < short)
\mathbf{int}{>}(\mathbf{div1.quot})) \ * \ \mathbf{asType}{<} \mathbf{int}{>} (\$\mathbf{heap}_{funcstart\_724,1}.\mathbf{b1}))))
\rightarrow [const static or extern object]
[53.4] heap_{724,1;740,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow asType<short
int>((div(heapIs \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1, 177).rem *
asType < int > (\$heap_{init}.r1)) - (asType < int > (asType < short)
int>(div1.quot)) * asType< int>($heap_{tuncstart\_724.1}.b1))))
\rightarrow [expand definition of constant 'r1' at prang.c (15,20)]
[53.5] \rho_{13,1;740,8} == \rho_{13,1;740,8} == \rho_{13,1;740,8} =- \rho_{
int>((div(heapIs \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1, 177).rem *
asType<int>(asType<short int>((int)171))) -
(asType<int>(asType<short int>(div1.quot)) *
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{b1}))))
\rightarrow [simplify]
[53.8] \text{sheap}_{724,1;740,8} == \text{sheap}_{funcstart\_724,1}.\_\text{replace}(\text{p1} \rightarrow \text{asType} < \text{short})
int>((div(heapIs \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1, 177).rem * 171)
- (asType<int>(asType<short int>(div1.quot)) *
asType < int > (\$heap_{funcstart\_724,1}.b1))))
\rightarrow [from term 11.6, div1 is equal to div(heapIs $heap_{funcstart_724,1},
heap_{funcstart_{-724,1}}.p1, 177)
[53.9] heap_{724,1;740,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow asType<short
```

```
int>((171 * div(heapIs \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1, 177).rem)
- (asType<int>(asType<short int>(div(heapIs $heap_{funcstart_724,1},))
heap_{funcstart_{724,1}}.p1, 177).quot) *
asType < int > (\$heap_{funcstart\_724,1}.b1))))
\rightarrow [simplify]
[53.11] \theta == 
int>((171 * div(heapIs $heap_{funcstart_724,1}, $heap_{funcstart_724,1}.p1, 177).rem)
- (\text{div}(\mathbf{heapIs} \$ \text{heap}_{funcstart\_724,1}, \$ \text{heap}_{funcstart\_724,1}.\text{p1}, 177).\text{quot} *
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{b1}))))
\rightarrow [const static or extern object]
[53.12] $\text{heap}_{724.1:740.8} == $\text{heap}_{funcstart\_724.1}._\text{replace}(p1 \rightarrow \text{asType} < \text{short}
int>((171 * div(heapIs \$heap_{funcstart\_724.1}, \$heap_{funcstart\_724.1}, p1, 177).rem)
- (\text{div}(\mathbf{heapIs} \$ \text{heap}_{funcstart\_724,1}, \$ \text{heap}_{funcstart\_724,1}.\text{p1}, 177).\text{quot} *
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{init}.\mathrm{b1}))))
\rightarrow [expand definition of constant 'b1' at prang.c (17,20)]
[53.13] heap_{724,1;740,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow asType<short
int>((171 * div(heapIs \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1, 177).rem)
- (div(heapIs heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p1, 177).quot *
asType < int > (asType < short int > ((int)2))))
\rightarrow [simplify]
[53.19] heap_{724,1;740,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).rem)))
[Take goal term]
[1.0] minof(int) \leq $heap<sub>724,1;740,8</sub>.b2
\rightarrow [simplify]
[1.1] -32768 < $\text{heap}_{724} \dagger_{1.740} \dagger_8.\text{b2}
\rightarrow [from term 53.19, $heap<sub>724,1:740,8</sub> is equal to
heap_{funcstart\_724,1}._replace(p1 \rightarrow (-2 * div(heapIs $heap_{funcstart\_724,1},
heap_{funcstart\_724,1}.p1, 177).quot + (171 * div(heapIs $heap_{funcstart\_724,1}, 177).quot) + (171 * div(heapIs $heap_{funcstart\_724,1}, 17
$heap_{funcstart\_724,1}.p1, 177).rem))]
[1.2] -32768 \leq $heap<sub>funcstart_724,1</sub>._replace(p1 \rightarrow ((-2 * div(heapIs)
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.\text{p1}, 177).\text{quot}) + (171 * \text{div}(\textbf{heapIs}))
\$ \mathrm{heap}_{funcstart\_724,1},\,\$ \mathrm{heap}_{funcstart\_724,1}.\mathrm{p1},\,177).\mathrm{rem}))).\mathrm{b2}
\rightarrow [const member of object with modified fields]
[1.3] -32768 \le \text{$heap}_{funcstart\_724.1}.b2
\rightarrow [const static or extern object]
[1.4] -32768 \le \text{$heap}_{init}.b2
```

```
\rightarrow [expand definition of constant 'b2' at prang.c (22,20)]
[1.5] -32768 \leq asType<short int>((int)35)
\rightarrow [simplify]
[1.8] true
Proof of verification condition: Type constraint satisfied in implicit
conversion from 'short int const' to 'int'
Condition generated at: C:\Escher\Customers\prang\prang.c (58,35)
Condition defined at:
To prove: heap_{724.1:740.8}.b2 \le maxof(int)
Given:
heap_{init}.LIMIT == (int)80
heap_{init}.M1 == asType < short int > ((int)30269)
\theta_{init}.r1 == asType < short int > ((int)171)
heap_{init}.a1 == asType < short int > ((int)177)
\theta
heap_{init}.M2 == asType < short int > ((int)30307)
\theta_{init}.r2 == asType < short int > ((int)172)
\theta
\theta sheap<sub>init</sub>.b2 == asType<short int>((int)35)
heap_{init}.M3 == asType < short int > ((int)30323)
heap_{init}.r3 == asType < short int > ((int)170)
heap_{init}.a3 == asType < short int > ((int)178)
\theta = asType < short int > ((int)63)
\theta = asType < short int > ((int)1)
\theta
\theta = asType < short int > ((int)3)
invariant1(heapIs heap_{funcstart_{-724,1}})
\operatorname{div1} == \operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724,1},
asType < int > (\$heap_{funcstart\_724.1}.p1),
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{a1}))
(asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.p1)) /
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a1))) = =
asType<integer>(div1.quot)
```

```
(asType < int > (asType < int > (\$heap_{funcstart\_724,1}.p1)) \%
\mathbf{asType} < \mathbf{integer} > (\mathbf{asType} < \mathbf{int} > (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{a1}))) = =
asType<integer>(div1.rem)
!(0 == asType < integer > (div1.rem)) || !(0 ==
asType < integer > (div1.quot))
div2 == div(\mathbf{heapIs} \$ heap_{funcstart\_724,1},
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p2}),
asType < int > (\$heap_{funcstart\_724,1}.a2))
(\mathbf{asType} < \mathbf{integer} > (\mathbf{asType} < \mathbf{int} > (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p2})) \ / \\
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a2))) = =
asType<integer>(div2.quot)
(asType < integer > (asType < int > (\$heap_{funcstart\_724.1}.p2)) \%
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a2))) = =
asType<integer>(div2.rem)
!(0 == asType < integer > (div2.rem)) || !(0 ==
asType < integer > (div2.quot))
div3 == div(\mathbf{heapIs} \$ heap_{funcstart\_724,1},
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p3}),
asType < int > (\$heap_{funcstart\_724,1}.a3))
(\mathbf{asType} < \mathbf{integer} > (\mathbf{asType} < \mathbf{int} > (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p3})) \ / \\
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a3))) = =
asType<integer>(div3.quot)
(\mathbf{asType} < \mathbf{integer} > (\mathbf{asType} < \mathbf{int} > (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p3})) \%
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a3))) = =
asType<integer>(div3.rem)
!(0 == asType < integer > (div3.rem)) || !(0 ==
asType<integer>(div3.quot))
heap_{724,1:740.8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow asType<short
int>((asType<int>(asType<short int>(div1.rem)) *
asType < int > (\$heap_{funcstart\_724,1}.r1)) - (asType < int > (asType < short)
int>(div1.quot)) * asType< int>($heap_{funcstart\_724,1}.b1))))
-asType<integer const>($heap<sub>724.1:740.8</sub>.M1) <
asType<integer>($heap<sub>724.1:740.8</sub>.p1)
!(0 == asType < integer > (\$heap_{724,1:740,8}.p1))
asType<integer>($heap<sub>724.1:740.8</sub>.p1) <
asType<integer>($heap<sub>724,1;740,8</sub>.M1)
Proof:
[Take given term]
[11.0] \operatorname{div1} == \operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724,1},
```

```
\mathbf{asType} < \mathbf{int} > (\$ \mathrm{heap}_{funcstart\_724,1}.\mathrm{p1}),
asType < int > (\$heap_{funcstart\_724,1}.a1))
\rightarrow [simplify]
[11.1] \ \mathrm{div1} == \mathrm{div}(\mathbf{heapIs} \ \$ \mathrm{heap}_{funcstart\_724,1}, \ \$ \mathrm{heap}_{funcstart\_724,1}.\mathrm{p1},
asType < int > (\$heap_{funcstart\_724,1}.a1))
\rightarrow [const static or extern object]
[11.2] div1 == div(heapIs heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p1,
asType < int > (\$heap_{init}.a1))
\rightarrow [expand definition of constant 'a1' at prang.c (16,20)]
[11.3] \operatorname{div1} == \operatorname{div}(\mathbf{heapIs} \operatorname{\$heap}_{funcstart\_724,1}, \operatorname{\$heap}_{funcstart\_724,1}.p1,
asType<int>(asType<short int>((int)177)))
\rightarrow [simplify]
[11.6] \text{ div1} == \text{div}(\mathbf{heapIs} \$ heap_{funcstart\_724,1}, \$ heap_{funcstart\_724,1}.p1, 177)
[Take given term]
[53.0] \rho_{1740,8} == \rho_{1740
int>((asType< int>(asType< short int>(div1.rem)) *
asType < int > (\$heap_{funcstart\_724,1}.r1)) - (asType < int > (asType < short)
int>(div1.quot)) * asType< int>($heap_{funcstart\_724,1}.b1))))
\rightarrow [from term 11.6, div1 is equal to div(heapIs $heap_{tuncstart_724.1},
heap_{funcstart_{-724,1}}.p1, 177)
[53.1] \theta == 
int>((asType<int>(asType<short int>(div(heapIs $heap_{funcstart\_724,1},
\rho_{tuncstart\_724,1.p1, 177}.rem) * asType < int > (\rho_{tuncstart\_724,1.r1}) - (\rho_{tuncstart\_724,1.r1}
(asType<int>(asType<short int>(div1.quot)) *
asType < int > (\$heap_{funcstart\_724,1}.b1))))
\rightarrow [simplify]
[53.3] heap_{724,1:740,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow asType<short
int>((div(heapIs \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1, 177).rem *
asType < int > (\$heap_{funcstart\_724,1}.r1)) - (asType < int > (asType < short)
int>(div1.quot)) * asType< int>($heap_{funcstart\_724,1}.b1))))
\rightarrow [const static or extern object]
[53.4] heap_{724,1;740,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow asType<short
int>((div(heapIs \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1, 177).rem *
asType < int > (\$heap_{init}.r1)) - (asType < int > (asType < short)
int>(div1.quot)) * asType< int>($heap_{funcstart\_724,1}.b1))))
\rightarrow [expand definition of constant 'r1' at prang.c (15,20)]
\text{[53.5] \$heap}_{724,1;740,8} == \$heap_{funcstart\_724,1}.\_\textbf{replace}(p1 \rightarrow \textbf{asType} < \textbf{short}
int>((div(heapIs \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1, 177).rem *
```

```
asType<int>(asType<short int>((int)171))) -
(asType<int>(asType<short int>(div1.quot)) *
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{b1}))))
\rightarrow [simplify]
[53.8] heap_{724,1;740,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow asType<short
int>((div(heapIs \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1, 177).rem * 171)
- (asType<int>(asType<short int>(div1.quot))
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{b1}))))
\rightarrow [from term 11.6, div1 is equal to div(heapIs $heap_{funcstart_{-724,1}},
heap_{funcstart_{724,1}}.p1, 177
[53.9] heap_{724,1:740.8} == heap_{funcstart\_724,1}-replace(p1 \rightarrow asType<short
int>((171 * div(heapIs \$heap_{funcstart\_724.1}, \$heap_{funcstart\_724.1}, p1, 177).rem)
- (asType<int>(asType<short int>(div(heapIs $heap_{funcstart\_724,1},))
heap_{funcstart_{724,1},p1,177}, quot)) *
asType < int > (\$heap_{funcstart\_724,1}.b1)))
\rightarrow [simplify]
[53.11] \theta_{13} = \theta_
int>((171 * div(heapIs $heap_{funcstart\_724,1}, $heap_{funcstart\_724,1}.p1, 177).rem)
- (\text{div}(\mathbf{heapIs} \$ \text{heap}_{funcstart\_724,1}, \$ \text{heap}_{funcstart\_724,1}.\text{p1}, 177).\text{quot} *
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{b1}))))
\rightarrow [const static or extern object]
[53.12] $\text{heap}_{724.1:740.8} == $\text{heap}_{funcstart\_724.1}._\text{replace}(p1 \rightarrow \text{asType} < \text{short}
int>((171 * div(heapIs \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1, 177).rem)
- (\text{div}(\mathbf{heapIs} \$ \text{heap}_{funcstart\_724,1}, \$ \text{heap}_{funcstart\_724,1}.\text{p1}, 177).\text{quot} *
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{init}.\mathrm{b1}))))
\rightarrow [expand definition of constant 'b1' at prang.c (17,20)]
[53.13] heap_{724,1;740,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow asType<short
int>((171 * div(heapIs $heap_{funcstart\_724,1}, $heap_{funcstart\_724,1}.p1, 177).rem)
- (\text{div}(\mathbf{heapIs} \$ \text{heap}_{funcstart\_724,1}, \$ \text{heap}_{funcstart\_724,1}.\text{p1}, 177).\text{quot} *
asType<int>(asType<short int>((int)2))))
\rightarrow [simplify]
[53.19] heap_{724,1;740,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).rem)))
[Take goal term]
[1.0] $heap<sub>724.1:740.8</sub>.b2 \leq maxof(int)
\rightarrow [from term 53.19, $heap<sub>724,1:740,8</sub> is equal to
heap_{funcstart\_724,1}._replace(p1 \rightarrow (-2 * div(heapIs heap_{funcstart\_724,1}),
\text{Sheap}_{funcstart\_724,1}.p1, 177).quot) + (171 * div(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
```

```
heap_{funcstart_{-724,1}.p1, 177).rem}
[1.1] \text{sheap}_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 * div(heapIs
\$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1, 177).quot) + (171 * div(\textbf{heapIs}) + (171 * div(\textbf{heapIs})) + (171
\$ heap_{funcstart\_724,1}, \$ heap_{funcstart\_724,1}.p1, 177).rem))).b2 \leq \mathbf{maxof(int)}
→ [const member of object with modified fields]
[1.2] $\text{heap}_{funcstart_724,1}.\text{b2} \leq \text{maxof(int)}
\rightarrow [const static or extern object]
[1.3] $heap<sub>init</sub>.b2 \leq maxof(int)
\rightarrow [expand definition of constant 'b2' at prang.c (22,20)]
[1.4] asType<short int>((int)35) \le maxof(int)
\rightarrow [simplify]
[1.8] true
Proof of verification condition: Arithmetic result of operator '*' is within
limit of type 'int'
Condition generated at: C:\Escher\Customers\prang\prang.c (58,38)
Condition defined at:
To prove: minof(int) \le (asType<int>(asType<short int>(div2.quot)) *
asType<int>($heap<sub>724.1:740.8</sub>.b2))
Given:
heap_{init}.LIMIT == (int)80
\theta sheap<sub>init</sub>.M1 == asType<short int>((int)30269)
\theta_{init}.r1 == asType < short int > ((int)171)
heap_{init}.a1 == asType < short int > ((int)177)
\theta = asType < short int > ((int)2)
\theta sheap<sub>init</sub>.M2 == asType<short int>((int)30307)
\theta_{init}.r2 == asType<short int>((int)172)
heap_{init}.a2 == asType < short int > ((int)176)
heap_{init}.b2 == asType < short int > ((int)35)
heap_{init}.M3 == asType < short int > ((int)30323)
\theta_{init}.r3 == asType<short int>((int)170)
heap_{init}.a3 == asType<short int>((int)178)
\theta = asType < short int > ((int)63)
\theta = asType < short int > ((int)1)
```

```
\rho_{init}.p2 == asType < short int > ((int)2)
\theta = asType < short int > ((int)3)
invariant1(heapIs heap_{funcstart\_724.1})
div1 == div(\mathbf{heapIs} \$heap_{funcstart\_724,1},
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p1}),
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{a1}))
(asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.p1)) /
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a1))) = =
asType<integer>(div1.quot)
(asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.p1)) \%
\mathbf{asType} < \mathbf{integer} > (\mathbf{asType} < \mathbf{int} > (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{a1}))) = =
asType<integer>(div1.rem)
!(0 == asType < integer > (div1.rem)) || !(0 ==
asType<integer>(div1.quot))
div2 == div(\mathbf{heapIs} \$heap_{funcstart\_724,1},
asType < int > (\$heap_{funcstart\_724,1}.p2),
asType < int > (\$heap_{funcstart\_724,1}.a2))
(asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.p2)) /
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a2))) = =
asType<integer>(div2.quot)
(\mathbf{asType} {<} \mathbf{integer} {>} (\mathbf{asType} {<} \mathbf{int} {>} (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p2})) \ \%
\mathbf{asType}{<}\mathbf{integer}{>}(\mathbf{asType}{<}\mathbf{int}{>}(\$\mathbf{heap}_{funcstart\_724,1}.\mathbf{a2}))) = =
asType<integer>(div2.rem)
!(0 == asType < integer > (div2.rem)) || !(0 ==
asType<integer>(div2.quot))
div3 == div(\mathbf{heapIs} \$ heap_{funcstart\_724,1},
asType < int > (\$heap_{funcstart\_724,1}.p3),
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{a3}))
(asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.p3)) /
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a3))) = =
asType<integer>(div3.quot)
(\mathbf{asType} {<} \mathbf{integer} {>} (\mathbf{asType} {<} \mathbf{int} {>} (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p3})) \ \%
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a3))) = =
asType<integer>(div3.rem)
!(0 == asType < integer > (div3.rem)) || !(0 ==
asType<integer>(div3.quot))
\text{Sheap}_{724,1;740,8} == \text{Sheap}_{funcstart\_724,1}.\_\mathbf{replace}(\text{p1} \to \mathbf{asType} < \mathbf{short})
int>((asType<int>(asType<short int>(div1.rem)) *
asType < int > (\$heap_{funcstart\_724,1}.r1)) - (asType < int > (asType < short)
```

```
\mathbf{int}{>}(\mathbf{div1.quot})) \ * \ \mathbf{asType}{<} \mathbf{int}{>} (\$\mathbf{heap}_{funcstart\_724,1}.\mathbf{b1}))))
-asType < integer const > (\$heap_{724,1:740.8}.M1) < 1
asType<integer>($heap<sub>724.1:740.8</sub>.p1)
!(0 == asType < integer > (\$heap_{724,1;740,8}.p1))
asType<integer>($heap<sub>724,1:740,8</sub>.p1) <
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathrm{heap}_{724,1;740,8}.\mathrm{M1})
Proof:
[Take given term]
[5.0] invariant1(heapIs heap_{funcstart\_724,1})
\rightarrow [expand definition of function 'invariant1' at prang.c (34,1)]
[5.1] ((((((0 < asType < integer > ($heap_{funcstart\_724,1}.p1)) &&
(\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{p1}) <
asType < integer > (\$heap_{funcstart\_724,1}.M1))) \&\& (0 <
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p2})))\ \&\&
(asType<integer>($heap_funcstart_724.1.p2) <
as
Type<integer>(\rho_{funcstart\_724,1}.M2))) & (0 <
asType < integer > (\$heap_{funcstart\_724,1}.p3))) \&\&
(\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{p3}) <
asType < integer > (\$heap_{funcstart\_724,1}.M3))
\rightarrow [simplify]
[5.3] \ (((((0 < \text{\$heap}_{funcstart\_724,1}.p1) \&\& \ (\text{\$heap}_{funcstart\_724,1}.p1 < (
as
Type<integer>(\rho_{funcstart\_724,1}.M1))) & (0 <
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p2})))\ \&\&
(asType<integer>($heap_funcstart_724.1.p2) <
asType < integer > (\$heap_{tuncstart\_724.1}.M2))) \&\& (0 <
asType < integer > (\$heap_{funcstart\_724,1}.p3))) \&\&
(\mathbf{asType} < \mathbf{integer} > (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p3}) <
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{M3}))
\rightarrow [const static or extern object]
[5.4] \; (((((0 < \$heap_{funcstart\_724,1}.p1) \&\& \; (\$heap_{funcstart\_724,1}.p1 <
asType < integer > (\$heap_{init}.M1))) \&\& (0 <
asType < integer > (\$heap_{funcstart\_724,1}.p2))) \&\&
(asType < integer > (\$heap_{funcstart\_724,1}.p2) < 
asType < integer > (\$heap_{funcstart\_724,1}.M2))) \&\& (0 <
asType < integer > (\$heap_{funcstart\_724,1}.p3))) \&\&
(asType<integer>($heap_{tuncstart\_724,1}.p3) <
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{M3}))
\rightarrow [expand definition of constant 'M1' at prang.c (14,20)]
[5.5] (((((0 < $heap_{funcstart_{724,1}}.p1) && ($heap_{funcstart_{724,1}}.p1 < ])
asType<integer>(asType<short int>((int)30269)))) && (0 <
```

```
asType < integer > (\$heap_{funcstart\_724,1}.p2))) \&\&
(\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{p2}) <
\mathbf{asType} {<} \mathbf{integer} {>} (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{M2}))) \ \&\& \ (0 <
asType < integer > (\$heap_{funcstart\_724,1}.p3))) \&\&
(\mathbf{asType} < \mathbf{integer} > (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p3}) <
asType<integer>($heap_funcstart_724,1.M3))
\rightarrow [simplify]
[5.16] \; ((((-30269 < -\$heap_{funcstart\_724,1}.p1) \; \land \; (0 < \$heap_{funcstart\_724,1}.p1) \; \land 
(0 < \text{$heap}_{funcstart\_724,1}.p2)) \&\& (\text{$heap}_{funcstart\_724,1}.p2 <
asType < integer > (\$heap_{funcstart\_724,1}.M2))) \&\& (0 <
asType < integer > (\$heap_{funcstart\_724,1}.p3))) \&\&
(\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{p3}) <
asType < integer > (\$heap_{funcstart\_724,1}.M3))
\rightarrow [const static or extern object]
[5.17] \left( \left( \left( \left( -30269 < -\$ \text{heap}_{funcstart\_724,1}.\text{p1} \right) \right. \wedge \left. \left( 0 < \$ \text{heap}_{funcstart\_724,1}.\text{p1} \right) \right. \wedge \right. \right)
(0 < \text{\$heap}_{funcstart\_724,1}.p2)) \&\& (\text{\$heap}_{funcstart\_724,1}.p2 <
asType < integer > (\$heap_{init}.M2))) \&\& (0 <
asType < integer > (\$heap_{funcstart\_724,1}.p3))) \&\&
(asType < integer > (\$heap_{funcstart_{-724,1}}.p3) < 
asType < integer > (\$heap_{funcstart\_724,1}.M3))
\rightarrow [expand definition of constant 'M2' at prang.c (19,20)]
[5.18] ((((-30269 < -$heap_{funcstart\_724,1}.p1) \lambda (0 < $heap_{funcstart\_724,1}.p1) \lambda
(0 < \text{\$heap}_{funcstart\_724,1}.p2)) \&\& (\text{\$heap}_{funcstart\_724,1}.p2 <
asType<integer>(asType<short int>((int)30307)))) && (0 <
asType < integer > (\$heap_{funcstart\_724,1}.p3))) \&\&
(asType < integer > (\$heap_{funcstart\_724,1}.p3) < 
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{M3}))
\rightarrow [simplify]
[5.30] ((-30307 < -\$heap_{funcstart\_724,1}.p2) \land (-30269 <
-\$heap_{funcstart\_724,1}.p1) \land (0 < \$heap_{funcstart\_724,1}.p1) \land (0 < \$heap_{funcstart\_724,1}.p1)
\text{Sheap}_{funcstart_{-724,1}.p2} \land (0 < \text{Sheap}_{funcstart_{-724,1}.p3})) \&\&
(\text{\$heap}_{funcstart\_724,1}.p3 < asType < integer > (\text{\$heap}_{funcstart\_724,1}.M3))
\rightarrow [const static or extern object]
[5.31] ((-30307 < -$heap_funcstart_724,1.p2) \land (-30269 <
-\$heap_{funcstart\_724,1}.p1) \land (0 < \$heap_{funcstart\_724,1}.p1) \land (0 < \$heap_{funcstart\_724,1}.p1)
\text{Sheap}_{funcstart\_724,1.p2} \land (0 < \text{Sheap}_{funcstart\_724,1.p3})) \&\&
(\text{\$heap}_{funcstart\_724,1}.\text{p3} < \mathbf{asType} < \mathbf{integer} > (\text{\$heap}_{init}.\text{M3}))
\rightarrow [expand definition of constant 'M3' at prang.c (24,20)]
[5.32] ((-30307 < -$heap_funcstart_724,1.p2) \land (-30269 <
-\$heap_{funcstart\_724,1}.p1) \land (0 < \$heap_{funcstart\_724,1}.p1) \land (0 < \$heap_{funcstart\_724,1}.p1)
\text{Sheap}_{funcstart_{-724,1}.p2} \land (0 < \text{Sheap}_{funcstart_{-724,1}.p3})) \&\&
```

```
(\$heap_{funcstart\_724,1}.p3 < \mathbf{asType} < \mathbf{integer} > (\mathbf{asType} < \mathbf{short}
int > ((int)30323)))
\rightarrow [simplify]
[5.40] (-30323 < -$heap_{funcstart\_724,1}.p3) \land (-30307 <
-\$heap_{funcstart\_724,1}.p2) \land (-30269 < -\$heap_{funcstart\_724,1}.p1) \land (0 < -\$heap_{funcstart\_724,1}.p1)
\text{Sheap}_{funcstart\_724,1}.\text{p1}) \land (0 < \text{Sheap}_{funcstart\_724,1}.\text{p2}) \land (0 <
heap_{funcstart_{724,1}.p3}
[Work on sub-term 5 of conjunction in term 5.40]
\textit{[9.0] 0} < \$ heap_{funcstart\_724,1}.p2
[Take given term]
[11.0] div1 == div(heapIs heap_{funcstart\_724,1},
asType < int > (\$heap_{funcstart\_724,1}.p1),
asType < int > (\$heap_{funcstart\_724,1}.a1))
\rightarrow [simplify]
[11.1] \ \mathrm{div1} == \mathrm{div}(\mathbf{heapIs} \ \$ \mathrm{heap}_{funcstart\_724,1}, \ \$ \mathrm{heap}_{funcstart\_724,1}.\mathrm{p1},
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{a1}))
\rightarrow [const static or extern object]
[11.2] \ \mathrm{div1} == \mathrm{div}(\mathbf{heapIs} \ \$ \mathrm{heap}_{funcstart\_724,1}, \ \$ \mathrm{heap}_{funcstart\_724,1}.\mathrm{p1},
asType < int > (\$heap_{init}.a1))
\rightarrow [expand definition of constant 'a1' at prang.c (16,20)]
[11.3] \operatorname{div1} == \operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724,1}, \$ \operatorname{heap}_{funcstart\_724,1}.p1,
asType<int>(asType<short int>((int)177)))
\rightarrow [simplify]
[11.6] \text{ div1} == \text{div}(\text{heapIs } \text{$heap}_{funcstart\_724,1}, \text{$heap}_{funcstart\_724,1}.\text{p1}, 177)
[Take given term]
[25.0] div2 == div(heapIs $heap_{funcstart\_724,1},
asType < int > (\$heap_{funcstart\_724,1}.p2),
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{a2}))
\rightarrow [simplify]
[25.1]~{\rm div2} == {\rm div}(\mathbf{heapIs}~\$ \mathrm{heap}_{funcstart\_724,1},\,\$ \mathrm{heap}_{funcstart\_724,1}.\mathrm{p2},
asType < int > (\$heap_{funcstart\_724,1}.a2))
\rightarrow [const static or extern object]
[25.2] \operatorname{div2} == \operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.p2,
asType < int > (\$heap_{init}.a2))
\rightarrow [expand definition of constant 'a2' at prang.c (21,20)]
[25.3] \operatorname{div2} == \operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p2,
```

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asType<int>(asType<short int>((int)176)))
\rightarrow [simplify]
[25.6] div2 == div(heapIs $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}.p2, 176)
[Assume known post-assertion, class invariant or type constraint for term 25.6]
[28.0] (asType<integer>(peq_{funcstart\_724,1}.p2) /
asType<integer>(176)) == asType<integer>(div(heapIs
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.p2, 176).quot)
\rightarrow [simplify]
[28.2] ($heap<sub>funcstart_724,1.</sub>p2 / 176) == asType<integer>(div(heapIs)
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.p2, 176).quot)
→ [expand definition of operator './' in class 'int' at built in declaration]
[28.3] \; ([\mathbf{asType} < \mathbf{integer} > (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p2}) < 0] :
-(-\mathbf{asType} < \mathbf{integer} > (\$ heap_{funcstart\_724,1}.p2) \ / \ 176), \ []:
asType < integer > ($heap_{funcstart\_724,1}.p2) / 176) ==
asType<integer>(div(heapIs $heap_{tuncstart\_724.1}, $heap_{tuncstart\_724.1.p2},
→ [explicitly assert falsehood of skipped guards in subsequent guards]
[28.4] ([asType<integer>(sheap_{funcstart\_724,1}.p2) < 0]:
-(-asType < integer > (\$heap_{funcstart\_724,1}.p2) / 176),
[!(asType < integer > (\$heap_{funcstart\_724,1}.p2) < 0)]:
asType < integer > (\$heap_{funcstart\_724,1}.p2) / 176) ==
\mathbf{asType} < \mathbf{integer} > (\mathbf{div}(\mathbf{heapIs} \ \$ \mathbf{heap}_{funcstart\_724,1}, \ \$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p2}, \\
176).quot)
\rightarrow [simplify]
[28.7] ([0 < -$heap<sub>funcstart_724,1</sub>.p2]:
-(-asType < integer > (\$heap_{funcstart\_724,1}.p2) / 176),
[!(asType < integer > (\$heap_{funcstart\_724,1}.p2) < 0)]:
asType < integer > (\$heap_{funcstart\_724,1}.p2) / 176) ==
asType<integer>(div(heapIs heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p2,
176).quot)
\rightarrow [from term 9.0, literala < -$heap<sub>funcstart_724,1</sub>.p2 is false whenever -2 < (0
+ literala)]
   Proof of rule precondition:
   [28.7.0] - 2 < (0 + 0)
   \rightarrow [simplify]
   [28.7.2] true
\label{eq:continuous_section} \textit{[[false]: } -(-asType < integer > (\$heap_{funcstart\_724,1}.p2) \ / \ 176),
[!(asType < integer > (\$heap_{funcstart\_724,1}.p2) < 0)]:
```

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asType < integer > (\$heap_{funcstart\_724,1}.p2) / 176) ==
\mathbf{asType} < \mathbf{integer} > (\mathrm{div}(\mathbf{heapIs} \ \$ \mathrm{heap}_{funcstart\_724,1}, \ \$ \mathrm{heap}_{funcstart\_724,1}.\mathrm{p2},
176).quot)
\rightarrow [simplify]
[28.11] ([false]: -(-asType < integer > (\$heap_{funcstart\_724,1}.p2) / 176), [!(0 <
-\$heap_{funcstart\_724,1}.p2): asType<integer>(\$heap_{funcstart\_724,1}.p2) / 176)
== asType < integer > (div(heapIs $heap_{funcstart\_724,1},
heap_{funcstart_{-724,1}}.p2, 176).quot
\rightarrow [from term 9.0, literala < -$heap<sub>funcstart_724,1</sub>.p2 is false whenever -2 < (0
+ literala)]
                Proof of rule precondition:
                [28.11.0] - 2 < (0 + 0)
                \rightarrow [simplify]
                [28.11.2] true
 [28.12] ([false]: -(-asType < integer > (\$heap_{funcstart\_724.1}.p2) / 176),
[!false]: asType<integer>(\theta) = ==
asType<integer>(div(heapIs heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p2,
176).quot)
\rightarrow [simplify]
[28.17] 0 == (-\operatorname{div}(\mathbf{heapIs} \ \hat{\mathbf{s}}_{funcstart\_724,1}, \ \hat{\mathbf{s}}_{funcstart\_724,1}.p2,
176).quot + (\text{$heap}_{funcstart\_724,1}.p2 / 176))
[Take given term]
[53.0] \rho_{1740,8} == \rho_{1740,8} == \rho_{1740,8} == \rho_{1740,8} - \rho_{1740,8} == \rho_{1740,8} == \rho_{1740,8} - \rho_{1740,8} == \rho_{1740,8} 
int>((asType<int>(asType<short int>(div1.rem)) *
asType < int > (\$heap_{funcstart\_724,1}.r1)) - (asType < int > (asType < short)
int>(div1.quot)) * asType< int>($heap_{tuncstart\_724.1}.b1))))
\rightarrow [from term 11.6, div1 is equal to div(heapIs $heap_{funcstart\_724,1},
heap_{funcstart_{-724,1}}.p1, 177)
[53.1] heap_{724,1;740,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow asType<short
int>((asType<int>(asType<short int>(div(heapIs $heap_{funcstart\_724,1},))
\theta_{funcstart\_724,1.p1, 177}.rem) * asType < int > (\theta_{funcstart\_724,1.p1, 177}.rem) - (\theta_{funcstart\_
(asType<int>(asType<short int>(div1.quot)) *
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{b1}))))
\rightarrow [simplify]
[53.3] \theta == 
int>((div(heapIs \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1, 177).rem *
asType < int > (\$heap_{tuncstart\_724.1}.r1)) - (asType < int > (asType < short)
int>(div1.quot)) * asType< int>($heap_{tuncstart\_724.1}.b1))))
```

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\rightarrow [const static or extern object]
[53.4] heap_{724,1:740,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow asType<short
int>((div(heapIs \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1, 177).rem *
asType < int > (\$heap_{init}.r1)) - (asType < int > (asType < short)
\mathbf{int}{>}(\mathbf{div1.quot})) * \mathbf{asType}{<} \mathbf{int}{>} (\$\mathbf{heap}_{funcstart\_724,1}.\mathbf{b1}))))
\rightarrow [expand definition of constant 'r1' at prang.c (15,20)]
[53.5] heap_{724,1:740.8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow asType<short
int>((div(heapIs \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1, 177).rem *
asType < int > (asType < short int > ((int)171))) -
(asType < int > (asType < short int > (div1.quot)) *
asType < int > (\$heap_{funcstart_{-724.1}}.b1)))
\rightarrow [simplify]
[53.8] \text{sheap}_{724,1;740,8} == \text{sheap}_{funcstart\_724,1}.\_replace(p1 \rightarrow asType < short)
int>((div(heapIs \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1, 177).rem * 171)
- (asType<int>(asType<short int>(div1.quot)) *
asType < int > (\$heap_{funcstart\_724,1}.b1))))
\rightarrow [from term 11.6, div1 is equal to div(heapIs $heap_{funcstart\_724,1},
heap_{funcstart_{-724,1}}.p1, 177)
[53.9] heap_{724,1;740,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow asType<short
\mathbf{int} > ((171 * \operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724,1}, \$ \operatorname{heap}_{funcstart\_724,1}.\operatorname{p1}, 177).\operatorname{rem})
- (asType<int>(asType<short int>(div(heapIs $heap_{funcstart_724.1},
heap_{funcstart_{724,1},p1, 177}, quot)) *
asType < int > (\$heap_{funcstart\_724.1}.b1)))
\rightarrow [simplify]
[53.11] \theta_{13} = \theta_
int > ((171 * div(heapIs \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1, 177).rem)
- (\text{div}(\mathbf{heapIs} \$ \text{heap}_{funcstart\_724.1}, \$ \text{heap}_{funcstart\_724.1}. \text{p1}, 177).\text{quot} *
asType < int > (\$heap_{funcstart\_724.1}.b1)))
\rightarrow [const static or extern object]
[53.12] \theta_{12} = \theta_{124,1;740,8} = \theta_{124,1;74
int>((171 * div(heapIs $heap_{funcstart\_724,1}, $heap_{funcstart\_724,1}.p1, 177).rem)
- (\text{div}(\mathbf{heapIs} \$ \text{heap}_{funcstart\_724,1}, \$ \text{heap}_{funcstart\_724,1}.\text{p1}, 177).\text{quot} *
asType < int > (\$heap_{init}.b1)))
\rightarrow [expand definition of constant 'b1' at prang.c (17,20)]
[53.13] heap_{724,1;740,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow asType<short
int>((171 * div(heapIs $heap_{funcstart\_724,1}, $heap_{funcstart\_724,1}.p1, 177).rem)
- (\text{div}(\mathbf{heapIs} \$ \text{heap}_{funcstart\_724,1}, \$ \text{heap}_{funcstart\_724,1}.\text{p1}, 177).\text{quot} *
asType<int>(asType<short int>((int)2))))
\rightarrow [simplify]
```

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[53.19] $heap<sub>724,1;740,8</sub> == $heap<sub>funcstart_724,1</sub>._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).quot) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).rem)))
[Take goal term]
[1.0]  minof(int) \leq (asType<int>(asType<short int>(div2.quot)) *
asType < int > ($heap_{724,1;740,8}.b2))
\rightarrow [simplify]
[1.1] -32768 \leq (asType<int>(asType<short int>(div2.quot)) *
asType<int>($heap<sub>724,1:740.8</sub>.b2))
\rightarrow [from term 25.6, div2 is equal to div(heapIs $heap_{tuncstart\_724.1},
heap_{funcstart_{-724,1}}.p2, 176)
[1.2] -32768 \le (asType<int>(asType<short int>(div(heapIs
\text{Sheap}_{funcstart_{724,1}}, \text{Sheap}_{funcstart_{724,1}}, p2, 176).quot)) *
asType<int>($heap<sub>724,1:740.8</sub>.b2))
\rightarrow [simplify]
[1.4] - 32768 \le (\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.\operatorname{p2},
176).quot * asType<int>($heap<sub>724.1:740.8</sub>.b2))
\rightarrow [from term 53.19, $heap<sub>724,1;740.8</sub> is equal to
heap_{funcstart\_724,1}._replace(p1 \rightarrow (-2 * div(heapIs heap_{funcstart\_724,1}),
\text{Sheap}_{funcstart\_724,1}.p1, 177).quot) + (171 * div(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
heap_{funcstart_{-724,1}.p1, 177).rem}
[1.5] \ -32768 \leq (\mathrm{div}(\mathbf{heapIs} \ \$ \mathrm{heap}_{funcstart\_724,1}, \ \$ \mathrm{heap}_{funcstart\_724,1}.\mathrm{p2},
176).quot * asType<int>($heap_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).quot) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.\operatorname{p1}, \ 177).\operatorname{rem}))).\operatorname{b2}))
\rightarrow [const member of object with modified fields]
[1.6] -32768 \leq (div(heapIs $heap_{funcstart\_724,1}, $heap_{funcstart\_724,1}.p2,
176).quot * asType < int > (\$heap_{funcstart\_724,1}.b2))
\rightarrow [const static or extern object]
[1.7] -32768 \le (\text{div}(\mathbf{heapIs} \$ \text{heap}_{funcstart\_724,1}, \$ \text{heap}_{funcstart\_724,1}.\text{p2},
176).quot * asType<int>($heap<sub>init</sub>.b2))
\rightarrow [expand definition of constant 'b2' at prang.c (22,20)]
[1.8] -32768 \leq (div(heapIs $heap_{funcstart\_724,1}, $heap_{funcstart\_724,1}.p2,
176).quot * asType<int>(asType<short int>((int)35)))
\rightarrow [simplify]
[1.13] -32769 < (35 * div(heapIs \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p2,
176).quot)
\rightarrow [literal comparison of product]
```

```
[1.14] ([35 < 0]: (-32769 / -35) < -{\rm div}({\bf heap Is}\ {\rm \$heap}_{funcstart\_724,1},
heap_{funcstart\_724,1.p2}, 176).quot, [0 < 35]: (-32769 / 35) < div(heapIs)
\$ heap_{funcstart\_724,1}, \, \$ heap_{funcstart\_724,1}.p2, \, 176).quot, \, [0 == 35]: \, -32769 < 0)
→ [explicitly assert falsehood of skipped guards in subsequent guards]
[1.15] ([35 < 0]: (-32769 / -35) < -\text{div}(\mathbf{heapIs} \$ \mathbf{heap}_{funcstart\_724,1},
\theta_{10} = \theta
div(\mathbf{heapIs} \ \text{$heap}_{funcstart\_724,1}, \ \text{$heap}_{funcstart\_724,1}.p2, \ 176).quot, \ [(0 == 35)]
\wedge !(0 < 35) \wedge !(35 < 0)]: -32769 < 0
\rightarrow [simplify]
\label{eq:loss_funcstart_724,1} \text{-937} < \text{div}(\textbf{heapIs} \ \$ \text{heap}_{funcstart\_724,1}, \ \$ \text{heap}_{funcstart\_724,1}.\text{p2},
176).quot
\rightarrow [negate goal and search for contradiction]
[1.24] !(-937 < div(heapIs heap_{funcstart_{-724,1}}, heap_{funcstart_{-724,1}}.p2,
176).quot)
\rightarrow [simplify]
[1.26] 936 < -\text{div}(\text{heapIs } \text{$heap}_{funcstart\_724,1}, \text{$heap}_{funcstart\_724,1}.p2,
176).quot
[Create new term from terms 1.26, 28.17 using rule: transitivity 15]
[59.0] (0 + 936) < -(\text{$heap_{funcstart\_724,1.p2} / 176})
\rightarrow [simplify]
[59.7] \ 164736 < -\$ heap_{funcstart\_724,1}.p2
\rightarrow [from term 9.0, literala < -$heap<sub>funcstart_724,1.</sub>p2 is false whenever -2 < (0
+ literala)]
          Proof of rule precondition:
          [59.7.0] - 2 < (0 + 164736)
          \rightarrow [simplify]
          [59.7.2] true
[59.8] false
Proof of verification condition: Arithmetic result of operator '*' is within
limit of type 'int'
Condition generated at: C:\Escher\Customers\prang\prang.c (58,38)
Condition defined at:
To prove: (asType<int>(asType<short int>(div2.quot)) *
```

 $asType < int > (\$heap_{724.1:740.8}.b2)) \le maxof(int)$ 

Given:

```
heap_{init}.LIMIT == (int)80
heap_{init}.M1 == asType < short int > ((int)30269)
\theta_{init}.r1 == asType < short int > ((int)171)
heap_{init}.a1 == asType < short int > ((int)177)
heap_{init}.M2 == asType < short int > ((int)30307)
\theta_{init}.r2 == asType < short int > ((int)172)
heap_{init}.a2 == asType < short int > ((int)176)
\theta = asType < short int > ((int)35)
heap_{init}.M3 == asType < short int > ((int)30323)
\theta_{init}.r3 == asType<short int>((int)170)
heap_{init}.a3 == asType < short int > ((int)178)
\theta = asType < short int > ((int)63)
\theta = asType < short int > ((int)1)
\theta
\theta = asType < short int > ((int)3)
invariant1(heapIs heap_{funcstart\_724,1})
\operatorname{div1} == \operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724,1},
asType < int > (\$heap_{funcstart\_724,1}.p1),
asType < int > (\$heap_{funcstart\_724,1}.a1))
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a1))) = =
asType<integer>(div1.quot)
(asType<integer>(asType<int>($heap_{tuncstart\_724.1}.p1)) %
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a1))) = =
asType<integer>(div1.rem)
!(0 == asType < integer > (div1.rem)) || !(0 ==
asType<integer>(div1.quot))
div2 == div(\mathbf{heapIs} \$heap_{funcstart\_724,1},
asType < int > (\$heap_{funcstart\_724,1}.p2),
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{a2}))
(\mathbf{asType} < \mathbf{integer} > (\mathbf{asType} < \mathbf{int} > (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p2})) \ / \\
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a2))) = =
asType<integer>(div2.quot)
(asType<int>(asType<int>($heap_{funcstart\_724,1}.p2)) %
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a2))) = =
```

```
asType<integer>(div2.rem)
!(0 == asType < integer > (div2.rem)) || !(0 ==
asType<integer>(div2.quot))
div3 == div(\mathbf{heapIs} \$ heap_{funcstart\_724,1},
asType < int > (\$heap_{funcstart\_724,1}.p3),
asType < int > (\$heap_{funcstart\_724,1}.a3))
(\mathbf{asType}{<}\mathbf{integer}{>}(\mathbf{asType}{<}\mathbf{int}{>}(\$\mathbf{heap}_{funcstart\_724,1}.\mathbf{p3})) \ / \\
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a3))) = =
asType<integer>(div3.quot)
(asType<int>(asType<int>($heap_{funcstart\_724.1}.p3)) %
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a3))) = =
asType<integer>(div3.rem)
!(0 == asType < integer > (div3.rem)) || !(0 ==
asType<integer>(div3.quot))
heap_{724,1;740,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow asType<short
int>((asType<int>(asType<short int>(div1.rem)) *
asType < int > (\$heap_{tuncstart\_724.1}.r1)) - (asType < int > (asType < short)
int>(div1.quot)) * asType< int>($heap_{funcstart\_724,1}.b1))))
-\mathbf{asType}{<}\mathbf{integer\ const}{>}(\$\mathrm{heap}_{724,1;740,8}.\mathrm{M1}) <
asType<integer>($heap<sub>724,1:740,8</sub>.p1)
!(0 == asType < integer > (\$heap_{724,1;740,8}.p1))
asType<integer>($heap<sub>724,1:740,8</sub>.p1) <
asType<integer>($heap<sub>724,1;740,8</sub>.M1)
Proof:
[Take given term]
[5.0] invariant1(heapIs heap_{funcstart_{724.1}})
\rightarrow [expand definition of function 'invariant1' at prang.c (34,1)]
[5.1] (((((0 < asType < integer > ($heap_{funcstart\_724,1}.p1)) &&
(asType < integer > (\$heap_{funcstart\_724,1}.p1) < 
asType < integer > (\$heap_{funcstart\_724,1}.M1))) \&\& (0 <
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{p2})))\ \&\&
(asType < integer > ($heap_{funcstart\_724,1}.p2) < 
asType < integer > (\$heap_{funcstart\_724,1}.M2))) \&\& (0 <
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p3})))\ \&\&
(\mathbf{asType} {<} \mathbf{integer} {>} (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p3}) <
\mathbf{asType} < \mathbf{integer} > (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{M3}))
\rightarrow [simplify]
[5.3] (((((0 < $heap_{funcstart_724,1}.p1) && ($heap_{funcstart_724,1}.p1 < footnote{if the content of the c
asType < integer > (\$heap_{funcstart\_724,1}.M1))) \&\& (0 <
```

```
asType < integer > (\$heap_{funcstart\_724,1}.p2))) \&\&
(asType < integer > (\$heap_{funcstart\_724,1}.p2) < 
\mathbf{asType} {<} \mathbf{integer} {>} (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{M2}))) \ \&\& \ (0 <
asType < integer > (\$heap_{funcstart\_724,1}.p3))) \&\&
(\mathbf{asType} < \mathbf{integer} > (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p3}) <
asType<integer>($heap_funcstart_724,1.M3))
\rightarrow [const static or extern object]
[5.4] (((((0 < \theta_{funcstart\_724,1.p1}) && (\theta_{funcstart\_724,1.p1})
asType<integer>(heap_{init}.M1))) && (0 <
asType < integer > (\$heap_{funcstart\_724,1}.p2))) \&\&
(\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{p2}) <
\mathbf{asType} \small{<} \mathbf{integer} \small{>} (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{M2}))) \ \&\& \ (0 <
asType < integer > (\$heap_{funcstart\_724,1}.p3))) \&\&
(\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{p3}) <
asType < integer > (\$heap_{funcstart\_724,1}.M3))
\rightarrow [expand definition of constant 'M1' at prang.c (14,20)]
[5.5] (((((0 < $heap_{funcstart\_724,1}.p1) && ($heap_{funcstart\_724,1}.p1 < ])
asType<integer>(asType<short int>((int)30269)))) && (0 <
asType < integer > (\$heap_{funcstart\_724,1}.p2))) \&\&
(\mathbf{asType} < \mathbf{integer} > (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p2}) <
as
Type<integer>($heap_{funcstart\_724,1}.M2))) && (0 <
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p3})))\ \&\&
(asType < integer > (\$heap_{funcstart_{-724.1}}.p3) < 
asType < integer > (\$heap_{funcstart_{-724.1}}.M3))
\rightarrow [simplify]
[5.16] \; ((((-30269 < -\$heap_{funcstart\_724,1}.p1) \; \land \; (0 < \$heap_{funcstart\_724,1}.p1) \; \land 
(0 < \mathrm{\$heap}_{funcstart\_724,1}.\mathrm{p2})) && (\mathrm{\$heap}_{funcstart\_724,1}.\mathrm{p2} <
asType < integer > (\$heap_{funcstart\_724,1}.M2))) \&\& (0 < 1)
asType < integer > (\$heap_{funcstart\_724,1}.p3))) \&\&
(\mathbf{asType} < \mathbf{integer} > (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p3}) <
\mathbf{asType} {<} \mathbf{integer} {>} (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{M3}))
\rightarrow [const static or extern object]
\label{eq:final_start_724,1.p1} [(((-30269 < -\$heap_{funcstart\_724,1}.p1) \land (0 < \$heap_{funcstart\_724,1}.p1) \land (0 < \$he
(0 < \text{\$heap}_{funcstart_{724,1},p2})) \&\& (\text{\$heap}_{funcstart_{724,1},p2} <
asType < integer > (\$heap_{init}.M2))) \&\& (0 <
asType < integer > (\$heap_{funcstart\_724,1}.p3))) \&\&
(asType < integer > (\$heap_{funcstart\_724,1}.p3) < 
asType < integer > (\$heap_{funcstart\_724,1}.M3))
\rightarrow [expand definition of constant 'M2' at prang.c (19,20)]
[5.18] ((((-30269 < -\$heap_{funcstart\_724,1}.p1) \land (0 < \$heap_{funcstart\_724,1}.p1) 
(0 < \text{\$heap}_{funcstart\_724,1}.p2)) \&\& (\text{\$heap}_{funcstart\_724,1}.p2 <
```

```
asType<integer>(asType<short int>((int)30307)))) && (0 <
asType < integer > (\$heap_{funcstart\_724,1}.p3))) \&\&
(\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{p3}) <
asType < integer > (\$heap_{funcstart\_724,1}.M3))
\rightarrow [simplify]
[5.30] ((-30307 < -$heap<sub>funcstart_724,1</sub>.p2) \wedge (-30269 <
-\text{\$heap}_{funcstart\_724,1}.\text{p1}) \land (0 < \text{\$heap}_{funcstart\_724,1}.\text{p1}) \land (0 <
\text{Sheap}_{funcstart_{724,1}.p2} \land (0 < \text{Sheap}_{funcstart_{724,1}.p3})) \&\&
(\text{\$heap}_{funcstart\_724,1}.p3 < asType < integer > (\text{\$heap}_{funcstart\_724,1}.M3))
\rightarrow [const static or extern object]
[5.31] ((-30307 < -$heap_funcstart_724.1.p2) \land (-30269 <
-\$ heap_{funcstart\_724,1}.p1) \land (0 < \$ heap_{funcstart\_724,1}.p1) \land (0 < \$ heap_{funcstart\_724,1}.p1) \land (0 < \$ heap_{funcstart\_724,1}.p1)
\mathrm{\$heap}_{funcstart\_724,1}.\mathrm{p2}) \, \wedge \, (0 < \mathrm{\$heap}_{funcstart\_724,1}.\mathrm{p3})) \, \&\& \,
(\$heap_{funcstart\_724,1}.p3 < \textbf{asType} < \textbf{integer} > (\$heap_{init}.M3))
\rightarrow [expand definition of constant 'M3' at prang.c (24,20)]
[5.32] ((-30307 < -$heap<sub>funcstart_724,1.</sub>p2) \wedge (-30269 <
-\$heap_{funcstart\_724,1}.p1) \land (0 < \$heap_{funcstart\_724,1}.p1) \land (0 < \$heap_{funcstart\_724,1}.p1)
\text{Sheap}_{funcstart\_724,1.p2}) \land (0 < \text{Sheap}_{funcstart\_724,1.p3})) \&\&
(\text{sheap}_{funcstart\_724,1}.\text{p3} < \text{asType} < \text{integer} > (\text{asType} < \text{short})
int > ((int)30323)))
\rightarrow [simplify]
[5.40] (-30323 < -$heap<sub>funcstart_724,1.</sub>p3) \land (-30307 <
-\$heap_{funcstart\_724,1}.p2) \wedge (-30269 < -\$heap_{funcstart\_724,1}.p1) \wedge (0 <
\text{Sheap}_{funcstart\_724,1}.\text{p1}) \land (0 < \text{Sheap}_{funcstart\_724,1}.\text{p2}) \land (0 <
heap_{funcstart_{-724,1}.p3}
[Work on sub-term 2 of conjunction in term 5.40]
\label{eq:fine_start_724,1.p2} \ [6.0] \ -30307 < -\$ \mathrm{heap}_{funcstart\_724,1}.\mathrm{p2}
[Work on sub-term 5 of conjunction in term 5.40]
[9.0] 0 < $heap_{funcstart_724,1}.p2
[Take given term]
[11.0] \operatorname{div1} == \operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724,1},
asType < int > (\$heap_{funcstart\_724,1}.p1),
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{a1}))
\rightarrow [simplify]
[11.1]~{\rm div1} == {\rm div}(\mathbf{heapIs}~\$ \mathrm{heap}_{funcstart\_724,1},\,\$ \mathrm{heap}_{funcstart\_724,1}.\mathrm{p1},
asType < int > (\$heap_{funcstart_{-724,1}}.a1))
\rightarrow [const static or extern object]
[11.2] \operatorname{div1} == \operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724,1}, \$ \operatorname{heap}_{funcstart\_724,1}.p1,
```

```
asType < int > (\$heap_{init}.a1))
\rightarrow [expand definition of constant 'a1' at prang.c (16,20)]
[11.3] \operatorname{div1} == \operatorname{div}(\mathbf{heapIs} \operatorname{\$heap}_{funcstart\_724,1}, \operatorname{\$heap}_{funcstart\_724,1}.p1,
asType<int>(asType<short int>((int)177)))
\rightarrow [simplify]
[11.6] div1 == div(heapIs heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p1, 177)
[Take given term]
[25.0] div2 == div(heapIs $heap_{funcstart\_724,1},
asType < int > (\$heap_{funcstart\_724,1}.p2),
asType < int > (\$heap_{funcstart\_724.1}.a2))
\rightarrow [simplify]
[25.1]~{\rm div2} == {\rm div}(\mathbf{heapIs}~\$ \mathrm{heap}_{funcstart\_724,1},\,\$ \mathrm{heap}_{funcstart\_724,1}.\mathrm{p2},
asType < int > (\$heap_{funcstart\_724,1}.a2))
\rightarrow [const static or extern object]
\label{eq:continuous} \textit{[25.2]} \ \text{div2} == \ \text{div} (\mathbf{heapIs} \ \$ \text{heap}_{funcstart\_724,1}, \ \$ \text{heap}_{funcstart\_724,1}.\text{p2},
asType < int > (\$heap_{init}.a2))
\rightarrow [expand definition of constant 'a2' at prang.c (21,20)]
[25.3] div2 == div(heapIs \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}.p2,
asType<int>(asType<short int>((int)176)))
\rightarrow [simplify]
[25.6] div2 == div(heapIs \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}.p2, 176)
[Assume known post-assertion, class invariant or type constraint for term 25.6]
[28.0] (asType<integer>(heap_{funcstart\_724,1}.p2) /
asType < integer > (176)) == asType < integer > (div(heapIs))
heap_{funcstart_{724,1}}, heap_{funcstart_{724,1}}, p2, 176).quot
\rightarrow [simplify]
[28.2] ($heap<sub>funcstart_724.1</sub>.p2 / 176) == asType<integer>(div(heapIs)
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.p2, 176).quot)
→ [expand definition of operator './' in class 'int' at built in declaration]
[28.3] ([asType<integer>(peq: funcstart_{-724,1}.p2) < 0]:
-(-asType < integer > (\$heap_{funcstart\_724,1}.p2) / 176), []:
asType < integer > ($heap_{funcstart\_724,1}.p2) / 176) ==
\mathbf{asType} < \mathbf{integer} > (\mathbf{div}(\mathbf{heapIs} \ \$ \mathbf{heap}_{funcstart\_724,1}, \ \$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p2}, \\
176).quot)
→ [explicitly assert falsehood of skipped guards in subsequent guards]
[28.4] ([asType<integer>(heap_{funcstart\_724,1}.p2) < 0]:
```

```
-(-asType < integer > (\$heap_{funcstart\_724,1}.p2) / 176),
[!(asType < integer > (\$heap_{funcstart\_724,1}.p2) < 0)]:
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p2})~/~176) ==
asType<integer>(div(heapIs p_{funcstart\_724,1}, p_{funcstart\_724,1}, p_{funcstart\_724,1})
176).quot)
\rightarrow [simplify]
[28.7] ([0 < -$heap<sub>funcstart_724,1</sub>.p2]:
-(-asType < integer > (\$heap_{funcstart\_724,1}.p2) / 176),
[!(asType < integer > (\$heap_{funcstart\_724,1}.p2) < 0)]:
asType < integer > (\$heap_{funcstart\_724,1}.p2) / 176) = =
\mathbf{asType} < \mathbf{integer} > (\mathbf{div}(\mathbf{heapIs} \$ \mathbf{heap}_{funcstart\_724,1}, \$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p2},
176).quot)
\rightarrow [from term 9.0, literala < -$heap<sub>funcstart_724.1</sub>.p2 is false whenever -2 < (0
+ literala)]
    Proof of rule precondition:
    [28.7.0] - 2 < (0 + 0)
    \rightarrow [simplify]
    [28.7.2] true
[28.8] ([false]: -(-asType < integer > (\$heap_{funcstart\_724,1}.p2) / 176),
[!(asType < integer > (\$heap_{funcstart\_724,1}.p2) < 0)]:
\mathbf{asType} < \mathbf{integer} > (\$ heap_{funcstart\_724,1}.p2) \ / \ 176) = =
asType<integer>(div(heapIs $heap_{tuncstart\_724.1}, $heap_{tuncstart\_724.1}.p2,
176).quot)
\rightarrow [simplify]
[28.11] ([false]: -(-asType < integer > (\$heap_{funcstart\_724,1}.p2) / 176), [!(0 <
-\$heap_{funcstart\_724,1}.p2): asType<integer>(\$heap_{funcstart\_724,1}.p2) / 176)
== asType<integer>(div(heapIs $heap_{funcstart_724,1},
heap_{funcstart_{-724,1}}.p2, 176).quot
\rightarrow [from term 9.0, literala < -$heap<sub>funcstart_724,1</sub>.p2 is false whenever -2 < (0
+ literala)]
    Proof of rule precondition:
    [28.11.0] - 2 < (0 + 0)
    \rightarrow [simplify]
    [28.11.2] true
[28.12] ([false]: -(-asType < integer > (\$heap_{funcstart\_724,1}.p2) / 176),
[!false]: asType<integer>(\theta) = ==
\mathbf{asType} < \mathbf{integer} > (\mathbf{div}(\mathbf{heapIs} \ \$ \mathbf{heap}_{funcstart\_724,1}, \ \$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p2}, \\
176).quot)
```

```
\rightarrow [simplify]
[28.17] \ 0 == (-\text{div}(\mathbf{heapIs} \ \$ \text{heap}_{funcstart\_724,1}, \ \$ \text{heap}_{funcstart\_724,1}.\text{p2},
176).quot + (\text{$heap}_{funcstart\_724,1}.p2 / 176))
[Take given term]
[53.0] \rho_{1740,8} == \rho_{1740
int>((asType<int>(asType<short int>(div1.rem)) *
asType < int > (\$heap_{funcstart\_724,1}.r1)) - (asType < int > (asType < short)
int>(div1.quot)) * asType< int>($heap_{funcstart\_724,1}.b1))))
\rightarrow [from term 11.6, div1 is equal to div(heapIs $heap_{tuncstart_724.1},
heap_{funcstart_{-724,1},p1,177}
[53.1] \text{heap}_{724,1;740,8} == \text{heap}_{funcstart\_724,1}._replace(p1 \rightarrow asType<short
int>((asType<int>(asType<short int>(div(heapIs $heap_{tuncstart\_724,1},))
\theta_{tuncstart\_724,1.p1, 177}.rem) * asType < int > (\theta_{tuncstart\_724,1.r1}) - (\theta_{tuncstart\_724,1.r1}
(asType<int>(asType<short int>(div1.quot)) *
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{b1}))))
\rightarrow [simplify]
[53.3] heap_{724,1:740,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow asType<short
int>((div(heapIs \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1, 177).rem *
asType < int > (\$heap_{funcstart\_724,1}.r1)) - (asType < int > (asType < short)
int>(div1.quot)) * asType< int>($heap_{funcstart\_724,1}.b1))))
\rightarrow [const static or extern object]
[53.4] \; \$ heap_{724,1;740,8} == \$ heap_{funcstart\_724,1}.\_\mathbf{replace} (p1 \to \mathbf{asType} < \mathbf{short}
int>((div(heapIs \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1, 177).rem *
asType < int > (\$heap_{init}.r1)) - (asType < int > (asType < short)
int>(div1.quot)) * asType< int>($heap_{funcstart\_724,1}.b1))))
\rightarrow [expand definition of constant 'r1' at prang.c (15,20)]
[53.5] heap_{724,1;740,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow asType<short
int>((div(heapIs \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1, 177).rem *
asType<int>(asType<short int>((int)171))) -
(asType<int>(asType<short int>(div1.quot)) *
asType < int > (\$heap_{funcstart\_724,1}.b1))))
\rightarrow [simplify]
[53.8] \text{sheap}_{724,1;740,8} == \text{sheap}_{funcstart\_724,1}.\_replace(p1 \rightarrow asType < short)
int > ((div(heapIs \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1, 177).rem * 171)
  - (asType < int > (asType < short int > (div1.quot))*
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{b1}))))
\rightarrow [from term 11.6, div1 is equal to div(heapIs $heap_{tuncstart_724.1},
heap_{funcstart_{-724,1}}.p1, 177
[53.9] \rho_{13,1;740,8} == \rho_{13,1;740,8} == \rho_{13,1;740,8} =- \rho_{
```

```
int>((171 * div(heapIs \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1, 177).rem)
- (asType<int>(asType<short int>(div(heapIs $heap_{funcstart_724,1},))
heap_{funcstart_{724,1}}.p1, 177).quot) *
asType < int > (\$heap_{funcstart\_724,1}.b1))))
\rightarrow [simplify]
[53.11] \theta == 
int>((171 * div(heapIs $heap_{funcstart_724,1}, $heap_{funcstart_724,1}.p1, 177).rem)
- (\text{div}(\mathbf{heapIs} \$ \text{heap}_{funcstart\_724,1}, \$ \text{heap}_{funcstart\_724,1}.\text{p1}, 177).\text{quot} *
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{b1}))))
\rightarrow [const static or extern object]
[53.12] $\text{heap}_{724.1:740.8} == $\text{heap}_{funcstart\_724.1}._\text{replace}(p1 \rightarrow \text{asType} < \text{short}
int>((171 * div(heapIs \$heap_{tuncstart\_724.1}, \$heap_{tuncstart\_724.1}, p1, 177).rem)
- (\text{div}(\mathbf{heapIs} \$ \text{heap}_{funcstart\_724,1}, \$ \text{heap}_{funcstart\_724,1}.\text{p1}, 177).\text{quot} *
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{init}.\mathrm{b1}))))
\rightarrow [expand definition of constant 'b1' at prang.c (17,20)]
[53.13] heap_{724,1;740,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow asType<short
int>((171 * div(heapIs \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1, 177).rem)
- (div(heapIs heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p1, 177).quot *
asType < int > (asType < short int > ((int)2))))
\rightarrow [simplify]
[53.19] $\text{heap}_{724,1;740,8} == \text{$heap}_{funcstart\_724,1}._\text{$replace}(p1 \to ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).rem)))
[Take goal term]
[1.0] (asType<int>(asType<short int>(div2.quot)) *
asType < int > (\$heap_{724,1;740,8}.b2)) \le maxof(int)
\rightarrow [from term 25.6, div2 is equal to div(heapIs $heap_{funcstart\_724,1},
heap_{funcstart_{-724,1}}.p2, 176
[1.1] (asType<int>(asType<short int>(div(heapIs $heap_{funcstart\_724,1},))
\text{sheap}_{funcstart\_724,1}.\text{p2}, 176).\text{quot}) * asType < int > (\text{sheap}_{724,1;740,8}.\text{b2})) \le
maxof(int)
\rightarrow [simplify]
[1.3] (div(heapIs heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p2, 176).quot *
asType < int > (\$heap_{724,1;740,8}.b2)) \le maxof(int)
\rightarrow [from term 53.19, heap_{724,1;740,8} is equal to
heap_{funcstart\_724,1}._replace(p1 \rightarrow (-2 * div(heapIs \$heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1}.p1, 177).quot + (171 * div(\textbf{heapIs} \$heap_{funcstart\_724,1},
$heap_{funcstart\_724,1}.p1, 177).rem))]
[1.4] (div(heapIs heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p2, 176).quot *
```

```
asType < int > (\$heap_{funcstart\_724,1}.\_replace(p1 \rightarrow ((-2 * div(heapIs))))))
\theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}
\operatorname{Sheap}_{funcstart\_724,1}, \operatorname{Sheap}_{funcstart\_724,1}.p1, 177).rem))).b2)) \leq \operatorname{maxof(int)}
→ [const member of object with modified fields]
[1.5] (div(heapIs heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p2, 176).quot *
asType < int > (\$heap_{funcstart\_724,1}.b2)) \le maxof(int)
\rightarrow [const static or extern object]
[1.6] (div(heapIs heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p2, 176).quot *
asType < int > (\$heap_{init}.b2)) \le maxof(int)
\rightarrow [expand definition of constant 'b2' at prang.c (22,20)]
[1.7] (div(heapIs heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p2, 176).quot *
asType < int > (asType < short int > ((int)35))) \le maxof(int)
\rightarrow [simplify]
 [1.20] \ -32768 < (-35 \ * \ \mathrm{div}(\mathbf{heapIs} \ \$ \mathrm{heap}_{funcstart\_724,1}, \ \$ \mathrm{heap}_{funcstart\_724,1}.\mathrm{p2}, 
176).quot)
\rightarrow [literal comparison of product]
[1.21] ([-35 < 0]: (-32768 / 35) < -\text{div}(\mathbf{heapIs} \$ \mathbf{heap}_{funcstart\_724,1},
\rho_{funcstart_{-724,1},p2,176}, quot, [0 < -35]: (-32768 / -35) < \text{div}(heapIs)
\$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p2, 176).quot, [-35 == 0]: -32768 < 0)
→ [explicitly assert falsehood of skipped guards in subsequent guards]
[1.22] ([-35 < 0]: (-32768 / 35) < -\text{div}(\text{heapIs } \text{$heap}_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1.p2}, 176).\text{quot}, [(0 < -35) \land !(-35 < 0)]: (-32768 / -35) < 0
div(\mathbf{heapIs} \ \$heap_{funcstart\_724,1}, \ \$heap_{funcstart\_724,1}.p2, \ 176).quot, \ [(-35 == 0)]
\wedge !(-35 < 0) \wedge !(0 < -35)]: -32768 < 0)
\rightarrow [simplify]
[1.26] -937 < -\text{div}(\mathbf{heapIs} \$ \text{heap}_{funcstart\_724,1}, \$ \text{heap}_{funcstart\_724,1}.\text{p2},
176).quot
\rightarrow [negate goal and search for contradiction]
[1.27] ! (-937 < -\text{div}(\textbf{heapIs} \$ \text{heap}_{funcstart\_724,1}, \$ \text{heap}_{funcstart\_724,1}.\text{p2},
176).quot)
\rightarrow [simplify]
[1.30] 936 < div(heapIs heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p2, 176).quot
[Create new term from terms 1.30, 28.17 using rule: transitivity 16]
[59.0] (0 + 936) < (\text{$heap_{funcstart\_724,1}.p2 / 176})
\rightarrow [simplify]
[59.8] \ 164911 < \$ heap_{funcstart\_724,1}.p2
```

```
\rightarrow [from term 6.0, literala < $heap_{funcstart\_724,1}.p2 is false whenever -2 <
(-30307 + literala)
       Proof of rule precondition:
       [59.8.0] - 2 < (-30307 + 164911)
       \rightarrow [simplify]
       [59.8.2] true
[59.9] false
Proof of verification condition: Type constraint satisfied in implicit
conversion from 'int' to 'short int'
Condition generated at: C:\Escher\Customers\prang\prang.c (58,33)
Condition defined at:
To prove: minof(short\ int) \le ((asType < int > (asType < short\ int) < (asTy
int>(div2.rem) * asType<int>($heap_{724,1;740,8}.r2)) -
(asType<int>(asType<short int>(div2.quot)) *
asType < int > (\$heap_{724.1:740.8}.b2)))
Given:
heap_{init}.LIMIT == (int)80
\theta sheap<sub>init</sub>.M1 == asType<short int>((int)30269)
\theta_{init}.r1 == asType < short int > ((int)171)
heap_{init}.a1 == asType < short int > ((int)177)
\theta = asType < short int > ((int)2)
\theta sheap<sub>init</sub>.M2 == asType<short int>((int)30307)
\theta_{init}.r2 == asType < short int > ((int)172)
heap_{init}.a2 == asType < short int > ((int)176)
\theta = asType < short int > ((int)35)
heap_{init}.M3 == asType < short int > ((int)30323)
heap_{init}.r3 == asType < short int > ((int)170)
heap_{init}.a3 == asType < short int > ((int)178)
\theta = asType < short int > ((int)63)
\theta = asType < short int > ((int)1)
\theta
\theta = asType < short int > ((int)3)
```

invariant1(heapIs  $heap_{funcstart_{-724,1}}$ )

```
div1 == div(\mathbf{heapIs} \$heap_{funcstart\_724,1},
asType < int > (\$heap_{funcstart\_724,1}.p1),
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{a1}))
(asType<int>(asType<int>($heap_{tuncstart\_724.1}.p1)) /
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a1))) = =
asType<integer>(div1.quot)
(\mathbf{asType} {<} \mathbf{integer} {>} (\mathbf{asType} {<} \mathbf{int} {>} (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p1})) \ \%
\mathbf{asType}{<}\mathbf{integer}{>}(\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{a1}))) = =
asType<integer>(div1.rem)
!(0 == asType < integer > (div1.rem)) || !(0 ==
asType<integer>(div1.quot))
div2 == div(\mathbf{heapIs} \$heap_{funcstart\_724,1},
asType < int > (\$heap_{funcstart\_724,1}.p2),
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{a2}))
(asType<integer>(asType<int>($heap_{tuncstart\_724.1}.p2)) /
asType < integer > (asType < int > (\$heap_{funcstart\_724.1}.a2))) = =
asType<integer>(div2.quot)
(asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.p2)) \%
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a2))) = =
asType < integer > (div2.rem)
!(0 == asType < integer > (div2.rem)) || !(0 ==
asType<integer>(div2.quot))
div3 == div(\mathbf{heapIs} \$heap_{funcstart\_724,1},
asType < int > (\$heap_{funcstart\_724,1}.p3),
asType < int > (\$heap_{funcstart\_724,1}.a3))
(asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.p3)) /
asType < integer > (asType < int > (\$heap_{funcstart\_724.1}.a3))) = =
asType<integer>(div3.quot)
(asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.p3)) \%
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a3))) = = 
asType<integer>(div3.rem)
!(0 == asType < integer > (div3.rem)) || !(0 ==
asType < integer > (div3.quot))
\$heap_{724,1;740,8} == \$heap_{funcstart\_724,1}.\_\mathbf{replace}(p1 \to \mathbf{asType} < \mathbf{short}
int>((asType<int>(asType<short int>(div1.rem)) *
asType < int > (\$heap_{funcstart\_724,1}.r1)) - (asType < int > (asType < short)
\mathbf{int}{>}(\mathbf{div1}.\mathbf{quot})) \ * \ \mathbf{asType}{<} \mathbf{int}{>} (\$\mathbf{heap}_{funcstart\_724,1}.\mathbf{b1}))))
-asType < integer\ const > (\$heap_{724,1;740,8}.M1) < 1
asType<integer>($heap<sub>724.1:740.8</sub>.p1)
!(0 == asType < integer > (\$heap_{724,1:740.8}.p1))
```

```
asType < integer > (\$heap_{724,1;740,8}.p1) <
asType<integer>($heap<sub>724,1:740,8</sub>.M1)
Proof:
[Take given term]
[5.0] invariant1(heapIs heap_{funcstart\_724,1})
\rightarrow [expand definition of function 'invariant1' at prang.c (34,1)]
[5.1] ((((((0 < asType < integer > ($heap_{funcstart_724,1}.p1)) &&
(asType < integer > ($heap_{funcstart\_724,1}.p1) < 
asType < integer > (\$heap_{funcstart\_724,1}.M1))) \&\& (0 <
asType < integer > (\$heap_{funcstart\_724,1}.p2))) \&\&
(\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{p2}) <
asType < integer > (\$heap_{funcstart\_724,1}.M2))) \&\& (0 <
asType < integer > ($heap_{funcstart\_724,1}.p3))) &&
(\mathbf{asType} < \mathbf{integer} > (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p3}) <
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{M3}))
\rightarrow [simplify]
[5.3] (((((0 < \theta_{funcstart\_724,1.p1) && (\theta_{funcstart\_724,1.p1)
asType < integer > (\$heap_{funcstart\_724,1}.M1))) \&\& (0 < function for the start of the start 
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p2})))\ \&\&
(\mathbf{asType} < \mathbf{integer} > (\$ \mathrm{heap}_{funcstart\_724,1}.\mathrm{p2}) <
as
Type<integer>(\rho_{funcstart\_724,1}.M2))) & (0 <
asType < integer > (\$heap_{funcstart\_724,1}.p3))) \&\&
(\mathbf{asType} < \mathbf{integer} > (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p3}) <
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{M3}))
\rightarrow [const static or extern object]
[5.4] (((((0 < $heap_{funcstart_{724,1}}.p1) && ($heap_{funcstart_{724,1}}.p1 < ]
asType < integer > (\$heap_{init}.M1))) \&\& (0 <
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p2})))\ \&\&
(asType < integer > (\$heap_{funcstart\_724,1}.p2) <
asType<integer>(\theta_{tuncstart\_724,1}.M2))) && (0 <
asType < integer > (\$heap_{funcstart_{-724,1}}.p3))) \&\&
(\mathbf{asType} < \mathbf{integer} > (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p3}) <
asType < integer > (\$heap_{funcstart\_724,1}.M3))
\rightarrow [expand definition of constant 'M1' at prang.c (14,20)]
[5.5] (((((0 < $heap_{funcstart_{724,1}}.p1) && ($heap_{funcstart_{724,1}}.p1 < 
asType < integer > (asType < short int > ((int)30269)))) && (0 < integer) && (0 < integer
asType < integer > (\$heap_{funcstart\_724,1}.p2))) \&\&
(\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{p2}) <
as
Type<integer>(\rho_{funcstart\_724,1}.M2))) & (0 <
asType < integer > (\$heap_{funcstart\_724,1}.p3))) \&\&
(asType < integer > (\$heap_{funcstart\_724,1}.p3) <
```

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asType < integer > (\$heap_{funcstart_{-724,1}}.M3))
\rightarrow [simplify]
[5.16] ((((-30269 < -\$heap_{funcstart\_724,1}.p1) \land (0 < \$heap_{funcstart\_724,1}.p1) 
(0 < \text{\$heap}_{funcstart\_724,1}.p2)) \&\& (\text{\$heap}_{funcstart\_724,1}.p2 <
asType < integer > (\$heap_{funcstart\_724,1}.M2))) \&\& (0 <
asType < integer > (\$heap_{funcstart\_724,1}.p3))) \&\&
(\mathbf{asType} < \mathbf{integer} > (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p3}) <
asType < integer > (\$heap_{funcstart\_724,1}.M3))
\rightarrow [const static or extern object]
[5.17] \; ((((-30269 < -\$heap_{funcstart\_724,1}.p1) \; \land \; (0 < \$heap_{funcstart\_724,1}.p1) \; \land 
(0 < \text{$heap}_{funcstart_{-724,1}.p2})) \&\& (\text{$heap}_{funcstart_{-724,1}.p2} <
asType < integer > (\$heap_{init}.M2))) \&\& (0 <
asType < integer > (\$heap_{funcstart\_724,1}.p3))) \&\&
(\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{p3}) <
asType < integer > (\$heap_{funcstart\_724,1}.M3))
\rightarrow [expand definition of constant 'M2' at prang.c (19,20)]
[5.18] ((((-30269 < -\$heap_{funcstart\_724,1}.p1) \land (0 < \$heap_{funcstart\_724,1}.p1) 
(0 < \text{\$heap}_{funcstart\_724,1}.p2)) \&\& (\text{\$heap}_{funcstart\_724,1}.p2 <
asType < integer > (asType < short int > ((int)30307)))) && (0 < footnote{integer}) && (0 < footnote
asType < integer > (\$heap_{funcstart\_724,1}.p3))) \&\&
(asType < integer > (\$heap_{funcstart\_724,1}.p3) < 
asType < integer > (\$heap_{funcstart\_724,1}.M3))
\rightarrow [simplify]
[5.30] ((-30307 < -$heap_{funcstart\_724,1}.p2) \land (-30269 <
-\$heap_{funcstart\_724,1}.p1) \land (0 < \$heap_{funcstart\_724,1}.p1) \land (0 < \$heap_{funcstart\_724,1}.p1)
\text{Sheap}_{funcstart_{724,1}.p2} \land (0 < \text{Sheap}_{funcstart_{724,1}.p3})) \&\&
(\text{\$heap}_{funcstart\_724,1}.\text{p3} < \mathbf{asType} < \mathbf{integer} > (\text{\$heap}_{funcstart\_724,1}.\text{M3}))
\rightarrow [const static or extern object]
[5.31] ((-30307 < -$heap<sub>funcstart_724,1.</sub>p2) \land (-30269 <
 -\$heap_{funcstart\_724,1}.p1) \land (0 < \$heap_{funcstart\_724,1}.p1) \land (0 < \$heap_{funcstart\_724,1}.p1)
\text{Sheap}_{funcstart\_724,1}.p2) \land (0 < \text{Sheap}_{funcstart\_724,1}.p3)) \&\&
(\text{\$heap}_{funcstart\_724,1}.\text{p3} < \text{asType} < \text{integer} > (\text{\$heap}_{init}.\text{M3}))
\rightarrow [expand definition of constant 'M3' at prang.c (24,20)]
[5.32] ((-30307 < -$heap<sub>funcstart_724,1.p2</sub>) \wedge (-30269 <
-\$heap_{funcstart\_724,1}.p1) \land (0 < \$heap_{funcstart\_724,1}.p1) \land (0 < \$heap_{funcstart\_724,1}.p1)
\text{Sheap}_{funcstart_{724,1}.p2} \land (0 < \text{Sheap}_{funcstart_{724,1}.p3})) \&\&
(\text{sheap}_{funcstart\_724,1}.\text{p3} < \text{asType} < \text{integer} > (\text{asType} < \text{short})
int > ((int)30323)))
\rightarrow [simplify]
[5.40] (-30323 < -$heap_funcstart_724,1.p3) \land (-30307 <
```

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-\$heap_{funcstart\_724,1}.p2) \wedge (-30269 < -\$heap_{funcstart\_724,1}.p1) \wedge (0 <
\text{Sheap}_{funcstart\_724,1}.\text{p1}) \land (0 < \text{Sheap}_{funcstart\_724,1}.\text{p2}) \land (0 <
heap_{funcstart_{-724,1}.p3}
[Work on sub-term 2 of conjunction in term 5.40]
[6.0] -30307 < -$heap<sub>funcstart_724,1</sub>.p2
[Work on sub-term 5 of conjunction in term 5.40]
[9.0] 0 < \text{$heap}_{funcstart\_724,1}.p2
[Take given term]
[11.0] \operatorname{div1} == \operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724,1},
asType < int > (\$heap_{funcstart\_724,1}.p1),
asType < int > (\$heap_{funcstart\_724,1}.a1))
\rightarrow [simplify]
[11.1] \ \mathrm{div1} == \mathrm{div}(\mathbf{heapIs} \ \$ \mathrm{heap}_{funcstart\_724,1}, \ \$ \mathrm{heap}_{funcstart\_724,1}.\mathrm{p1},
asType < int > (\$heap_{funcstart\_724,1}.a1))
\rightarrow [const static or extern object]
[11.2] \ \mathrm{div1} == \mathrm{div}(\mathbf{heapIs} \ \$ \mathrm{heap}_{funcstart\_724,1}, \ \$ \mathrm{heap}_{funcstart\_724,1}.\mathrm{p1},
asType < int > (\$heap_{init}.a1))
\rightarrow [expand definition of constant 'a1' at prang.c (16,20)]
[11.3] \ \mathrm{div1} == \mathrm{div}(\mathbf{heapIs} \ \$ \mathrm{heap}_{funcstart\_724,1}, \ \$ \mathrm{heap}_{funcstart\_724,1}.\mathrm{p1},
asType<int>(asType<short int>((int)177)))
\rightarrow [simplify]
[11.6] div1 == div(heapIs \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}.p1, 177)
[Take given term]
[25.0] \operatorname{div2} == \operatorname{div}(\mathbf{heapIs} \ \operatorname{\$heap}_{funcstart\_724,1},
asType < int > (\$heap_{funcstart\_724.1}.p2),
asType < int > (\$heap_{funcstart\_724,1}.a2))
\rightarrow [simplify]
[25.1] \operatorname{div2} == \operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.p2,
asType < int > (\$heap_{funcstart\_724,1}.a2))
\rightarrow [const static or extern object]
[25.2] \operatorname{div2} == \operatorname{div}(\mathbf{heapIs} \ \text{$heap}_{funcstart\_724,1}, \ \text{$heap}_{funcstart\_724,1}.p2,
asType < int > (\$heap_{init}.a2))
\rightarrow [expand definition of constant 'a2' at prang.c (21,20)]
[25.3] \operatorname{div2} == \operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.p2,
asType<int>(asType<short int>((int)176)))
\rightarrow [simplify]
```

```
[25.6] div2 == div(heapIs $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}.p2, 176)
[Assume known post-assertion, class invariant or type constraint for term 25.6]
[28.0] \; (\mathbf{asType} {<} \mathbf{integer} {>} (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p2}) \; / \\
asType<integer>(176)) == asType<integer>(div(heapIs
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.p2, 176).quot)
\rightarrow [simplify]
[28.2] ($heap<sub>funcstart_724,1.</sub>p2 / 176) == asType<integer>(div(heapIs)
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.p2, 176).quot)
→ [expand definition of operator './' in class 'int' at built in declaration]
[28.3] ([asType<integer>(heap_{funcstart\_724,1}.p2) < 0]:
-(-asType < integer > (\$heap_{funcstart\_724,1}.p2) / 176), []:
asType < integer > ($heap_{funcstart\_724,1}.p2) / 176) ==
asType<integer>(div(heapIs $heap_{tuncstart\_724.1}, $heap_{tuncstart\_724.1}.p2,
176).quot)
→ [explicitly assert falsehood of skipped guards in subsequent guards]
[28.4] ([asType<integer>($heap_{funcstart\_724,1}.p2) < 0]:
-(-asType < integer > (\$heap_{funcstart\_724,1}.p2) / 176),
[!(asType < integer > (\$heap_{funcstart\_724,1}.p2) < 0)]:
asType < integer > (\$heap_{funcstart\_724.1}.p2) / 176) = =
\mathbf{asType} {<} \mathbf{integer} {>} ( \mathrm{div}(\mathbf{heapIs} \ \$ \mathrm{heap}_{funcstart\_724,1}, \ \$ \mathrm{heap}_{funcstart\_724,1}.\mathrm{p2}, \\
176).quot)
\rightarrow [simplify]
[28.7] ([0 < -\$heap_{funcstart\_724,1}.p2]:
-(-asType < integer > (\$heap_{funcstart\_724,1}.p2) / 176),
[!(asType < integer > (\$heap_{funcstart\_724,1}.p2) < 0)]:
asType < integer > (\$heap_{funcstart\_724,1}.p2) / 176) ==
asType<integer>(div(heapIs heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p2,
176).quot)
\rightarrow [from term 9.0, literala < -$heap<sub>funcstart_724,1.</sub>p2 is false whenever -2 < (0
+ literala)]
   Proof of rule precondition:
   [28.7.0] - 2 < (0 + 0)
   \rightarrow [simplify]
   [28.7.2] true
[28.8] ([false]: -(-asType < integer > (\$heap_{funcstart\_724,1}.p2) / 176),
[!(\mathbf{asType} < \mathbf{integer} > (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p2}) < 0)]:
asType < integer > (\$heap_{funcstart\_724.1}.p2) / 176) = =
asType<integer>(div(heapIs heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p2,
176).quot)
```

```
\rightarrow [simplify]
[28.11] ([false]: -(-asType < integer > (\$heap_{funcstart\_724,1}.p2) / 176), [!(0 <
-\$heap_{funcstart\_724,1}.p2): asType<integer>(\$heap_{funcstart\_724,1}.p2) / 176)
== asType < integer > (div(heapIs $heap_{funcstart\_724,1},
heap_{funcstart_{-724,1}.p2, 176}, quot
\rightarrow [from term 9.0, literala < -$heap<sub>funcstart_724,1.</sub>p2 is false whenever -2 < (0
+ literala)]
    Proof of rule precondition:
    [28.11.0] - 2 < (0 + 0)
    \rightarrow [simplify]
    [28.11.2] true
[28.12] ([\mathbf{false}]: -(-\mathbf{asType} < \mathbf{integer} > (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p2}) \ / \ 176),
[!false]: asType<integer>(\theta) (\theta) ==
asType<integer>(div(heapIs p_{funcstart\_724,1}, p_{funcstart\_724,1}, p_{funcstart\_724,1})
176).quot)
\rightarrow [simplify]
[28.17] 0 == (-\text{div}(\mathbf{heapIs} \$ \text{heap}_{funcstart\_724,1}, \$ \text{heap}_{funcstart\_724,1}.\text{p2},
176).quot + (\text{$heap}_{funcstart\_724,1}.p2 / 176))
[Assume known post-assertion, class invariant or type constraint for term 25.6]
[29.0] (asType<integer>(heap_{funcstart\_724,1}.p2) %
asType<integer>(176)) == asType<integer>(div(heapIs
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.p2, 176).rem
\rightarrow [simplify]
[29.2] ($heap<sub>funcstart_724,1.</sub>p2 % 176) == asType<integer>(div(heapIs)
\$ heap_{funcstart\_724,1}, \$ heap_{funcstart\_724,1}.p2, \ 176).rem)
→ [expand definition of operator '.%' in class 'int' at built in declaration]
\label{eq:content} \textit{[29.3]} \; ([\textbf{asType} < \textbf{integer} > (\$ \text{heap}_{funcstart\_724,1}.\text{p2}) < 0]:
-(-asType < integer > (\$heap_{funcstart\_724,1}.p2) \% 176), []:
asType < integer > (\$heap_{funcstart\_724,1}.p2) \% 176) ==
\mathbf{asType} {<} \mathbf{integer} {>} ( \mathrm{div}(\mathbf{heapIs} \ \$ \mathrm{heap}_{funcstart\_724,1}, \ \$ \mathrm{heap}_{funcstart\_724,1}.\mathrm{p2}, \\
176).rem)
→ [explicitly assert falsehood of skipped guards in subsequent guards]
[29.4] ([asType<integer>(peq:total)) ([asType<integer) (peq:total)):
-(-asType < integer > (\$heap_{funcstart\_724,1}.p2) \% 176),
[!(asType < integer > (\$heap_{funcstart\_724,1}.p2) < 0)]:
asType < integer > (\$heap_{funcstart\_724,1}.p2) \% 176) = =
\mathbf{asType} < \mathbf{integer} > (\mathbf{div}(\mathbf{heapIs} \ \$ \mathbf{heap}_{funcstart\_724,1}, \ \$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p2}, \\
176).rem)
```

```
\rightarrow [simplify]
[29.7] ([0 < -$heap<sub>funcstart_724,1</sub>.p2]:
-(-asType < integer > (\$heap_{funcstart\_724.1}.p2) \% 176),
[!(\mathbf{asType} < \mathbf{integer} > (\$ heap_{funcstart\_724,1}.p2) < 0)]:
asType < integer > (\$heap_{funcstart\_724.1}.p2) \% 176) = =
asType<integer>(div(heapIs heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p2,
176).rem)
\rightarrow [from term 9.0, literala < -$heap<sub>funcstart_724,1.</sub>p2 is false whenever -2 < (0
+ literala)]
    Proof of rule precondition:
    [29.7.0] - 2 < (0 + 0)
    \rightarrow [simplify]
    [29.7.2] true
[29.8] ([false]: -(-asType < integer > (\$heap_{tuncstart\_724.1}.p2) \% 176),
[!(asType < integer > (\$heap_{funcstart\_724,1}.p2) < 0)]:
asType < integer > (\$heap_{funcstart\_724,1}.p2) \% 176) ==
asType<integer>(div(heapIs $heap_{tuncstart\_724.1}, $heap_{tuncstart\_724.1}.p2,
176).rem)
\rightarrow [simplify]
[29.11] ([false]: -(-asType < integer > (\$heap_{funcstart\_724,1}.p2) \% 176), [!(0
<-\$ heap_{funcstart\_724,1}.p2)]: \ \mathbf{asType} < \mathbf{integer} > (\$ heap_{funcstart\_724,1}.p2) \ \%
176) == asType < integer > (div(heapIs \$heap_{funcstart\_724,1},
heap_{funcstart_{-724,1}.p2, 176}.rem
\rightarrow [from term 9.0, literala < -$heap<sub>funcstart_724.1</sub>.p2 is false whenever -2 < (0
+ literala)]
    Proof of rule precondition:
    [29.11.0] - 2 < (0 + 0)
    \rightarrow [simplify]
    [29.11.2] true
[29.12] ([false]: -(-asType < integer > (\$heap_{funcstart\_724,1}.p2) \% 176),
[!false]: asType<integer>(\ensuremath{\text{sheap}}_{funcstart\_724,1}.p2) % 176) ==
\mathbf{asType} < \mathbf{integer} > (\mathbf{div}(\mathbf{heapIs} \ \$ \mathbf{heap}_{funcstart\_724,1}, \ \$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p2}, \\
176).rem)
\rightarrow [simplify]
[29.17] 0 == (-\text{div}(\mathbf{heapIs} \$ \text{heap}_{funcstart\_724,1}, \$ \text{heap}_{funcstart\_724,1}.\text{p2},
176).rem + (\text{$heap}_{funcstart\_724,1}.p2 \% 176))
[Take given term]
[53.0] heap_{724,1;740,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow asType<short
```

```
int>((asType<int>(asType<short int>(div1.rem)) *
\mathbf{asType} \hspace{-0.1em}<\hspace{-0.1em} \mathbf{int} \hspace{-0.1em}> \hspace{-0.1em} (\$ heap_{funcstart\_724,1}.r1)) - (\mathbf{asType} \hspace{-0.1em}<\hspace{-0.1em} \mathbf{int} \hspace{-0.1em}> \hspace{-0.1em} (\mathbf{asType} \hspace{-0.1em}<\hspace{-0.1em} \mathbf{short})
\mathbf{int}{>}(\mathbf{div1.quot})) * \mathbf{asType}{<} \mathbf{int}{>} (\$\mathbf{heap}_{funcstart\_724,1}.\mathbf{b1}))))
\rightarrow [from term 11.6, div1 is equal to div(heapIs $heap_{tuncstart_724.1},
heap_{funcstart_{-724,1},p1,177}
[53.1] \theta == 
int>((asType<int>(asType<short int>(div(heapIs $heap_{funcstart\_724,1},))
\theta_{funcstart\_724,1.p1, 177}.rem) * asType < int > (\theta_{funcstart\_724,1.r1}) - (\theta_{funcstart\_724,1.r1}
(asType<int>(asType<short int>(div1.quot)) *
asType < int > (\$heap_{funcstart, 724,1}.b1)))
\rightarrow [simplify]
[53.3] \text{sheap}_{724,1;740,8} == \text{sheap}_{funcstart\_724,1}._replace(p1 \rightarrow asType<short
int>((div(heapIs \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1, 177).rem *
asType < int > (\$heap_{funcstart\_724,1}.r1)) - (asType < int > (asType < short)
int>(div1.quot)) * asType< int>($heap_{funcstart\_724,1}.b1))))
\rightarrow [const static or extern object]
[53.4] heap_{724,1;740,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow asType<short
int>((div(heapIs \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1, 177).rem *
asType < int > (\$heap_{init}.r1)) - (asType < int > (asType < short)
\mathbf{int}{>}(\mathbf{div1.quot})) * \mathbf{asType}{<} \mathbf{int}{>} (\$\mathbf{heap}_{funcstart\_724,1}.\mathbf{b1}))))
\rightarrow [expand definition of constant 'r1' at prang.c (15,20)]
[53.5] heap_{724,1:740.8} == heap_{funcstart\_724,1}-replace(p1 \rightarrow asType<short
int>((div(heapIs \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1, 177).rem *
asType<int>(asType<short int>((int)171))) -
(asType<int>(asType<short int>(div1.quot)) *
asType < int > (\$heap_{funcstart\_724,1}.b1))))
\rightarrow [simplify]
[53.8] heap_{724,1;740,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow asType<short
int > ((div(heapIs \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1, 177).rem * 171)
 - (asType < int > (asType < short int > (div1.quot))
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{b1}))))
\rightarrow [from term 11.6, div1 is equal to div(heapIs $heap_{funcstart\_724.1},
heap_{funcstart_{-724,1}}.p1, 177
[53.9] heap_{724,1:740,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow asType<short
int>((171 * div(heapIs $heap_{funcstart\_724,1}, $heap_{funcstart\_724,1}.p1, 177).rem)
 - (asType<int>(asType<short int>(div(heapIs $heap_{funcstart\_724,1},))
heap_{funcstart_{724,1}}.p1, 177).quot) *
asType < int > (\$heap_{funcstart\_724,1}.b1)))
\rightarrow [simplify]
[53.11] $\text{heap}_{724,1:740.8} == \text{heap}_{funcstart\_724,1}._\text{replace}(p1 \rightarrow \text{asType} < \text{short}
```

```
int>((171 * div(heapIs \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1, 177).rem)
- (\text{div}(\mathbf{heapIs} \$ \text{heap}_{funcstart\_724,1}, \$ \text{heap}_{funcstart\_724,1}.\text{p1}, 177).\text{quot} *
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{b1}))))
\rightarrow [const static or extern object]
[53.12] \theta_{12} = \theta_{124,1;740,8} = \theta_{124,1;74
int>((171 * div(heapIs \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1, 177).rem)
- (\text{div}(\mathbf{heapIs} \$ \text{heap}_{funcstart\_724,1}, \$ \text{heap}_{funcstart\_724,1}.\text{p1}, 177).\text{quot} *
asType < int > (\$heap_{init}.b1)))
\rightarrow [expand definition of constant 'b1' at prang.c (17,20)]
[53.13] \$ heap_{724,1;740,8} == \$ heap_{funcstart\_724,1}.\_\mathbf{replace} (p1 \to \mathbf{asType} < \mathbf{short})
int>((171 * div(heapIs \$heap_{tuncstart\_724.1}, \$heap_{tuncstart\_724.1}, p1, 177).rem)
- (div(heapIs \rho_{funcstart\_724,1}, \rho_{funcstart\_724,1.p1}, 177).quot *
\mathbf{asType}{<}\mathbf{int}{>}(\mathbf{asType}{<}\mathbf{short}\ \mathbf{int}{>}((\mathbf{int})2)))))
\rightarrow [simplify]
[53.19] $\text{heap}_{724,1;740,8} == \text{$heap}_{funcstart_724,1}.$\text{$_{-}$replace}(p1 \to ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 \ *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}. p1, 177).rem)))
[Take goal term]
[1.0] minof(short int) \leq ((asType<int>(asType<short int>(div2.rem)) *
asType < int > (\$heap_{724,1;740,8}.r2)) - (asType < int > (asType < short)
int>(div2.quot)) * asType< int>($heap_{724.1:740.8}.b2)))
\rightarrow [simplify]
[1.1] -32768 \leq ((asType<int>(asType<short int>(div2.rem)) *
asType < int > (\$heap_{724.1:740.8}.r2)) - (asType < int > (asType < short)
int>(div2.quot)) * asType<int>($heap<sub>724.1:740.8</sub>.b2)))
\rightarrow [from term 25.6, div2 is equal to div(heapIs $heap_{funcstart\_724,1},
heap_{funcstart_{-724,1}}.p2, 176
[1.2] -32768 \leq ((asType\leqint>(asType\leqshort int>(div(heapIs
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.p2, 176).rem)) *
asType < int > (\$heap_{724.1:740.8}.r2)) - (asType < int > (asType < short)
int>(div2.quot)) * asType< int>($heap_{724,1;740,8}.b2)))
\rightarrow [simplify]
[1.4] -32768 \leq ((div(heapIs $heap_{funcstart\_724,1}, $heap_{funcstart\_724,1}.p2,
176).rem * asType<int>($heap<sub>724,1;740,8</sub>.r2)) -
(asType < int > (asType < short int > (div2.quot)) *
asType<int>($heap<sub>724,1;740,8</sub>.b2)))
\rightarrow [from term 53.19, $heap<sub>724,1;740,8</sub> is equal to
heap_{funcstart\_724,1}._replace(p1 \rightarrow (-2 * div(heapIs heap_{funcstart\_724,1}),
heap_{funcstart\_724,1}.p1, 177).quot + (171 * div(heapIs $heap_{funcstart\_724,1}, 177).quot) + (171 * div(heapIs $heap_{funcstart\_724,1}, 17
```

```
heap_{funcstart_{-724,1}.p1, 177).rem}
\textit{[1.5] -32768} \leq ((\text{div}(\textbf{heapIs} \$ \text{heap}_{funcstart\_724,1}, \$ \text{heap}_{funcstart\_724,1}.\text{p2},
176).rem * asType<int>(p1 \rightarrow (-2 * p_{tuncstart})
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724.1}, \ \$ \operatorname{heap}_{funcstart\_724.1}. \operatorname{p1}, \ 177).\operatorname{rem}))).r2)) -
(asType<int>(asType<short int>(div2.quot))
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{724,1;740,8}.\mathrm{b2})))
→ [const member of object with modified fields]
[1.6] -32768 \leq ((\operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724,1}, \$ \operatorname{heap}_{funcstart\_724,1}.\operatorname{p2},
176).rem * asType < int > (\$heap_{funcstart\_724,1}.r2)) -
(asType<int>(asType<short int>(div2.quot)) *
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{724,1;740,8}.\mathrm{b2})))
\rightarrow [const static or extern object]
[1.7] \ -32768 \leq ((\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.\operatorname{p2},
176).rem * asType<int>($heap_{init}.r2)) - (asType<int>(asType<short
int>(div2.quot)) * asType<int>($heap<sub>724.1:740.8</sub>.b2)))
\rightarrow [expand definition of constant 'r2' at prang.c (20,20)]
[1.8] -32768 \leq ((div(heapIs $heap_{funcstart\_724.1}, $heap_{funcstart\_724.1}.p2,
176).rem * asType<int>(asType<short int>((int)172))) -
(asType<int>(asType<short int>(div2.quot)) *
asType<int>($heap<sub>724.1:740.8</sub>.b2)))
\rightarrow [simplify]
[1.11] -32768 \leq ((div(heapIs $heap_{funcstart\_724,1}, $heap_{funcstart\_724,1}.p2,
176).rem * 172) - (asType<int>(asType<short int>(div2.quot)) *
\mathbf{asType}{<}\mathbf{int}{>}(\${heap}_{724,1;740,8}.b2)))
\rightarrow [from term 25.6, div2 is equal to div(heapIs $heap_{funcstart\_724,1},
heap_{funcstart_{-724,1}}.p2, 176
[1.12] -32768 \leq ((172 * div(heapIs $heap_{funcstart\_724,1},)
\theta_{funcstart\_724,1.p2, 176}.rem) - (asType<int>(asType<short)
int>(div(heapIs \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p2, 176).quot))*
asType < int > (\$heap_{724,1;740,8}.b2)))
\rightarrow [simplify]
[1.14] -32768 \leq ((172 * div(heapIs $heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1}.\text{p2}, 176).\text{rem} - (div(heapIs \text{Sheap}_{funcstart\_724,1},
\text{sheap}_{funcstart\_724,1}.\text{p2}, 176).\text{quot} * \mathbf{asType} < \mathbf{int} > (\text{sheap}_{724,1;740,8}.\text{b2})))
\rightarrow [from term 53.19, $heap<sub>724,1;740,8</sub> is equal to
heap_{funcstart\_724,1}._replace(p1 \rightarrow (-2 * div(heapIs $heap_{funcstart\_724,1},
heap_{funcstart\_724,1}.p1, 177).quot + (171 * div(heapIs p_{funcstart\_724,1}),
heap_{funcstart_{-724,1},p1,177,rem}
```

```
 \label{eq:continuous} \mbox{[1.15] -32768} \leq ((172 * \mbox{div}(\mathbf{heapIs} \ \$ \mbox{heap}_{funcstart\_724,1}, \ \$ \mbox{heap}_{funcstart\_724,1}.\mbox{p2}, 
176).rem) – (\text{div}(\mathbf{heapIs} \$ \text{heap}_{funcstart\_724,1}, \$ \text{heap}_{funcstart\_724,1}.\text{p2},
176).quot * asType<int>($heap_{funcstart\_724,1}.\_replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).quot) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.\operatorname{p1}, \ 177).\operatorname{rem}))).\operatorname{b2})))
→ [const member of object with modified fields]
[1.16] -32768 \leq ((172 * div(heapIs $heap_{funcstart\_724,1},
\rho_{funcstart\_724,1.p2, 176}.rem) - (div(heapIs \rho_{funcstart\_724,1,p2})
\theta = \frac{176}{100} $\text{sheap}_{funcstart_724,1}$.p2, 176).quot * asType<int>(\text{sheap}_{funcstart_724,1}$.b2)))
\rightarrow [const static or extern object]
[1.17] -32768 \leq ((172 * div(heapIs $heap_{funcstart_724.1}),
heap_{funcstart\_724,1}.p2, 176).rem – (div(heapIs heap_{funcstart\_724,1},
\theta_{funcstart_{724,1},p2,176}, quot * asType<int>(\theta_{init})
\rightarrow [expand definition of constant 'b2' at prang.c (22,20)]
\label{eq:continuous} \mbox{[1.18] -32768} \leq ((172 * \mbox{div}(\mathbf{heapIs} \; \$ \mbox{heap}_{funcstart\_724,1}, \; \$ \mbox{heap}_{funcstart\_724,1}.\mbox{p2},
176).rem) - (\text{div}(\mathbf{heapIs} \$ \text{heap}_{funcstart\_724,1}, \$ \text{heap}_{funcstart\_724,1}.\text{p2},
176).quot * asType<int>(asType<short int>((int)35))))
\rightarrow [simplify]
 [1.25] -32769 < ((-35 * div(\mathbf{heapIs} \$ heap_{funcstart\_724,1}, \$ heap_{funcstart\_724,1}.p2,
176).quot) + (172 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_724,1}, \text{\$heap}_{funcstart\_724,1}.\text{p2},
176).rem))
\rightarrow [negate goal and search for contradiction]
[1.26] ! (-32769 < ((-35 * div(heapIs $heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724.1.p2}, 176).\text{quot} + (172 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724.1},
\theta_{funcstart_{-724,1}.p2, 176).rem}
\rightarrow [simplify]
[1.31] 32768 < ((35 * div(heapIs $heap_{funcstart\_724,1}, $heap_{funcstart\_724,1}.p2,
176).quot) + (-172 * \text{div}(\mathbf{heapIs} \$ \text{heap}_{funcstart\_724,1}, \$ \text{heap}_{funcstart\_724,1}.\text{p2},
176).rem))
[Copy term 1.31]
[62.0] 32768 < ((-172 * div(\mathbf{heapIs} \$heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1}.\text{p2}, 176).\text{rem} + (35 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
heap_{funcstart_{724,1}}.p2, 176).quot)
\rightarrow [from\ term\ 29.17,\ div(\textbf{heapIs}\ \$heap_{funcstart\_724,1},\ \$heap_{funcstart\_724,1}.p2,
176).rem is equal to heap_{funcstart_{724,1}}.p2 \% 176
[62.1] 32768 < ((-172 * (pap_{funcstart\_724,1}) + (35 * div(pap_{funcstart\_724,1}) + (35 * div(pap_{funcstart\_724,1})
heap_{funcstart_{-724.1}}, heap_{funcstart_{-724.1}}, p2, 176).quot)
[Create new term from term 28.17 using rule: condition for equality of division]
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```
[79.0] ((176 * (0 + -(-\text{div}(\mathbf{heapIs} \$ \text{heap}_{funcstart\_724,1},
\text{Sheap}_{funcstart_{724,1}.p2}, 176).\text{quot})) < (1 + \text{Sheap}_{funcstart_{724,1}.p2})) \land
(\text{$heap}_{funcstart\_724.1}.p2 < (176 * (0 + 1 + -(-div(\textbf{heapIs})))
heap_{funcstart_{724,1}}, heap_{funcstart_{724,1}}, 176).quot))))
\rightarrow [simplify]
[79.15] (-1 < ((-176 * div(heapIs \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p2,
(-176).quot) + \text{heap}_{funcstart\_724,1}.p2)) \land (-176 < (-\text{heap}_{funcstart\_724,1}.p2 +
(176 * \text{div}(\mathbf{heapIs} \$ \text{heap}_{funcstart\_724,1}, \$ \text{heap}_{funcstart\_724,1}.\text{p2}, 176).\text{quot})))
[Work on sub-term 2 of conjunction in term 79.15]
\textit{[80.0]} \ -1 < ((-176 \ ^* \ \mathrm{div}(\mathbf{heapIs} \ \$ \mathrm{heap}_{funcstart\_724,1}, \ \$ \mathrm{heap}_{funcstart\_724,1}.\mathrm{p2},
176).quot) + $heap<sub>funcstart_724,1.</sub>p2)
[Create new term from terms 80.0, 6.0 using rule: transitivity 2]
[92.0] (-30307 + -1 + 1) < (-176 * div(heapIs $heap_{funcstart\_724.1},
heap_{funcstart_{724,1}}.p2, 176).quot
\rightarrow [simplify]
[92.1] -30307 < (-176 * div(heapIs $heap_{funcstart\_724,1},
heap_{funcstart_{-724,1}}.p2, 176).quot
\rightarrow [literal comparison of product]
[92.2] ([-176 < 0]: (-30307 / 176) < -\text{div}(\text{heapIs } \text{$heap}_{funcstart\_724,1},
\theta_{100} = \theta_{1000} =
\$ heap_{funcstart\_724,1}, \$ heap_{funcstart\_724,1}.p2, \ 176).quot, \ [-176 == 0]: \ -30307 < 0.0000, \ [-176 == 0]: \ -30307 < 0.0000, \ [-176 == 0]: \ -30307 < 0.0000, \ [-176 == 0]: \ -30307 < 0.0000, \ [-176 == 0]: \ -30307 < 0.0000, \ [-176 == 0]: \ -30307 < 0.0000, \ [-176 == 0]: \ -30307 < 0.0000, \ [-176 == 0]: \ -30307 < 0.0000, \ [-176 == 0]: \ -30307 < 0.0000, \ [-176 == 0]: \ -30307 < 0.0000, \ [-176 == 0]: \ -30307 < 0.0000, \ [-176 == 0]: \ -30307 < 0.0000, \ [-176 == 0]: \ -30307 < 0.0000, \ [-176 == 0]: \ -30307 < 0.0000, \ [-176 == 0]: \ -30307 < 0.0000, \ [-176 == 0]: \ -30307 < 0.0000, \ [-176 == 0]: \ -30307 < 0.0000, \ [-176 == 0]: \ -30307 < 0.0000, \ [-176 == 0]: \ -30307 < 0.0000, \ [-176 == 0]: \ -30307 < 0.0000, \ [-176 == 0]: \ -30307 < 0.0000, \ [-176 == 0]: \ -30307 < 0.0000, \ [-176 == 0]: \ -30307 < 0.0000, \ [-176 == 0]: \ -30307 < 0.0000, \ [-176 == 0]: \ -30307 < 0.0000, \ [-176 == 0]: \ -30307 < 0.0000, \ [-176 == 0]: \ -30307 < 0.0000, \ [-176 == 0]: \ -30307 < 0.0000, \ [-176 == 0]: \ -30307 < 0.0000, \ [-176 == 0]: \ -30307 < 0.0000, \ [-176 == 0]: \ -30307 < 0.0000, \ [-176 == 0]: \ -30307 < 0.0000, \ [-176 == 0]: \ -30307 < 0.0000, \ [-176 == 0]: \ -30307 < 0.0000, \ [-176 == 0]: \ -30307 < 0.0000, \ [-176 == 0]: \ -30307 < 0.0000, \ [-176 == 0]: \ -30307 < 0.0000, \ [-176 == 0]: \ -30307 < 0.0000, \ [-176 == 0]: \ -30307 < 0.0000, \ [-176 == 0]: \ -30307 < 0.0000, \ [-176 == 0]: \ -30307 < 0.0000, \ [-176 == 0]: \ -30307 < 0.0000, \ [-176 == 0]: \ -30307 < 0.0000, \ [-176 == 0]: \ -30307 < 0.0000, \ [-176 == 0]: \ -30307 < 0.0000, \ [-176 == 0]: \ -30307 < 0.0000, \ [-176 == 0]: \ -30307 < 0.0000, \ [-176 == 0]: \ -30307 < 0.0000, \ [-176 == 0]: \ -30307 < 0.0000, \ [-176 == 0]: \ -30307 < 0.0000, \ [-176 == 0]: \ -30307 < 0.0000, \ [-176 == 0]: \ -30307 < 0.0000, \ [-176 == 0]: \ -30307 < 0.0000, \ [-176 == 0]: \ -30307 < 0.0000, \ [-176 == 0]: \ -30307 < 0.0000, \ [-176 == 0]: \ -30307 < 0.0000, \ [-176 == 0]: \ -30307 < 0.0000, \ [-176 == 0]: \ -30307 < 0.0000, \ [-
0)
→ [explicitly assert falsehood of skipped guards in subsequent guards]
[92.3] ([-176 < 0]: (-30307 / 176) < -\text{div}(\mathbf{heapIs} \$ \text{heap}_{funcstart\_724,1},
\label{eq:localization} $ \text{heap}_{funcstart\_724,1}.\text{p2},\ 176).\text{quot},\ [(0 < -176) \land !(-176 < 0)] \colon (-30307 \ / \ -176) $ 
< \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_724,1}, \text{\$heap}_{funcstart\_724,1}.\text{p2}, 176).\text{quot}, [(-176)]
==0) \land !(-176 < 0) \land !(0 < -176)]: -30307 < 0)
\rightarrow [simplify]
[92.7] \ -173 < -\mathrm{div}(\mathbf{heapIs} \ \$ \mathrm{heap}_{funcstart\_724,1}, \ \$ \mathrm{heap}_{funcstart\_724,1}.\mathrm{p2},
176).quot
[Create new term from terms 92.7, 62.1 using rule: transitivity 5]
 [94.0] \ 32768 < ((-172 \ * \ (\$heap_{funcstart\_724,1}.p2 \ \% \ 176)) \ + \ (35 \ * \ -(-173 \ + \ 1))) 
\rightarrow [simplify]
[94.5] 26748 < (-172 * (\$heap_{funcstart\_724,1}.p2 \% 176))
\rightarrow [literal comparison of product]
[94.6] ([-172 < 0]: (26748 / 172) < -(\text{\$heap}_{funcstart\_724,1}.p2 \% 176), [0 < 0]
-172]: (26748 / -172) < (\text{$heap}_{funcstart\_724,1}.p2 \% 176), [-172 == 0]: 26748 <
```

```
→ [explicitly assert falsehood of skipped guards in subsequent guards]
[94.7] ([-172 < 0]: (26748 / 172) < -(\$heap_{funcstart\_724,1}.p2 \% 176), [(0 <
-172) \land !(-172 < 0)]: (26748 / -172) < ($heap_{funcstart\_724,1}.p2 % 176), [(-172)]
==0) \land !(-172 < 0) \land !(0 < -172)]: 26748 < 0)
\rightarrow [simplify]
[94.12] false
Proof of verification condition: Type constraint satisfied in implicit
conversion from 'int' to 'short int'
Condition generated at: C:\Escher\Customers\prang\prang.c (58,33)
Condition defined at:
To prove: ((asType<int>(asType<short int>(div2.rem)) *
\mathbf{asType} \small{<} \mathbf{int} \small{>} (\$ \mathrm{heap}_{724,1;740,8}.\mathrm{r2})) \\ - (\mathbf{asType} \small{<} \mathbf{int} \small{>} (\mathbf{asType} \small{<} \mathbf{short} \\
int>(div2.quot)) * asType< int>($heap_{724.1:740.8}.b2))) \le maxof(short int)
Given:
heap_{init}.LIMIT == (int)80
heap_{init}.M1 == asType < short int > ((int)30269)
\theta
heap_{init}.a1 == asType < short int > ((int)177)
heap_{init}.b1 == asType < short int > ((int)2)
\theta sheap<sub>init</sub>.M2 == asType<short int>((int)30307)
\theta_{init}.r2 == asType<short int>((int)172)
heap_{init}.a2 == asType < short int > ((int)176)
\theta = asType < short int > ((int)35)
\theta = asType < short int > ((int)30323)
heap_{init}.r3 == asType < short int > ((int)170)
heap_{init}.a3 == asType < short int > ((int)178)
\theta = asType < short int > ((int)63)
\theta = asType < short int > ((int)1)
\theta
\theta = asType < short int > ((int)3)
invariant1(heapIs heap_{funcstart_{-724,1}})
\operatorname{div1} == \operatorname{div}(\mathbf{heapIs} \ \operatorname{\$heap}_{funcstart\_724,1},
```

0)

```
asType < int > (\$heap_{funcstart\_724,1}.p1),
asType < int > (\$heap_{funcstart\_724,1}.a1))
(\mathbf{asType}{<}\mathbf{integer}{>}(\mathbf{asType}{<}\mathbf{int}{>}(\$\mathbf{heap}_{funcstart\_724,1}.\mathbf{p1})) \ / \\
asType<integer>(asType<int>($heap_{tuncstart\_724.1}.a1))) ==
asType<integer>(div1.quot)
(\mathbf{asType} < \mathbf{integer} > (\mathbf{asType} < \mathbf{int} > (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p1})) \ \%
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathtt{a1}))) ==
asType<integer>(div1.rem)
!(0 == asType < integer > (div1.rem)) || !(0 ==
asType<integer>(div1.quot))
div2 == div(\mathbf{heapIs} \$ heap_{funcstart_{-724.1}},
asType < int > (\$heap_{funcstart\_724.1}.p2),
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{a2}))
(\mathbf{asType}{<}\mathbf{integer}{>}(\mathbf{asType}{<}\mathbf{int}{>}(\$\mathbf{heap}_{funcstart\_724,1}.\mathbf{p2})) \ / \\
asType<integer>(asType<int>($heap_{tuncstart\_724.1}.a2))) ==
asType<integer>(div2.quot)
(asType < int > (asType < int > (\$heap_{funcstart\_724,1}.p2)) \%
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a2))) = =
asType<integer>(div2.rem)
!(0 == asType < integer > (div2.rem)) || !(0 ==
asType<integer>(div2.quot))
div3 == div(\mathbf{heapIs} \$heap_{funcstart\_724,1},
asType < int > (\$heap_{funcstart\_724,1}.p3),
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{a3}))
(\mathbf{asType}{<}\mathbf{integer}{>}(\mathbf{asType}{<}\mathbf{int}{>}(\$\mathbf{heap}_{funcstart\_724,1}.\mathbf{p3})) \ / \\
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a3))) = =
asType<integer>(div3.quot)
(asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.p3)) \%
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a3))) = =
asType<integer>(div3.rem)
!(0 == asType < integer > (div3.rem)) || !(0 ==
asType<integer>(div3.quot))
heap_{724,1:740.8} == heap_{funcstart_{724,1}}._replace(p1 \rightarrow asType<short
int>((asType<int>(asType<short int>(div1.rem)) *
asType < int > (\$heap_{funcstart\_724,1}.r1)) - (asType < int > (asType < short)
int>(div1.quot)) * asType< int>($heap_{funcstart\_724,1}.b1))))
-asType < integer const > (\$heap_{724,1;740,8}.M1) < 1
asType < integer > ($heap_{724,1;740,8}.p1)
!(0 == asType < integer > (\$heap_{724,1;740,8}.p1))
```

```
asType < integer > (\$heap_{724,1;740,8}.p1) <
asType<integer>($heap<sub>724,1:740,8</sub>.M1)
Proof:
[Take given term]
[5.0] invariant1(heapIs heap_{funcstart\_724,1})
\rightarrow [expand definition of function 'invariant1' at prang.c (34,1)]
[5.1] ((((((0 < asType < integer > ($heap_{funcstart_724,1}.p1)) &&
(asType < integer > ($heap_{funcstart\_724,1}.p1) < 
asType < integer > (\$heap_{funcstart\_724,1}.M1))) \&\& (0 <
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{p2})))\ \&\&
(\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{p2}) <
asType < integer > (\$heap_{funcstart\_724,1}.M2))) \&\& (0 <
asType < integer > ($heap_{funcstart\_724,1}.p3))) &&
(\mathbf{asType} < \mathbf{integer} > (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p3}) <
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{M3}))
\rightarrow [simplify]
[5.3] (((((0 < \theta_{funcstart\_724,1.p1) && (\theta_{funcstart\_724,1.p1)
asType < integer > (\$heap_{funcstart\_724,1}.M1))) \&\& (0 < function for the start of the start 
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p2})))\ \&\&
(\mathbf{asType} < \mathbf{integer} > (\$ \mathrm{heap}_{funcstart\_724,1}.\mathrm{p2}) <
as
Type<integer>(\rho_{funcstart\_724,1}.M2))) & (0 <
asType < integer > (\$heap_{funcstart\_724,1}.p3))) \&\&
(\mathbf{asType} < \mathbf{integer} > (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p3}) <
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{M3}))
\rightarrow [const static or extern object]
[5.4] (((((0 < $heap_{funcstart_{724,1}}.p1) && ($heap_{funcstart_{724,1}}.p1 < ]
asType < integer > (\$heap_{init}.M1))) \&\& (0 <
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p2})))\ \&\&
(asType < integer > (\$heap_{funcstart\_724,1}.p2) <
asType<integer>(\theta_{tuncstart\_724,1}.M2))) && (0 <
asType < integer > (\$heap_{funcstart_{-724,1}}.p3))) \&\&
(\mathbf{asType} < \mathbf{integer} > (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p3}) <
asType < integer > (\$heap_{funcstart\_724,1}.M3))
\rightarrow [expand definition of constant 'M1' at prang.c (14,20)]
[5.5] (((((0 < $heap_{funcstart_{724,1}}.p1) && ($heap_{funcstart_{724,1}}.p1 < 
asType < integer > (asType < short int > ((int)30269)))) && (0 < integer) && (0 < integer
asType < integer > (\$heap_{funcstart\_724,1}.p2))) \&\&
(\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{p2}) <
as
Type<integer>(\rho_{funcstart\_724,1}.M2))) & (0 <
asType < integer > (\$heap_{funcstart\_724,1}.p3))) \&\&
(asType < integer > (\$heap_{funcstart\_724,1}.p3) <
```

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asType < integer > (\$heap_{funcstart_{-724,1}}.M3))
\rightarrow [simplify]
[5.16] ((((-30269 < -\$heap_{funcstart\_724,1}.p1) \land (0 < \$heap_{funcstart\_724,1}.p1) 
(0 < \text{\$heap}_{funcstart\_724,1}.p2)) \&\& (\text{\$heap}_{funcstart\_724,1}.p2 <
asType < integer > (\$heap_{funcstart\_724,1}.M2))) \&\& (0 <
asType < integer > (\$heap_{funcstart\_724,1}.p3))) \&\&
(\mathbf{asType} < \mathbf{integer} > (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p3}) <
asType < integer > (\$heap_{funcstart\_724,1}.M3))
\rightarrow [const static or extern object]
[5.17] \; ((((-30269 < -\$heap_{funcstart\_724,1}.p1) \; \land \; (0 < \$heap_{funcstart\_724,1}.p1) \; \land 
(0 < \text{$heap}_{funcstart_{-724,1}.p2})) \&\& (\text{$heap}_{funcstart_{-724,1}.p2} <
asType < integer > (\$heap_{init}.M2))) \&\& (0 <
asType < integer > (\$heap_{funcstart\_724,1}.p3))) \&\&
(\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{p3}) <
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{M3}))
\rightarrow [expand definition of constant 'M2' at prang.c (19,20)]
[5.18] ((((-30269 < -\$heap_{funcstart\_724,1}.p1) \land (0 < \$heap_{funcstart\_724,1}.p1) 
(0 < \text{\$heap}_{funcstart\_724,1}.p2)) \&\& (\text{\$heap}_{funcstart\_724,1}.p2 <
asType < integer > (asType < short int > ((int)30307)))) && (0 < footnote{integer}) && (0 < footnote
asType < integer > (\$heap_{funcstart\_724,1}.p3))) \&\&
(asType < integer > ($heap_{funcstart\_724,1}.p3) < 
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{M3}))
\rightarrow [simplify]
[5.30] ((-30307 < -$heap_{funcstart\_724,1}.p2) \land (-30269 <
-\$heap_{funcstart\_724,1}.p1) \land (0 < \$heap_{funcstart\_724,1}.p1) \land (0 < \$heap_{funcstart\_724,1}.p1)
\text{Sheap}_{funcstart_{724,1}.p2} \land (0 < \text{Sheap}_{funcstart_{724,1}.p3})) \&\&
(\text{\$heap}_{funcstart\_724,1}.\text{p3} < \mathbf{asType} < \mathbf{integer} > (\text{\$heap}_{funcstart\_724,1}.\text{M3}))
\rightarrow [const static or extern object]
[5.31] ((-30307 < -$heap<sub>funcstart_724,1.</sub>p2) \land (-30269 <
 -\$heap_{funcstart\_724,1}.p1) \land (0 < \$heap_{funcstart\_724,1}.p1) \land (0 < \$heap_{funcstart\_724,1}.p1)
\text{Sheap}_{funcstart\_724,1}.p2) \land (0 < \text{Sheap}_{funcstart\_724,1}.p3)) \&\&
(\text{\$heap}_{funcstart\_724,1}.\text{p3} < \text{asType} < \text{integer} > (\text{\$heap}_{init}.\text{M3}))
\rightarrow [expand definition of constant 'M3' at prang.c (24,20)]
[5.32] ((-30307 < -$heap<sub>funcstart_724,1.p2</sub>) \wedge (-30269 <
-\$heap_{funcstart\_724,1}.p1) \land (0 < \$heap_{funcstart\_724,1}.p1) \land (0 < \$heap_{funcstart\_724,1}.p1)
\text{Sheap}_{funcstart_{724,1}.p2} \land (0 < \text{Sheap}_{funcstart_{724,1}.p3})) \&\&
(\$heap_{funcstart\_724,1}.p3 < \mathbf{asType} < \mathbf{integer} > (\mathbf{asType} < \mathbf{short}
int > ((int)30323)))
\rightarrow [simplify]
[5.40] (-30323 < -$heap_funcstart_724,1.p3) \land (-30307 <
```

```
-\$heap_{funcstart\_724,1}.p2) \wedge (-30269 < -\$heap_{funcstart\_724,1}.p1) \wedge (0 <
\text{Sheap}_{funcstart\_724,1}.\text{p1}) \land (0 < \text{Sheap}_{funcstart\_724,1}.\text{p2}) \land (0 <
heap_{funcstart_{-724,1}.p3}
[Work on sub-term 5 of conjunction in term 5.40]
[9.0] 0 < $heap_{funcstart_724,1}.p2
[Take given term]
[11.0] \operatorname{div1} == \operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724,1},
asType < int > (\$heap_{funcstart\_724,1}.p1),
asType < int > (\$heap_{funcstart\_724,1}.a1))
\rightarrow [simplify]
[11.1] \ \mathrm{div1} == \mathrm{div}(\mathbf{heapIs} \ \$ \mathrm{heap}_{funcstart\_724,1}, \ \$ \mathrm{heap}_{funcstart\_724,1}.\mathrm{p1},
asType < int > (\$heap_{funcstart\_724.1}.a1))
\rightarrow [const static or extern object]
[11.2] \operatorname{div1} == \operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1,
asType < int > (\$heap_{init}.a1))
\rightarrow [expand definition of constant 'a1' at prang.c (16,20)]
[11.3] \ \mathrm{div1} == \mathrm{div}(\mathbf{heapIs} \ \$ \mathrm{heap}_{funcstart\_724,1}, \ \$ \mathrm{heap}_{funcstart\_724,1}.\mathrm{p1},
asType<int>(asType<short int>((int)177)))
\rightarrow [simplify]
[11.6] \ \mathrm{div1} == \mathrm{div}(\mathbf{heapIs} \ \$ \mathrm{heap}_{funcstart\_724,1}, \ \$ \mathrm{heap}_{funcstart\_724,1}.\mathrm{p1}, \ 177)
[Take given term]
[25.0] \operatorname{div2} == \operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724,1},
\mathbf{asType} < \mathbf{int} > (\$ \mathrm{heap}_{funcstart\_724,1}.\mathrm{p2}),
asType < int > (\$heap_{funcstart\_724,1}.a2))
\rightarrow [simplify]
[25.1] \operatorname{div2} == \operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724,1}, \$ \operatorname{heap}_{funcstart\_724,1}.p2,
asType < int > (\$heap_{funcstart\_724,1}.a2))
\rightarrow [const static or extern object]
[25.2]~{\rm div2} == {\rm div}(\mathbf{heapIs}~\$ \mathrm{heap}_{funcstart\_724,1},\,\$ \mathrm{heap}_{funcstart\_724,1}.\mathrm{p2},
asType < int > (\$heap_{init}.a2))
\rightarrow [expand definition of constant 'a2' at prang.c (21,20)]
\label{eq:continuous} \mbox{[25.3] div2} == \mbox{div}(\mathbf{heapIs} \ \mbox{\$heap}_{funcstart\_724,1}, \ \mbox{\$heap}_{funcstart\_724,1}.\mbox{p2},
asType<int>(asType<short int>((int)176)))
\rightarrow [simplify]
[25.6] div2 == div(heapIs $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}.p2, 176)
[Assume known post-assertion, class invariant or type constraint for term 25.6]
```

```
[28.0] (asType<integer>(peq_{funcstart\_724,1}.p2) /
asType<integer>(176)) == asType<integer>(div(heapIs
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.p2, 176).quot)
\rightarrow [simplify]
[28.2] ($heap<sub>funcstart_724,1.</sub>p2 / 176) == asType<integer>(div(heapIs)
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.p2, 176).quot)
→ [expand definition of operator './' in class 'int' at built in declaration]
[28.3] ([asType<integer>(heap_{funcstart\_724,1}.p2) < 0]:
-(-asType < integer > (\$heap_{funcstart\_724,1}.p2) / 176), []:
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p2}) \ / \ 176) ==
asType<integer>(div(heapIs $heap_{tuncstart\_724.1}, $heap_{tuncstart\_724.1}.p2,
→ [explicitly assert falsehood of skipped guards in subsequent guards]
[28.4] ([asType<integer>(heap_{funcstart\_724,1}.p2) < 0]:
-(-asType < integer > (\$heap_{funcstart\_724,1}.p2) / 176),
[!(\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathbf{heap}_{funcstart\_724,1}.\mathbf{p2})<0)]:
asType < integer > (\$heap_{funcstart\_724.1}.p2) / 176) = =
asType<integer>(div(heapIs heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p2,
176).quot)
\rightarrow [simplify]
[28.7] ([0 < -$heap<sub>funcstart_724,1</sub>.p2]:
-(-asType < integer > (\$heap_{funcstart\_724,1}.p2) / 176),
[!(asType < integer > (\$heap_{funcstart\_724,1}.p2) < 0)]:
asType < integer > (\$heap_{funcstart\_724,1}.p2) / 176) ==
\mathbf{asType} \small{<} \mathbf{integer} \small{>} ( \mathrm{div}(\mathbf{heapIs} \ \$ \mathrm{heap}_{funcstart\_724,1}, \ \$ \mathrm{heap}_{funcstart\_724,1}.\mathrm{p2}, \\
176).quot)
\rightarrow [from term 9.0, literala < -$heap<sub>funcstart_724.1</sub>.p2 is false whenever -2 < (0
+ literala)]
    Proof of rule precondition:
    [28.7.0] - 2 < (0 + 0)
    \rightarrow [simplify]
    [28.7.2] true
[28.8] \; ([\mathbf{false}]: \; -(-\mathbf{asType} < \mathbf{integer} > (\$ \mathrm{heap}_{funcstart\_724,1}.\mathrm{p2}) \; / \; 176),
[!(\mathbf{asType} < \mathbf{integer} > (\$ heap_{funcstart\_724,1}.p2) < 0)]:
asType < integer > (\$heap_{funcstart\_724.1}.p2) / 176) = =
asType<integer>(div(heapIs $heap_{tuncstart\_724.1}, $heap_{tuncstart\_724.1.p2},
176).quot)
\rightarrow [simplify]
[28.11] \; ([{\bf false}]: \; -({\bf -asType}{<} {\bf integer}{>} (\$ {\rm heap}_{funcstart\_724,1}.{\rm p2}) \; / \; 176), \; [!(0 <
```

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-\$heap_{funcstart\_724,1}.p2)]: asType<integer>(\$heap_{funcstart\_724,1}.p2) / 176)
== asType<integer>(div(heapIs $heap_{funcstart\_724,1},
heap_{funcstart_{-724,1}}.p2, 176).quot
\rightarrow [from term 9.0, literala < -$heap<sub>funcstart_724.1</sub>.p2 is false whenever -2 < (0
+ literala)]
   Proof of rule precondition:
   [28.11.0] - 2 < (0 + 0)
   \rightarrow [simplify]
   [28.11.2] true
[28.12] ([false]: -(-asType < integer > (\$heap_{funcstart\_724,1}.p2) / 176),
[!false]: asType<integer>($heap<sub>funcstart_724,1.</sub>p2) / 176) ==
\mathbf{asType} < \mathbf{integer} > (\mathbf{div}(\mathbf{heapIs} \ \$ \mathbf{heap}_{funcstart\_724,1}, \ \$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p2},
176).quot)
\rightarrow [simplify]
[28.17] 0 == (-div(heapIs \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}.p2,
176).quot + (heap_{funcstart\_724,1}.p2 / 176))
[Assume known post-assertion, class invariant or type constraint for term 25.6]
[29.0] (asType<integer>(sheap_{funcstart\_724,1}.p2) %
asType<integer>(176)) == asType<integer>(div(heapIs
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.\text{p2}, 176).\text{rem}
\rightarrow [simplify]
[29.2] ($heap<sub>funcstart_724,1.</sub>p2 % 176) == asType<integer>(div(heapIs)
\text{$heap}_{funcstart\_724,1}, \text{$heap}_{funcstart\_724,1}.p2, 176).rem
→ [expand definition of operator '.%' in class 'int' at built in declaration]
[29.3] ([asType<integer>(sheap_{funcstart\_724,1}.p2) < 0]:
-(-asType < integer > (\$heap_{funcstart\_724,1}.p2) \% 176), []:
asType < integer > (\$heap_{funcstart\_724,1}.p2) \% 176) ==
asType<integer>(div(heapIs $heap_{funcstart\_724,1}, $heap_{funcstart\_724,1}.p2,
176).rem)
→ [explicitly assert falsehood of skipped guards in subsequent guards]
[29.4] \; ([\mathbf{asType} < \mathbf{integer} > (\$ heap_{funcstart\_724,1}.p2) < 0]:
-(-asType < integer > (\$heap_{funcstart\_724,1}.p2) \% 176),
[!(asType < integer > (\$heap_{funcstart\_724,1}.p2) < 0)]:
asType < integer > (\$heap_{funcstart\_724,1}.p2) \% 176) ==
asType<integer>(div(heapIs $heap_{tuncstart\_724.1}, $heap_{tuncstart\_724.1}.p2,
176).rem)
\rightarrow [simplify]
[29.7] ([0 < -$heap<sub>funcstart_724,1</sub>.p2]:
```

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-(-asType < integer > (\$heap_{funcstart\_724,1}.p2) \% 176),
[!(\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{p2}) < 0)]:
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p2})~\%~176) ==
asType<integer>(div(heapIs $heap_funcstart_724,1, $heap_funcstart_724,1.p2,
176).rem)
\rightarrow [from term 9.0, literala < -$heap<sub>funcstart_724.1</sub>.p2 is false whenever -2 < (0
+ literala)]
    Proof of rule precondition:
    [29.7.0] - 2 < (0 + 0)
    \rightarrow [simplify]
    [29.7.2] true
[29.8] ([false]: -(-asType < integer > (\$heap_{funcstart\_724,1}.p2) \% 176),
[!(asType < integer > (\$heap_{funcstart\_724.1}.p2) < 0)]:
asType < integer > (\$heap_{funcstart\_724.1}.p2) \% 176) = =
\mathbf{asType} {<} \mathbf{integer} {>} ( \mathrm{div}(\mathbf{heapIs} \ \$ \mathrm{heap}_{funcstart\_724,1}, \ \$ \mathrm{heap}_{funcstart\_724,1}.\mathrm{p2}, \\
176).rem)
\rightarrow [simplify]
[29.11] ([false]: -(-asType < integer > (\$heap_{funcstart\_724,1}.p2) \% 176), [!(0)]
<-$heap_{funcstart\_724,1}.p2)]: asType<integer>($heap_{funcstart\_724,1}.p2) %
176) == asType<integer>(div(heapIs heapIs heap_{funcstart\_724,1},
heap_{funcstart_{-724,1}.p2, 176}.rem
\rightarrow [from term 9.0, literala < -$heap<sub>funcstart_724,1</sub>.p2 is false whenever -2 < (0
+ literala)
    Proof of rule precondition:
    [29.11.0] - 2 < (0 + 0)
    \rightarrow [simplify]
    [29.11.2] true
[29.12] ([false]: -(-asType < integer > (\$heap_{funcstart\_724,1}.p2) \% 176),
[!false]: asType<integer>($heap_{funcstart\_724,1}.p2) % 176) ==
\mathbf{asType} < \mathbf{integer} > (\mathbf{div}(\mathbf{heapIs} \ \$ \mathbf{heap}_{funcstart\_724,1}, \ \$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p2}, \\
176).rem)
\rightarrow [simplify]
[29.17] 0 == (-\text{div}(\mathbf{heapIs} \$ \text{heap}_{funcstart\_724,1}, \$ \text{heap}_{funcstart\_724,1}.\text{p2},
176).rem + (\text{$heap}_{funcstart\_724,1}.p2 \% 176))
[Take given term]
[38.0]!(0 == asType < integer > (div2.rem)) || !(0 ==
asType<integer>(div2.quot))
\rightarrow [from term 25.6, div2 is equal to div(heapIs $heap_{funcstart\_724,1},
```

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heap_{funcstart_{-724,1}}.p2, 176)
[38.1]!(0 == asType < integer) = (div(heapIs $heap_{tuncstart\_724,1}, 
\frac{\text{sheap}_{funcstart\_724,1.p2, 176}.rem)}{\text{l}} || !(0 == asType < integer > (div2.quot))}|
\rightarrow [simplify]
[38.2] !(0 == div(heapIs \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}.p2,
176).rem) ||!(0 == asType < integer > (div2.quot))
\rightarrow [from term 25.6, div2 is equal to div(heapIs $heap_{funcstart\_724,1},
heap_{funcstart_{724,1}}.p2, 176)
[38.3] !(0 == div(heapIs \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}.p2,
176).rem) || !(0 == asType < integer) = (div(heapIs $heap_{funcstart\_724,1}, 
heap_{funcstart_{-724,1}}.p2, 176).quot)
\rightarrow [simplify]
[38.5] ! (0 == \operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724,1}, \$ \operatorname{heap}_{funcstart\_724,1}.\operatorname{p2},
176).quot) \vee !(0 == \operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724,1}, \$ \operatorname{heap}_{funcstart\_724,1}.p2,
176).rem)
[Take given term]
[53.0] heap_{724,1:740,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow asType<short
int>((asType<int>(asType<short int>(div1.rem)) *
asType < int > (\$heap_{funcstart\_724,1}.r1)) - (asType < int > (asType < short)
int>(div1.quot)) * asType< int>($heap_{funcstart\_724,1}.b1))))
\rightarrow [from term 11.6, div1 is equal to div(heapIs $heap_{funcstart\_724,1},
heap_{funcstart_{-724,1}}.p1, 177
[53.1] \text{heap}_{724,1;740,8} == \text{heap}_{funcstart\_724,1}._replace(p1 \rightarrow asType<short
int>((asType<int>(asType<short int>(div(heapIs $heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1}.\text{p1}, 177).\text{rem}) * asType < int > (\text{Sheap}_{funcstart\_724,1}.\text{r1})) -
(asType<int>(asType<short int>(div1.quot)) *
asType < int > (\$heap_{funcstart\_724,1}.b1))))
\rightarrow [simplify]
[53.3] \rho_{13,1;740,8} == \rho_{13,1;740,8} == \rho_{13,1;740,8} =- \rho_{
int>((div(heapIs \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1, 177).rem *
\mathbf{asType} \hspace{-0.1em}<\hspace{-0.1em} \mathbf{int} \hspace{-0.1em}> \hspace{-0.1em} (\$ heap_{funcstart\_724,1}.r1)) - (\mathbf{asType} \hspace{-0.1em}<\hspace{-0.1em} \mathbf{int} \hspace{-0.1em}> \hspace{-0.1em} (\mathbf{asType} \hspace{-0.1em}<\hspace{-0.1em} \mathbf{short})
int>(div1.quot)) * asType< int>($heap_{funcstart\_724,1}.b1))))
\rightarrow [const static or extern object]
[53.4] \; \$ heap_{724,1;740,8} == \$ heap_{funcstart\_724,1}.\_\mathbf{replace} (p1 \to \mathbf{asType} < \mathbf{short}
\mathbf{int}{>}((\mathrm{div}(\mathbf{heapIs}\ \$\mathrm{heap}_{funcstart\_724,1},\ \$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p1},\ 177).\mathrm{rem}\ *
asType < int > (\$heap_{init}.r1)) - (asType < int > (asType < short)
int>(div1.quot)) * asType< int>($heap_{funcstart\_724,1}.b1))))
\rightarrow [expand definition of constant 'r1' at prang.c (15,20)]
```

```
[53.5] heap_{724,1;740,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow asType<short
int>((div(heapIs \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1, 177).rem *
asType<int>(asType<short int>((int)171))) -
(asType<int>(asType<short int>(div1.quot)) *
asType < int > (\$heap_{funcstart\_724,1}.b1))))
\rightarrow [simplify]
[53.8] heap_{724,1:740.8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow asType<short
int>((div(heapIs \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1, 177).rem * 171)
- (asType<int>(asType<short int>(div1.quot)) *
asType < int > (\$heap_{funcstart\ 724.1}.b1))))
\rightarrow [from term 11.6, div1 is equal to div(heapIs $heap_{funcstart\_724,1},
heap_{funcstart_{-724,1}}.p1, 177)
[53.9] \; \$ heap_{724,1;740,8} == \$ heap_{funcstart\_724,1}.\_\mathbf{replace} (p1 \to \mathbf{asType} < \mathbf{short}
\mathbf{int} > ((171 * \operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724,1}, \$ \operatorname{heap}_{funcstart\_724,1}.\operatorname{p1}, 177).\operatorname{rem})
- (asType<int>(asType<short int>(div(heapIs $heap_{funcstart_724,1},))
heap_{funcstart_{-724,1}}.p1, 177).quot)
asType < int > (\$heap_{funcstart\_724,1}.b1))))
\rightarrow [simplify]
[53.11] \theta_{13} = \theta_
int>((171 * div(heapIs $heap_{funcstart_724,1}, $heap_{funcstart_724,1}.p1, 177).rem)
- (\text{div}(\mathbf{heapIs} \$ \text{heap}_{funcstart\_724,1}, \$ \text{heap}_{funcstart\_724,1}.\text{p1}, 177).\text{quot} *
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{b1}))))
\rightarrow [const static or extern object]
[53.12] \theta_{12} = \theta_{124,1;740,8} = \theta_{124,1;74
\mathbf{int} > ((171 * \operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724,1}, \$ \operatorname{heap}_{funcstart\_724,1}.\operatorname{p1}, 177).\operatorname{rem})
- (\text{div}(\mathbf{heapIs} \$ \text{heap}_{funcstart\_724,1}, \$ \text{heap}_{funcstart\_724,1}.\text{p1}, 177).\text{quot} *
asType < int > (\$heap_{init}.b1)))
\rightarrow [expand definition of constant 'b1' at prang.c (17,20)]
[53.13] heap_{724,1;740,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow asType<short
int>((171 * div(heapIs $heap_{funcstart\_724,1}, $heap_{funcstart\_724,1}.p1, 177).rem)
- (\text{div}(\mathbf{heapIs} \$ \text{heap}_{funcstart\_724,1}, \$ \text{heap}_{funcstart\_724,1}.\text{p1}, 177).\text{quot} *
asType<int>(asType<short int>((int)2))))
\rightarrow [simplify]
[53.19] $\text{heap}_{724,1:740,8} == $\text{heap}_{funcstart\_724,1}._\text{replace}(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).quot) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.p1, \ 177).rem)))
[Take goal term]
[1.0] ((asType<int>(asType<short int>(div2.rem)) *
asType < int > (\$heap_{724.1:740.8}.r2)) - (asType < int > (asType < short)
int>(div2.quot) * asType<int>(heap_{724.1:740.8}.b2)) \leq maxof(short int)
```

```
\rightarrow [from term 25.6, div2 is equal to div(heapIs $heap_{funcstart\_724,1},
heap_{funcstart_{724,1}}.p2, 176
[1.1] ((asType<int>(asType<short int>(div(heapIs $heap_{funcstart\_724,1},
\text{sheap}_{funcstart\_724,1.p2, 176}.\text{rem}) * asType < int > (\text{sheap}_{724,1.740,8.r2})) -
(asType<int>(asType<short int>(div2.quot)) *
asType < int > (\$heap_{724.1:740.8}.b2))) \le maxof(short int)
\rightarrow [simplify]
[1.3] ((div(heapIs heap_{funcstart_{-724,1}}, heap_{funcstart_{-724,1}}, p_2, 176).rem *
\mathbf{asType}{<}\mathbf{int}{>}(\$\text{heap}_{724,1;740,8}.\text{r2})) - (\mathbf{asType}{<}\mathbf{int}{>}(\mathbf{asType}{<}\mathbf{short}
\mathbf{int}{>}(\mathrm{div2.quot})) \ * \ \mathbf{asType}{<} \mathbf{int}{>} (\$\mathrm{heap}_{724,1;740,8}.\mathrm{b2}))) \leq \mathbf{maxof}(\mathbf{short} \ \mathbf{int})
\rightarrow [from term 53.19, $heap<sub>724.1:740.8</sub> is equal to
heap_{funcstart\_724.1}._replace(p1 \rightarrow (-2 * div(heapIs heap_{funcstart\_724.1}),
heap_{funcstart_{724,1},p1, 177}, quot) + (171 * div(heapIs p_{funcstart_{724,1},p1, 177}), quot)
\$heap_{funcstart\_724,1}.p1,\ 177).rem))]
[1.4] ((div(heapIs \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, p_2, 176).rem *
asType < int > (\$heap_{funcstart\_724.1}.\_replace(p1 \rightarrow ((-2 * div(heapIs))))))
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.\text{p1}, 177).\text{quot}) + (171 * \text{div}(\text{heapIs}))
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.p1, 177).rem))).r2)) -
(asType<int>(asType<short int>(div2.quot)) *
asType < int > (\$heap_{724.1:740.8}.b2))) \le maxof(short int)
→ [const member of object with modified fields]
[1.5] ((div(heapIs heap_{funcstart_{724,1}}, heap_{funcstart_{724,1}}, p_2, 176).rem *
asType < int > (\$heap_{funcstart\_724,1}.r2)) - (asType < int > (asType < short)
int>(div2.quot)) * asType< int>($heap_{724,1;740,8}.b2))) \le maxof(short int)
\rightarrow [const static or extern object]
[1.6] ((div(heapIs \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, p_2, 176).rem *
asType < int > (\$heap_{init}.r2)) - (asType < int > (asType < short)
int>(div2.quot)) * asType< int>($heap_{724,1;740,8}.b2))) \le maxof(short int)
\rightarrow [expand definition of constant 'r2' at prang.c (20,20)]
[1.7] ((div(heapIs \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, p_2, 176).rem *
asType<int>(asType<short int>((int)172))) -
(asType<int>(asType<short int>(div2.quot)) *
asType < int > (\$heap_{724.1:740.8}.b2))) \le maxof(short int)
\rightarrow [simplify]
[1.10] ((div(heapIs $heap_{funcstart\_724,1}, $heap_{funcstart\_724,1}.p2, 176).rem *
172) - (asType<int>(asType<short int>(div2.quot))
asType < int > (\$heap_{724,1;740,8}.b2))) \le maxof(short int)
\rightarrow [from term 25.6, div2 is equal to div(heapIs $heap_{funcstart\_724,1},
heap_{funcstart_{-724,1},p2,176}
```

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[1.11] ((172 * div(heapIs heap_{funcstart-724,1}, heap_{funcstart-724,1.p2},
176).rem) - (asType<int>(asType<short int>(div(heapIs
heap_{funcstart_{724,1}}, heap_{funcstart_{724,1}}, 176).quot)
asType < int > (\$heap_{724,1;740,8}.b2))) \le maxof(short int)
\rightarrow [simplify]
[1.13] ((172 * div(heapIs heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p2,
176).rem) – (\text{div}(\mathbf{heapIs} \$ \text{heap}_{funcstart\_724,1}, \$ \text{heap}_{funcstart\_724,1}.p2,
176).quot * asType<int>($heap<sub>724.1:740.8</sub>.b2))) \leq maxof(short int)
\rightarrow [from term 53.19, $heap<sub>724,1;740,8</sub> is equal to
heap_{funcstart\_724,1}._replace(p1 \rightarrow (-2 * div(heapIs heap_{funcstart\_724,1}),
heap_{funcstart\_724,1}.p1, 177).quot + (171 * div(heapIs $heap_{funcstart\_724,1},
heap_{funcstart_{724,1}.p1, 177).rem}
[1.14] ((172 * div(heapIs $heap_{funcstart\_724,1}, $heap_{funcstart\_724,1}.p2,
176).rem) – (\operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724,1}, \$ \operatorname{heap}_{funcstart\_724,1}.p2,
176).quot * asType<int>($heap_{tuncstart\_724,1}._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).rem))).b2))) \le
maxof(short int)
\rightarrow [const member of object with modified fields]
[1.15] ((172 * div(heapIs \rho_{funcstart\_724,1}, \rho_{funcstart\_724,1}, \rho_{funcstart\_724,1},
176).rem) – (\text{div}(\mathbf{heapIs} \$ \text{heap}_{funcstart\_724,1}, \$ \text{heap}_{funcstart\_724,1}.p2,
176).quot * asType<int>($heap<sub>funcstart_724,1</sub>.b2))) \leq maxof(short int)
\rightarrow [const static or extern object]
[1.16] ((172 * div(heapIs $heap_{funcstart\_724,1}, $heap_{funcstart\_724,1}.p2,
176).rem) – (\text{div}(\mathbf{heapIs} \$ \text{heap}_{funcstart\_724,1}, \$ \text{heap}_{funcstart\_724,1}.\text{p2},
176).quot * asType < int > (\$heap_{init}.b2))) \le maxof(short int)
\rightarrow [expand definition of constant 'b2' at prang.c (22,20)]
[1.17] ((172 * div(heapIs heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p2,
176).rem) – (\text{div}(\mathbf{heapIs} \ \$\text{heap}_{funcstart\_724,1}, \ \$\text{heap}_{funcstart\_724,1}.\text{p2},
176).quot * asType<int>(asType<short int>((int)35)))) \leq maxof(short
int)
\rightarrow [simplify]
[1.36] -32768 < ((-172 * div(heapIs $heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724.1.p2}, 176).\text{rem} + (35 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724.1},
heap_{funcstart_{-724,1}.p2, 176}, quot))
\rightarrow [negate goal and search for contradiction]
[1.37]!(-32768 < ((-172 * div(heapIs $heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1}.\text{p2}, 176).\text{rem} + (35 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
heap_{funcstart_{-724.1}}.p2, 176).quot))
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\rightarrow [simplify]
[1.42] 32767 < ((172 * div(\mathbf{heapIs} \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p2,
176).rem) + (-35 * div(heapIs heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p2,
176).quot))
[Branch on disjunction or conditional in term 38.5]
[58.0] ! (0 == \operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.p2,
176).quot) \vee!(0 == div(heapIs $heap_{funcstart\_724,1}, $heap_{funcstart\_724,1}.p2,
176).rem) \vee (0 == div(heapIs heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p2,
176).quot)
[Copy term 1.42]
\label{eq:condition} \textit{[62.0] } 32767 < ((-35 * div(\textbf{heapIs} \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p2,
176).quot) + (172 * div(heapIs \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}.p2,
176).rem))
\rightarrow [from term 29.17, div(heapIs $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p2,
176).rem is equal to heap_{funcstart\_724,1}.p2 \% 176
\textit{[62.1] } 32767 < ((-35 * \text{div}(\textbf{heapIs} \$ \text{heap}_{funcstart\_724,1}, \$ \text{heap}_{funcstart\_724,1}.\text{p2},
176).quot) + (172 * (\text{$heap}_{funcstart\_724,1}.p2 \% 176)))
[Copy term 58.0]
[78.0] !(0 == div(heapIs heap_{funcstart_{-724,1}}, heap_{funcstart_{-724,1}}.p2,
176).quot) \vee!(0 == div(heapIs $heap_{funcstart\_724,1}, $heap_{funcstart\_724,1}.p2,
176).rem) \vee (0 == div(heapIs $heap_{funcstart\_724,1}, $heap_{funcstart\_724,1}.p2,
176).quot)
\rightarrow [from\ term\ 28.17,\ div(\mathbf{heapIs}\ \$heap_{funcstart\_724,1},\ \$heap_{funcstart\_724,1}.p2,
176).quot is equal to $heap_tuncstart_724.1.p2 / 176]
[78.1]!(0 == (\text{$heap}_{funcstart\_724,1}.p2 / 176)) \lor ...
[Create new term from term 28.17 using rule: condition for equality of division]
[79.0] ((176 * (0 + -(-\text{div}(\mathbf{heapIs} \$ \text{heap}_{funcstart\_724,1},
\text{Sheap}_{funcstart_724,1}.p2, 176).quot))) < (1 + \text{Sheap}_{funcstart_724,1}.p2)) \land
(heap_{funcstart\_724,1}.p2 < (176 * (0 + 1 + -(-div(heapIs)
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.p2, 176).quot))))
\rightarrow [simplify]
[79.15] (-1 < ((-176 * div(heapIs p_{funcstart_{-724,1}}, p_{funcstart_{-724,1}}, p_{funcstart_{-724,1}})
(-176).quot) + \text{heap}_{funcstart\_724,1}.p2)) \land (-176 < (-\text{heap}_{funcstart\_724,1}.p2 +
(176 * \text{div}(\mathbf{heapIs} \$ \text{heap}_{funcstart\_724,1}, \$ \text{heap}_{funcstart\_724,1}.\text{p2}, 176).\text{quot})))
\rightarrow [separate conjunction and work on first sub-term]
[79.16] -176 < (-\$heap_{funcstart\_724,1}.p2 + (176 * div(heapIs))]
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.p2, 176).quot)
[Create new term from term 78.1 using rule: condition for inequality of
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division]
[84.0] (!((0 * 176) < (1 + $heap_{funcstart_{724,1}}.p2)) \vee !($heap_{funcstart_{724,1}}.p2)
< (176 * (0 + 1))) \lor !(0 == \text{div}(\text{heapIs } \text{$heap}_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1}.\text{p2}, 176).\text{rem} \lor (0 == \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
heap_{funcstart_{-724,1}.p2, 176}.quot)
\rightarrow [simplify]
[84.3] (!(-1 < $heap_{funcstart_724,1}.p2) \vee !($heap_{funcstart_724,1}.p2 < (176 * (0 +
1))))) \vee ...
\rightarrow [from term 9.0, literala < $heap_{funcstart_724.1}.p2 is true whenever (-1 +
literala) < 0
        Proof of rule precondition:
        [84.3.0](-1+-1)<0
        \rightarrow [simplify]
        [84.3.2] true
[84.4] (!true \vee !($heap<sub>funcstart_724,1</sub>.p2 < (176 * (0 + 1)))) \vee ...
\rightarrow [simplify]
[84.14] (175 < \text{$heap}_{funcstart\_724,1}.p2) \lor ...
[Create new term from terms 84.14, 79.16 using rule: transitivity 3]
[85.0] ((-176 + 1 + 175) < (176 * div(heapIs $heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1}.\text{p2}, 176).\text{quot})) \lor !(0 == \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1}.\text{p2}, 176).\text{rem} \lor (0 == \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
heap_{funcstart_{-724,1}}.p2, 176).quot
\rightarrow [simplify]
[85.1] (0 < (176 * div(heapIs heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p2,
176).quot)) \vee ...
\rightarrow [product is positive]
[85.2] (((0 < 176) \land (0 < div(heapIs $heap<sub>funcstart_724,1</sub>,
heap_{funcstart\_724,1.p2}, 176).quot) \lor ((176 < 0) \land (div(heapIs))
\$ \mathrm{heap}_{funcstart\_724,1},\, \$ \mathrm{heap}_{funcstart\_724,1}.\mathrm{p2},\, 176).\mathrm{quot} < 0))) \,\vee\, \dots
\rightarrow [simplify]
[85.7] (0 < div(heapIs heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p2, 176).quot)
[Create new term from terms 85.7, 62.1 using rule: transitivity 11]
[87.0] ((1 + 32767 + (0 * 35)) < (172 * (part = 172 + 172 + 172 + 172 + 172 + 172 + 172 + 172 + 172 + 172 + 172 + 172 + 172 + 172 + 172 + 172 + 172 + 172 + 172 + 172 + 172 + 172 + 172 + 172 + 172 + 172 + 172 + 172 + 172 + 172 + 172 + 172 + 172 + 172 + 172 + 172 + 172 + 172 + 172 + 172 + 172 + 172 + 172 + 172 + 172 + 172 + 172 + 172 + 172 + 172 + 172 + 172 + 172 + 172 + 172 + 172 + 172 + 172 + 172 + 172 + 172 + 172 + 172 + 172 + 172 + 172 + 172 + 172 + 172 + 172 + 172 + 172 + 172 + 172 + 172 + 172 + 172 + 172 + 172 + 172 + 172 + 172 + 172 + 172 + 172 + 172 + 172 + 172 + 172 + 172 + 172 + 172 + 172 + 172 + 172 + 172 + 172 + 172 + 172 + 172 + 172 + 172 + 172 + 172 + 172 + 172 + 172 + 172 + 172 + 172 + 172 + 172 + 172 + 172 + 172 + 172 + 172 + 172 + 172 + 172 + 172 + 172 + 172 + 172 + 172 + 172 + 172 + 172 + 172 + 172 + 172 + 172 + 172 + 172 + 172 + 172 + 172 + 172 + 172 + 172 + 172 + 172 + 172 + 172 + 172 + 172 + 172 + 172 + 172 + 172 + 172 + 172 + 172 + 172 + 172 + 172 + 172 + 172 + 172 + 172 + 172 + 172 + 172 + 172 + 172 + 172 + 172 + 172 + 172 + 172 + 172 + 172 + 172 + 172 + 172 + 172 + 172 + 172 + 172 + 172 + 172 + 172 + 172 + 172 + 172 + 172 + 172 + 172 + 172 + 172 + 172 + 172 + 172 + 172 + 172 + 172 + 172 + 172 + 172 + 172 + 172 + 172 + 172 + 172 + 172 + 172 + 172 + 172 + 172 + 172 + 172 + 172 + 172 + 172 + 172 + 172 + 172 + 172 + 172 + 172 + 172 + 172 + 172 + 172 + 172 + 172 + 172 + 172 + 172 + 172 + 172 + 172 + 172 + 172 + 172 + 172 + 172 + 172 + 172 + 172 + 172 + 172 + 172 + 172 + 172 + 172 + 172 + 172 + 172 + 172 + 172 + 172 + 172 + 172 + 172 + 172 + 172 + 172 + 172 + 172 + 172 + 172 + 172 + 172 + 172 + 172 + 172 + 172 + 172 + 172 + 172 + 172 + 172 + 172 + 172 + 172 + 172 + 172 + 172 + 172 + 172 + 172 + 172 + 172 + 172 + 172 + 172 + 172 + 172 + 172 + 172 + 172 + 172 + 172 + 172 + 172 + 172 + 172 + 172 + 172 + 172 + 172 + 172 + 172 + 172 + 172 + 172 + 172 + 172 + 172 + 172 + 172 + 172 + 172 + 172 + 172 + 172 + 172 + 172 + 172 + 172 + 172 + 172 + 172 + 172 + 172 + 172 + 172 + 172 + 172 + 172 + 172 + 172 
== div(heapIs heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p2, 176).rem) \vee (0
== \operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p2, \ 176).quot)
```

```
\rightarrow [simplify]
[87.2] (32768 < (172 * ($heap_{funcstart\_724,1}.p2 % 176))) \vee ...
\rightarrow [literal comparison of product]
[87.3] ([172 < 0]: (32768 / -172) < -($heap_{funcstart\_724,1}.p2 % 176), [0 < 172]:
(32768 \ / \ 172) < (\$ heap_{funcstart\_724,1}.p2 \ \% \ 176), \ [0 == 172]: \ 32768 < 0) \ \lor \dots
→ [explicitly assert falsehood of skipped guards in subsequent guards]
[87.4] ([172 < 0]: (32768 / -172) < -($heap_{funcstart\_724.1}.p2 % 176), [(0 <
(172) \land !(172 < 0): (32768 / 172) < (\$heap_{funcstart\_724,1}.p2 \% 176), [(0 ==
172) \land !(0 < 172) \land !(172 < 0)]: 32768 < 0) \lor ...
\rightarrow [simplify]
[87.13] false \vee ...
Remove 'false' term 87.13 and fetch new term from containing clause
[90.0] 0 == \text{div}(\text{heapIs } \text{$heap}_{funcstart\_724,1}, \text{$heap}_{funcstart\_724,1}.p2, 176).quot
[Copy term 1.42]
\label{eq:continuous} \textit{[62.1] } 32767 < ((-35 * div(\textbf{heapIs} \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p2,
176).quot) + (172 * (\text{$heap}_{funcstart\_724,1}.p2 \% 176)))
\rightarrow [from term 90.0, div(heapIs $heap_{funcstart\_724,1}, $heap_{funcstart\_724,1}.p2,
176).quot is equal to 0
[62.2] 32767 < ((-35 * 0) + (172 * (\$heap_{funcstart\_724.1}.p2 \% 176)))
\rightarrow [simplify]
[62.4] 32767 < (172 * (\text{$heap}_{funcstart\_724,1}.\text{p2} \% 176))
\rightarrow [literal comparison of product]
\label{eq:continuous} \textit{[62.5]}\;(\texttt{[172<0]:}\;(32767\ /\ -172)<-(\$\text{heap}_{funcstart\_724,1}.\text{p2}\ \%\ 176),\,[0<172]:
(32767 / 172) < (\text{$heap}_{funcstart\_724,1}.p2 \% 176), [0 == 172]: 32767 < 0)
→ [explicitly assert falsehood of skipped guards in subsequent guards]
[62.6] ([172 < 0]: (32767 / -172) < -($heap_{funcstart\_724.1}.p2 % 176), [(0 <
172) \land !(172 < 0)]: (32767 / 172) < ($heap_{funcstart\_724,1}.p2 % 176), [(0 ==
172) \land !(0 < 172) \land !(172 < 0)]: 32767 < 0)
\rightarrow [simplify]
[62.15] false
Proof of verification condition: Assertion valid
Condition generated at: C:\Escher\Customers\prang\prang.c (59,31)
To prove: asType<integer>(\theta) (\theta) (\theta) (\theta)
asType<integer>($heap<sub>724,1;742,8</sub>.M2)
```

## Given:

```
heap_{init}.LIMIT == (int)80
\theta sheap<sub>init</sub>.M1 == asType<short int>((int)30269)
\theta_{init}.r1 == asType < short int > ((int)171)
heap_{init}.a1 == asType < short int > ((int)177)
\theta = asType < short int > ((int)2)
\theta sheap<sub>init</sub>.M2 == asType<short int>((int)30307)
\rho_{init}.r2 == asType < short int > ((int)172)
heap_{init}.a2 == asType < short int > ((int)176)
\theta = asType < short int > ((int)35)
\theta sheap<sub>init</sub>.M3 == asType<short int>((int)30323)
\theta_{init}.r3 == asType<short int>((int)170)
heap_{init}.a3 == asType<short int>((int)178)
\theta = asType < short int > ((int)63)
\theta = asType < short int > ((int)1)
\theta
\theta = asType < short int > ((int)3)
invariant
1(heapIs heap_{funcstart_{-724,1}})
\operatorname{div1} == \operatorname{div}(\mathbf{heapIs} \ \operatorname{\$heap}_{funcstart\_724,1},
asType < int > (\$heap_{funcstart\_724,1}.p1),
asType < int > (\$heap_{funcstart\_724,1}.a1))
(asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.p1)) /
\mathbf{asType}{<}\mathbf{integer}{>}(\mathbf{asType}{<}\mathbf{int}{>}(\$\mathbf{heap}_{funcstart\_724,1}.\mathbf{a1}))) = =
asType<integer>(div1.quot)
(asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.p1)) \%
\mathbf{asType}{<}\mathbf{integer}{>}(\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{a1}))) = =
asType<integer>(div1.rem)
!(0 == asType < integer > (div1.rem)) || !(0 ==
asType<integer>(div1.quot))
div2 == div(\mathbf{heapIs} \$heap_{funcstart\_724,1},
asType < int > (\$heap_{funcstart\_724,1}.p2),
asType < int > (\$heap_{funcstart\_724,1}.a2))
(asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.p2)) /
asType<integer>(asType<int>($heap_{tuncstart\_724.1}.a2))) ==
asType<integer>(div2.quot)
(asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.p2)) \%
```

```
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a2))) = =
asType<integer>(div2.rem)
!(0 == asType < integer > (div2.rem)) || !(0 ==
asType<integer>(div2.quot))
div3 == div(\mathbf{heapIs} \$ heap_{funcstart\_724,1},
asType < int > (\$heap_{funcstart\_724,1}.p3),
asType < int > (\$heap_{funcstart\_724,1}.a3))
(asType<integer>(asType<int>($heap_{tuncstart\_724.1}.p3)) /
\mathbf{asType}{<}\mathbf{integer}{>}(\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{a3}))) ==
asType<integer>(div3.quot)
(asType < integer > (asType < int > (\$heap_{tuncstart\_724.1}.p3)) \%
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a3))) = =
asType<integer>(div3.rem)
!(0 == asType < integer > (div3.rem)) || !(0 ==
asType<integer>(div3.quot))
heap_{724,1;740,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow asType<short
int>((asType<int>(asType<short int>(div1.rem)) *
asType < int > (\$heap_{funcstart\_724,1}.r1)) - (asType < int > (asType < short)
\mathbf{int}{>}(\mathbf{div1.quot})) * \mathbf{asType}{<} \mathbf{int}{>} (\$\mathbf{heap}_{funcstart\_724,1}.\mathbf{b1}))))
-asType<integer const>($heap<sub>724,1:740,8</sub>.M1) <
asType<integer>($heap<sub>724,1:740,8</sub>.p1)
!(0 == asType < integer > (\$heap_{724,1;740,8}.p1))
asType<integer>($heap<sub>724,1:740,8</sub>.p1) <
asType<integer>($heap<sub>724.1:740.8</sub>.M1)
heap_{724,1;742,8} == heap_{724,1;740,8}.replace(p2 \rightarrow asType<short
int>((asType<int>(asType<short int>(div2.rem)) *
asType < int > (\$heap_{724,1;740,8}.r2)) - (asType < int > (asType < short)
int>(div2.quot)) * asType< int>($heap_{724.1:740.8}.b2))))
-asType < integer const > (\$heap_{724,1:742.8}.M2) < 
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathrm{heap}_{724,1;742,8}.\mathrm{p2})
!(0 == asType < integer > (\$heap_{724,1;742,8}.p2))
Proof:
[Take given term]
[5.0] invariant1(heapIs heap_{funcstart\_724,1})
\rightarrow [expand definition of function 'invariant1' at prang.c (34,1)]
[5.1] ((((((0 < asType < integer > (heap_{funcstart_{-724,1}}.p1)) &&
(asType < integer > (\$heap_{funcstart\_724,1}.p1) <
asType < integer > (\$heap_{funcstart_{-724,1}}.M1))) \&\& (0 <
```

```
asType < integer > (\$heap_{funcstart\_724,1}.p2))) \&\&
(asType < integer > (\$heap_{funcstart\_724,1}.p2) < 
\mathbf{asType} {<} \mathbf{integer} {>} (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{M2}))) \ \&\& \ (0 <
asType < integer > (\$heap_{funcstart\_724,1}.p3))) \&\&
(\mathbf{asType} < \mathbf{integer} > (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p3}) <
asType<integer>($heap_funcstart_724,1.M3))
\rightarrow [simplify]
[5.3] (((((0 < \theta_{funcstart\_724,1.p1) && (\theta_{funcstart\_724,1.p1)
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{M1})))~\&\&~(0<
asType < integer > (\$heap_{funcstart\_724,1}.p2))) \&\&
(\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p2}) <
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{M2})))~\&\&~(0<
asType < integer > (\$heap_{funcstart\_724,1}.p3))) \&\&
(\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{p3}) <
asType < integer > (\$heap_{funcstart\_724,1}.M3))
\rightarrow [const static or extern object]
[5.4] (((((0 < $heap_{funcstart\_724,1}.p1) && ($heap_{funcstart\_724,1}.p1 < ])
asType < integer > (\$heap_{init}.M1))) \&\& (0 <
asType < integer > (\$heap_{funcstart\_724,1}.p2))) \&\&
(\mathbf{asType} < \mathbf{integer} > (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p2}) <
as
Type<integer>($heap_{funcstart\_724,1}.M2))) && (0 <
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{p3})))\ \&\&
(asType < integer > (\$heap_{funcstart_{-724.1}}.p3) < 
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{M3}))
\rightarrow [expand definition of constant 'M1' at prang.c (14,20)]
[5.5] (((((0 < $heap_{funcstart_{-724,1}}.p1) && ($heap_{funcstart_{-724,1}}.p1 < 
asType<integer>(asType<short int>((int)30269)))) && (0 <
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p2})))\ \&\&
(asType < integer > (\$heap_{funcstart\_724,1}.p2) <
asType<integer>(heap_{funcstart\_724,1}.M2))) && (0 <
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p3})))\ \&\&
(asType < integer > (\$heap_{funcstart\_724,1}.p3) < 
asType < integer > (\$heap_{funcstart\_724.1}.M3))
\rightarrow [simplify]
[5.16] \; ((((-30269 < -\$heap_{funcstart\_724,1}.p1) \; \land \; (0 < \$heap_{funcstart\_724,1}.p1) \; \land 
(0 < \text{\$heap}_{funcstart\_724,1}.p2)) \&\& (\text{\$heap}_{funcstart\_724,1}.p2 <
as
Type<integer>($heap_{funcstart\_724,1}.M2))) && (0 <
asType < integer > (\$heap_{tuncstart\_724.1}.p3))) \&\&
(\mathbf{asType} < \mathbf{integer} > (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p3}) <
\mathbf{asType} < \mathbf{integer} > (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{M3}))
\rightarrow [const static or extern object]
```

```
[5.17] ((((-30269 < -\$heap_{funcstart\_724,1}.p1) \land (0 < \$heap_{funcstart\_724,1}.p1) 
(0 < \text{\$heap}_{funcstart\_724,1}.p2)) \&\& (\text{\$heap}_{funcstart\_724,1}.p2 <
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathrm{heap}_{init}.\mathrm{M2})))~\&\&~(0<
asType < integer > (\$heap_{funcstart\_724,1}.p3))) \&\&
(\mathbf{asType} < \mathbf{integer} > (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p3}) <
asType<integer>($heap_funcstart_724,1.M3))
\rightarrow [expand definition of constant 'M2' at prang.c (19,20)]
[5.18] ((((-30269 < -\$heap_{funcstart\_724,1}.p1) \land (0 < \$heap_{funcstart\_724,1}.p1) 
(0 < \text{$heap}_{funcstart\_724,1}.p2)) \&\& (\text{$heap}_{funcstart\_724,1}.p2 <
asType<integer>(asType<short int>((int)30307)))) && (0 <
asType < integer > (\$heap_{funcstart\_724,1}.p3))) \&\&
(\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{p3}) <
asType < integer > (\$heap_{funcstart\_724,1}.M3))
\rightarrow [simplify]
[5.30] ((-30307 < -$heap_{tuncstart_724,1}.p2) \land (-30269 <
-\$heap_{funcstart\_724,1}.p1) \land (0 < \$heap_{funcstart\_724,1}.p1) \land (0 < \$heap_{funcstart\_724,1}.p1)
\text{Sheap}_{funcstart\_724,1.p2}) \land (0 < \text{Sheap}_{funcstart\_724,1.p3})) \&\&
(\text{\$heap}_{funcstart\_724,1}.\text{p3} < \text{asType} < \text{integer} > (\text{\$heap}_{funcstart\_724,1}.\text{M3}))
\rightarrow [const static or extern object]
[5.31] ((-30307 < -$heap<sub>funcstart_724,1.</sub>p2) \wedge (-30269 <
-\$heap_{funcstart\_724,1}.p1) \land (0 < \$heap_{funcstart\_724,1}.p1) \land (0 < \$heap_{funcstart\_724,1}.p1)
\text{Sheap}_{funcstart_{-724,1}.p2} \land (0 < \text{Sheap}_{funcstart_{-724,1}.p3})) \&\&
(\$heap_{funcstart\_724,1}.p3 < \mathbf{asType} < \mathbf{integer} > (\$heap_{init}.M3))
\rightarrow [expand definition of constant 'M3' at prang.c (24,20)]
[5.32] ((-30307 < -$heap_{funcstart\_724,1}.p2) \land (-30269 <
-\$heap_{funcstart\_724,1}.p1) \land (0 < \$heap_{funcstart\_724,1}.p1) \land (0 < \$heap_{funcstart\_724,1}.p1)
\text{Sheap}_{funcstart\_724,1}.p2) \land (0 < \text{Sheap}_{funcstart\_724,1}.p3)) \&\&
(\text{sheap}_{funcstart\_724,1}.p3 < asType < integer > (asType < short)
int > ((int)30323))
\rightarrow [simplify]
[5.40] (-30323 < -\$heap_{funcstart\_724,1}.p3) \land (-30307 < -30307)
 -\$heap_{funcstart\_724,1}.p2) \wedge (-30269 < -\$heap_{funcstart\_724,1}.p1) \wedge (0 <
\text{Sheap}_{funcstart\_724,1}.\text{p1}) \land (0 < \text{Sheap}_{funcstart\_724,1}.\text{p2}) \land (0 <
heap_{funcstart_{-724,1}.p3}
[Work on sub-term 5 of conjunction in term 5.40]
\textit{[9.0] 0} < \$ heap_{funcstart\_724,1}.p2
[Take given term]
[11.0] \operatorname{div1} == \operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724,1},
asType < int > (\$heap_{funcstart\_724,1}.p1),
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{a1}))
```

```
\rightarrow [simplify]
[11.1] \ \mathrm{div1} == \mathrm{div}(\mathbf{heapIs} \ \$ \mathrm{heap}_{funcstart\_724,1}, \ \$ \mathrm{heap}_{funcstart\_724,1}.\mathrm{p1},
asType < int > (\$heap_{funcstart\_724,1}.a1))
\rightarrow [const static or extern object]
\textit{[11.2]} \ \text{div1} == \text{div}(\mathbf{heapIs} \ \$ \text{heap}_{funcstart\_724,1}, \ \$ \text{heap}_{funcstart\_724,1}.\text{p1},
asType < int > (\$heap_{init}.a1))
\rightarrow [expand definition of constant 'a1' at prang.c (16,20)]
[11.3] \operatorname{div1} == \operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724,1}, \$ \operatorname{heap}_{funcstart\_724,1}.p1,
asType<int>(asType<short int>((int)177)))
\rightarrow [simplify]
[11.6] div1 == div(heapIs \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}.p1, 177)
[Take given term]
[25.0] \operatorname{div2} == \operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724,1},
asType < int > (\$heap_{funcstart\_724,1}.p2),
asType < int > (\$heap_{funcstart\_724,1}.a2))
\rightarrow [simplify]
[25.1] \operatorname{div2} == \operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p2,
asType < int > (\$heap_{funcstart\_724,1}.a2))
\rightarrow [const static or extern object]
[25.2] \operatorname{div2} == \operatorname{div}(\mathbf{heapIs} \operatorname{\$heap}_{funcstart\_724,1}, \operatorname{\$heap}_{funcstart\_724,1}.p2,
asType < int > (\$heap_{init}.a2))
\rightarrow [expand definition of constant 'a2' at prang.c (21,20)]
[25.3] div2 == div(heapIs \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}.p2,
asType<int>(asType<short int>((int)176)))
\rightarrow [simplify]
[25.6] \text{ div2} == \text{div}(\mathbf{heapIs} \$ \text{heap}_{funcstart\_724,1}, \$ \text{heap}_{funcstart\_724,1}.\text{p2}, 176)
[Assume known post-assertion, class invariant or type constraint for term 25.6]
[28.0] (asType<integer>(heap_{funcstart\_724,1}.p2) /
asType<integer>(176)) == asType<integer>(div(heapIs
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.\text{p2}, 176).\text{quot}
\rightarrow [simplify]
[28.2] ($heap<sub>funcstart_724.1</sub>.p2 / 176) == asType<integer>(div(heapIs)
heap_{funcstart_{724,1}}, heap_{funcstart_{724,1}}, p2, 176).quot
→ [expand definition of operator './' in class 'int' at built in declaration]
[28.3] ([asType<integer>(heap_{funcstart}_724.1.p2) < 0]:
-(-asType < integer > (\$heap_{funcstart\_724,1}.p2) / 176), []:
```

```
asType < integer > (\$heap_{funcstart\_724,1}.p2) / 176) ==
asType<integer>(div(heapIs heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p2,
176).quot)
→ [explicitly assert falsehood of skipped guards in subsequent guards]
[28.4] \; ([\mathbf{asType} < \mathbf{integer} > (\$ heap_{funcstart\_724,1}.p2) < 0]:
-(-asType < integer > (\$heap_{funcstart\_724,1}.p2) / 176),
[!(\mathbf{asType} < \mathbf{integer} > (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p2}) < 0)]:
asType < integer > (\$heap_{funcstart\_724,1}.p2) / 176) ==
\mathbf{asType} {<} \mathbf{integer} {>} ( \mathbf{div} (\mathbf{heapIs} \ \$ \mathbf{heap}_{funcstart\_724,1}, \ \$ \mathbf{heap}_{funcstart\_724,1}. \mathbf{p2}, \\
176).quot)
\rightarrow [simplify]
[28.7] ([0 < -$heap<sub>funcstart_724,1</sub>.p2]:
-(-asType < integer > (\$heap_{funcstart\_724,1}.p2) / 176),
[!(\mathbf{asType} < \mathbf{integer} > (\$ heap_{funcstart\_724,1}.p2) < 0)]:
asType < integer > (\$heap_{funcstart\_724,1}.p2) / 176) ==
asType<integer>(div(heapIs heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p2,
176).quot)
\rightarrow [from term 9.0, literala < -$heap<sub>funcstart_724.1</sub>.p2 is false whenever -2 < (0
+ literala)]
    Proof of rule precondition:
    [28.7.0] - 2 < (0 + 0)
    \rightarrow [simplify]
    [28.7.2] true
[28.8] ([false]: -(-asType < integer > (\$heap_{funcstart\_724,1}.p2) / 176),
[!(asType < integer > (\$heap_{funcstart\_724,1}.p2) < 0)]:
asType < integer > (\$heap_{funcstart\_724,1}.p2) / 176) ==
\mathbf{asType} < \mathbf{integer} > (\mathbf{div}(\mathbf{heapIs} \ \$ \mathbf{heap}_{funcstart\_724,1}, \ \$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p2}, \\
176).quot)
\rightarrow [simplify]
[28.11] ([false]: -(-asType < integer > (\$heap_{funcstart\_724,1}.p2) / 176), [!(0 <
-\$heap_{funcstart\_724,1}.p2)]: \ \mathbf{asType} < \mathbf{integer} > (\$heap_{funcstart\_724,1}.p2) \ / \ 176)
== asType < integer > (div(heapIs $heap_{funcstart\_724,1},
heap_{funcstart_{-724.1}}.p2, 176).quot
\rightarrow [from term 9.0, literala < -$heap<sub>funcstart_724,1</sub>.p2 is false whenever -2 < (0
+ literala)
    Proof of rule precondition:
    [28.11.0] - 2 < (0 + 0)
    \rightarrow [simplify]
```

```
[28.11.2] true
[28.12] ([false]: -(-asType < integer > (\$heap_{funcstart\_724,1}.p2) / 176),
[!false]: asType<integer>($heap<sub>funcstart_724,1.</sub>p2) / 176) ==
\mathbf{asType} < \mathbf{integer} > (\mathbf{div}(\mathbf{heapIs} \ \$ \mathbf{heap}_{funcstart\_724,1}, \ \$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p2}, \\
176).quot)
\rightarrow [simplify]
[28.17] 0 == (-div(heapIs \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}.p2,
176).quot + (\text{$heap}_{funcstart\_724,1}.p2 / 176))
[Assume known post-assertion, class invariant or type constraint for term 25.6]
[29.0] (asType<integer>(sheap_{funcstart\_724,1}.p2) %
asType<integer>(176)) == asType<integer>(div(heapIs
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.p2, 176).rem
\rightarrow [simplify]
[29.2] ($heap<sub>funcstart_724,1.</sub>p2 % 176) == asType<integer>(div(heapIs)
\text{Sheap}_{funcstart\_724.1}, \text{Sheap}_{funcstart\_724.1}.p2, 176).rem
→ [expand definition of operator '.%' in class 'int' at built in declaration]
[29.3] \; ([\mathbf{asType} < \mathbf{integer} > (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p2}) < 0] :
-(-asType < integer > (\$heap_{funcstart\_724,1}.p2) \% 176), []:
asType < integer > (\$heap_{funcstart\_724,1}.p2) \% 176) ==
asType<integer>(div(heapIs $heap_{funcstart\_724,1}, $heap_{funcstart\_724,1}.p2,
176).rem)
→ [explicitly assert falsehood of skipped guards in subsequent guards]
[29.4] \; ([\mathbf{asType} < \mathbf{integer} > (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p2}) < 0] :
-(-asType < integer > (\$heap_{funcstart\_724,1}.p2) \% 176),
[!(asType < integer > (\$heap_{funcstart\_724,1}.p2) < 0)]:
asType < integer > (\$heap_{funcstart\_724,1}.p2) \% 176) ==
asType<integer>(div(heapIs $heap_{tuncstart\_724.1}, $heap_{tuncstart\_724.1}.p2,
176).rem)
\rightarrow [simplify]
[29.7] ([0 < -$heap<sub>funcstart_724,1</sub>.p2]:
-(-asType < integer > (\$heap_{funcstart\_724,1}.p2) \% 176),
[!(\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{p2}) < 0)]:
asType < integer > (\$heap_{funcstart\_724,1}.p2) \% 176) ==
asType<integer>(div(heapIs $heap_funcstart_724,1, $heap_funcstart_724,1.p2,
\rightarrow [from term 9.0, literala < -$heap<sub>funcstart_724,1</sub>.p2 is false whenever -2 < (0
+ literala)]
   Proof of rule precondition:
   [29.7.0] - 2 < (0 + 0)
```

```
\rightarrow [simplify]
   [29.7.2] true
[29.8] ([false]: -(-asType < integer > (\$heap_{funcstart\_724,1}.p2) \% 176),
[!(asType < integer > (\$heap_{funcstart\_724,1}.p2) < 0)]:
asType < integer > (\$heap_{funcstart\_724,1}.p2) \% 176) ==
asType<integer>(div(heapIs heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p2,
176).rem)
\rightarrow [simplify]
[29.11] ([false]: -(-asType < integer > ($heap_{funcstart\_724,1}.p2) \% 176), [!(0
<-$heap<sub>funcstart_724,1.</sub>p2)]: asType<integer>($heap<sub>funcstart_724,1.</sub>p2) %
176) == asType<integer>(div(heapIs heapIs heapfuncstart_{-724,1},
heap_{funcstart_{-724,1}.p2, 176}.rem)
\rightarrow [from term 9.0, literala < -$heap<sub>funcstart_724,1</sub>.p2 is false whenever -2 < (0
+ literala)]
   Proof of rule precondition:
   [29.11.0] - 2 < (0 + 0)
   \rightarrow [simplify]
   [29.11.2] true
[29.12] ([false]: -(-asType < integer > (\$heap_{funcstart\_724,1}.p2) \% 176),
[!false]: asType<integer>(sheap_{funcstart\_724,1.p2}) \% 176 ==
\mathbf{asType} < \mathbf{integer} > (\mathbf{div}(\mathbf{heapIs} \ \$ \mathbf{heap}_{funcstart\_724,1}, \ \$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p2},
176).rem)
\rightarrow [simplify]
[29.17] \ 0 == (-\text{div}(\mathbf{heapIs} \ \$ \text{heap}_{funcstart\_724,1}, \ \$ \text{heap}_{funcstart\_724,1}.\text{p2},
176).rem + (\text{$heap}_{funcstart\_724,1}.p2 \% 176))
[Take given term]
[38.0]!(0 == asType < integer > (div2.rem)) || !(0 ==
asType<integer>(div2.quot))
\rightarrow [from term 25.6, div2 is equal to div(heapIs $heap_{funcstart\_724,1},
heap_{funcstart_{-724,1}}.p2, 176
[38.1] !(0 == asType<integer>(div(heapIs \theta_{funcstart\_724,1}),
heap_{funcstart\_724,1.p2, 176}.rem) | | !(0 == asType < integer > (div2.quot))
\rightarrow [simplify]
[38.2] !(0 == div(heapIs \text{$heap}_{funcstart\_724,1}, \text{$heap}_{funcstart\_724,1}.p2,
176).rem) ||!(0 == asType < integer > (div2.quot))
\rightarrow [from term 25.6, div2 is equal to div(heapIs $heap_{funcstart\_724,1},
heap_{funcstart_{724,1}}.p2, 176
```

```
[38.3] !(0 == div(heapIs heap_{funcstart-724,1}, heap_{funcstart-724,1}.p2,
176).rem) || !(0 == asType < integer) > (div(heapIs \$heap_{funcstart\_724,1}, 
\theta_{funcstart_{724,1},p2,176}.quot))
\rightarrow [simplify]
[38.5] !(0 == div(heapIs heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p2,
176).quot) \vee !(0 == \text{div}(\mathbf{heapIs} \$ heap_{funcstart\_724,1}, \$ heap_{funcstart\_724,1}.p2,
176).rem)
[Take given term]
[53.0] \text{sheap}_{724,1;740,8} == \text{sheap}_{funcstart\_724,1}._replace(p1 \rightarrow asType<short
int>((asType<int>(asType<short int>(div1.rem)) *
asType < int > (\$heap_{tuncstart\_724.1}.r1)) - (asType < int > (asType < short)
\mathbf{int}{>}(\mathbf{div1.quot})) \ * \ \mathbf{asType}{<} \mathbf{int}{>} (\$\mathbf{heap}_{funcstart\_724,1}.\mathbf{b1}))))
\rightarrow [from term 11.6, div1 is equal to div(heapIs $heap_{funcstart_{724,1}},
heap_{funcstart_{-724,1}}.p1, 177
[53.1] \theta == 
\mathbf{int}{>}((\mathbf{asType}{<}\mathbf{int}{>}(\mathbf{asType}{<}\mathbf{short}\ \mathbf{int}{>}(\mathbf{div}(\mathbf{heapIs}\ \$\mathbf{heap}_{funcstart\_724,1},
\text{Sheap}_{funcstart=724,1}.\text{p1}, 177).\text{rem}) * asType < int > (\text{Sheap}_{funcstart=724,1}.\text{r1})) -
(asType<int>(asType<short int>(div1.quot)) *
asType < int > (\$heap_{funcstart\_724,1}.b1))))
\rightarrow [simplify]
[53.3] \text{heap}_{724,1;740,8} == \text{heap}_{funcstart\_724,1}._replace(p1 \rightarrow asType<short
int>((div(heapIs \$heap_{funcstart\_724.1}, \$heap_{funcstart\_724.1}, p1, 177).rem *
asType < int > (\$heap_{funcstart\_724,1}.r1)) - (asType < int > (asType < short)
\mathbf{int}{>}(\mathbf{div1.quot})) * \mathbf{asType}{<} \mathbf{int}{>} (\$\mathbf{heap}_{funcstart\_724,1}.\mathbf{b1}))))
\rightarrow [const static or extern object]
[53.4] heap_{724,1;740,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow asType<short
int>((div(heapIs \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1, 177).rem *
asType < int > (\$heap_{init}.r1)) - (asType < int > (asType < short)
int>(div1.quot)) * asType< int>($heap_{funcstart\_724,1}.b1))))
\rightarrow [expand definition of constant 'r1' at prang.c (15,20)]
[53.5] \rho_{13,1;740,8} == \rho_{
int>((div(heapIs \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1, 177).rem *
asType < int > (asType < short int > ((int)171))) -
(asType<int>(asType<short int>(div1.quot)) *
\mathbf{asType} < \mathbf{int} > (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{b1}))))
\rightarrow [simplify]
[53.8] heap_{724,1;740,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow asType<short
int>((div(heapIs \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1, 177).rem * 171)
- (asType<int>(asType<short int>(div1.quot))
asType < int > (\$heap_{funcstart\_724,1}.b1))))
```

```
\rightarrow [from term 11.6, div1 is equal to div(heapIs $heap_{tuncstart_724.1},
heap_{funcstart_{724,1}}.p1, 177
[53.9] heap_{724,1:740,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow asType<short
int > ((171 * div(heapIs \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1, 177).rem)
- (asType<int>(asType<short int>(div(heapIs $heap_{funcstart_724.1},
heap_{funcstart_{724,1}}.p1, 177).quot) *
asType < int > (\$heap_{funcstart\_724,1}.b1))))
\rightarrow [simplify]
[53.11] \theta_{13} = \theta_
int>((171 * div(heapIs \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1, 177).rem)
- (div(heapIs heap_{funcstart_{724,1}}, heap_{funcstart_{724,1}}, 177).quot *
asType < int > (\$heap_{funcstart\_724,1}.b1))))
\rightarrow [const static or extern object]
[53.12] \theta_{12} = \theta_{124,1;740,8} = \theta_{124,1;74
int>((171 * div(heapIs \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1, 177).rem)
- (\text{div}(\mathbf{heapIs} \$ \text{heap}_{funcstart\_724.1}, \$ \text{heap}_{funcstart\_724.1}. \text{p1}, 177).\text{quot} *
asType < int > (\$heap_{init}.b1)))
\rightarrow [expand definition of constant 'b1' at prang.c (17,20)]
[53.13] \theta_{13} = \theta_
int>((171 * div(heapIs $heap_{funcstart\_724,1}, $heap_{funcstart\_724,1}.p1, 177).rem)
- (\text{div}(\mathbf{heapIs} \$ \text{heap}_{funcstart\_724,1}, \$ \text{heap}_{funcstart\_724,1}.\text{p1}, 177).\text{quot} *
asType<int>(asType<short int>((int)2))))
\rightarrow [simplify]
[53.19] $\text{heap}_{724,1;740,8} == \text{$heap}_{funcstart\_724,1}.$\text{-replace}(p1 \to ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.p1, \ 177).rem)))
[Take given term]
[57.0] $\text{heap}_{724,1:742,8} == $\text{heap}_{724,1:740,8}._\text{replace}(p2 \to \text{asType} < \text{short}
int>((asType<int>(asType<short int>(div2.rem)) *
asType < int > (\$heap_{724,1:740,8}.r2)) - (asType < int > (asType < short)
int>(div2.quot)) * asType<int>($heap<sub>724,1:740,8</sub>.b2))))
\rightarrow [from term 53.19, $heap<sub>724,1;740,8</sub> is equal to
heap_{funcstart\_724.1}._replace(p1 \rightarrow (-2 * div(heapIs heap_{funcstart\_724.1}),
\text{Sheap}_{funcstart\_724,1.p1}, 177).\text{quot} + (171 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
heap_{funcstart_{724,1}.p1, 177).rem}
[57.1] heap_{724,1;742,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).quot) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1,
(177).rem))._replace(p2 \rightarrow asType<short
int>((asType<int>(asType<short int>(div2.rem)) *
```

```
asType < int > (\$heap_{724.1:740.8}.r2)) - (asType < int > (asType < short)
int > (div2.quot)) * asType < int > (\$heap_{724,1;740,8}.b2))))
\rightarrow [from term 25.6, div2 is equal to div(heapIs $heap_{funcstart_{724,1}},
heap_{funcstart_{724,1}}.p2, 176
[57.2] $\text{heap}_{724,1;742,8} == $\text{heap}_{funcstart\_724,1}._\text{replace}(p1 \to ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.p1,
177).rem))).\_replace(p2 \rightarrow asType < short
int>((asType<int>(asType<short int>(div(heapIs $heap_{funcstart\_724.1},
\text{Sheap}_{funcstart\ 724,1}.\text{p2},\ 176).\text{rem}) * asType < int > (\text{Sheap}_{724,1:740.8}.\text{r2})) -
(asType<int>(asType<short int>(div2.quot)) *
asType < int > (\$heap_{724,1;740,8}.b2))))
\rightarrow [simplify]
[57.4] heap_{724,1;742,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 \ *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.p1,
177).rem))).\_\mathbf{replace}(p2 \to \mathbf{asType} < \mathbf{short\ int} > ((div(\mathbf{heapIs}))))
heap_{funcstart_{724,1}}, heap_{funcstart_{724,1}}.p2, 176).rem *
asType < int > (\$heap_{724,1:740.8}.r2)) - (asType < int > (asType < short)
int>(div2.quot)) * asType<int>($heap<sub>724.1:740.8</sub>.b2))))
\rightarrow [from term 53.19, $heap<sub>724,1;740,8</sub> is equal to
heap_{funcstart\_724,1}._replace(p1 \rightarrow (-2 * div(heapIs p_{funcstart\_724,1}),
heap_{funcstart\_724,1}.p1, 177).quot + (171 * div(heapIs p_{funcstart\_724,1}),
heap_{funcstart_{-724,1}}.p1, 177).rem)
[57.5] heap_{724,1;742,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 *
\operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724,1}, \$ \operatorname{heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow asType<short int>((div(heapIs
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.p2, 176).rem *
asType < int > (\$heap_{funcstart\_724,1}.\_replace(p1 \rightarrow ((-2 * div(heapIs))))))
\theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}
\label{eq:heapfuncstart_724,1} \$ heap_{funcstart\_724,1}.p1,\ 177).rem))).r2)) \ -
(asType<int>(asType<short int>(div2.quot)) *
asType<int>($heap<sub>724,1;740,8</sub>.b2))))
\rightarrow [const member of object with modified fields]
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 \ *
\operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724.1}, \$ \operatorname{heap}_{funcstart\_724.1}.p1,
177).rem)))._{\mathbf{replace}}(p2 \rightarrow \mathbf{asType} < \mathbf{short\ int} > ((\operatorname{div}(\mathbf{heapIs}))))
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.p2, 176).rem *
asType < int > (\$heap_{funcstart\_724,1}.r2)) - (asType < int > (asType < short)
int>(div2.quot)) * asType< int>($heap_{724,1:740,8}.b2))))
```

```
\rightarrow [const static or extern object]
[57.7] heap_{724,1;742,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow asType<short int>((div(heapIs
heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p2, 176).rem *
asType < int > (\$heap_{init}.r2)) - (asType < int > (asType < short)
int>(div2.quot)) * asType<int>($heap<sub>724.1:740.8</sub>.b2))))
\rightarrow [expand definition of constant 'r2' at prang.c (20,20)]
[57.8] heap_{724,1;742,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 *
div(\mathbf{heapIs} \ \$heap_{funcstart\_724,1}, \ \$heap_{funcstart\_724,1}.p1, \ 177).quot) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1,
177).rem)))._{\mathbf{replace}}(p2 \rightarrow \mathbf{asType} < \mathbf{short\ int} > ((\operatorname{div}(\mathbf{heapIs}))))
heap_{funcstart_{724,1}}, heap_{funcstart_{724,1},p2,176}.rem *
asType<int>(asType<short int>((int)172))) -
(asType<int>(asType<short int>(div2.quot)) *
asType<int>($heap<sub>724.1:740.8</sub>.b2))))
\rightarrow [simplify]
[57.11] $\text{heap}_{724,1;742,8} == \text{$heap}_{funcstart\_724,1}._\text{$replace}(p1 \to ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow asType<short int>((div(heapIs
heap_{funcstart_{-724,1}}, heap_{funcstart_{-724,1}}.p2, 176).rem * 172) -
(asType<int>(asType<short int>(div2.quot)) *
asType < int > (\$heap_{724,1;740,8}.b2))))
\rightarrow [from term 25.6, div2 is equal to div(heapIs $heap_{funcstart_724,1},
heap_{funcstart_{724,1},p2,176}
[57.12] $\text{heap}_{724,1;742,8} == \text{$heap}_{funcstart\_724,1}._\text{replace}(p1 \to ((-2 *
div(\mathbf{heapIs} \ \$heap_{funcstart\_724.1}, \ \$heap_{funcstart\_724.1}.p1, \ 177).quot) + (171 *
\operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724,1}, \$ \operatorname{heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow asType<short int>((172 * div(heapIs
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.p2, 176).rem) -
(asType < int > (asType < short int > (div(heapIs $heap_{funcstart\_724,1}, 
\text{Sheap}_{funcstart\_724,1}.\text{p2}, 176).\text{quot}) * asType < int > (\text{Sheap}_{724,1;740,8}.\text{b2}))))
\rightarrow [simplify]
[57.14] heap_{724,1;742,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).quot) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow asType<short int>((172 * div(heapIs
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.\text{p2}, 176).\text{rem}) - (\text{div}(\text{heapIs})
heap_{funcstart_{724,1}}, heap_{funcstart_{724,1}}, 2, 176).quot *
asType < int > (\$heap_{724,1;740,8}.b2))))
```

```
\rightarrow [from term 53.19, $heap<sub>724.1:740.8</sub> is equal to
heap_{funcstart\_724,1}._replace(p1 \rightarrow (-2 * div(heapIs heap_{funcstart\_724,1}),
\text{Sheap}_{funcstart\_724,1}.p1, 177).quot) + (171 * div(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
heap_{funcstart_{-724,1}}.p1, 177).rem
[57.15] $heap<sub>724,1;742,8</sub> == $heap<sub>funcstart_724,1</sub>._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.\operatorname{p1}, \ 177).\operatorname{quot}) + (171 \ *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow asType<short int>((172 * div(heapIs
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.\text{p2}, 176).\text{rem}) - (\text{div}(\text{heapIs})
heap_{funcstart_{724,1}}, heap_{funcstart_{724,1}}.p2, 176).quot *
\mathbf{asType}{<}\mathbf{int}{>}(\$\text{heap}_{funcstart\_724,1}.\mathbf{\_replace}(\text{p1} \rightarrow ((\text{-}2 * \text{div}(\mathbf{heapIs}
\theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}
heap_{funcstart_{-724.1}}, heap_{funcstart_{-724.1}}, 177).rem)).b2))))
\rightarrow [const member of object with modified fields]
[57.16] $\text{heap}_{724.1:742.8} == $\text{heap}_{funcstart_724.1}._\text{replace}(p1 \to ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 \ *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow asType<short int>((172 * div(heapIs
heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p2, 176).rem) - (div(heapIs
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.p2, 176).quot *
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{b2}))))
\rightarrow [const static or extern object]
[57.17] $heap<sub>724,1;742,8</sub> == $heap<sub>funcstart_724,1</sub>._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 *
\operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724,1}, \$ \operatorname{heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow asType<short int>((172 * div(heapIs
\theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}
heap_{funcstart_{724,1}}, heap_{funcstart_{724,1}}, 2, 176.quot *
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{init}.\mathrm{b2}))))
\rightarrow [expand definition of constant 'b2' at prang.c (22,20)]
[57.18] $\text{heap}_{724,1;742,8} == \text{$heap}_{funcstart\_724,1}.$\text{$_-replace}(p1 \to ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 \ *
\operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724,1}, \$ \operatorname{heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow asType<short int>((172 * div(heapIs
\theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}.p2, 176).rem) - \theta_{funcstart\_724,1}.p2, 176).rem) - \theta_{funcstart\_724,1}
\theta_{funcstart_{724,1}}, \theta_{funcstart_{724,1}}, \theta_{funcstart_{724,1}}, \theta_{funcstart_{724,1}}
asType<int>(asType<short int>((int)35)))))
\rightarrow [simplify]
[57.24] $\text{heap}_{724,1:742,8} == \text{$heap}_{funcstart\_724,1}.$\text{$_-\text{replace}(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).quot) + (171 *
\label{eq:div_heap} \text{div}(\textbf{heapIs} \ \$ \text{heap}_{funcstart\_724,1}, \ \$ \text{heap}_{funcstart\_724,1}.\text{p1},
177).rem)))._replace(p2 \rightarrow ((-35 * div(heapIs $heap_{funcstart\_724,1},
```

```
\theta_{funcstart_{-724,1},p2,176} + (172 * div(heapIs \theta_{funcstart_{-724,1},p2,176}) + (172 * div(heapIs \theta_{funcstart_{-724,1},p2,176})
heap_{funcstart_{-724,1}.p2, 176).rem)
[Take goal term]
[1.0] asType<integer>($heap_{724,1;742,8}.p2) <
asType<integer>($heap<sub>724.1:742.8</sub>.M2)
\rightarrow [from term 57.24, $heap<sub>724,1;742,8</sub> is equal to
heap_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 * div(heapIs $heap_{funcstart\_724,1},
heap_{funcstart\_724,1}.p1, 177).quot + (171 * div(heapIs $heap_{funcstart\_724,1}, 177).quot) + (171 * div(heapIs $heap_{funcstart\_724,1}, 17
heap_{funcstart=724,1}.p1, 177).rem))._replace(p2 \rightarrow (-35 * div(heapIs)))._
heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p2, 176).quot) + (172 * div(heapIs)
heap_{funcstart_{724,1}}, heap_{funcstart_{724,1}}, 2, 176).rem
[1.1] asType<integer>(heap_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 \ *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow ((-35 * div(heapIs $heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1}.\text{p2}, 176).\text{quot} + (172 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
heap_{funcstart_{-724,1}.p2, 176).rem})).p2) <
asType<integer>($heap<sub>724,1:742,8</sub>.M2)
\rightarrow [simplify]
[1.3] ((-35 * div(heapIs heap_{funcstart_{724,1}}, heap_{funcstart_{724,1}}, p_2,
176).quot) + (172 * \text{div}(\textbf{heapIs} \$ \text{heap}_{funcstart\_724,1}, \$ \text{heap}_{funcstart\_724,1}.\text{p2},
(176).rem) < asType < integer > (\$heap_{724,1:742.8}.M2)
\rightarrow [from term 57.24, $heap<sub>724.1:742.8</sub> is equal to
heap_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 * div(heapIs *heap_{funcstart\_724,1},
heap_{funcstart\_724,1}.p1, 177).quot + (171 * div(heapIs p_{funcstart\_724,1}),
\rho_{funcstart\_724,1.p1, 177).rem})).\_replace(p2 \rightarrow (-35 * div(heapIs))).
heap_{funcstart_{-724,1}}, p_{funcstart_{-724,1}}, p_{funcstart_{-724,1}}, p_{funcstart_{-724,1}}, p_{funcstart_{-724,1}}
\$ heap_{funcstart\_724,1}, \$ heap_{funcstart\_724,1}.p2, 176).rem))]
[1.4] \; ((-35 * \mathrm{div}(\mathbf{heapIs} \; \$ \mathrm{heap}_{funcstart\_724,1}, \, \$ \mathrm{heap}_{funcstart\_724,1}.\mathrm{p2}, \, 176).\mathrm{quot})
+ (172 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_724,1}, \text{\$heap}_{funcstart\_724,1}.\text{p2}, 176).\text{rem})) <
asType<integer>(heap_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 * div(heapIs
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.p1, 177).quot) + (171 * div(heapIs)
\rho_{uncstart_{724,1}}, \rho_{uncstart_{724,1},p1,177}.rem))._replace(p2 \rightarrow ((-35)
* div(heapIs heap_{funcstart_{-724.1}}, heap_{funcstart_{-724.1}}, p2, 176).quot) + (172 *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.\operatorname{p2}, \ 176).\operatorname{rem}))).\operatorname{M2})
\rightarrow [const member of object with modified fields]
[1.6] ((-35 * div(heapIs heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p2,
176).quot) + (172 * div(heapIs \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}
176).\text{rem})) < \mathbf{asType} < \mathbf{integer} > (\$ \text{heap}_{funcstart\_724,1}.\text{M2})
\rightarrow [const static or extern object]
[1.7] ((-35 * div(heapIs heap_{funcstart_{-724,1}}, heap_{funcstart_{-724,1},p2})
```

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176).quot) + (172 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_724,1}, \text{\$heap}_{funcstart\_724,1}.\text{p2},
(176).rem) < asType < integer > (\$heap_{init}.M2)
\rightarrow [expand definition of constant 'M2' at prang.c (19.20)]
[1.8] ((-35 * div(heap
Is \rho_{uncstart\_724,1}, \rho_{uncstart\_724,1}, \rho_{uncstart\_724,1}, \rho_{uncstart\_724,1}
176).quot) + (172 * div(heapIs heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p2,
176).rem)) < asType<integer>(asType<short int>((int)30307))
\rightarrow [simplify]
[1.18] -30307 < ((-172 * div(heapIs $heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724.1.p2}, 176).\text{rem} + (35 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724.1},
heap_{funcstart_{724,1}}.p2, 176).quot)
\rightarrow [negate goal and search for contradiction]
[1.19]!(-30307 < ((-172 * div(heapIs $heap_{funcstart\_724.1},
\text{Sheap}_{funcstart\_724.1.p2}, 176).\text{rem} + (35 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724.1},
heap_{funcstart_{724.1}}.p2, 176).quot))
\rightarrow [simplify]
 [1.24] \ 30306 < ((172 * div(\mathbf{heapIs} \$ heap_{funcstart\_724,1}, \$ heap_{funcstart\_724,1}.p2,
176).rem) + (-35 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_724,1}, \text{\$heap}_{funcstart\_724,1}.p2,
176).quot))
[Branch on disjunction or conditional in term 38.5]
\textit{[61.0] !} (0 == \operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.\operatorname{p2},
176).quot) \vee !(0 == \operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724,1}, \$ \operatorname{heap}_{funcstart\_724,1}.p2,
176).rem) \vee (0 == div(heapIs $heap_{funcstart\_724,1}, $heap_{funcstart\_724,1}.p2,
176).quot)
[Copy term 1.24]
\textit{[65.0] } 30306 < ((-35 * div(\textbf{heapIs} \$ heap_{funcstart\_724,1}, \$ heap_{funcstart\_724,1}.p2,
176).quot) + (172 * div(heapIs heapIs = f_{uncstart_{724,1}}, heap_{funcstart_{724,1}}, p_{uncstart_{724,1}}
176).rem))
\rightarrow [from\ term\ 29.17,\ div(\textbf{heapIs}\ \$heap_{funcstart\_724,1},\ \$heap_{funcstart\_724,1}.p2,
176).rem is equal to heap_{funcstart_{724,1}}.p2 \% 176
\textit{[65.1] } 30306 < ((-35 * div(\textbf{heapIs} \$ heap_{funcstart\_724,1}, \$ heap_{funcstart\_724,1}.p2,
176).quot) + (172 * (\text{$heap}_{funcstart\_724,1}.p2 \% 176)))
[Copy term 61.0]
[81.0] !(0 == div(heapIs \theta_{funcstart_{724,1}}, \theta_{funcstart_{724,1}}, \theta_{funcstart_{724,1}}.p2,
176).quot) \vee !(0 == \operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724,1}, \$ \operatorname{heap}_{funcstart\_724,1}.p2,
176).rem) \vee (0 == div(heapIs $heap_{funcstart\_724,1}, $heap_{funcstart\_724,1}.p2,
176).quot)
\rightarrow [from term 28.17, div(heapIs $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p2,
176).<br/>quot is equal to \rho_{funcstart\_724,1.p2}/176
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[81.1]!(0 == (\text{$heap}_{funcstart\_724,1}.p2 / 176)) \lor ...
[Create new term from term 28.17 using rule: condition for equality of division]
[82.0] ((176 * (0 + -(-\text{div}(\mathbf{heapIs} \$heap_{funcstart\_724,1},
\text{Sheap}_{funcstart_{-724,1},p2}, 176).\text{quot}))) < (1 + \text{Sheap}_{funcstart_{-724,1},p2})) \land
(heap_{funcstart_724,1}.p2 < (176 * (0 + 1 + -(-div(heapIs)))
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.p2, 176).quot))))
\rightarrow [simplify]
[82.15] (-1 < ((-176 * div(heapIs $heap_{funcstart\_724.1}, $heap_{funcstart\_724.1}, p2,
176).quot) + heap_{funcstart_{-724,1}.p2}) \land (-176 < (-heap_{funcstart_{-724,1}.p2} + -heap_{funcstart_{-724,1}.p2})
(176 * \text{div}(\mathbf{heapIs} \$ \text{heap}_{funcstart\_724,1}, \$ \text{heap}_{funcstart\_724,1}.\text{p2}, 176).\text{quot})))
\rightarrow [separate conjunction and work on first sub-term]
[82.16] -176 < (-$heap_{funcstart\_724,1}.p2 + (176 * div(heapIs
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.p2, 176).quot)
[Create new term from term 81.1 using rule: condition for inequality of
division]
[87.0] (!((0 * 176) < (1 + $heap_{funcstart_{724,1}}.p2)) \vee !($heap_{funcstart_{724,1}}.p2)
< (176 * (0 + 1))) \lor !(0 == div(heapIs \$heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1}.\text{p2}, 176).\text{rem}) \vee (0 == \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
heap_{funcstart_{-724,1}}.p2, 176).quot
\rightarrow [simplify]
[87.3] (!(-1 < \text{$heap_{funcstart\_724,1.p2}$}) \lor !(\text{$heap_{funcstart\_724,1.p2}$} < (176 * (0 + 
1)))) ∨ ...
\rightarrow [from term 9.0, literala < $heap_{funcstart\_724,1}.p2 is true whenever (-1 +
literala) < 0
    Proof of rule precondition:
    [87.3.0](-1+-1)<0
    \rightarrow [simplify]
    [87.3.2] true
[87.4] (!true \vee !($heap_{funcstart_724,1}.p2 < (176 * (0 + 1)))) \vee ...
\rightarrow [simplify]
[87.14] (175 < \text{$heap}_{funcstart\_724,1.p2}) \lor \dots
[Create new term from terms 87.14, 82.16 using rule: transitivity 3]
[88.0] ((-176 + 1 + 175) < (176 * div(heapIs $heap_{funcstart\_724.1},
\text{Sheap}_{funcstart\_724,1}.\text{p2}, 176).\text{quot})) \vee !(0 == \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1}.\text{p2}, 176).\text{rem}) \vee (0 == \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
heap_{funcstart_{-724,1}}.p2, 176).quot
\rightarrow [simplify]
```

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[88.1] (0 < (176 * div(heapIs heap_{funcstart_{-724,1}}, heap_{funcstart_{-724,1}}.p2,
176).quot)) ∨ ...
\rightarrow [product is positive]
[88.2] (((0 < 176) \land (0 < div(heapIs $heap<sub>funcstart_724,1</sub>,
\text{Sheap}_{funcstart\_724,1}.\text{p2}, 176).\text{quot})) \lor ((176 < 0) \land (\text{div}(\textbf{heapIs})))
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.p2, 176).quot < 0))) \lor ...
\rightarrow [simplify]
[88.7] (0 < div(heapIs heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p2, 176).quot)
[Create new term from terms 88.7, 65.1 using rule: transitivity 11]
== \operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p2, \ 176).rem) \lor (0
== \operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724.1}, \$ \operatorname{heap}_{funcstart\_724.1}.p2, 176).\operatorname{quot})
\rightarrow [simplify]
[90.2] (30307 < (172 * ($heap_{funcstart\_724,1}.p2 % 176))) \vee \dots
\rightarrow [literal comparison of product]
[90.3] \; ([172<0] \colon (30307 \; / \; \text{-}172) < -(\$ \mathrm{heap}_{funcstart\_724,1}.\mathrm{p2} \; \% \; 176), \; [0<172] \colon
(30307 / 172) < (\$heap_{funcstart\_724,1}.p2 \% 176), [0 == 172]: 30307 < 0) \lor ...
→ [explicitly assert falsehood of skipped guards in subsequent guards]
[90.4] ([172 < 0]: (30307 / -172) < -($heap_{funcstart\_724,1}.p2 % 176), [(0 < 0.4])
172) \land!(172 < 0)]: (30307 / 172) < ($heap_{funcstart\_724,1}.p2 % 176), [(0 ==
172) \land !(0 < 172) \land !(172 < 0)]: 30307 < 0) \lor ...
\rightarrow [simplify]
[90.13] false \vee ...
[Remove 'false' term 90.13 and fetch new term from containing clause]
[93.0] 0 == \text{div}(\text{heapIs } \text{heap}_{funcstart\_724,1}, \text{heap}_{funcstart\_724,1}.\text{p2}, 176).\text{quot}
[Copy term 1.24]
\textit{[65.1] } 30306 < ((-35 * div(\textbf{heapIs} \$ heap_{funcstart\_724,1}, \$ heap_{funcstart\_724,1}.p2,
176).quot) + (172 * (\text{$heap}_{funcstart\_724,1}.p2 \% 176)))
\rightarrow [from term 93.0, div(heapIs $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}$.p2,
176).quot is equal to 0]
[65.2] 30306 < ((-35 * 0) + (172 * (\$heap_{funcstart\_724,1}.p2 \% 176)))
\rightarrow [simplify]
[65.4] 30306 < (172 * ($heap_{funcstart\_724,1}.p2 % 176))
\rightarrow [literal comparison of product]
[65.5] ([172 < 0]: (30306 / -172) < -($heap<sub>funcstart_724,1</sub>.p2 % 176), [0 < 172]:
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(30306 / 172) < (\text{\$heap}_{funcstart\_724,1}.p2 \% 176), [0 == 172]: 30306 < 0)
\rightarrow [explicitly assert falsehood of skipped guards in subsequent guards]
[65.6] ([172 < 0]: (30306 / -172) < -($heap_{funcstart\_724,1}.p2 % 176), [(0 <
172) \land!(172 < 0)]: (30306 / 172) < ($heap_{funcstart\_724,1}.p2 % 176), [(0 ==
172) \land !(0 < 172) \land !(172 < 0)]: 30306 < 0)
\rightarrow [simplify]
[65.15] false
Proof of verification condition: Assertion valid
Condition generated at: C:\Escher\Customers\prang\prang.c (59,12)
To prove: -asType<integer const>($heap_{724,1:742,8}.M2) <
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathrm{heap}_{724,1;742,8}.\mathrm{p2})
Given:
heap_{init}.LIMIT == (int)80
\theta sheap<sub>init</sub>.M1 == asType<short int>((int)30269)
\theta
\theta
\theta
heap_{init}.M2 == asType < short int > ((int)30307)
heap_{init}.r2 == asType < short int > ((int)172)
heap_{init}.a2 == asType < short int > ((int)176)
\theta
\theta = asType < short int > ((int)30323)
heap_{init}.r3 == asType < short int > ((int)170)
heap_{init}.a3 == asType < short int > ((int)178)
\theta = asType < short int > ((int)63)
\theta = asType < short int > ((int)1)
\theta
heap_{init}.p3 == asType < short int > ((int)3)
invariant1(heapIs heap_{funcstart_{-724,1}})
div1 == div(\mathbf{heapIs} \$heap_{funcstart\_724,1},
asType < int > (\$heap_{funcstart\_724,1}.p1),
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{a1}))
(asType<integer>(asType<int>($heap_{tuncstart\_724,1}.p1)) /
```

```
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a1))) = =
asType<integer>(div1.quot)
(\mathbf{asType}{<}\mathbf{int}{>}(\mathbf{asType}{<}\mathbf{int}{>}(\$\mathbf{heap}_{funcstart\_724,1}.\mathbf{p1}))~\%
\mathbf{asType}{<}\mathbf{integer}{>}(\mathbf{asType}{<}\mathbf{int}{>}(\$\mathbf{heap}_{funcstart\_724,1}.\mathbf{a1}))) = =
asType<integer>(div1.rem)
!(0 == asType < integer > (div1.rem)) || !(0 ==
asType<integer>(div1.quot))
div2 == div(\mathbf{heapIs} \$heap_{funcstart\_724,1},
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p2}),
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{a2}))
(asType<integer>(asType<int>($heap_{tuncstart\_724.1}.p2)) /
asType < integer > (asType < int > (\$heap_{funcstart\_724.1}.a2))) = =
asType<integer>(div2.quot)
(\mathbf{asType}{<}\mathbf{int}{>}(\mathbf{asType}{<}\mathbf{int}{>}(\$\mathbf{heap}_{funcstart\_724,1}.\mathbf{p2}))~\%
\mathbf{asType} < \mathbf{integer} > (\mathbf{asType} < \mathbf{int} > (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{a2}))) = =
asType<integer>(div2.rem)
!(0 == asType < integer > (div2.rem)) || !(0 ==
asType<integer>(div2.quot))
div3 == div(\mathbf{heapIs} \$ heap_{funcstart\_724,1},
\mathbf{asType} < \mathbf{int} > (\$ \mathrm{heap}_{funcstart\_724,1}.\mathrm{p3}),
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{a3}))
(asType<integer>(asType<int>($heap_{tuncstart\_724.1}.p3)) /
asType < integer > (asType < int > (\$heap_{funcstart, 724,1}, a3))) = =
asType<integer>(div3.quot)
(\mathbf{asType}{<}\mathbf{int}{>}(\mathbf{asType}{<}\mathbf{int}{>}(\$\mathbf{heap}_{funcstart\_724,1}.\mathbf{p3}))~\%
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a3))) = =
asType<integer>(div3.rem)
!(0 == asType < integer > (div3.rem)) || !(0 ==
asType<integer>(div3.quot))
$heap_{724,1;740,8} == $heap_{funcstart\_724,1}.\_replace(p1 \rightarrow asType < short)
int>((asType<int>(asType<short int>(div1.rem)) *
\mathbf{asType} \hspace{-0.1em}<\hspace{-0.1em} \mathbf{int} \hspace{-0.1em}> \hspace{-0.1em} (\$ \mathrm{heap}_{funcstart\_724,1}.\mathrm{r1})) - (\mathbf{asType} \hspace{-0.1em}<\hspace{-0.1em} \mathbf{int} \hspace{-0.1em}> \hspace{-0.1em} (\mathbf{asType} \hspace{-0.1em}<\hspace{-0.1em} \mathbf{short})
int>(div1.quot)) * asType< int>($heap_{tuncstart\_724.1}.b1))))
-asType<integer const>($heap<sub>724.1:740.8</sub>.M1) <
asType<integer>($heap<sub>724.1:740.8</sub>.p1)
!(0 == asType < integer > (\$heap_{724,1;740,8}.p1))
asType<integer>($heap<sub>724.1:740.8</sub>.p1) <
asType<integer>($heap<sub>724.1:740.8</sub>.M1)
\text{$heap}_{724,1;742,8} == \text{$heap}_{724,1;740,8}.\_\textbf{replace}(p2 \to \textbf{asType} < \textbf{short}
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```
int>((asType<int>(asType<short int>(div2.rem)) *
asType < int > (\$heap_{724,1:740.8}.r2)) - (asType < int > (asType < short)
int>(div2.quot)) * asType<int>($heap<sub>724,1:740,8</sub>.b2))))
Proof:
[Take given term]
[5.0] invariant1(heapIs heap_{funcstart\_724,1})
\rightarrow [expand definition of function 'invariant1' at prang.c (34,1)]
[5.1] ((((((0 < asType < integer > ($heap_{funcstart\_724,1}.p1)) &&
(\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{p1}) <
asType < integer > (\$heap_{funcstart\_724,1}.M1))) \&\& (0 < funcstart\_724,1)
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p2})))\ \&\&
(asType < integer > ($heap_{funcstart\_724,1}.p2) < 
asType < integer > (\$heap_{funcstart\_724,1}.M2))) \&\& (0 <
asType < integer > (\$heap_{funcstart\_724,1}.p3))) \&\&
(\mathbf{asType} {<} \mathbf{integer} {>} (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p3}) <
asType < integer > (\$heap_{funcstart_{-724.1}}.M3))
\rightarrow [simplify]
[5.3] (((((0 < $heap_{funcstart_{724,1}}.p1) && ($heap_{funcstart_{724,1}}.p1 < 
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{M1})))~\&\&~(0<
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{p2})))\ \&\&
(\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{p2}) <
asType < integer > (\$heap_{funcstart\_724,1}.M2))) \&\& (0 < 1)
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p3})))\ \&\&
(\mathbf{asType} {<} \mathbf{integer} {>} (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p3}) <
\mathbf{asType} {<} \mathbf{integer} {>} (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{M3}))
\rightarrow [const static or extern object]
[5.4] \ (((((0 < \text{\$heap}_{funcstart\_724,1}.\text{p1}) \&\& \ (\text{\$heap}_{funcstart\_724,1}.\text{p1} <
asType < integer > (\$heap_{init}.M1))) \&\& (0 <
asType < integer > (\$heap_{funcstart\_724,1}.p2))) \&\&
(\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{p2}) <
asType < integer > (\$heap_{funcstart\_724,1}.M2))) \&\& (0 <
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p3})))\ \&\&
(asType < integer > (\$heap_{funcstart\_724,1}.p3) < 
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{M3}))
\rightarrow [expand definition of constant 'M1' at prang.c (14,20)]
[5.5] \ (((((0 < \text{\$heap}_{funcstart\_724,1}.\text{p1}) \&\& \ (\text{\$heap}_{funcstart\_724,1}.\text{p1} <
asType<integer>(asType<short int>((int)30269)))) && (0 <
asType < integer > (\$heap_{funcstart\_724,1}.p2))) \&\&
(asType<integer>($heap_{tuncstart\_724.1}.p2) <
asType < integer > (\$heap_{funcstart\_724,1}.M2))) \&\& (0 <
asType < integer > (\$heap_{funcstart\_724,1}.p3))) \&\&
```

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(\mathbf{asType} {<} \mathbf{integer} {>} (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p3}) <
asType < integer > (\$heap_{funcstart\_724,1}.M3))
\rightarrow [simplify]
[5.16] \; ((((-30269 < -\$heap_{funcstart\_724,1}.p1) \; \land \; (0 < \$heap_{funcstart\_724,1}.p1) \; \land 
(0 < \mathrm{\$heap}_{funcstart\_724,1}.\mathrm{p2})) && (\mathrm{\$heap}_{funcstart\_724,1}.\mathrm{p2} <
asType < integer > (\$heap_{funcstart\_724,1}.M2))) \&\& (0 <
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p3})))\ \&\&
(asType<integer>($heap_{tuncstart\_724,1}.p3) <
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{M3}))
\rightarrow [const static or extern object]
[5.17] \left( \left( \left( \left( -30269 < -\$ \text{heap}_{funcstart\_724,1}.\text{p1} \right) \right. \wedge \left. \left( 0 < \$ \text{heap}_{funcstart\_724,1}.\text{p1} \right) \right. \wedge \right. \right)
(0 < \text{\$heap}_{funcstart\_724,1}.p2)) \&\& (\text{\$heap}_{funcstart\_724,1}.p2 <
asType < integer > (\$heap_{init}.M2))) \&\& (0 <
asType < integer > ($heap_{funcstart\_724,1}.p3))) &&
(asType < integer > ($heap_{funcstart\_724,1}.p3) < 
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{M3}))
\rightarrow [expand definition of constant 'M2' at prang.c (19,20)]
[5.18] ((((-30269 < -\$heap_{funcstart\_724,1}.p1) \land (0 < \$heap_{funcstart\_724,1}.p1) 
(0 < \mathrm{\$heap}_{funcstart\_724,1}.p2)) && ( \mathrm{\$heap}_{funcstart\_724,1}.p2 <
asType < integer > (asType < short int > ((int)30307)))) && (0 < integer) && (0 < integer
asType < integer > (\$heap_{funcstart\_724,1}.p3))) \&\&
(\mathbf{asType} {<} \mathbf{integer} {>} (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p3}) <
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{M3}))
\rightarrow [simplify]
[5.30] ((-30307 < -\$heap_{funcstart\_724,1}.p2) \land (-30269 <
-\$heap_{funcstart\_724,1}.p1) \land (0 < \$heap_{funcstart\_724,1}.p1) \land (0 < \$heap_{funcstart\_724,1}.p1)
\text{Sheap}_{funcstart_{724,1}.p2} \land (0 < \text{Sheap}_{funcstart_{724,1}.p3})) \&\&
(\text{\$heap}_{funcstart\_724,1}.p3 < asType < integer > (\text{\$heap}_{funcstart\_724,1}.M3))
\rightarrow [const static or extern object]
[5.31] ((-30307 < -$heap<sub>funcstart_724,1.</sub>p2) \land (-30269 <
 -\$heap_{funcstart\_724,1}.p1) \land (0 < \$heap_{funcstart\_724,1}.p1) \land (0 < \$heap_{funcstart\_724,1}.p1)
\text{Sheap}_{funcstart_{724,1}.p2} \land (0 < \text{Sheap}_{funcstart_{724,1}.p3})) \&\&
(\$heap_{funcstart\_724,1}.p3 < \textbf{asType} < \textbf{integer} > (\$heap_{init}.M3))
\rightarrow [expand definition of constant 'M3' at prang.c (24,20)]
[5.32] ((-30307 < -$heap_funcstart_724,1.p2) \land (-30269 <
-$heap_{funcstart\_724,1}.p1) \land (0 < $heap_{funcstart\_724,1}.p1) \land (0 <
\text{Sheap}_{funcstart_{724,1}.p2} \land (0 < \text{Sheap}_{funcstart_{724,1}.p3})) \&\&
(\text{sheap}_{funcstart\_724,1}.p3 < asType < integer > (asType < short)
int > ((int)30323)))
\rightarrow [simplify]
```

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[5.40] (-30323 < -\text{$heap}_{funcstart\_724,1}.p3) \land (-30307 < -\text{$ps.})
-\$heap_{funcstart\_724,1}.p2) \land (-30269 < -\$heap_{funcstart\_724,1}.p1) \land (0 < -\$heap_{funcstart\_724,1}.p1)
\text{Sheap}_{funcstart\_724,1}.\text{p1}) \land (0 < \text{Sheap}_{funcstart\_724,1}.\text{p2}) \land (0 <
heap_{funcstart_{-724,1}.p3}
[Work on sub-term 2 of conjunction in term 5.40]
\textit{[6.0] -30307} < -\$ heap_{funcstart\_724,1}.p2
[Work on sub-term 5 of conjunction in term 5.40]
\textit{[9.0] 0} < \$ heap_{funcstart\_724,1}.p2
[Take given term]
[11.0] \operatorname{div1} == \operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724,1},
asType < int > (\$heap_{funcstart\_724,1}.p1),
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{a1}))
\rightarrow [simplify]
[11.1] div1 == div(heapIs heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p1,
asType < int > (\$heap_{funcstart\_724.1}.a1))
\rightarrow [const static or extern object]
[11.2] \ \mathrm{div1} == \mathrm{div}(\mathbf{heapIs} \ \$ \mathrm{heap}_{funcstart\_724,1}, \ \$ \mathrm{heap}_{funcstart\_724,1}.\mathrm{p1},
asType < int > (\$heap_{init}.a1))
\rightarrow [expand definition of constant 'a1' at prang.c (16,20)]
\textit{[11.3]} \ \text{div1} == \text{div}(\mathbf{heapIs} \ \$ \text{heap}_{funcstart\_724,1}, \ \$ \text{heap}_{funcstart\_724,1}.\text{p1},
asType<int>(asType<short int>((int)177)))
\rightarrow [simplify]
[11.6] div1 == div(heapIs \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}.p1, 177)
[Take given term]
[25.0] div2 == div(heapIs $heap_{tuncstart\_724.1},
asType < int > (\$heap_{funcstart\_724,1}.p2),
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{a2}))
\rightarrow [simplify]
\label{eq:continuous} \textit{[25.1]} \ \text{div2} == \ \text{div}(\mathbf{heapIs} \ \$ \text{heap}_{funcstart\_724,1}, \ \$ \text{heap}_{funcstart\_724,1}.\text{p2},
asType < int > (\$heap_{funcstart\_724,1}.a2))
\rightarrow [const static or extern object]
[25.2]~{\rm div2} == {\rm div}(\mathbf{heapIs}~\$ \mathrm{heap}_{funcstart\_724,1},\,\$ \mathrm{heap}_{funcstart\_724,1}.\mathrm{p2},
asType < int > (\$heap_{init}.a2))
\rightarrow [expand definition of constant 'a2' at prang.c (21,20)]
[25.3] \operatorname{div2} == \operatorname{div}(\mathbf{heapIs} \operatorname{\$heap}_{funcstart\_724,1}, \operatorname{\$heap}_{funcstart\_724,1}.p2,
asType<int>(asType<short int>((int)176)))
```

```
\rightarrow [simplify]
[25.6] div2 == div(heapIs $heap_{funcstart\_724,1}, $heap_{funcstart\_724,1}.p2, 176)
[Assume known post-assertion, class invariant or type constraint for term 25.6]
[28.0] \; (\mathbf{asType} {<} \mathbf{integer} {>} (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p2}) \; / \\
asType<integer>(176)) == asType<integer>(div(heapIs
heap_{funcstart_{-724,1}}, heap_{funcstart_{-724,1}}, p_{176}
\rightarrow [simplify]
[28.2] ($heap<sub>funcstart_724,1.</sub>p2 / 176) == asType<integer>(div(heapIs)
heap_{funcstart_{724,1}}, heap_{funcstart_{724,1}}, 176).quot
→ [expand definition of operator './' in class 'int' at built in declaration]
[28.3] ([asType<integer>(heap_{funcstart\_724,1}.p2) < 0]:
-(-asType < integer > (\$heap_{funcstart\_724,1}.p2) / 176), []:
asType < integer > (\$heap_{funcstart\_724,1}.p2) / 176) = =
asType<integer>(div(heapIs p_{funcstart\_724,1}, p_{funcstart\_724,1}, p_{funcstart\_724,1})
176).quot)
→ [explicitly assert falsehood of skipped guards in subsequent guards]
[28.4] ([asType<integer>($heap_{funcstart\_724,1}.p2) < 0]:
-(-asType < integer > (\$heap_{funcstart\_724,1}.p2) / 176),
[!(asType < integer > (\$heap_{funcstart\_724,1}.p2) < 0)]:
asType < integer > (\$heap_{funcstart\_724,1}.p2) / 176) ==
\mathbf{asType} {<} \mathbf{integer} {>} ( \mathrm{div}(\mathbf{heapIs} \ \$ \mathrm{heap}_{funcstart\_724,1}, \ \$ \mathrm{heap}_{funcstart\_724,1}.\mathrm{p2}, \\
176).quot)
\rightarrow [simplify]
[28.7] ([0 < -$heap_{funcstart\_724,1}.p2]:
-(-asType < integer > (\$heap_{funcstart\_724,1}.p2) / 176),
[!(asType < integer > (\$heap_{funcstart\_724,1}.p2) < 0)]:
asType < integer > (\$heap_{funcstart\_724,1}.p2) / 176) ==
asType<integer>(div(heapIs $heap_{tuncstart\_724.1}, $heap_{tuncstart\_724.1}.p2,
176).quot)
\rightarrow [from term 9.0, literala < -$heap<sub>funcstart_724.1</sub>.p2 is false whenever -2 < (0
+ literala)]
   Proof of rule precondition:
   [28.7.0] - 2 < (0 + 0)
   \rightarrow [simplify]
   [28.7.2] true
[28.8] ([false]: -(-asType < integer > (\$heap_{funcstart\_724,1}.p2) / 176),
[!(asType < integer > (\$heap_{funcstart\_724,1}.p2) < 0)]:
asType < integer > (\$heap_{funcstart\_724,1}.p2) / 176) = =
```

```
\mathbf{asType} < \mathbf{integer} > (\mathbf{div}(\mathbf{heapIs} \ \$ \mathbf{heap}_{funcstart\_724,1}, \ \$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p2}, \\
176).quot)
\rightarrow [simplify]
[28.11] ([false]: -(-asType < integer > (\$heap_{funcstart\_724,1}.p2) / 176), [!(0 < integer > (\$heap_{funcstart\_724,1}.p2) / 176)]
-\$heap_{funcstart\_724,1}.p2): asType<integer>(\$heap_{funcstart\_724,1}.p2) / 176)
== asType < integer > (div(heapIs $heap_{funcstart\_724,1},
heap_{funcstart_{724,1}}.p2, 176).quot
\rightarrow [from term 9.0, literala < -$heap<sub>funcstart_724,1</sub>.p2 is false whenever -2 < (0
+ literala)
    Proof of rule precondition:
    [28.11.0] - 2 < (0 + 0)
    \rightarrow [simplify]
    [28.11.2] true
[28.12] ([false]: -(-asType < integer > (\$heap_{funcstart\_724,1}.p2) / 176),
[!false]: asType<integer>($heap<sub>funcstart_724,1.</sub>p2) / 176) ==
\mathbf{asType} < \mathbf{integer} > (\mathbf{div}(\mathbf{heapIs} \ \$ \mathbf{heap}_{funcstart\_724,1}, \ \$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p2}, \\
176).quot)
\rightarrow [simplify]
\label{eq:continuous} \textit{[28.17] } 0 == (-\text{div}(\mathbf{heapIs} \ \$ \text{heap}_{funcstart\_724,1}, \ \$ \text{heap}_{funcstart\_724,1}.\text{p2},
176).quot + (\text{$heap}_{funcstart\_724,1.p2} / 176))
[Assume known post-assertion, class invariant or type constraint for term 25.6]
[29.0] (asType<integer>(peq:temp_{funcstart\_724,1}.p2) %
asType<integer>(176)) == asType<integer>(div(heapIs
\$heap_{funcstart\_724,1},\,\$heap_{funcstart\_724,1}.p2,\,176).rem)
\rightarrow [simplify]
[29.2] ($heap<sub>funcstart_724,1.</sub>p2 % 176) == asType<integer>(div(heapIs)
heap_{funcstart_{-724,1}}, heap_{funcstart_{-724,1}}, 2, 176).rem
→ [expand definition of operator '.%' in class 'int' at built in declaration]
[29.3] ([asType<integer>(sheap_{funcstart\_724,1.p2}) < 0]:
-(-asType < integer > (\$heap_{tuncstart\_724,1}.p2) \% 176), []:
asType < integer > (\$heap_{funcstart\_724,1}.p2) \% 176) ==
asType<integer>(div(heapIs heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p2,
176).rem)
→ [explicitly assert falsehood of skipped guards in subsequent guards]
[29.4] ([asType<integer>($heap_{funcstart\_724,1}.p2) < 0]:
-(-asType < integer > (\$heap_{funcstart\_724,1}.p2) \% 176),
[!(asType < integer > (\$heap_{funcstart\_724,1}.p2) < 0)]:
asType < integer > (\$heap_{funcstart\_724,1}.p2) \% 176) ==
```

```
asType<integer>(div(heapIs heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p2,
176).rem)
\rightarrow [simplify]
[29.7] ([0 < -\$heap_{funcstart\_724,1}.p2]:
-(-asType < integer > (\$heap_{funcstart\_724,1}.p2) \% 176),
[!(asType < integer > (\$heap_{funcstart\_724,1}.p2) < 0)]:
asType < integer > (\$heap_{funcstart\_724,1}.p2) \% 176) ==
asType<integer>(div(heapIs $heap_{funcstart\_724.1}, $heap_{funcstart\_724.1}.p2,
176).rem)
\rightarrow [from term 9.0, literala < -$heap<sub>funcstart_724,1</sub>.p2 is false whenever -2 < (0
+ literala)
   Proof of rule precondition:
   [29.7.0] - 2 < (0 + 0)
   \rightarrow [simplify]
   [29.7.2] true
[29.8] ([false]: -(-asType < integer > (\$heap_{funcstart\_724,1}.p2) \% 176),
[!(\mathbf{asType} < \mathbf{integer} > (\$ heap_{funcstart\_724,1}.p2) < 0)]:
asType<integer>($heap<sub>funcstart_724,1.</sub>p2) % 176) ==
asType<integer>(div(heapIs heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p2,
176).rem)
\rightarrow [simplify]
[29.11] ([false]: -(-asType < integer > ($heap_{funcstart\_724,1}.p2) \% 176), [!(0
<-$heap<sub>funcstart_724,1.</sub>p2)]: asType<integer>($heap<sub>funcstart_724,1.</sub>p2) %
176) == asType<integer>(div(heapIs $heap_{tuncstart\_724.1},)
heap_{funcstart_{-724,1}.p2, 176}.rem
\rightarrow [from term 9.0, literala < -$heap<sub>funcstart_724,1</sub>.p2 is false whenever -2 < (0
+ literala)]
   Proof of rule precondition:
   [29.11.0] - 2 < (0 + 0)
   \rightarrow [simplify]
   [29.11.2] true
[29.12] ([false]: -(-asType < integer > (\$heap_{funcstart\_724,1}.p2) \% 176),
[!false]: asType<integer>(sheap_{funcstart\_724,1}.p2) \% 176 ==
asType < integer > (div(heapIs \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p2,
176).rem)
\rightarrow [simplify]
[29.17] \ 0 == (-\text{div}(\mathbf{heapIs} \ \$ \text{heap}_{funcstart\_724,1}, \ \$ \text{heap}_{funcstart\_724,1}.\text{p2},
176).rem + (\text{$heap}_{funcstart\_724,1}.p2 \% 176))
```

```
[Take given term]
[53.0] \rho_{1740,8} == \rho_{1740,8} == \rho_{1740,8} == \rho_{1740,8} - \rho_{1740,8} == \rho_{1740,8} == \rho_{1740,8} - \rho_{1740,8} == \rho_{
int>((asType<int>(asType<short int>(div1.rem)) *
\mathbf{asType} \small{<} \mathbf{int} \small{>} (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{r1})) - (\mathbf{asType} \small{<} \mathbf{int} \small{>} (\mathbf{asType} \small{<} \mathbf{short}
int>(div1.quot)) * asType<int>($heap_{funcstart\_724.1}.b1)))
\rightarrow [from term 11.6, div1 is equal to div(heapIs $heap_{funcstart\_724,1},
heap_{funcstart_{-724,1}}.p1, 177
[53.1] \text{heap}_{724,1;740,8} == \text{heap}_{funcstart\_724,1}._replace(p1 \rightarrow asType<short
int>((asType<int>(asType<short int>(div(heapIs $heap_{funcstart_724,1},))
\text{Sheap}_{funcstart\_724,1}.\text{p1}, 177).\text{rem}) * asType<int>(\text{Sheap}_{funcstart\_724,1}.\text{r1})) -
(asType<int>(asType<short int>(div1.quot)) *
asType < int > (\$heap_{funcstart\_724,1}.b1))))
\rightarrow [simplify]
[53.3] \rho_{13,1;740,8} == \rho_{13,1;740,8} == \rho_{13,1;740,8} =- \rho_{
int>((div(heapIs \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1, 177).rem *
asType < int > (\$heap_{funcstart\_724.1}.r1)) - (asType < int > (asType < short)
int>(div1.quot)) * asType< int>($heap_{tuncstart\_724.1}.b1))))
\rightarrow [const static or extern object]
[53.4] \rho_{13,1;740,8} == \rho_{13,1;740,8} == \rho_{13,1;740,8} =- \rho_{
int>((div(heapIs \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1, 177).rem *
asType < int > (\$heap_{init}.r1)) - (asType < int > (asType < short)
int>(div1.quot)) * asType< int>($heap_{tuncstart\_724.1}.b1))))
\rightarrow [expand definition of constant 'r1' at prang.c (15,20)]
[53.5] heap_{724,1;740,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow asType<short
int>((div(heapIs \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1, 177).rem *
asType < int > (asType < short int > ((int)171))) -
(asType<int>(asType<short int>(div1.quot)) *
asType < int > (\$heap_{funcstart\_724.1}.b1))))
\rightarrow [simplify]
[53.8] \text{sheap}_{724,1;740,8} == \text{sheap}_{funcstart\_724,1}._replace(p1 \rightarrow asType<short
int>((div(heapIs \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1, 177).rem * 171)
- (asType<int>(asType<short int>(div1.quot)) *
asType < int > (\$heap_{funcstart_{724.1}}.b1))))
\rightarrow [from term 11.6, div1 is equal to div(heapIs $heap_{funcstart\_724,1},
heap_{funcstart_{-724,1}}.p1, 177
[53.9] heap_{724,1;740,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow asType<short
\mathbf{int} > ((171 * \operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724,1}, \$ \operatorname{heap}_{funcstart\_724,1}.\operatorname{p1}, 177).\operatorname{rem})
 - (asType < int > (asType < short int > (div(heapIs $heap_{funcstart\_724,1}, 
heap_{funcstart_{724,1}}.p1, 177).quot) *
asType < int > (\$heap_{funcstart\_724.1}.b1))))
```

```
\rightarrow [simplify]
[53.11] \theta == 
int>((171 * div(heapIs $heap_{funcstart\_724,1}, $heap_{funcstart\_724,1}.p1, 177).rem)
- (div(heapIs heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p1, 177).quot *
asType < int > (\$heap_{funcstart\_724.1}.b1)))
\rightarrow [const static or extern object]
[53.12] heap_{724,1;740,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow asType<short
\mathbf{int} > ((171 * \operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724,1}, \$ \operatorname{heap}_{funcstart\_724,1}.\operatorname{p1}, 177).\operatorname{rem})
- (\text{div}(\mathbf{heapIs} \$ \text{heap}_{funcstart\_724,1}, \$ \text{heap}_{funcstart\_724,1}.\text{p1}, 177).\text{quot} *
asType < int > (\$heap_{init}.b1)))
\rightarrow [expand definition of constant 'b1' at prang.c (17,20)]
[53.13] $\text{heap}_{724,1:740.8} == \text{$heap}_{funcstart\_724,1}._\text{replace}(p1 \rightarrow \text{asType} < \text{short}
int>((171 * div(heapIs $heap_{funcstart\_724,1}, $heap_{funcstart\_724,1}.p1, 177).rem)
- (\text{div}(\mathbf{heapIs} \$ \text{heap}_{funcstart\_724,1}, \$ \text{heap}_{funcstart\_724,1}.\text{p1}, 177).\text{quot} *
asType<int>(asType<short int>((int)2))))
\rightarrow [simplify]
[53.19] $\text{heap}_{724,1:740.8} == $\text{heap}_{funcstart\_724,1}._\text{replace}(p1 \to ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).rem)))
[Take given term]
[57.0] $\text{heap}_{724,1:742,8} == $\text{heap}_{724,1:740,8}.$\_\text{replace}(p2 \rightarrow \text{asType} < \text{short}
int>((asType<int>(asType<short int>(div2.rem)) *
asType < int > (\$heap_{724,1:740.8}.r2)) - (asType < int > (asType < short)
int>(div2.quot)) * asType< int>($heap_{724,1;740,8}.b2))))
\rightarrow [from term 53.19, $heap<sub>724.1:740.8</sub> is equal to
heap_{funcstart\_724,1}._replace(p1 \rightarrow (-2 * div(heapIs $heap_{funcstart\_724,1},
heap_{funcstart_{-724,1},p1, 177}, quot) + (171 * div(heapIs heap_{funcstart_{-724,1},p1, 177})
heap_{funcstart_{-724,1},p1,177,rem}
[57.1] $heap<sub>724,1:742,8</sub> == $heap<sub>funcstart_724,1</sub>._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1,
(177).rem))._replace(p2 \rightarrow asType<short
int>((asType<int>(asType<short int>(div2.rem)) *
asType < int > (\$heap_{724.1:740.8}.r2)) - (asType < int > (asType < short)
\mathbf{int}{>}(\mathrm{div2.quot})) \ * \ \mathbf{asType}{<} \mathbf{int}{>} (\$\mathrm{heap}_{724,1;740,8}.\mathrm{b2}))))
\rightarrow [from term 25.6, div2 is equal to div(heapIs $heap_{funcstart_724,1},
heap_{funcstart_{-724,1},p2,176}
[57.2] heap_{724,1;742,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).quot) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1,
```

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(177).rem))._replace(p2 \rightarrow asType<short
int>((asType<int>(asType<short int>(div(heapIs $heap_{funcstart\_724,1},
\text{sheap}_{funcstart\_724,1.p2, 176}.\text{rem}) * asType < int > (\text{sheap}_{724,1:740,8}.\text{r2})) -
(asType<int>(asType<short int>(div2.quot)) *
asType < int > (\$heap_{724,1;740,8}.b2))))
\rightarrow [simplify]
[57.4] $heap<sub>724,1:742,8</sub> == $heap<sub>funcstart_724,1</sub>._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).quot) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow asType<short int>((div(heapIs
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.p2, 176).rem *
asType < int > (\$heap_{724,1:740,8}.r2)) - (asType < int > (asType < short)
int>(div2.quot)) * asType<int>($heap<sub>724,1:740,8</sub>.b2))))
\rightarrow [from term 53.19, $heap<sub>724.1:740.8</sub> is equal to
heap_{funcstart\_724.1}._replace(p1 \rightarrow (-2 * div(heapIs heap_{funcstart\_724.1}),
heap_{funcstart\_724,1}.p1, 177).quot) + (171 * div(heapIs $heap_{funcstart\_724,1}, 1
\$heap_{funcstart\_724,1}.p1,\ 177).rem))]
[57.5] heap_{724,1;742,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}. p1, \ 177). \operatorname{quot}) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow asType<short int>((div(heapIs
\theta_{funcstart_{724,1}}, \theta_{funcstart_{724,1}}, \theta_{funcstart_{724,1}}, \theta_{funcstart_{724,1}}
asType < int > (\$heap_{funcstart\_724,1}.\_replace(p1 \rightarrow ((-2 * div(heapIs))))))
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.\text{p1}, 177).\text{quot}) + (171 * \text{div}(\text{heapIs}))
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.p1, 177).rem))).r2)) -
(asType<int>(asType<short int>(div2.quot)) *
asType < int > (\$heap_{724.1:740.8}.b2))))
\rightarrow [const member of object with modified fields]
[57.6] $heap<sub>724,1;742,8</sub> == $heap<sub>funcstart_724,1</sub>._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1,
177).rem)))._{\mathbf{replace}}(p2 \rightarrow \mathbf{asType} < \mathbf{short\ int} > ((\operatorname{div}(\mathbf{heapIs}))))
heap_{funcstart_{724,1}}, heap_{funcstart_{724,1}}, p_{176}.rem *
\mathbf{asType} < \mathbf{int} > (\$ \mathrm{heap}_{funcstart\_724,1}.\mathrm{r2})) - (\mathbf{asType} < \mathbf{int} > (\mathbf{asType} < \mathbf{short}))
int>(div2.quot)) * asType<int>($heap<sub>724.1:740.8</sub>.b2))))
\rightarrow [const static or extern object]
[57.7] heap_{724,1;742,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 *
div(\mathbf{heapIs} \ \$heap_{funcstart\_724,1}, \ \$heap_{funcstart\_724,1}.p1, \ 177).quot) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1,
177).rem))).replace(p2 \rightarrow asType < short int > ((div(heapIs)))
\theta_{funcstart_{724,1}}, \theta_{funcstart_{724,1},p2, 176}.rem *
asType < int > (\$heap_{init}.r2)) - (asType < int > (asType < short)
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int>(div2.quot)) * asType< int>($heap_{724.1:740.8}.b2))))
\rightarrow [expand definition of constant 'r2' at prang.c (20,20)]
[57.8] heap_{724,1;742,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).quot) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow asType<short int>((div(heapIs
p_{funcstart_{724,1}}, p_{funcstart_{724,1},p_{724,1}}, p_{724,1}, p_{724,1
asType<int>(asType<short int>((int)172))) -
(asType<int>(asType<short int>(div2.quot)) *
asType<int>($heap<sub>724.1:740.8</sub>.b2))))
\rightarrow [simplify]
[57.11] $\text{heap}_{724,1;742,8} == \text{$heap}_{funcstart\_724,1}._\text{$replace}(p1 \to ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).quot) + (171 *
\label{eq:div_heap} \text{div}(\textbf{heapIs} \ \$ \text{heap}_{funcstart\_724,1}, \ \$ \text{heap}_{funcstart\_724,1}.\text{p1},
177).rem)))._replace(p2 \rightarrow asType<short int>((div(heapIs
\text{Sheap}_{funcstart_{-724,1}}, \text{Sheap}_{funcstart_{-724,1}}.p2, 176).rem * 172) -
(asType<int>(asType<short int>(div2.quot)) *
asType<int>($heap<sub>724,1:740,8</sub>.b2))))
\rightarrow [from term 25.6, div2 is equal to div(heapIs $heap_{tuncstart_{724.1}},
heap_{funcstart_{-724,1}}.p2, 176
[57.12] $heap<sub>724,1;742,8</sub> == $heap<sub>funcstart_724,1</sub>._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).quot) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow asType<short int>((172 * div(heapIs
heap_{funcstart_{-724,1}}, heap_{funcstart_{-724,1}}, p_{176}.rem) -
(asType < int > (asType < short int > (div(heapIs $heap_{funcstart\_724,1}, 
\text{sheap}_{funcstart\_724,1.p2}, 176).\text{quot}) * asType<int>(\text{sheap}_{724,1;740,8.b2}))))
\rightarrow [simplify]
[57.14] $\text{heap}_{724,1;742,8} == \text{$heap}_{funcstart\_724,1}._\text{$-replace}(p1 \to ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).quot) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow asType<short int>((172 * div(heapIs
\theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}.p2, 176).rem) - (div(heapIs
heap_{funcstart_{724,1}}, heap_{funcstart_{724,1}}, p2, 176).quot *
asType<int>($heap<sub>724.1:740.8</sub>.b2))))
\rightarrow [from term 53.19, $heap<sub>724,1;740,8</sub> is equal to
heap_{funcstart\_724,1}._replace(p1 \rightarrow (-2 * div(heapIs heap_{funcstart\_724,1}),
heap_{funcstart\_724,1}.p1, 177).quot + (171 * div(heapIs p_{funcstart\_724,1})
heap_{funcstart} 724.1.p1, 177).rem))]
[57.15] $\text{heap}_{724,1;742,8} == \text{$heap}_{funcstart\_724,1}._\text{replace}(p1 \to ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 *
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\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow asType<short int>((172 * div(heapIs
heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p2, 176).rem) - (div(heapIs)
heap_{funcstart_{724,1}}, heap_{funcstart_{724,1}}.p2, 176).quot *
\mathbf{asType}{<}\mathbf{int}{>}(\$\text{heap}_{funcstart\_724,1}.\_\mathbf{replace}(\text{p1} \rightarrow ((\text{-2} * \text{div}(\mathbf{heapIs}
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.p1, 177).quot) + (171 * div(heapIs)
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.p1, 177).rem))).b2))))
\rightarrow [const member of object with modified fields]
[57.16] $\text{heap}_{724,1:742,8} == \text{$heap}_{funcstart\_724,1}._\text{$replace}(p1 \to ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}. p1, \ 177). \operatorname{quot}) + (171 *
\label{eq:div_heap} \text{div}(\textbf{heapIs} \ \$ \text{heap}_{funcstart\_724,1}, \ \$ \text{heap}_{funcstart\_724,1}.\text{p1},
177).rem)))._replace(p2 \rightarrow asType<short int>((172 * div(heapIs
\theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}.p2, 176).rem) - (div(heapIs
heap_{funcstart_{724,1}}, heap_{funcstart_{724,1}}.p2, 176).quot *
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{b2}))))
\rightarrow [const static or extern object]
[57.17] $heap<sub>724,1;742,8</sub> == $heap<sub>funcstart_724,1</sub>._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 \ *
\operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart} 724.1, \$ \operatorname{heap}_{funcstart} 1.p1,
177).rem)))._replace(p2 \rightarrow asType<short int>((172 * div(heapIs
\theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}
heap_{funcstart_{724,1}}, heap_{funcstart_{724,1}}.p2, 176).quot *
asType < int > (\$heap_{init}.b2))))
\rightarrow [expand definition of constant 'b2' at prang.c (22,20)]
[57.18] $heap<sub>724,1;742,8</sub> == $heap<sub>funcstart_724,1</sub>._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 \ *
\operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724,1}, \$ \operatorname{heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow asType<short int>((172 * div(heapIs
\theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}
heap_{funcstart_{724,1}}, heap_{funcstart_{724,1}}.p2, 176).quot *
asType<int>(asType<short int>((int)35)))))
\rightarrow [simplify]
[57.24] $heap<sub>724,1;742,8</sub> == $heap<sub>funcstart_724,1</sub>._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow ((-35 * div(heapIs $heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1}.\text{p2}, 176).\text{quot} + (172 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
heap_{funcstart_{-724,1}}.p2, 176).rem)
[Take goal term]
[1.0] -asType<integer const>($heap_{724.1:742.8}.M2) <
asType<integer>($heap<sub>724.1:742.8</sub>.p2)
```

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\rightarrow [from term 57.24, $heap<sub>724.1:742.8</sub> is equal to
heap_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 * div(heapIs $heap_{funcstart\_724,1},
heap_{funcstart\_724,1}.p1, 177).quot + (171 * div(heapIs p_{funcstart\_724,1})
heap_{funcstart\_724,1}.p1, 177).rem)._replace(p2 \rightarrow (-35 * div(heapIs)))._
heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p2, 176).quot) + (172 * div(heapIs)
heap_{funcstart_{724,1}}, heap_{funcstart_{724,1}}, p2, 176).rem)
[1.1] -asType < integer const > (\$heap_{funcstart\_724,1}.\_replace(p1 \rightarrow ((-2 * funcstart\_724,1)))))
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 \ *
\operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724.1}, \$ \operatorname{heap}_{funcstart\_724.1}.p1,
177).rem)))._replace(p2 \rightarrow ((-35 * div(heapIs $heap_{funcstart\_724,1},
\rho_{funcstart\_724,1}.p2, 176).quot) + (172 * div(heapIs \rho_{funcstart\_724,1}),
heap_{funcstart_{724,1},p2, 176,rem})).M2) <
asType<integer>($heap<sub>724.1:742.8</sub>.p2)
\rightarrow [const member of object with modified fields]
[1.3] -asType<integer const>(\rho_{tart_{1}}=0.3) <
asType<integer>($heap<sub>724.1:742.8</sub>.p2)
\rightarrow [const static or extern object]
[1.4] -asType<integer const>(\theta) (\theta)
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathrm{heap}_{724,1;742,8}.\mathrm{p2})
\rightarrow [expand definition of constant 'M2' at prang.c (19,20)]
[1.5] -asType<integer const>(asType<short int>((int)30307)) <
asType<integer>($heap<sub>724.1:742.8</sub>.p2)
\rightarrow [simplify]
[1.9] -30307 < asType < integer > ($heap_{724,1:742.8}.p2)
\rightarrow [from term 57.24, $heap<sub>724,1;742,8</sub> is equal to
heap_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 * div(heapIs $heap_{funcstart\_724,1},
heap_{funcstart_{-724,1},p1, 177}, quot) + (171 * div(heapIs heap_{funcstart_{-724,1},p1, 177})
heap_{funcstart\_724.1}.p1, 177).rem)._replace(p2 \rightarrow (-35 * div(heapIs)))._
heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p2, 176).quot) + (172 * div(heapIs)
heap_{funcstart_{724,1}}, heap_{funcstart_{724,1}}, p2, 176).rem)
[1.10] -30307 < asType<integer>($heap<sub>funcstart_724,1</sub>._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).quot) + (171 *
\operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724.1}, \$ \operatorname{heap}_{funcstart\_724.1}.p1,
177).rem)))._replace(p2 \rightarrow ((-35 * div(heapIs $heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1}.\text{p2}, 176).\text{quot} + (172 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
heap_{funcstart_{-724,1}.p2, 176).rem})).p2)
\rightarrow [simplify]
 [1.12] -30307 < ((-35 * div(\mathbf{heapIs} \$ heap_{funcstart\_724,1}, \$ heap_{funcstart\_724,1}.p2,
176).quot) + (172 * div(heapIs heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p2,
176).rem))
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\rightarrow [negate goal and search for contradiction]
[1.13] ! (-30307 < ((-35 * div(heapIs $heap_{funcstart\_724,1},
\rho_{tuncstart_{-724,1},p2,176} (unit) + (172 * div(heapIs \rho_{tuncstart_{-724,1},p2}
heap_{funcstart_{-724,1}}.p2, 176).rem))
\rightarrow [simplify]
176).quot) + (-172 * div(heapIs heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p2,
176).rem))
[Copy term 1.18]
\label{eq:continuous} \textit{[63.0] } 30306 < ((-172 * div(\textbf{heapIs} \$heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1}.\text{p2}, 176).\text{rem} + (35 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
heap_{funcstart_{-724,1}}.p2, 176).quot)
\rightarrow [from term 29.17, div(heapIs $heap_{funcstart_724.1}, $heap_{funcstart_724.1}.p2,
176).rem is equal to heap_{funcstart_{-724,1},p2} \% 176]
[63.1] 30306 < ((-172 * (\$heap_{funcstart\_724,1}.p2 \% 176)) + (35 * div(heapIs))
\$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p2, 176).quot))
[Create new term from term 28.17 using rule: condition for equality of division]
[80.0] ((176 * (0 + -(-div(heapIs heapIs funcstart_{-724,1}),
\text{Sheap}_{funcstart_724,1}.p2, 176).quot))) < (1 + \text{Sheap}_{funcstart_724,1}.p2)) \land
(\text{$heap}_{funcstart\_724,1}.\text{p2} < (176 * (0 + 1 + -(-\text{div}(\textbf{heapIs}))))
heap_{funcstart_{724,1}}, heap_{funcstart_{724,1}}, 176).quot))))
\rightarrow [simplify]
[80.15] (-1 < ((-176 * div(heapIs $heap_{funcstart\_724,1}, $heap_{funcstart\_724,1}.p2,
176).quot) + heap_{funcstart\_724,1}.p2) \land (-176 < (-heap_{funcstart\_724,1}.p2 + funcstart\_724,1})
(176 * div(\mathbf{heapIs} \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p2, 176).quot)))
[Work on sub-term 2 of conjunction in term 80.15]
[81.0] -1 < ((-176 * div(heapIs $heap_{funcstart\_724,1}, $heap_{funcstart\_724,1}.p2,
176).quot) + $heap<sub>funcstart_724,1.</sub>p2)
[Create new term from terms 81.0, 6.0 using rule: transitivity 2]
[93.0] (-30307 + -1 + 1) < (-176 * div(heapIs $heap_{funcstart\_724,1},
heap_{funcstart_{-724,1}.p2, 176}, quot
\rightarrow [simplify]
[93.1] -30307 < (-176 * div(heapIs $heap_{funcstart\_724,1},
heap_{funcstart_{-724,1}}.p2, 176).quot
\rightarrow [literal comparison of product]
[93.2] ([-176 < 0]: (-30307 / 176) < -\text{div}(\text{heapIs } \text{$heap}_{tuncstart\_724.1},
\theta_{funcstart\_724,1}.p2, 176.quot, [0 < -176]: (-30307 / -176) < div(heapIs)
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.\text{p2}, 176).\text{quot}, [-176 == 0]: -30307 <
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0)
→ [explicitly assert falsehood of skipped guards in subsequent guards]
[93.3] ([-176 < 0]: (-30307 / 176) < -\text{div}(\text{heapIs } \text{$heap}_{tuncstart\_724.1},
\text{Sheap}_{funcstart\_724,1.p2}, 176).\text{quot}, [(0 < -176) \land !(-176 < 0)]: (-30307 / -176)
< \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_724,1}, \text{\$heap}_{funcstart\_724,1}.\text{p2}, 176).\text{quot}, [(-176)]
==0) \land !(-176 < 0) \land !(0 < -176)]: -30307 < 0)
\rightarrow [simplify]
[93.7] - 173 < -\text{div}(\text{heapIs } \text{$heap}_{funcstart\_724,1}, \text{$heap}_{funcstart\_724,1}.\text{p2},
176).quot
[Create new term from terms 93.7, 63.1 using rule: transitivity 5]
[95.0] 30306 < ((-172 * ($heap_{funcstart\_724,1}.p2 % 176)) + (35 * -(-173 + 1)))
\rightarrow [simplify]
[95.5] 24286 < (-172 * (\text{$heap}_{funcstart\_724,1}.p2 \% 176))
\rightarrow [literal comparison of product]
[95.6] ([-172 < 0]: (24286 / 172) < -($heap_{funcstart\_724,1}.p2 % 176), [0 < 176]
-172]: (24286 / -172) < (\text{$heap}_{funcstart\_724,1}.p2 \% 176), [-172 == 0]: 24286 <
→ [explicitly assert falsehood of skipped guards in subsequent guards]
[95.7] ([-172 < 0]: (24286 / 172) < -($heap_{funcstart\_724,1}.p2 % 176), [(0 <
-172) \wedge !(-172 < 0)]: (24286 / -172) < ($heap_{funcstart\_724,1}.p2 % 176), [(-172)]
==0) \land !(-172 < 0) \land !(0 < -172)]: 24286 < 0)
\rightarrow [simplify]
[95.12] false
Proof of verification condition: Type constraint satisfied in explicit
conversion from 'int' to 'short int'
Condition generated at: C:\Escher\Customers\prang\prang.c (60,15)
Condition defined at:
To prove: minof(short int) \le div3.rem
Given:
heap_{init}.LIMIT == (int)80
\theta sheap<sub>init</sub>.M1 == asType<short int>((int)30269)
\theta_{init}.r1 == asType < short int > ((int)171)
```

 $\hat{s}_{init}.a1 == asType < short int > ((int)177)$  $\hat{s}_{init}.b1 == asType < short int > ((int)2)$ 

```
heap_{init}.M2 == asType < short int > ((int)30307)
\theta_{init}.r2 == asType < short int > ((int)172)
\theta_{init}.a2 == asType<short int>((int)176)
heap_{init}.b2 == asType<short int>((int)35)
heap_{init}.M3 == asType < short int > ((int)30323)
heap_{init}.r3 == asType < short int > ((int)170)
heap_{init}.a3 == asType < short int > ((int)178)
\theta = asType < short int > ((int)63)
\theta = asType < short int > ((int)1)
\theta
\rho = asType < short int > ((int)3)
invariant1(heapIs heap_{funcstart_{-724,1}})
div1 == div(\mathbf{heapIs} \$ heap_{funcstart\_724.1},
asType < int > (\$heap_{funcstart\_724.1}.p1),
asType < int > (\$heap_{funcstart\_724,1}.a1))
(asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.p1)) /
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a1))) ==
asType<integer>(div1.quot)
(asType < int > (asType < int > (\$heap_{funcstart\_724,1}.p1)) \%
asType < integer > (asType < int > (\$heap_{funcstart_{-724.1}}.a1))) = =
asType<integer>(div1.rem)
!(0 == asType < integer > (div1.rem)) || !(0 ==
asType<integer>(div1.quot))
div2 == div(\mathbf{heapIs} \$heap_{funcstart\_724,1},
asType < int > (\$heap_{funcstart\_724.1}.p2),
asType < int > (\$heap_{funcstart\_724,1}.a2))
(asType<integer>(asType<int>($heap_{funcstart\_724.1}.p2)) /
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a2))) = =
asType<integer>(div2.quot)
(\mathbf{asType} < \mathbf{integer} > (\mathbf{asType} < \mathbf{int} > (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p2})) \ \%
asType < integer > (asType < int > (\$heap_{funcstart_{-724,1}}.a2))) = =
asType<integer>(div2.rem)
!(0 == asTvpe < integer > (div2.rem)) || !(0 ==
asType<integer>(div2.quot))
div3 == div(\mathbf{heapIs} \$ heap_{funcstart\_724,1},
asType < int > (\$heap_{funcstart\_724,1}.p3),
asType < int > (\$heap_{funcstart\_724,1}.a3))
```

```
(\mathbf{asType} {<} \mathbf{integer} {>} (\mathbf{asType} {<} \mathbf{int} {>} (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p3})) \ / \\
\mathbf{asType} {<} \mathbf{integer} {>} (\mathbf{asType} {<} \mathbf{int} {>} (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{a3}))) = =
asType<integer>(div3.quot)
(asType<int>(asType<int>($heap_{funcstart\_724.1}.p3)) %
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a3))) = =
asType<integer>(div3.rem)
!(0 == asType < integer > (div3.rem)) || !(0 ==
asType<integer>(div3.quot))
\$heap_{724,1;740,8} == \$heap_{funcstart\_724,1}.\_\textbf{replace}(p1 \rightarrow \textbf{asType} < \textbf{short}
int>((asType<int>(asType<short int>(div1.rem)) *
asType < int > (\$heap_{funcstart\_724,1}.r1)) - (asType < int > (asType < short)
int>(div1.quot)) * asType<int>($heap_{funcstart\_724,1}.b1)))
-asType<integer const>($heap<sub>724,1:740,8</sub>.M1) <
asType<integer>($heap<sub>724,1:740,8</sub>.p1)
!(0 == asType < integer > (\$heap_{724,1;740,8}.p1))
\mathbf{asType}{<}\mathbf{integer}{>}(\${heap}_{724,1;740,8}.p1) <
asType<integer>($heap<sub>724.1:740.8</sub>.M1)
\text{heap}_{724.1:742.8} == \text{heap}_{724.1:740.8}._replace(p2 \rightarrow asType<short)
int>((asType<int>(asType<short int>(div2.rem))
asType < int > (\$heap_{724,1:740,8}.r2)) - (asType < int > (asType < short)
int>(div2.quot)) * asType<int>($heap<sub>724.1:740.8</sub>.b2))))
-asType < integer\ const > (\$heap_{724,1;742,8}.M2) < 
asType<integer>($heap<sub>724.1:742.8</sub>.p2)
!(0 == asType < integer > (\$heap_{724,1:742.8}.p2))
asType<integer>($heap<sub>724.1:742.8</sub>.p2) <
asType<integer>($heap<sub>724.1:742.8</sub>.M2)
Proof:
[Take given term]
[5.0] invariant1(heapIs heap_{funcstart\_724,1})
\rightarrow [expand definition of function 'invariant1' at prang.c (34,1)]
\texttt{[5.1]} \; (((((0 < \mathbf{asType} < \mathbf{integer} > (\$ heap_{funcstart\_724,1}.p1)) \; \&\& \;
(asType<integer>($heap_funcstart_724.1.p1) <
asType < integer > (\$heap_{funcstart\_724,1}.M1))) \&\& (0 <
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p2})))\ \&\&
(\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{p2}) <
asType < integer > (\$heap_{funcstart\_724,1}.M2))) \&\& (0 <
asType < integer > (\$heap_{funcstart\_724,1}.p3))) \&\&
(\mathbf{asType} < \mathbf{integer} > (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p3}) <
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{M3}))
```

```
\rightarrow [simplify]
[5.3] (((((0 < \theta_{funcstart\_724,1.p1) && (\theta_{funcstart\_724,1.p1)
asType < integer > (\$heap_{funcstart\_724,1}.M1))) \&\& (0 <
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p2})))\ \&\&
(asType < integer > (\$heap_{funcstart\_724,1}.p2) < 
as
Type<integer>(\rho_{funcstart\_724,1}.M2))) & (0 <
asType < integer > (\$heap_{funcstart\_724,1}.p3))) \&\&
(\mathbf{asType} {<} \mathbf{integer} {>} (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p3}) <
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{M3}))
\rightarrow [const static or extern object]
[5.4] \ (((((0 < \text{\$heap}_{funcstart\_724,1}.\text{p1}) \&\& \ (\text{\$heap}_{funcstart\_724,1}.\text{p1} <
asType < integer > (\$heap_{init}.M1))) \&\& (0 <
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p2})))\ \&\&
(asType<integer>($heap_funcstart_724.1.p2) <
asType < integer > (\$heap_{funcstart\_724,1}.M2))) \&\& (0 <
asType < integer > (\$heap_{funcstart\_724,1}.p3))) \&\&
(\mathbf{asType} < \mathbf{integer} > (\$ heap_{funcstart\_724,1}.p3) <
\mathbf{asType} < \mathbf{integer} > (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{M3}))
\rightarrow [expand definition of constant 'M1' at prang.c (14,20)]
[5.5] (((((0 < $heap_{funcstart_724,1}.p1) && ($heap_{funcstart_724,1}.p1 <
asType<integer>(asType<short int>((int)30269)))) && (0 <
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p2})))\ \&\&
(\mathbf{asType} {<} \mathbf{integer} {>} (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p2}) <
asType < integer > (\$heap_{funcstart\_724,1}.M2))) \&\& (0 <
asType < integer > ($heap_{funcstart\_724,1}.p3))) &&
(\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{p3}) <
asType < integer > (\$heap_{funcstart\_724,1}.M3))
\rightarrow [simplify]
[5.16] ((((-30269 < -\$heap_{funcstart\_724,1}.p1) \land (0 < \$heap_{funcstart\_724,1}.p1) 
(0 < \text{\$heap}_{funcstart\_724,1}.\text{p2})) && (\text{\$heap}_{funcstart\_724,1}.\text{p2} <
asType < integer > (\$heap_{funcstart\_724,1}.M2))) \&\& (0 <
asType < integer > (\$heap_{funcstart\_724,1}.p3))) \&\&
(asType < integer > (\$heap_{funcstart\_724,1}.p3) < 
asType < integer > (\$heap_{funcstart\_724,1}.M3))
\rightarrow [const static or extern object]
[5.17] \left( \left( \left( \left( -30269 < -\$ \text{heap}_{funcstart\_724,1}.\text{p1} \right) \right. \wedge \left. \left( 0 < \$ \text{heap}_{funcstart\_724,1}.\text{p1} \right) \right. \wedge \right. \right) \\
(0 < \text{\$heap}_{funcstart\_724,1}.p2)) \&\& (\text{\$heap}_{funcstart\_724,1}.p2 <
asType<integer>(heap_{init}.M2))) && (0 <
asType < integer > (\$heap_{funcstart\_724,1}.p3))) \&\&
(\mathbf{asType} < \mathbf{integer} > (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p3}) <
asType<integer>($heap_funcstart_724,1.M3))
```

```
\rightarrow [expand definition of constant 'M2' at prang.c (19,20)]
[5.18] ((((-30269 < -\$heap_{funcstart\_724,1}.p1) \land (0 < \$heap_{funcstart\_724,1}.p1) 
(0 < $heap_{funcstart\_724,1}.p2)) && ($heap_{funcstart\_724,1}.p2 <
asType < integer > (asType < short int > ((int)30307)))) && (0 < integer) && (0 < integer
asType < integer > (\$heap_{funcstart\_724,1}.p3))) \&\&
(\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{p3}) <
asType < integer > (\$heap_{funcstart\_724,1}.M3))
\rightarrow [simplify]
[5.30] ((-30307 < -$heap<sub>funcstart_724,1</sub>.p2) \wedge (-30269 <
-\$heap_{funcstart\_724,1}.p1) \land (0 < \$heap_{funcstart\_724,1}.p1) \land (0 < \$heap_{funcstart\_724,1}.p1)
\text{Sheap}_{funcstart_{724,1}.p2} \land (0 < \text{Sheap}_{funcstart_{724,1}.p3})) \&\&
(\text{\$heap}_{funcstart\_724,1}.\text{p3} < \text{asType} < \text{integer} > (\text{\$heap}_{funcstart\_724,1}.\text{M3}))
\rightarrow [const static or extern object]
[5.31] ((-30307 < -$heap<sub>funcstart_724,1</sub>.p2) \wedge (-30269 <
-\$heap_{funcstart\_724,1}.p1) \land (0 < \$heap_{funcstart\_724,1}.p1) \land (0 < \$heap_{funcstart\_724,1}.p1)
\text{Sheap}_{funcstart\_724,1.p2} \land (0 < \text{Sheap}_{funcstart\_724,1.p3})) \&\&
(\text{\$heap}_{funcstart\_724,1}.p3 < asType < integer > (\text{\$heap}_{init}.M3))
\rightarrow [expand definition of constant 'M3' at prang.c (24,20)]
[5.32] ((-30307 < -$heap_funcstart_724,1.p2) \land (-30269 <
 -\$heap_{funcstart\_724,1}.p1) \land (0 < \$heap_{funcstart\_724,1}.p1) \land (0 < \$heap_{funcstart\_724,1}.p1)
\text{Sheap}_{funcstart\_724,1.p2}) \land (0 < \text{Sheap}_{funcstart\_724,1.p3})) \&\&
(\text{sheap}_{funcstart\_724.1}.\text{p3} < \text{asType} < \text{integer} > (\text{asType} < \text{short})
int > ((int)30323))
\rightarrow [simplify]
[5.40] (-30323 < -$heap<sub>funcstart_724,1</sub>.p3) \land (-30307 <
-\$heap_{funcstart\_724,1}.p2) \land (-30269 < -\$heap_{funcstart\_724,1}.p1) \land (0 < -\$heap_{funcstart\_724,1}.p1)
\text{Sheap}_{funcstart\_724.1.p1} \land (0 < \text{Sheap}_{funcstart\_724.1.p2}) \land (0 <
heap_{funcstart_{724,1}.p3}
[Work on sub-term 6 of conjunction in term 5.40]
 [10.0] \ 0 < \$ heap_{funcstart\_724,1}.p3 
[Take given term]
[39.0] \operatorname{div3} == \operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724,1},
asType < int > (\$heap_{funcstart\_724,1}.p3),
asType < int > (\$heap_{funcstart\_724,1}.a3))
\rightarrow [simplify]
[39.1] \operatorname{div3} == \operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724,1}, \$ \operatorname{heap}_{funcstart\_724,1}.p3,
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{a3}))
\rightarrow [const static or extern object]
```

```
[39.2] \ \mathrm{div3} == \ \mathrm{div}(\mathbf{heapIs} \ \$ \mathrm{heap}_{funcstart\_724,1}, \ \$ \mathrm{heap}_{funcstart\_724,1}.\mathrm{p3},
asType < int > (\$heap_{init}.a3))
\rightarrow [expand definition of constant 'a3' at prang.c (26,20)]
[39.3] \operatorname{div3} == \operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724,1}, \$ \operatorname{heap}_{funcstart\_724,1}.p3,
asType<int>(asType<short int>((int)178)))
\rightarrow [simplify]
[39.6] div3 == div(heapIs heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p3, 178)
[Assume known post-assertion, class invariant or type constraint for term 39.6]
[43.0] (asType<integer>(sheap_{funcstart\_724,1}.p3) %
asType<integer>(178)) == asType<integer>(div(heapIs
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.\text{p3}, 178).\text{rem}
\rightarrow [simplify]
[43.2] ($heap_{funcstart\_724,1}.p3 % 178) == asType<integer>(div(heapIs
heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p3, 178).rem
→ [expand definition of operator '.%' in class 'int' at built in declaration]
[43.3] ([asType<integer>(sheap_{funcstart\_724.1}.p3) < 0]:
-(-asType < integer > (\$heap_{funcstart\_724,1}.p3) \% 178), []:
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p3})~\%~178) ==
asType < integer > (div(heapIs \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p3,
178).rem)
→ [explicitly assert falsehood of skipped guards in subsequent guards]
[43.4] ([asType<integer>($heap_{funcstart\_724,1}.p3) < 0]:
-(-\mathbf{asType} < \mathbf{integer} > (\$ \mathrm{heap}_{funcstart\_724,1}.\mathrm{p3}) \% \ 178),
[!(asType < integer > (\$heap_{funcstart\_724,1}.p3) < 0)]:
asType < integer > (\$heap_{funcstart\_724,1}.p3) \% 178) ==
asType<integer>(div(heapIs $heap_{tuncstart\_724.1}, $heap_{tuncstart\_724.1}.p3,
178).rem)
\rightarrow [simplify]
[43.7] ([0 < -$heap<sub>funcstart_724,1.</sub>p3]:
-(-asType < integer > (\$heap_{funcstart\_724,1}.p3) \% 178),
[!(asType < integer > (\$heap_{funcstart\_724,1}.p3) < 0)]:
asType < integer > (\$heap_{funcstart\_724,1}.p3) \% 178) ==
asType < integer > (div(heapIs \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p3,
178).rem)
\rightarrow [from term 10.0, literala < -$heap<sub>funcstart_724,1</sub>.p3 is false whenever -2 <
(0 + literala)
   Proof of rule precondition:
   [43.7.0] - 2 < (0 + 0)
```

```
\rightarrow [simplify]
    [43.7.2] true
[43.8] ([false]: -(-asType < integer > (\$heap_{funcstart\_724,1}.p3) \% 178),
[!(asType < integer > (\$heap_{funcstart\_724,1}.p3) < 0)]:
asType < integer > (\$heap_{funcstart\_724,1}.p3) \% 178) ==
asType < integer > (div(heapIs \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p3,
178).rem)
\rightarrow [simplify]
<-$heap<sub>funcstart_724,1.</sub>p3)]: asType<integer>($heap<sub>funcstart_724,1.</sub>p3) %
178) == asType < integer > (div(heapIs $heap_{funcstart\_724,1},
heap_{funcstart_{-724,1}.p3, 178}.rem
\rightarrow [from term 10.0, literala < -$heap<sub>funcstart_724,1</sub>.p3 is false whenever -2 <
(0 + literala)
    Proof of rule precondition:
    [43.11.0] - 2 < (0 + 0)
    \rightarrow \textit{[simplify]}
    [43.11.2] true
[43.12] ([false]: -(-asType < integer > (\$heap_{funcstart\_724,1}.p3) \% 178),
[!false]: asType<integer>(sheap_{funcstart\_724,1.p3}) \% 178 ==
\mathbf{asType} < \mathbf{integer} > (\mathbf{div}(\mathbf{heapIs} \ \$ \mathbf{heap}_{funcstart\_724,1}, \ \$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p3},
178).rem)
\rightarrow [simplify]
\textit{[43.17] 0} == (-\text{div}(\textbf{heapIs} \ \$ \text{heap}_{funcstart\_724,1}, \ \$ \text{heap}_{funcstart\_724,1}.\text{p3},
178).rem + (\text{$heap}_{funcstart\_724,1}.p3 \% 178))
[Assume known post-assertion, class invariant or type constraint for term
43.17
[50.0] \operatorname{minof(int)} \leq \operatorname{div}(\operatorname{heapIs} \operatorname{\$heap}_{funcstart\_724,1}, \operatorname{\$heap}_{funcstart\_724,1}.p3,
178).rem
\rightarrow [simplify]
[50.3] \ -32769 < {\rm div}(\mathbf{heapIs} \ \$ \mathrm{heap}_{funcstart\_724,1}, \ \$ \mathrm{heap}_{funcstart\_724,1}.\mathrm{p3},
178).rem
[Take goal term]
[1.0] minof(short int) \leq div3.rem
\rightarrow [simplify]
[1.1] -32768 \le \text{div}3.\text{rem}
\rightarrow [from term 39.6, div3 is equal to div(heapIs $heap_{funcstart\_724,1},
```

```
heap_{funcstart_{-724,1}}.p3, 178
[1.2] -32768 \le \operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724,1}, \$ \operatorname{heap}_{funcstart\_724,1}.\operatorname{p3},
178).rem
\rightarrow [simplify]
[1.4] -32769 < \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_724,1}, \text{\$heap}_{funcstart\_724,1}.p3,
178).rem
\rightarrow [from term 50.3, literala < div(heapIs $heap_{funcstart_{724,1}},
heap_{funcstart\_724,1}.p3, 178.rem is true whenever (-1 + literala) < -32769
   Proof of rule precondition:
   [1.4.0] (-32769 + -1) < -32769
   \rightarrow [simplify]
   [1.4.2] true
[1.5] true
Proof of verification condition: Type constraint satisfied in explicit
conversion from 'int' to 'short int'
Condition generated at: C:\Escher\Customers\prang\prang.c (60,15)
Condition defined at:
To prove: div3.rem \le maxof(short int)
Given:
heap_{init}.LIMIT == (int)80
heap_{init}.M1 == asType < short int > ((int)30269)
\theta_{init}.r1 == asType < short int > ((int)171)
heap_{init}.a1 == asType < short int > ((int)177)
\theta
\theta sheap<sub>init</sub>.M2 == asType<short int>((int)30307)
\theta
heap_{init}.a2 == asType < short int > ((int)176)
heap_{init}.b2 == asType < short int > ((int)35)
heap_{init}.M3 == asType < short int > ((int)30323)
\theta_{init}.r3 == asType<short int>((int)170)
heap_{init}.a3 == asType < short int > ((int)178)
\theta = asType < short int > ((int)63)
\theta = asType < short int > ((int)1)
```

```
\rho_{init}.p2 == asType < short int > ((int)2)
\theta = asType < short int > ((int)3)
invariant1(heapIs $heap_{funcstart_724.1})
div1 == div(\mathbf{heapIs} \$heap_{funcstart\_724,1},
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p1}),
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{a1}))
(asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.p1)) /
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a1))) = =
asType<integer>(div1.quot)
(asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.p1)) \%
\mathbf{asType} < \mathbf{integer} > (\mathbf{asType} < \mathbf{int} > (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{a1}))) = =
asType<integer>(div1.rem)
!(0 == asType < integer > (div1.rem)) || !(0 ==
asType<integer>(div1.quot))
div2 == div(\mathbf{heapIs} \$heap_{funcstart\_724,1},
asType < int > (\$heap_{funcstart\_724,1}.p2),
asType < int > (\$heap_{funcstart\_724,1}.a2))
(asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.p2)) /
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a2))) = =
asType<integer>(div2.quot)
(\mathbf{asType} {<} \mathbf{integer} {>} (\mathbf{asType} {<} \mathbf{int} {>} (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p2})) \ \%
\mathbf{asType}{<}\mathbf{integer}{>}(\mathbf{asType}{<}\mathbf{int}{>}(\$\mathbf{heap}_{funcstart\_724,1}.\mathbf{a2}))) = =
asType<integer>(div2.rem)
!(0 == asType < integer > (div2.rem)) || !(0 ==
asType<integer>(div2.quot))
div3 == div(\mathbf{heapIs} \$ heap_{funcstart\_724,1},
asType < int > (\$heap_{funcstart\_724,1}.p3),
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{a3}))
(asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.p3)) /
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a3))) = =
asType<integer>(div3.quot)
(\mathbf{asType} {<} \mathbf{integer} {>} (\mathbf{asType} {<} \mathbf{int} {>} (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p3})) \ \%
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a3))) = =
asType<integer>(div3.rem)
!(0 == asType < integer > (div3.rem)) || !(0 ==
asType<integer>(div3.quot))
\text{Sheap}_{724,1;740,8} == \text{Sheap}_{funcstart\_724,1}.\_\mathbf{replace}(\text{p1} \to \mathbf{asType} < \mathbf{short})
int>((asType<int>(asType<short int>(div1.rem)) *
asType < int > (\$heap_{funcstart\_724,1}.r1)) - (asType < int > (asType < short)
```

```
\mathbf{int}{>}(\mathbf{div1.quot})) \ * \ \mathbf{asType}{<} \mathbf{int}{>} (\$\mathbf{heap}_{funcstart\_724,1}.\mathbf{b1}))))
-asType < integer const > (\$heap_{724,1:740.8}.M1) < 
asType<integer>($heap<sub>724.1:740.8</sub>.p1)
!(0 == asType < integer > (\$heap_{724,1:740.8}.p1))
asType<integer>($heap<sub>724,1:740,8</sub>.p1) <
asType<integer>($heap<sub>724,1:740,8</sub>.M1)
heap_{724,1;742,8} == heap_{724,1;740,8}.replace(p2 \rightarrow asType<short
int>((asType<int>(asType<short int>(div2.rem)) *
asType < int > (\$heap_{724.1:740.8}.r2)) - (asType < int > (asType < short)
int>(div2.quot)) * asType<int>($heap<sub>724.1:740.8</sub>.b2))))
-asType<integer const>($heap<sub>724,1:742,8</sub>.M2) <
asType<integer>($heap<sub>724,1;742,8</sub>.p2)
!(0 == asType < integer > (\$heap_{724.1:742.8}.p2))
asType<integer>($heap<sub>724,1:742,8</sub>.p2) <
asType<integer>($heap<sub>724,1:742,8</sub>.M2)
Proof:
[Take given term]
[5.0] invariant1(heapIs heap_{funcstart\_724,1})
\rightarrow [expand definition of function 'invariant1' at prang.c (34,1)]
 \texttt{[5.1]} \; (((((0 < \mathbf{asType} < \mathbf{integer} > (\$ heap_{funcstart\_724,1}.p1)) \; \&\& \\
(asType < integer > (\$heap_{funcstart\_724,1}.p1) < 
asType < integer > (\$heap_{funcstart\_724,1}.M1))) \&\& (0 < funcstart\_724,1.M2))
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p2})))\ \&\&
(asType < integer > (\$heap_{funcstart\_724,1}.p2) <
asType < integer > (\$heap_{funcstart\_724,1}.M2))) \&\& (0 <
asType < integer > (\$heap_{funcstart_{-724,1}}.p3))) \&\&
(\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{p3}) <
asType < integer > (\$heap_{funcstart\_724,1}.M3))
\rightarrow [simplify]
[5.3] (((((0 < $heap_{funcstart\_724,1}.p1) && ($heap_{funcstart\_724,1}.p1 < 
asType < integer > (\$heap_{funcstart\_724,1}.M1))) \&\& (0 < 1)
asType < integer > (\$heap_{funcstart\_724,1}.p2))) \&\&
(\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{p2}) <
as
Type<integer>(\rho_{funcstart\_724,1}.M2))) & (0 <
asType < integer > (\$heap_{funcstart\_724,1}.p3))) \&\&
(asType<integer>($heap_funcstart_724.1.p3) <
asType < integer > (\$heap_{funcstart\_724,1}.M3))
\rightarrow [const static or extern object]
[5.4] (((((0 < $heap_{funcstart_{-724,1}}.p1) && ($heap_{funcstart_{-724,1}}.p1 < ])
```

```
asType < integer > (\$heap_{init}.M1))) \&\& (0 <
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p2})))\ \&\&
(\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{p2}) <
asType < integer > (\$heap_{funcstart\_724,1}.M2))) \&\& (0 <
asType < integer > ($heap_{funcstart\_724,1}.p3))) &&
(asType<integer>($heap_{tuncstart\_724,1}.p3) <
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{M3}))
\rightarrow [expand definition of constant 'M1' at prang.c (14,20)]
[5.5] (((((0 < $heap_{funcstart_{724,1}}.p1) && ($heap_{funcstart_{724,1}}.p1 < 
asType<integer>(asType<short int>((int)30269)))) && (0 <
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p2})))\ \&\&
(\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p2}) <
asType < integer > (\$heap_{funcstart\_724,1}.M2))) \&\& (0 <
asType < integer > (\$heap_{funcstart\_724,1}.p3))) \&\&
(asType < integer > (\$heap_{funcstart\_724,1}.p3) < 
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{M3}))
\rightarrow [simplify]
[5.16] \; ((((-30269 < -\$heap_{funcstart\_724,1}.p1) \; \land \; (0 < \$heap_{funcstart\_724,1}.p1) \; \land 
(0 < \text{Sheap}_{funcstart_{-724,1},p2})) \&\& (\text{Sheap}_{funcstart_{-724,1},p2} <
\mathbf{asType} {<} \mathbf{integer} {>} (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{M2}))) \ \&\& \ (0 <
asType < integer > (\$heap_{funcstart\_724,1}.p3))) \&\&
(\mathbf{asType} < \mathbf{integer} > (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p3}) <
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{M3}))
\rightarrow [const static or extern object]
[5.17] \left( \left( \left( \left( -30269 < -\$ \text{heap}_{funcstart\_724,1}.\text{p1} \right) \right. \wedge \left. \left( 0 < \$ \text{heap}_{funcstart\_724,1}.\text{p1} \right) \right. \wedge \right. \right)
(0 < \text{\$heap}_{funcstart_{-724,1}.p2})) \&\& (\text{\$heap}_{funcstart_{-724,1}.p2} <
asType < integer > (\$heap_{init}.M2))) \&\& (0 <
asType < integer > (\$heap_{funcstart\_724,1}.p3))) \&\&
(asType<integer>($heap_funcstart_724,1.p3) <
asType < integer > (\$heap_{funcstart\_724,1}.M3))
\rightarrow [expand definition of constant 'M2' at prang.c (19,20)]
[5.18] ((((-30269 < -\$heap_{funcstart\_724,1}.p1) \land (0 < \$heap_{funcstart\_724,1}.p1) 
(0 < \text{\$heap}_{funcstart\_724,1}.p2)) \&\& (\text{\$heap}_{funcstart\_724,1}.p2 <
asType<integer>(asType<short int>((int)30307)))) && (0 <
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p3})))\ \&\&
(asType < integer > (\$heap_{funcstart\_724,1}.p3) < 
\mathbf{asType} < \mathbf{integer} > (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{M3}))
\rightarrow [simplify]
[5.30] ((-30307 < -$heap_{funcstart\_724,1}.p2) \land (-30269 <
-\$heap_{funcstart\_724,1}.p1) \land (0 < \$heap_{funcstart\_724,1}.p1) \land (0 < \$heap_{funcstart\_724,1}.p1)
\text{Sheap}_{funcstart_{-724,1}.p2} \land (0 < \text{Sheap}_{funcstart_{-724,1}.p3})) \&\&
```

```
(\text{\$heap}_{funcstart\_724,1}.\text{p3} < \mathbf{asType} < \mathbf{integer} > (\text{\$heap}_{funcstart\_724,1}.\text{M3}))
\rightarrow [const static or extern object]
[5.31] ((-30307 < -$heap_funcstart_724,1.p2) \land (-30269 <
-\$ heap_{funcstart\_724,1}.p1) \land (0 < \$ heap_{funcstart\_724,1}.p1) \land (0 < \$ heap_{funcstart\_724,1}.p1) \land (0 < \$ heap_{funcstart\_724,1}.p1)
\text{Sheap}_{funcstart\_724,1.p2}) \land (0 < \text{Sheap}_{funcstart\_724,1.p3})) \&\&
(\text{\$heap}_{funcstart\_724,1}.\text{p3} < \text{asType} < \text{integer} > (\text{\$heap}_{init}.\text{M3}))
\rightarrow [expand definition of constant 'M3' at prang.c (24,20)]
[5.32] ((-30307 < -$heap<sub>funcstart_724.1</sub>.p2) \wedge (-30269 <
-\$heap_{funcstart\_724,1}.p1) \land (0 < \$heap_{funcstart\_724,1}.p1) \land (0 < \$heap_{funcstart\_724,1}.p1)
\text{Sheap}_{funcstart_{-724,1}.p2} \land (0 < \text{Sheap}_{funcstart_{-724,1}.p3})) \&\&
(\text{sheap}_{funcstart\_724.1}.p3 < asType < integer > (asType < short)
int > ((int)30323))
\rightarrow [simplify]
[5.40] (-30323 < -\$heap_{funcstart\_724,1}.p3) \land (-30307 < -30307)
-\$heap_{funcstart\_724,1}.p2) \land (-30269 < -\$heap_{funcstart\_724,1}.p1) \land (0 < -\$heap_{funcstart\_724,1}.p1)
\text{Sheap}_{funcstart\_724,1}.\text{p1}) \land (0 < \text{Sheap}_{funcstart\_724,1}.\text{p2}) \land (0 <
heap_{funcstart_{-724,1}.p3}
[Work on sub-term 6 of conjunction in term 5.40]
[10.0] 0 < $\text{heap}_{funcstart_{-724,1}}.p3$
[Take given term]
[39.0] \operatorname{div3} == \operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724,1},
asType < int > (\$heap_{funcstart\_724,1}.p3),
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{a3}))
\rightarrow [simplify]
[39.1] \ \mathrm{div3} == \mathrm{div}(\mathbf{heapIs} \ \$ \mathrm{heap}_{funcstart\_724,1}, \ \$ \mathrm{heap}_{funcstart\_724,1}.\mathrm{p3},
asType < int > (\$heap_{funcstart\_724.1}.a3))
\rightarrow [const static or extern object]
[39.2] \ \mathrm{div3} == \ \mathrm{div}(\mathbf{heapIs} \ \$ \mathrm{heap}_{funcstart\_724,1}, \ \$ \mathrm{heap}_{funcstart\_724,1}.\mathrm{p3},
asType < int > (\$heap_{init}.a3))
\rightarrow [expand definition of constant 'a3' at prang.c (26,20)]
[39.3] div3 == div(heapIs \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}.p3,
asType<int>(asType<short int>((int)178)))
\rightarrow [simplify]
[39.6] div3 == div(heapIs $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}.p3, 178)
[Assume known post-assertion, class invariant or type constraint for term 39.6]
[43.0] (as
Type<integer>($heap_{funcstart\_724,1}.p3) \%
asType<integer>(178)) == asType<integer>(div(heapIs
```

```
\text{$heap}_{funcstart\_724,1}, \text{$heap}_{funcstart\_724,1}.p3, 178).rem
\rightarrow [simplify]
[43.2] ($heap<sub>funcstart_724,1.</sub>p3 % 178) == asType<integer>(div(heapIs)
\text{$heap}_{funcstart\_724,1}, \text{$heap}_{funcstart\_724,1}.p3, 178).rem
→ [expand definition of operator '.%' in class 'int' at built in declaration]
[43.3] ([asType<integer>($heap_{funcstart\_724,1}.p3) < 0]:
-(-asType < integer > (\$heap_{funcstart\_724,1}.p3) \% 178), []:
asType < integer > (\$heap_{funcstart\_724,1}.p3) \% 178) = =
asType<integer>(div(heapIs $heap_{tuncstart_724.1}, $heap_{tuncstart_724.1}.p3,
178).rem)
→ [explicitly assert falsehood of skipped guards in subsequent guards]
[43.4] ([asType<integer>(sheap_{funcstart\_724,1}.p3) < 0]:
-(-asType < integer > (\$heap_{funcstart\_724.1}.p3) \% 178),
[!(asType < integer > (\$heap_{funcstart\_724.1}.p3) < 0)]:
asType < integer > (\$heap_{funcstart\_724,1}.p3) \% 178) ==
asType<integer>(div(heapIs heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p3,
178).\text{rem}
\rightarrow [simplify]
[43.7] ([0 < -\text{$heap}_{funcstart\_724,1}.p3]:
-(-asType < integer > (\$heap_{funcstart\_724,1}.p3) \% 178),
[!(\mathbf{asType} < \mathbf{integer} > (\$ heap_{funcstart\_724,1}.p3) < 0)]:
asType < integer > (\$heap_{funcstart\_724.1}.p3) \% 178) = =
asType<integer>(div(heapIs $heap_funcstart_724,1, $heap_funcstart_724,1.p3,
178).rem)
\rightarrow [from term 10.0, literala < -$heap<sub>funcstart_724,1</sub>.p3 is false whenever -2 <
(0 + literala)
   Proof of rule precondition:
   [43.7.0] - 2 < (0 + 0)
   \rightarrow [simplify]
   [43.7.2] true
[43.8] ([false]: -(-asType < integer > (\$heap_{funcstart\_724,1}.p3) \% 178),
[!(asType < integer > (\$heap_{funcstart\_724,1}.p3) < 0)]:
asType < integer > (\$heap_{funcstart\_724,1}.p3) \% 178) ==
\mathbf{asType} {<} \mathbf{integer} {>} ( \mathrm{div}(\mathbf{heapIs} \ \$ \mathrm{heap}_{funcstart\_724,1}, \ \$ \mathrm{heap}_{funcstart\_724,1}.\mathrm{p3}, \\
178).rem)
\rightarrow [simplify]
[43.11] ([false]: -(-asType < integer > (\$heap_{funcstart\_724,1}.p3) \% 178), [!(0)]
<-\$heap_{funcstart\_724,1}.p3)]:asType<integer>(\$heap_{funcstart\_724,1}.p3) %
178) == asType < integer > (div(heapIs \$heap_{funcstart\_724.1},
```

```
heap_{funcstart_{-724,1}.p3, 178}.rem
\rightarrow [from term 10.0, literala < -$heap_{funcstart\_724,1}.p3 is false whenever -2 <
(0 + literala)
   Proof of rule precondition:
   [43.11.0] - 2 < (0 + 0)
   \rightarrow \textit{[simplify]}
   [43.11.2] true
[43.12] ([false]: -(-asType < integer > (\$heap_{funcstart\_724,1}.p3) \% 178),
[!false]: asType<integer>($heap<sub>funcstart_724,1.</sub>p3) % 178) ==
asType < integer > (div(heapIs \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p3,
178).rem)
\rightarrow [simplify]
[43.17] \ 0 == (-\text{div}(\mathbf{heapIs} \ \$ \text{heap}_{funcstart\_724,1}, \ \$ \text{heap}_{funcstart\_724,1}.\text{p3},
178).rem + (\text{$heap}_{funcstart\_724,1}.p3 \% 178))
[Assume known post-assertion, class invariant or type constraint for term
[51.0] div(heapIs heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p3, 178).rem \leq
maxof(int)
\rightarrow [simplify]
178).rem
[Take goal term]
[1.0] div3.rem \leq maxof(short int)
\rightarrow [from term 39.6, div3 is equal to div(heapIs $heap_{funcstart\_724,1},
heap_{funcstart_{724,1}}.p3, 178
[1.1] div(heapIs \theta_{funcstart_{724,1}}, \theta_{funcstart_{724,1}}, \theta_{funcstart_{724,1}}, \theta_{funcstart_{724,1}}.
maxof(short int)
\rightarrow [simplify]
[1.10] - 32768 < -{\rm div}(\mathbf{heapIs} \ \$ \mathrm{heap}_{funcstart\_724,1}, \ \$ \mathrm{heap}_{funcstart\_724,1}.\mathrm{p3},
178).rem
\rightarrow [from term 51.9, literala < -\text{div}(\text{heapIs }\$\text{heap}_{funcstart\_724.1},
heap_{funcstart_{-724,1}.p3}, 178).rem is true whenever (-1 + literala) < -32768
   Proof of rule precondition:
   [1.10.0](-32768 + -1) < -32768
   \rightarrow [simplify]
   [1.10.2] true
```

## [1.11] **true**

```
Proof of verification condition: Type constraint satisfied in implicit
conversion from 'short int' to 'int'
Condition generated at: C:\Escher\Customers\prang\prang.c (60,15)
Condition defined at:
To prove: minof(int) \le asType < short int > (div3.rem)
Given:
heap_{init}.LIMIT == (int)80
\theta
heap_{init}.r1 == asType < short int > ((int)171)
heap_{init}.a1 == asType < short int > ((int)177)
\theta
heap_{init}.M2 == asType < short int > ((int)30307)
\rho_{init}.r2 == asType < short int > ((int)172)
heap_{init}.a2 == asType < short int > ((int)176)
\theta
\theta sheap<sub>init</sub>.M3 == asType<short int>((int)30323)
\theta
heap_{init}.a3 == asType<short int>((int)178)
heap_{init}.b3 == asType<short int>((int)63)
\theta = asType < short int > ((int)1)
\theta
\theta = asType < short int > ((int)3)
invariant1(heapIs heap_{funcstart_{724,1}})
\operatorname{div1} == \operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724,1},
\mathbf{asType} < \mathbf{int} > (\$ \mathrm{heap}_{funcstart\_724,1}.\mathrm{p1}),
asType < int > (\$heap_{funcstart_{-724,1}}.a1))
(asType<integer>(asType<int>($heap_{tuncstart}, 724,1.p1)) /
\mathbf{asType} < \mathbf{integer} > (\mathbf{asType} < \mathbf{int} > (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{a1}))) = =
asType<integer>(div1.quot)
(asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.p1)) \%
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a1))) = =
asType<integer>(div1.rem)
!(0 == asType < integer > (div1.rem)) || !(0 ==
```

```
asType<integer>(div1.quot))
div2 == div(\mathbf{heapIs} \$heap_{funcstart\_724,1},
asType < int > (\$heap_{funcstart\_724,1}.p2),
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{a2}))
(asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.p2)) /
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a2))) = =
asType<integer>(div2.quot)
(\mathbf{asType}{<}\mathbf{int}{>}(\mathbf{asType}{<}\mathbf{int}{>}(\$\mathbf{heap}_{funcstart\_724,1}.\mathbf{p2}))~\%
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a2))) = =
asType<integer>(div2.rem)
!(0 == asType < integer > (div2.rem)) || !(0 ==
asType<integer>(div2.quot))
div3 == div(\mathbf{heapIs} \$ heap_{funcstart\_724,1},
asType < int > (\$heap_{funcstart\_724,1}.p3),
asType < int > (\$heap_{funcstart\_724,1}.a3))
(asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.p3)) /
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a3))) = =
asType<integer>(div3.quot)
(\mathbf{asType} < \mathbf{integer} > (\mathbf{asType} < \mathbf{int} > (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p3})) \ \%
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a3))) = =
asType<integer>(div3.rem)
!(0 == asType < integer > (div3.rem)) || !(0 ==
asType<integer>(div3.quot))
\text{Sheap}_{724,1;740,8} == \text{Sheap}_{funcstart\_724,1}.\_\mathbf{replace}(\text{p1} \to \mathbf{asType} < \mathbf{short})
int>((asType<int>(asType<short int>(div1.rem)) *
asType < int > (\$heap_{funcstart\_724,1}.r1)) - (asType < int > (asType < short)
int>(div1.quot)) * asType<int>($heap_{funcstart\_724,1}.b1)))
-asType < integer const > (\$heap_{724.1:740.8}.M1) < 
asType < integer > ($heap_{724,1:740,8}.p1)
!(0 == \mathbf{asType} {<} \mathbf{integer} {>} (\$ \mathrm{heap}_{724,1;740,8}.\mathrm{p1}))
asType<integer>($heap<sub>724.1:740.8</sub>.p1) <
\mathbf{asType} < \mathbf{integer} > (\$ \mathrm{heap}_{724,1;740,8}.\mathrm{M1})
heap_{724,1:742,8} == heap_{724,1:740,8}.replace(p2 \rightarrow asType<short
int>((asType<int>(asType<short int>(div2.rem)) *
asType < int > (\$heap_{724.1:740.8}.r2)) - (asType < int > (asType < short)
int > (div2.quot)) * asType < int > ($heap_{724,1:740.8}.b2))))
-asType<integer const>($heap<sub>724.1:742.8</sub>.M2) <
asType<integer>($heap<sub>724.1:742.8</sub>.p2)
!(0 == asType < integer > (\$heap_{724,1:742,8}.p2))
```

```
asType < integer > (\$heap_{724,1;742,8}.p2) <
asType<integer>($heap<sub>724,1:742,8</sub>.M2)
Proof:
[Take given term]
[5.0] invariant1(heapIs heap_{funcstart\_724,1})
\rightarrow [expand definition of function 'invariant1' at prang.c (34,1)]
[5.1] ((((((0 < asType < integer > ($heap_{funcstart_724,1}.p1)) &&
(asType < integer > ($heap_{funcstart\_724,1}.p1) < 
asType < integer > (\$heap_{funcstart\_724,1}.M1))) \&\& (0 <
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{p2})))\ \&\&
(\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{p2}) <
asType < integer > (\$heap_{funcstart\_724,1}.M2))) \&\& (0 <
asType < integer > ($heap_{funcstart\_724,1}.p3))) &&
(\mathbf{asType} < \mathbf{integer} > (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p3}) <
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{M3}))
\rightarrow [simplify]
[5.3] (((((0 < \theta_{funcstart\_724,1.p1) && (\theta_{funcstart\_724,1.p1)
asType < integer > (\$heap_{funcstart\_724,1}.M1))) \&\& (0 < function for the start of the start 
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p2})))\ \&\&
(\mathbf{asType} < \mathbf{integer} > (\$ \mathrm{heap}_{funcstart\_724,1}.\mathrm{p2}) <
as
Type<integer>(\rho_{funcstart\_724,1}.M2))) & (0 <
asType < integer > (\$heap_{funcstart\_724,1}.p3))) \&\&
(\mathbf{asType} < \mathbf{integer} > (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p3}) <
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{M3}))
\rightarrow [const static or extern object]
[5.4] (((((0 < $heap_{funcstart_{724,1}}.p1) && ($heap_{funcstart_{724,1}}.p1 < 
asType < integer > (\$heap_{init}.M1))) \&\& (0 <
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p2})))\ \&\&
(asType < integer > (\$heap_{funcstart\_724,1}.p2) < 
asType<integer>(\theta_{tuncstart\_724,1}.M2))) && (0 <
asType < integer > (\$heap_{funcstart_{-724,1}}.p3))) \&\&
(\mathbf{asType} < \mathbf{integer} > (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p3}) <
asType < integer > (\$heap_{funcstart\_724,1}.M3))
\rightarrow [expand definition of constant 'M1' at prang.c (14,20)]
[5.5] (((((0 < $heap_{funcstart_{724,1}}.p1) && ($heap_{funcstart_{724,1}}.p1 < 
asType < integer > (asType < short int > ((int)30269)))) && (0 < integer) && (0 < integer
asType < integer > (\$heap_{funcstart\_724,1}.p2))) \&\&
(\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{p2}) <
as
Type<integer>(\rho_{funcstart\_724,1}.M2))) & (0 <
asType < integer > (\$heap_{funcstart\_724,1}.p3))) \&\&
(asType < integer > (\$heap_{funcstart\_724,1}.p3) <
```

```
asType < integer > (\$heap_{funcstart_{-724,1}}.M3))
\rightarrow [simplify]
[5.16] ((((-30269 < -\$heap_{funcstart\_724,1}.p1) \land (0 < \$heap_{funcstart\_724,1}.p1) 
(0 < \text{\$heap}_{funcstart\_724,1}.p2)) \&\& (\text{\$heap}_{funcstart\_724,1}.p2 <
asType < integer > (\$heap_{funcstart\_724,1}.M2))) \&\& (0 <
asType < integer > (\$heap_{funcstart\_724,1}.p3))) \&\&
(\mathbf{asType} < \mathbf{integer} > (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p3}) <
asType < integer > (\$heap_{funcstart\_724,1}.M3))
\rightarrow [const static or extern object]
[5.17] \; ((((-30269 < -\$heap_{funcstart\_724,1}.p1) \; \land \; (0 < \$heap_{funcstart\_724,1}.p1) \; \land 
(0 < \text{$heap}_{funcstart_{-724,1}.p2})) \&\& (\text{$heap}_{funcstart_{-724,1}.p2} <
asType < integer > (\$heap_{init}.M2))) \&\& (0 <
asType < integer > (\$heap_{funcstart\_724,1}.p3))) \&\&
(\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{p3}) <
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{M3}))
\rightarrow [expand definition of constant 'M2' at prang.c (19,20)]
[5.18] ((((-30269 < -\$heap_{funcstart\_724,1}.p1) \land (0 < \$heap_{funcstart\_724,1}.p1) 
(0 < \text{\$heap}_{funcstart\_724,1}.p2)) \&\& (\text{\$heap}_{funcstart\_724,1}.p2 <
asType < integer > (asType < short int > ((int)30307)))) && (0 < footnote{integer}) && (0 < footnote
asType < integer > (\$heap_{funcstart\_724,1}.p3))) \&\&
(asType < integer > (\$heap_{funcstart\_724,1}.p3) < 
asType < integer > (\$heap_{funcstart\_724,1}.M3))
\rightarrow [simplify]
[5.30] ((-30307 < -$heap_{funcstart\_724,1}.p2) \land (-30269 <
-\$heap_{funcstart\_724,1}.p1) \land (0 < \$heap_{funcstart\_724,1}.p1) \land (0 < \$heap_{funcstart\_724,1}.p1)
\text{Sheap}_{funcstart_{724,1}.p2} \land (0 < \text{Sheap}_{funcstart_{724,1}.p3})) \&\&
(\text{\$heap}_{funcstart\_724,1}.\text{p3} < \text{asType} < \text{integer} > (\text{\$heap}_{funcstart\_724,1}.\text{M3}))
\rightarrow [const static or extern object]
[5.31] ((-30307 < -$heap<sub>funcstart_724,1.</sub>p2) \land (-30269 <
 -\$heap_{funcstart\_724,1}.p1) \land (0 < \$heap_{funcstart\_724,1}.p1) \land (0 < \$heap_{funcstart\_724,1}.p1)
\text{Sheap}_{funcstart\_724,1}.p2) \land (0 < \text{Sheap}_{funcstart\_724,1}.p3)) \&\&
(\text{\$heap}_{funcstart\_724,1}.\text{p3} < \text{asType} < \text{integer} > (\text{\$heap}_{init}.\text{M3}))
\rightarrow [expand definition of constant 'M3' at prang.c (24,20)]
[5.32] ((-30307 < -$heap_{tuncstart_724,1}.p2) \land (-30269 <
-\$heap_{funcstart\_724,1}.p1) \land (0 < \$heap_{funcstart\_724,1}.p1) \land (0 < \$heap_{funcstart\_724,1}.p1)
\text{Sheap}_{funcstart_{724,1}.p2} \land (0 < \text{Sheap}_{funcstart_{724,1}.p3})) \&\&
(\$heap_{funcstart\_724,1}.p3 < \mathbf{asType} < \mathbf{integer} > (\mathbf{asType} < \mathbf{short}
int > ((int)30323)))
\rightarrow [simplify]
[5.40] (-30323 < -$heap_funcstart_724,1.p3) \land (-30307 <
```

```
-\$heap_{funcstart\_724,1}.p2) \wedge (-30269 < -\$heap_{funcstart\_724,1}.p1) \wedge (0 <
\theta_{funcstart\_724,1}.p1) \land (0 < \theta_{funcstart\_724,1}.p2) \land (0 < \theta_{funcstart\_724,1}.p2) \land (0 < \theta_{funcstart\_724,1}.p2)
heap_{funcstart_{-724,1}.p3}
[Work on sub-term 6 of conjunction in term 5.40]
[10.0] 0 < heap_{funcstart\_724,1}.p3
[Take given term]
[39.0] \operatorname{div3} == \operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724,1},
asType < int > (\$heap_{funcstart\_724.1}.p3),
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{a3}))
\rightarrow [simplify]
[39.1] \ \mathrm{div3} == \mathrm{div}(\mathbf{heapIs} \ \$ \mathrm{heap}_{funcstart\_724,1}, \ \$ \mathrm{heap}_{funcstart\_724,1}.\mathrm{p3},
asType < int > (\$heap_{funcstart\_724.1}.a3))
\rightarrow [const static or extern object]
[39.2] \operatorname{div3} == \operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p3,
asType < int > (\$heap_{init}.a3))
\rightarrow [expand definition of constant 'a3' at prang.c (26,20)]
[39.3] div3 == div(heapIs \theta_{funcstart_{-724,1}}, \theta_{funcstart_{-724,1}}.p3,
asType<int>(asType<short int>((int)178)))
\rightarrow [simplify]
[39.6]~{\rm div3} == {\rm div}(\mathbf{heapIs}~\$ \mathrm{heap}_{funcstart\_724,1},~\$ \mathrm{heap}_{funcstart\_724,1}.\mathrm{p3},~178)
[Assume known post-assertion, class invariant or type constraint for term 39.6]
[43.0] (asType<integer>(sheap_{funcstart\_724,1}.p3) %
asType<integer>(178)) == asType<integer>(div(heapIs
heap_{funcstart_{-724,1}}, heap_{funcstart_{-724,1}}, 178).rem
\rightarrow [simplify]
[43.2] ($heap<sub>funcstart_724,1.</sub>p3 % 178) == asType<integer>(div(heapIs)
\theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}.p3, 178).rem
→ [expand definition of operator '.%' in class 'int' at built in declaration]
[43.3] ([asType<integer>(sheap_{funcstart\_724,1.p3}) < 0]:
-(-asType < integer > (\$heap_{funcstart\_724,1}.p3) \% 178), []:
asType < integer > (\$heap_{funcstart_{-724,1}}.p3) \% 178) = =
asType<integer>(div(heapIs heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p3,
178).rem)
→ [explicitly assert falsehood of skipped guards in subsequent guards]
[43.4] \; ([\mathbf{asType} < \mathbf{integer} > (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p3}) < 0]:
-(-asType < integer > (\$heap_{funcstart\_724,1}.p3) \% 178),
[!(asType < integer > (\$heap_{funcstart\_724,1}.p3) < 0)]:
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```
asType < integer > (\$heap_{funcstart-724,1}.p3) \% 178) ==
\mathbf{asType} \small{<} \mathbf{integer} \small{>} ( \mathrm{div}(\mathbf{heapIs} \ \$ \mathrm{heap}_{funcstart\_724,1}, \ \$ \mathrm{heap}_{funcstart\_724,1}.\mathrm{p3}, \\
178).rem)
\rightarrow [simplify]
[43.7] ([0 < -$heap<sub>funcstart_724,1</sub>.p3]:
 -(-asType < integer > (\$heap_{funcstart\_724,1}.p3) \% 178),
[!(\mathbf{asType} < \mathbf{integer} > (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p3}) < 0)]:
asType < integer > (\$heap_{funcstart\_724,1}.p3) \% 178) ==
asType<integer>(div(heapIs $heap_{tuncstart\_724,1}, $heap_{tuncstart\_724,1}.p3,
178).rem)
\rightarrow [from term 10.0, literala < -$heap<sub>funcstart_724,1</sub>.p3 is false whenever -2 <
(0 + literala)
        Proof of rule precondition:
        [43.7.0] - 2 < (0 + 0)
        \rightarrow [simplify]
        [43.7.2] true
[43.8] \; ([\mathbf{false}]: \; -(-\mathbf{asType} < \mathbf{integer} > (\$ \mathrm{heap}_{funcstart\_724,1}.\mathrm{p3}) \; \% \; 178),
[!(asType < integer > (\$heap_{funcstart\_724,1}.p3) < 0)]:
asType < integer > (\$heap_{funcstart\_724,1}.p3) \% 178) ==
\mathbf{asType} {<} \mathbf{integer} {>} ( \mathrm{div}(\mathbf{heapIs} \ \$ \mathrm{heap}_{funcstart\_724,1}, \ \$ \mathrm{heap}_{funcstart\_724,1}.\mathrm{p3}, \\
178).rem)
\rightarrow [simplify]
[43.11] \; ([\mathbf{false}]: \; -(-\mathbf{asType} < \mathbf{integer} > (\$ heap_{funcstart\_724,1}.p3) \; \% \; 178), \; [!(0.12)] \; ((0.12)) \; ((0.12)) \; ((0.12)) \; ((0.12)) \; ((0.12)) \; ((0.12)) \; ((0.12)) \; ((0.12)) \; ((0.12)) \; ((0.12)) \; ((0.12)) \; ((0.12)) \; ((0.12)) \; ((0.12)) \; ((0.12)) \; ((0.12)) \; ((0.12)) \; ((0.12)) \; ((0.12)) \; ((0.12)) \; ((0.12)) \; ((0.12)) \; ((0.12)) \; ((0.12)) \; ((0.12)) \; ((0.12)) \; ((0.12)) \; ((0.12)) \; ((0.12)) \; ((0.12)) \; ((0.12)) \; ((0.12)) \; ((0.12)) \; ((0.12)) \; ((0.12)) \; ((0.12)) \; ((0.12)) \; ((0.12)) \; ((0.12)) \; ((0.12)) \; ((0.12)) \; ((0.12)) \; ((0.12)) \; ((0.12)) \; ((0.12)) \; ((0.12)) \; ((0.12)) \; ((0.12)) \; ((0.12)) \; ((0.12)) \; ((0.12)) \; ((0.12)) \; ((0.12)) \; ((0.12)) \; ((0.12)) \; ((0.12)) \; ((0.12)) \; ((0.12)) \; ((0.12)) \; ((0.12)) \; ((0.12)) \; ((0.12)) \; ((0.12)) \; ((0.12)) \; ((0.12)) \; ((0.12)) \; ((0.12)) \; ((0.12)) \; ((0.12)) \; ((0.12)) \; ((0.12)) \; ((0.12)) \; ((0.12)) \; ((0.12)) \; ((0.12)) \; ((0.12)) \; ((0.12)) \; ((0.12)) \; ((0.12)) \; ((0.12)) \; ((0.12)) \; ((0.12)) \; ((0.12)) \; ((0.12)) \; ((0.12)) \; ((0.12)) \; ((0.12)) \; ((0.12)) \; ((0.12)) \; ((0.12)) \; ((0.12)) \; ((0.12)) \; ((0.12)) \; ((0.12)) \; ((0.12)) \; ((0.12)) \; ((0.12)) \; ((0.12)) \; ((0.12)) \; ((0.12)) \; ((0.12)) \; ((0.12)) \; ((0.12)) \; ((0.12)) \; ((0.12)) \; ((0.12)) \; ((0.12)) \; ((0.12)) \; ((0.12)) \; ((0.12)) \; ((0.12)) \; ((0.12)) \; ((0.12)) \; ((0.12)) \; ((0.12)) \; ((0.12)) \; ((0.12)) \; ((0.12)) \; ((0.12)) \; ((0.12)) \; ((0.12)) \; ((0.12)) \; ((0.12)) \; ((0.12)) \; ((0.12)) \; ((0.12)) \; ((0.12)) \; ((0.12)) \; ((0.12)) \; ((0.12)) \; ((0.12)) \; ((0.12)) \; ((0.12)) \; ((0.12)) \; ((0.12)) \; ((0.12)) \; ((0.12)) \; ((0.12)) \; ((0.12)) \; ((0.12)) \; ((0.12)) \; ((0.12)) \; ((0.12)) \; ((0.12)) \; ((0.12)) \; ((0.12)) \; ((0.12)) \; ((0.12)) \; ((0.12)) \; ((0.12)) \; ((0.12)) \; ((0.12)) \; ((0.12)) \; ((0.12)) \; ((0.12)) \; ((0.12)) \; ((0.12)) \; ((0.12)) \; ((0.12)) \; ((0.12)) \; ((0.12)) \; ((0.12)) \; ((0.12)) \; ((0.12)) \; ((0.12)) \; ((0.12)) \; ((0.12)) \; ((0.12)) \; ((0.12)) \; ((0.12)) \; ((0.12)) \; ((0.12)) \; ((0.12)) \; ((0.12)) \; ((0.12)) \; ((0.12)) \;
< -$heap<sub>funcstart_724.1</sub>.p3)]: asType<integer>($heap<sub>funcstart_724.1</sub>.p3) %
178) == asType<integer>(div(heapIs $heap_{funcstart_724.1},)
heap_{funcstart_{-724,1}.p3, 178}.rem
\rightarrow [from term 10.0, literala < -$heap<sub>funcstart_724,1.</sub>p3 is false whenever -2 <
(0 + literala)
        Proof of rule precondition:
        [43.11.0] - 2 < (0 + 0)
        \rightarrow [simplify]
        [43.11.2] true
[43.12] ([false]: -(-asType < integer > (\$heap_{funcstart\_724,1}.p3) \% 178),
[!false]: asType<integer>(peq_{funcstart\_724,1}.p3) % 178) ==
asType<integer>(div(heapIs $heap_{tuncstart\_724.1}, $heap_{tuncstart\_724.1}.p3,
178).rem)
\rightarrow [simplify]
[43.17] \ 0 == (-\text{div}(\mathbf{heapIs} \ \$ \text{heap}_{funcstart\_724,1}, \ \$ \text{heap}_{funcstart\_724,1}.\text{p3},
```

```
178).rem + (\text{$heap}_{funcstart\_724,1}.p3 \% 178))
[Assume known post-assertion, class invariant or type constraint for term
43.17
[50.0] \operatorname{minof(int)} \leq \operatorname{div}(\operatorname{heapIs} \operatorname{\$heap}_{funcstart\_724,1}, \operatorname{\$heap}_{funcstart\_724,1}.p3,
178).rem
\rightarrow [simplify]
\label{eq:constant_724,1} [50.3] \ -32769 < \ \mathrm{div}(\mathbf{heapIs} \ \$ \mathrm{heap}_{funcstart\_724,1}, \ \$ \mathrm{heap}_{funcstart\_724,1}.\mathrm{p3},
178).rem
[Take goal term]
[1.0] minof(int) < asType<short int>(div3.rem)
\rightarrow [simplify]
[1.1] -32768 \leq asType<short int>(div3.rem)
\rightarrow [from term 39.6, div3 is equal to div(heapIs $heap_{funcstart\_724,1},
heap_{funcstart_{-724,1}}.p3, 178
[1.2] \ -32768 \leq \mathbf{asType} < \mathbf{short int} > (\mathrm{div}(\mathbf{heapIs} \ \$ \mathrm{heap}_{funcstart\_724,1},
heap_{funcstart_{-724,1}}.p3, 178).rem
\rightarrow [simplify]
[1.5] -32769 < \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_724,1}, \text{\$heap}_{funcstart\_724,1}.p3,
178).rem
\rightarrow [from term 50.3, literala < div(heapIs $heap_{funcstart\_724,1},
heap_{funcstart_{724,1}.p3}, 178).rem is true whenever (-1 + literala) < -32769
    Proof of rule precondition:
    [1.5.0](-32769 + -1) < -32769
    \rightarrow [simplify]
    [1.5.2] true
[1.6] true
Proof of verification condition: Type constraint satisfied in implicit
conversion from 'short int' to 'int'
Condition generated at: C:\Escher\Customers\prang\prang.c (60,15)
Condition defined at:
To prove: asType < short int > (div3.rem) \le maxof(int)
Given:
heap_{init}.LIMIT == (int)80
heap_{init}.M1 == asType < short int > ((int)30269)
```

```
\rho_{init}.r1 == asType < short int > ((int)171)
heap_{init}.a1 == asType < short int > ((int)177)
\theta = asType < short int > ((int)2)
heap_{init}.M2 == asType < short int > ((int)30307)
\theta_{init}.r2 == asType<short int>((int)172)
heap_{init}.a2 == asType < short int > ((int)176)
\theta = asType < short int > ((int)35)
heap_{init}.M3 == asType < short int > ((int)30323)
\theta_{init}.r3 == asType<short int>((int)170)
heap_{init}.a3 == asType < short int > ((int)178)
\theta = asType < short int > ((int)63)
\theta = asType < short int > ((int)1)
\theta
\theta = asType < short int > ((int)3)
invariant1(heapIs heap_{funcstart_{724.1}})
div1 == div(\mathbf{heapIs} \$heap_{funcstart\_724,1},
\mathbf{asType} < \mathbf{int} > (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p1}),
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{a1}))
(asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.p1)) /
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a1))) = =
asType<integer>(div1.quot)
(\mathbf{asType}{<}\mathbf{int}{>}(\mathbf{asType}{<}\mathbf{int}{>}(\$\mathbf{heap}_{funcstart\_724,1}.\mathbf{p1}))~\%
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a1))) = =
asType<integer>(div1.rem)
!(0 == asType < integer > (div1.rem)) || !(0 ==
asType<integer>(div1.quot))
div2 == div(\mathbf{heapIs} \$heap_{funcstart\_724,1},
asType < int > ($heap_{funcstart\_724,1}.p2),
asType < int > (\$heap_{funcstart\_724,1}.a2))
(asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.p2)) /
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a2))) = =
asType<integer>(div2.quot)
(\mathbf{asType} < \mathbf{int} > (\mathbf{asType} < \mathbf{int} > (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p2})) \ \%
asType < integer > (asType < int > (\$heap_{funcstart, 724,1}.a2))) = =
asType<integer>(div2.rem)
!(0 == asType < integer > (div2.rem)) || !(0 ==
```

```
asType<integer>(div2.quot))
div3 == div(\mathbf{heapIs} \$ heap_{funcstart\_724,1},
asType < int > (\$heap_{funcstart\_724,1}.p3),
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{a3}))
(asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.p3)) /
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a3))) = =
asType<integer>(div3.quot)
(\mathbf{asType} {<} \mathbf{integer} {>} (\mathbf{asType} {<} \mathbf{int} {>} (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p3})) \ \%
\mathbf{asType} < \mathbf{integer} > (\mathbf{asType} < \mathbf{int} > (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{a3}))) = =
asType<integer>(div3.rem)
!(0 == asType < integer > (div3.rem)) || !(0 ==
asType<integer>(div3.quot))
\$heap_{724,1;740,8} == \$heap_{funcstart\_724,1}.\_\mathbf{replace}(p1 \to \mathbf{asType} < \mathbf{short}
int>((asType<int>(asType<short int>(div1.rem)) *
asType < int > (\$heap_{funcstart\_724,1}.r1)) - (asType < int > (asType < short)
int>(div1.quot)) * asType<int>($heap_{funcstart\_724,1}.b1)))
-asType < integer const > (\$heap_{724.1:740.8}.M1) < 
asType < integer > ($heap_{724,1:740,8}.p1)
!(0 == asType < integer > (\$heap_{724,1:740.8}.p1))
asType < integer > (\$heap_{724,1;740,8}.p1) <
asType<integer>($heap<sub>724.1:740.8</sub>.M1)
\$heap_{724,1;742,8} == \$heap_{724,1;740,8}.\mathbf{\_replace}(p2 \rightarrow \mathbf{asType} {<} \mathbf{short}
int>((asType<int>(asType<short int>(div2.rem)) *
asType < int > (\$heap_{724,1:740.8}.r2)) - (asType < int > (asType < short)
int>(div2.quot)) * asType< int>($heap_{724,1;740,8}.b2))))
-{\bf asType}{<}{\bf integer~const}{>}(\${\rm heap}_{724,1;742,8}.{\rm M2})<
asType<integer>($heap<sub>724.1:742.8</sub>.p2)
!(0 == asType < integer > (\$heap_{724,1:742.8}.p2))
asType<integer>($heap<sub>724,1;742,8</sub>.p2) <
asType<integer>($heap<sub>724.1:742.8</sub>.M2)
Proof:
[Take given term]
[5.0] invariant1(heapIs heap_{funcstart\_724,1})
\rightarrow [expand definition of function 'invariant1' at prang.c (34,1)]
|5.1| (((((0 < asType<integer>($heap_{funcstart\_724,1}.p1)) &&
(asType < integer > (\$heap_{funcstart\_724,1}.p1) <
as
Type<integer>(\rho_{funcstart\_724,1}.M1))) & (0 <
asType < integer > (\$heap_{funcstart_{-724,1},p2}))) \&\&
```

```
(\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{p2}) <
asType < integer > (\$heap_{funcstart\_724,1}.M2))) \&\& (0 <
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{p3})))\ \&\&
(asType < integer > ($heap_{funcstart\_724,1}.p3) < 
\mathbf{asType} < \mathbf{integer} > (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{M3}))
\rightarrow [simplify]
[5.3] (((((0 < $heap_{funcstart_724,1}.p1) && ($heap_{funcstart_724,1}.p1 < function for the content of the 
asType < integer > (\$heap_{funcstart\_724,1}.M1))) \&\& (0 <
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{p2})))\ \&\&
(asType < integer > ($heap_{funcstart\_724,1}.p2) < 
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{M2})))~\&\&~(0<
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{p3})))\ \&\&
(asType < integer > (\$heap_{funcstart\_724,1}.p3) < 
asType < integer > (\$heap_{funcstart\_724,1}.M3))
\rightarrow [const static or extern object]
[5.4] (((((0 < $heap_{funcstart\_724,1}.p1) && ($heap_{funcstart\_724,1}.p1 < ])
asType < integer > (\$heap_{init}.M1))) \&\& (0 <
asType < integer > (\$heap_{funcstart\_724,1}.p2))) \&\&
(\mathbf{asType} < \mathbf{integer} > (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p2}) <
asType < integer > (\$heap_{funcstart\_724,1}.M2))) \&\& (0 <
asType < integer > (\$heap_{funcstart\_724,1}.p3))) \&\&
(\mathbf{asType} {<} \mathbf{integer} {>} (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p3}) <
asType < integer > (\$heap_{funcstart\_724,1}.M3))
\rightarrow [expand definition of constant 'M1' at prang.c (14,20)]
[5.5] (((((0 < $heap_{funcstart_{724,1}}.p1) && ($heap_{funcstart_{724,1}}.p1 < 
asType<integer>(asType<short int>((int)30269)))) && (0 <
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{p2})))\ \&\&
(asType < integer > ($heap_{funcstart\_724,1}.p2) < 
asType < integer > (\$heap_{funcstart\_724,1}.M2))) \&\& (0 <
asType < integer > (\$heap_{funcstart\_724,1}.p3))) \&\&
(asType<integer>($heap_funcstart_724.1.p3) <
asType < integer > (\$heap_{funcstart\_724.1}.M3))
\rightarrow [simplify]
[5.16] \left( \left( \left( \left( -30269 < -\$ \text{heap}_{funcstart\_724,1}.\text{p1} \right) \right. \wedge \left. \left( 0 < \$ \text{heap}_{funcstart\_724,1}.\text{p1} \right) \right. \wedge \right. \right)
(0 < \mathrm{\$heap}_{funcstart\_724,1}.\mathrm{p2})) && (\mathrm{\$heap}_{funcstart\_724,1}.\mathrm{p2} <
asType < integer > (\$heap_{funcstart\_724,1}.M2))) \&\& (0 <
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p3})))\ \&\&
(asType < integer > (\$heap_{funcstart\_724.1}.p3) < 
asType < integer > (\$heap_{funcstart\_724,1}.M3))
\rightarrow [const static or extern object]
[5.17] ((((-30269 < -$heap_{funcstart\_724,1}.p1) \lambda (0 < $heap_{funcstart\_724,1}.p1) \lambda
```

```
(0 < \text{$heap}_{funcstart\_724,1}.p2)) \&\& (\text{$heap}_{funcstart\_724,1}.p2 <
asType < integer > (\$heap_{init}.M2))) \&\& (0 <
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{p3})))\ \&\&
(asType < integer > ($heap_{funcstart\_724,1}.p3) < 
asType < integer > (\$heap_{funcstart\_724,1}.M3))
\rightarrow [expand definition of constant 'M2' at prang.c (19,20)]
[5.18] ((((-30269 < -\$heap_{funcstart\_724,1}.p1) \land (0 < \$heap_{funcstart\_724,1}.p1) 
(0 < \text{\$heap}_{funcstart\_724,1}.p2)) \&\& (\text{\$heap}_{funcstart\_724,1}.p2 <
asType < integer > (asType < short int > ((int)30307)))) && (0 < integer) && (0 < integer
asType < integer > (\$heap_{funcstart\_724,1}.p3))) \&\&
(asType < integer > (\$heap_{funcstart\_724,1}.p3) < 
asType < integer > (\$heap_{funcstart\_724,1}.M3))
\rightarrow [simplify]
[5.30] ((-30307 < -\$heap_{funcstart\_724,1}.p2) \land (-30269 <
-\$heap_{funcstart\_724,1}.p1) \land (0 < \$heap_{funcstart\_724,1}.p1) \land (0 < \$heap_{funcstart\_724,1}.p1)
\text{Sheap}_{funcstart\_724,1.p2}) \land (0 < \text{Sheap}_{funcstart\_724,1.p3})) \&\&
(\text{\$heap}_{funcstart\_724,1}.\text{p3} < \text{asType} < \text{integer} > (\text{\$heap}_{funcstart\_724,1}.\text{M3}))
\rightarrow [const static or extern object]
[5.31] ((-30307 < -$heap_{funcstart\_724,1}.p2) \land (-30269 <
-\$heap_{funcstart\_724,1}.p1) \land (0 < \$heap_{funcstart\_724,1}.p1) \land (0 < \$heap_{funcstart\_724,1}.p1)
\text{Sheap}_{funcstart\ 724.1.p2} \land (0 < \text{Sheap}_{funcstart\ 724.1.p3})) \&\&
(\$heap_{funcstart\_724,1}.p3 < \mathbf{asType} < \mathbf{integer} > (\$heap_{init}.M3))
\rightarrow [expand definition of constant 'M3' at prang.c (24,20)]
[5.32] ((-30307 < -$heap_funcstart_724,1.p2) \land (-30269 <
-\$heap_{funcstart\_724,1}.p1) \land (0 < \$heap_{funcstart\_724,1}.p1) \land (0 < \$heap_{funcstart\_724,1}.p1)
\text{Sheap}_{funcstart_{724,1}.p2} \land (0 < \text{Sheap}_{funcstart_{724,1}.p3})) \&\&
(\text{sheap}_{funcstart\_724,1}.p3 < asType < integer > (asType < short)
int > ((int)30323)))
\rightarrow [simplify]
[5.40] (-30323 < -\$heap_{funcstart\_724,1}.p3) \land (-30307 < -30307)
 -\$heap_{funcstart\_724,1}.p2) \land (-30269 < -\$heap_{funcstart\_724,1}.p1) \land (0 < -\$heap_{funcstart\_724,1}.p2)
\text{Sheap}_{funcstart_{-724,1}.p1} \land (0 < \text{Sheap}_{funcstart_{-724,1}.p2}) \land (0 <
heap_{funcstart_{724,1}.p3}
[Work on sub-term 6 of conjunction in term 5.40]
[10.0]~0 < \$ \mathrm{heap}_{funcstart\_724,1}.\mathrm{p3}
[Take given term]
[39.0] \operatorname{div3} == \operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724,1},
asType < int > (\$heap_{funcstart\_724,1}.p3),
asType < int > (\$heap_{funcstart\_724,1}.a3))
```

```
\rightarrow [simplify]
[39.1] div3 == div(heapIs \theta_{funcstart_{-724,1}}, \theta_{funcstart_{-724,1}}.p3,
asType < int > (\$heap_{funcstart\_724,1}.a3))
\rightarrow [const static or extern object]
[39.2] \ \mathrm{div3} == \mathrm{div}(\mathbf{heapIs} \ \$ \mathrm{heap}_{funcstart\_724,1}, \ \$ \mathrm{heap}_{funcstart\_724,1}.\mathrm{p3},
asType < int > (\$heap_{init}.a3))
\rightarrow [expand definition of constant 'a3' at prang.c (26,20)]
[39.3] div3 == div(heapIs $heap_{funcstart\_724.1}, $heap_{funcstart\_724.1}.p3,
asType<int>(asType<short int>((int)178)))
\rightarrow [simplify]
[39.6] div3 == div(heapIs \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}.p3, 178)
[Assume known post-assertion, class invariant or type constraint for term 39.6]
[43.0] (as
Type<integer>($heap_{funcstart\_724,1}.p3) \%
asType<integer>(178)) == asType<integer>(div(heapIs
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.\text{p3}, 178).\text{rem}
\rightarrow [simplify]
[43.2] ($heap<sub>funcstart_724.1</sub>.p3 % 178) == asType<integer>(div(heapIs)
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.p3, 178).rem
→ [expand definition of operator '.%' in class 'int' at built in declaration]
[43.3] ([asType<integer>(\ensuremath{\text{sheap}}_{funcstart\_724,1}.p3) < 0]:
-(-asType < integer > (\$heap_{funcstart\_724,1}.p3) \% 178), []:
asType < integer > (\$heap_{funcstart\_724,1}.p3) \% 178) ==
asType<integer>(div(heapIs heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p3,
178).rem)
→ [explicitly assert falsehood of skipped guards in subsequent guards]
[43.4] \; ([\mathbf{asType} < \mathbf{integer} > (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p3}) < 0]:
-(-asType < integer > (\$heap_{funcstart\_724,1}.p3) \% 178),
[!(asType < integer > (\$heap_{funcstart\_724,1}.p3) < 0)]:
asType < integer > (\$heap_{funcstart\_724,1}.p3) \% 178) ==
asType<integer>(div(heapIs $heap_{tuncstart_724.1}, $heap_{tuncstart_724.1}.p3,
178).rem)
\rightarrow [simplify]
[43.7] ([0 < -$heap<sub>funcstart_724,1</sub>.p3]:
-(-asType < integer > (\$heap_{funcstart\_724,1}.p3) \% 178),
[!(asType < integer > (\$heap_{funcstart\_724,1}.p3) < 0)]:
asType < integer > (\$heap_{funcstart\_724,1}.p3) \% 178) = =
\mathbf{asType} < \mathbf{integer} > (\mathbf{div}(\mathbf{heapIs} \ \$ \mathbf{heap}_{funcstart\_724,1}, \ \$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p3}, \\
178).rem)
```

```
\rightarrow [from term 10.0, literala < -$heap<sub>funcstart_724,1</sub>.p3 is false whenever -2 <
(0 + literala)
    Proof of rule precondition:
    [43.7.0] - 2 < (0 + 0)
    \rightarrow [simplify]
    [43.7.2] true
[43.8] \; ([\mathbf{false}]: \; -(-\mathbf{asType} < \mathbf{integer} > (\$ \mathrm{heap}_{funcstart\_724,1}.\mathrm{p3}) \; \% \; 178),
[!(asType < integer > (\$heap_{funcstart\_724,1}.p3) < 0)]:
asType < integer > (\$heap_{funcstart\_724,1}.p3) \% 178) = =
\mathbf{asType} {<} \mathbf{integer} {>} ( \mathrm{div}(\mathbf{heapIs} \ \$ \mathrm{heap}_{funcstart\_724,1}, \ \$ \mathrm{heap}_{funcstart\_724,1}.\mathrm{p3}, \\
178).rem)
\rightarrow [simplify]
[43.11] ([false]: -(-asType < integer > (\$heap_{funcstart\_724,1}.p3) \% 178), [!(0)]
<-$heap<sub>funcstart_724,1.</sub>p3)]: asType<integer>($heap<sub>funcstart_724,1.</sub>p3) %
178) == asType<integer>(div(heapIs heap_{funcstart\_724,1},
heap_{funcstart_{-724,1}.p3, 178).rem
\rightarrow [from term 10.0, literala < –$heap_funcstart_724,1.p3 is false whenever -2 <
(0 + literala)
    Proof of rule precondition:
    [43.11.0] - 2 < (0 + 0)
    \rightarrow [simplify]
    [43.11.2] true
[43.12] ([false]: -(-asType < integer > (\$heap_{funcstart\_724.1}.p3) \% 178),
[!false]: asType<integer>(sheap_{funcstart\_724,1.p3}) % 178) ==
\mathbf{asType} < \mathbf{integer} > (\mathbf{div}(\mathbf{heapIs} \ \$ \mathbf{heap}_{funcstart\_724,1}, \ \$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p3},
178).rem)
\rightarrow [simplify]
[43.17] 0 == (-\text{div}(\mathbf{heapIs} \$ \text{heap}_{funcstart\_724,1}, \$ \text{heap}_{funcstart\_724,1}.p3,
178).rem + (\text{$heap}_{funcstart\_724,1}.p3 \% 178))
[Assume known post-assertion, class invariant or type constraint for term
43.17
[51.0] div(heapIs heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p3, 178).rem \leq
maxof(int)
\rightarrow [simplify]
[51.9] - 32768 < -\text{div}(\mathbf{heapIs} \ \$ heap_{funcstart\_724,1}, \ \$ heap_{funcstart\_724,1}.p3,
178).rem
[Take goal term]
```

```
[1.0] asType<short int>(div3.rem) \leq maxof(int)
\rightarrow [from term 39.6, div3 is equal to div(heapIs $heap_{funcstart\_724,1},
heap_{funcstart_{-724,1}}.p3, 178
[1.1] asType<short int>(div(heapIs heap_{funcstart\_724,1},
\text{$heap}_{funcstart\_724,1}.p3, 178).rem) \leq \text{maxof(int)}
\rightarrow [simplify]
[1.11] - 32768 < -\text{div}(\textbf{heapIs} \$ \text{heap}_{funcstart\_724,1}, \$ \text{heap}_{funcstart\_724,1}.\text{p3},
178).rem
\rightarrow [from term 51.9, literala < -div(heapIs $heap_{funcstart\_724,1},
\rho_{funcstart\_724,1}.p3,\ 178).rem is true whenever (-1 + literala) < -32768
   Proof of rule precondition:
   [1.11.0](-32768 + -1) < -32768
   \rightarrow [simplify]
   [1.11.2] true
[1.12] true
Proof of verification condition: Type constraint satisfied in implicit
conversion from 'short int const' to 'int'
Condition generated at: C:\Escher\Customers\prang\prang.c (60,10)
Condition defined at:
To prove: minof(int) \le \$heap_{724,1:742,8}.r3
Given:
heap_{init}.LIMIT == (int)80
\theta sheap<sub>init</sub>.M1 == asType<short int>((int)30269)
\theta
\theta
\theta
\theta sheap<sub>init</sub>.M2 == asType<short int>((int)30307)
\theta_{init}.r2 == asType < short int > ((int)172)
heap_{init}.a2 == asType < short int > ((int)176)
\theta = asType < short int > ((int)35)
\theta = asType < short int > ((int)30323)
heap_{init}.r3 == asType < short int > ((int)170)
heap_{init}.a3 == asType < short int > ((int)178)
```

```
\theta = asType < short int > ((int)63)
\theta = asType < short int > ((int)1)
\theta_{init}.p2 == asType < short int > ((int)2)
\theta = asType < short int > ((int)3)
invariant1(heapIs heap_{funcstart\_724,1})
\operatorname{div1} == \operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1},
asType < int > (\$heap_{funcstart\_724,1}.p1),
asType < int > (\$heap_{funcstart\_724,1}.a1))
(asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.p1)) /
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a1))) = =
asType<integer>(div1.quot)
(\mathbf{asType}{<}\mathbf{int}{>}(\mathbf{asType}{<}\mathbf{int}{>}(\$\mathbf{heap}_{funcstart\_724,1}.\mathbf{p1}))~\%
\mathbf{asType}{<}\mathbf{integer}{>}(\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{a1}))) = =
asType<integer>(div1.rem)
!(0 == asType < integer > (div1.rem)) || !(0 ==
asType<integer>(div1.quot))
div2 == div(\mathbf{heapIs} \$heap_{funcstart\_724,1},
asType < int > (\$heap_{funcstart\_724,1}.p2),
asType < int > (\$heap_{funcstart\_724,1}.a2))
(asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.p2)) /
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a2))) = =
asType<integer>(div2.quot)
(\mathbf{asType}{<}\mathbf{integer}{>}(\mathbf{asType}{<}\mathbf{int}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{p2}))~\%
\mathbf{asType}{<}\mathbf{integer}{>}(\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{a2}))) ==
asType<integer>(div2.rem)
!(0 == asType < integer > (div2.rem)) || !(0 ==
asType<integer>(div2.quot))
div3 == div(\mathbf{heapIs} \$ heap_{funcstart\_724,1},
asType < int > (\$heap_{funcstart\_724,1}.p3),
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{a3}))
(asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.p3)) /
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a3))) = =
asType<integer>(div3.quot)
(\mathbf{asType} < \mathbf{int} > (\mathbf{asType} < \mathbf{int} > (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p3})) \ \%
\mathbf{asType} < \mathbf{integer} > (\mathbf{asType} < \mathbf{int} > (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{a3}))) = =
asType<integer>(div3.rem)
!(0 == asType < integer > (div3.rem)) || !(0 ==
asType<integer>(div3.quot))
```

```
\$heap_{724,1;740,8} == \$heap_{funcstart\_724,1}.\_\textbf{replace}(p1 \rightarrow \textbf{asType} < \textbf{short}
int>((asType<int>(asType<short int>(div1.rem)) *
asType < int > (\$heap_{funcstart\_724,1}.r1)) - (asType < int > (asType < short)
int>(div1.quot)) * asType< int>($heap_{funcstart\_724,1}.b1))))
-asType < integer const > (\$heap_{724.1:740.8}.M1) < 
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathrm{heap}_{724,1;740,8}.\mathrm{p1})
!(0 == asType < integer > (\$heap_{724,1;740,8}.p1))
asType<integer>($heap<sub>724,1:740,8</sub>.p1) <
asType<integer>($heap<sub>724,1:740,8</sub>.M1)
\$heap_{724,1;742,8} == \$heap_{724,1;740,8}. \textbf{\_replace}(p2 \rightarrow \textbf{asType} < \textbf{short}
int>((asType<int>(asType<short int>(div2.rem)) *
asType < int > (\$heap_{724.1:740.8}.r2)) - (asType < int > (asType < short)
int>(div2.quot)) * asType< int>($heap_{724,1:740,8}.b2))))
-{\bf asType}{<}{\bf integer~const}{>}(\${\rm heap}_{724,1;742,8}.{\rm M2})<
asType<integer>($heap<sub>724.1:742.8</sub>.p2)
!(0 == asType < integer > (\$heap_{724,1;742,8}.p2))
asType<integer>($heap<sub>724,1:742,8</sub>.p2) <
asType<integer>($heap<sub>724,1:742,8</sub>.M2)
Proof:
[Take given term]
[11.0] \operatorname{div1} == \operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724,1},
asType < int > (\$heap_{funcstart\_724,1}.p1),
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{a1}))
\rightarrow [simplify]
[11.1] \ \mathrm{div1} == \mathrm{div}(\mathbf{heapIs} \ \$ \mathrm{heap}_{funcstart\_724,1}, \ \$ \mathrm{heap}_{funcstart\_724,1}.\mathrm{p1},
asType < int > (\$heap_{funcstart\_724.1}.a1))
\rightarrow [const static or extern object]
[11.2] \ \mathrm{div1} == \mathrm{div}(\mathbf{heapIs} \ \$ \mathrm{heap}_{funcstart\_724,1}, \ \$ \mathrm{heap}_{funcstart\_724,1}.\mathrm{p1},
asType < int > (\$heap_{init}.a1))
\rightarrow [expand definition of constant 'a1' at prang.c (16,20)]
[11.3] \ \mathrm{div1} == \mathrm{div}(\mathbf{heapIs} \ \$ \mathrm{heap}_{funcstart\_724,1}, \ \$ \mathrm{heap}_{funcstart\_724,1}.\mathrm{p1},
asType<int>(asType<short int>((int)177)))
\rightarrow [simplify]
[11.6] div1 == div(heapIs heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p1, 177)
[Take given term]
[25.0] div2 == div(heapIs $heap_{funcstart\_724,1},
asType < int > (\$heap_{funcstart\_724,1}.p2),
```

```
asType < int > (\$heap_{funcstart\_724.1}.a2))
\rightarrow [simplify]
[25.1] div2 == div(heapIs heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p2,
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{a2}))
\rightarrow [const static or extern object]
[25.2] \operatorname{div2} == \operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.p2,
asType < int > (\$heap_{init}.a2))
\rightarrow [expand definition of constant 'a2' at prang.c (21,20)]
[25.3] \operatorname{div2} == \operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.p2,
asType<int>(asType<short int>((int)176)))
\rightarrow [simplify]
[25.6] div2 == div(heapIs $heap<sub>funcstart_724,1</sub>, $heap<sub>funcstart_724,1</sub>.p2, 176)
[Take given term]
[53.0] \rho_{1740,8} == \rho_{1740
int>((asType<int>(asType<short int>(div1.rem)) *
asType < int > (\$heap_{funcstart\_724,1}.r1)) - (asType < int > (asType < short)
\mathbf{int}{>}(\mathbf{div1.quot})) * \mathbf{asType}{<} \mathbf{int}{>} (\$\mathbf{heap}_{funcstart\_724,1}.\mathbf{b1}))))
\rightarrow [from term 11.6, div1 is equal to div(heapIs $heap_{funcstart\_724,1},
heap_{funcstart_{-724,1}}.p1, 177
[53.1] \text{heap}_{724,1;740,8} == \text{heap}_{funcstart\_724,1}._replace(p1 \rightarrow asType<short
int>((asType<int>(asType<short int>(div(heapIs $heap_{funcstart\_724,1},
\theta_{funcstart\_724,1}.p1, 177).rem ** asType<int>($\text{heap}_{funcstart\_724,1}.r1)) -
(asType<int>(asType<short int>(div1.quot)) *
asType < int > (\$heap_{funcstart\_724,1}.b1))))
\rightarrow [simplify]
[53.3] \theta == 
int>((div(heapIs \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1, 177).rem *
asType < int > (\$heap_{funcstart\_724.1}.r1)) - (asType < int > (asType < short)
\mathbf{int}{>}(\mathbf{div1.quot})) * \mathbf{asType}{<}\mathbf{int}{>}(\$\mathbf{heap}_{funcstart\_724,1}.\mathbf{b1}))))
\rightarrow [const static or extern object]
[53.4] heap_{724,1;740,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow asType<short
int>((div(heapIs \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1, 177).rem *
asType < int > (\$heap_{init}.r1)) - (asType < int > (asType < short)
\mathbf{int}{>}(\mathbf{div1.quot})) * \mathbf{asType}{<} \mathbf{int}{>} (\$\mathbf{heap}_{funcstart\_724,1}.\mathbf{b1}))))
\rightarrow [expand definition of constant 'r1' at prang.c (15,20)]
[53.5] \rho_{1740,8} == \rho_{1740,8} == \rho_{1740,8} == \rho_{1740,8} - \rho_{1740,8} == \rho_{1740,8} == \rho_{1740,8} - \rho_{1740,8} == \rho_{1740,8} 
int>((div(heapIs \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1, 177).rem *
asType<int>(asType<short int>((int)171))) -
```

```
(asType<int>(asType<short int>(div1.quot)) *
asType < int > (\$heap_{funcstart\_724,1}.b1))))
\rightarrow [simplify]
[53.8] heap_{724,1;740,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow asType<short
int>((div(heapIs \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1, 177).rem * 171)
- (asType<int>(asType<short int>(div1.quot)) *
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{b1}))))
\rightarrow [from term 11.6, div1 is equal to div(heapIs $heap_{funcstart_{724,1}},
heap_{funcstart_{-724,1}}.p1, 177
[53.9] heap_{724,1;740,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow asType<short
int>((171 * div(heapIs \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1, 177).rem)
- (asType<int>(asType<short int>(div(heapIs $heap_{funcstart_724.1},
heap_{funcstart_{724,1}}.p1, 177).quot)) *
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{b1}))))
\rightarrow [simplify]
[53.11] \text{heap}_{724,1;740,8} == \text{heap}_{funcstart\_724,1}._replace(p1 \rightarrow asType<short
int>((171 * div(heapIs \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1, 177).rem)
- (\text{div}(\mathbf{heapIs} \$ \text{heap}_{funcstart\_724,1}, \$ \text{heap}_{funcstart\_724,1}.\text{p1}, 177).\text{quot} *
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{b1}))))
\rightarrow [const static or extern object]
[53.12] heap_{724,1;740,8} == heap_{funcstart\_724,1}. replace(p1 \rightarrow asType<short
int>((171 * div(heapIs $heap_{funcstart\_724,1}, $heap_{funcstart\_724,1}.p1, 177).rem)
- (\text{div}(\mathbf{heapIs} \$ \text{heap}_{funcstart\_724,1}, \$ \text{heap}_{funcstart\_724,1}.\text{p1}, 177).\text{quot} *
asType < int > (\$heap_{init}.b1)))
\rightarrow [expand definition of constant 'b1' at prang.c (17,20)]
[53.13] heap_{724,1;740,8} == heap_{funcstart\_724,1}.replace(p1 \rightarrow asType<short
int>((171 * div(heapIs \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1, 177).rem)
- (\text{div}(\mathbf{heapIs} \$ \text{heap}_{funcstart\_724,1}, \$ \text{heap}_{funcstart\_724,1}.\text{p1}, 177).\text{quot} *
asType<int>(asType<short int>((int)2))))
\rightarrow [simplify]
[53.19] heap_{724,1;740,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724.1}, \ \text{\$heap}_{funcstart\_724.1}, 177).rem)))
[Take given term]
[57.0] $heap<sub>724.1:742.8</sub> == $heap<sub>724.1:740.8</sub>._replace(p2 \rightarrow asType<short
int>((asType<int>(asType<short int>(div2.rem)) *
asType < int > (\$heap_{724.1:740.8}.r2)) - (asType < int > (asType < short)
int>(div2.quot)) * asType<int>($heap<sub>724.1:740.8</sub>.b2))))
\rightarrow [from term 53.19, $heap<sub>724,1;740,8</sub> is equal to
```

```
heap_{funcstart\_724,1}._replace(p1 \rightarrow (-2 * div(heapIs $heap_{funcstart\_724,1},
heap_{funcstart_{724,1},p1, 177}, quot) + (171 * div(heapIs heap_{funcstart_{724,1},p1, 177})
heap_{funcstart_{-724,1}}.p1, 177).rem)
[57.1] heap_{724,1;742,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.p1,
(177).rem))._replace(p2 \rightarrow asType < short)
int>((asType<int>(asType<short int>(div2.rem)) *
asType < int > (\$heap_{724.1:740.8}.r2)) - (asType < int > (asType < short)
int>(div2.quot)) * asType< int>($heap_{724.1:740.8}.b2))))
\rightarrow [from term 25.6, div2 is equal to div(heapIs $heap_{funcstart\_724,1},
heap_{funcstart_{-724,1}}.p2, 176
[57.2] heap_{724,1;742,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 *
div(\mathbf{heapIs} \ \$heap_{funcstart\_724.1}, \ \$heap_{funcstart\_724.1}.p1, \ 177).quot) + (171 *
\operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724.1}, \$ \operatorname{heap}_{funcstart\_724.1}.p1,
177).rem))).\_replace(p2 \rightarrow asType < short
int>((asType<int>(asType<short int>(div(heapIs $heap_{funcstart\_724,1},
\rho_{tuncstart=724.1.p2, 176} (sheap<sub>724.1:740.8</sub>.r2)) + asType<int>(sheap<sub>724.1:740.8</sub>.r2)) -
(asType<int>(asType<short int>(div2.quot)) *
asType < int > (\$heap_{724,1;740,8}.b2))))
\rightarrow [simplify]
[57.4] heap_{724,1;742,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 \ *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow asType<short int>((div(heapIs
heap_{funcstart_{724,1}}, heap_{funcstart_{724,1}}.p2, 176).rem *
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{724,1;740,8}.\mathrm{r2})) - (\mathbf{asType}{<}\mathbf{int}{>}(\mathbf{asType}{<}\mathbf{short}
int>(div2.quot)) * asType< int>($heap_{724.1:740.8}.b2))))
\rightarrow [from term 53.19, $heap<sub>724.1:740.8</sub> is equal to
heap_{funcstart\_724,1}._replace(p1 \rightarrow (-2 * div(heapIs $heap_{funcstart\_724,1},
heap_{funcstart_{724,1},p1, 177}, quot) + (171 * div(heapIs p_{funcstart_{724,1},p1, 177}), quot)
heap_{funcstart_{724,1}}.p1, 177).rem)
[57.5] heap_{724,1;742,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 \ *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1,
177).rem))).\_\mathbf{replace}(p2 \rightarrow \mathbf{asType} < \mathbf{short\ int} > ((div(\mathbf{heapIs}
\text{Sheap}_{funcstart_{-724,1}}, \text{Sheap}_{funcstart_{-724,1}}.p2, 176).rem *
asType < int > (\$heap_{funcstart\_724,1}.\_replace(p1 \rightarrow ((-2 * div(heapIs)))))))
\$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1, 177).quot) + (171 * div(\textbf{heapIs}) + (171 * div(\textbf{heapIs})) + (171
\text{Sheap}_{funcstart_{724,1}}, \text{Sheap}_{funcstart_{724,1}}.p1, 177).rem))).r2)) -
(asType<int>(asType<short int>(div2.quot)) *
asType < int > (\$heap_{724.1:740.8}.b2))))
```

```
\rightarrow [const member of object with modified fields]
[57.6] $heap<sub>724,1:742,8</sub> == $heap<sub>funcstart_724,1</sub>._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).quot) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow asType<short int>((div(heapIs
heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p2, 176).rem *
asType < int > (\$heap_{funcstart\_724,1}.r2)) - (asType < int > (asType < short)
int>(div2.quot)) * asType<int>($heap<sub>724.1:740.8</sub>.b2))))
\rightarrow [const static or extern object]
[57.7] $heap<sub>724,1;742,8</sub> == $heap<sub>funcstart_724,1</sub>._replace(p1 \rightarrow ((-2 *
div(\mathbf{heapIs} \ \$heap_{funcstart\_724,1}, \ \$heap_{funcstart\_724,1}.p1, \ 177).quot) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1,
177).rem)))._{\mathbf{replace}}(p2 \rightarrow \mathbf{asType} < \mathbf{short\ int} > ((\operatorname{div}(\mathbf{heapIs}))))
heap_{funcstart_{724,1}}, heap_{funcstart_{724,1},p2,176}.rem *
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathbf{heap}_{init}.\mathbf{r2})) - (\mathbf{asType}{<}\mathbf{int}{>}(\mathbf{asType}{<}\mathbf{short}
int>(div2.quot)) * asType< int>($heap_{724,1:740.8}.b2))))
\rightarrow [expand definition of constant 'r2' at prang.c (20,20)]
[57.8] \rho_{7.8,1,742,8} == \rho_{1.742,1}.\_replace(p1 \rightarrow ((-2 * p1.57.8) + p1.57.8))
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).quot) + (171 *
\operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724.1}, \$ \operatorname{heap}_{funcstart\_724.1}.p1,
177).rem)))._{\mathbf{replace}}(p2 \rightarrow \mathbf{asType} < \mathbf{short\ int} > ((\operatorname{div}(\mathbf{heapIs}))))
heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p2, 176).rem *
asType<int>(asType<short int>((int)172))) -
(asType<int>(asType<short int>(div2.quot)) *
asType<int>($heap<sub>724.1:740.8</sub>.b2))))
\rightarrow [simplify]
[57.11] $\text{heap}_{724,1;742,8} == \text{$heap}_{funcstart\_724,1}._\text{replace}(p1 \to ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 \ *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1,
(177).rem)._replace(p2 \rightarrow asType<short int>((div(heapIs))
heap_{funcstart_{-724,1}}, heap_{funcstart_{-724,1}}.p2, 176).rem * 172) -
(asType<int>(asType<short int>(div2.quot)) *
asType < int > (\$heap_{724,1;740,8}.b2))))
\rightarrow [from term 25.6, div2 is equal to div(heapIs $heap_{funcstart_724.1},
heap_{funcstart_{724,1}}.p2, 176)
[57.12] \text{heap}_{724,1;742,8} == \text{heap}_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).quot) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow asType<short int>((172 * div(heapIs
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.p2, 176).rem) -
(asType<int>(asType<short int>(div(heapIs $heap_{funcstart\_724.1},
\text{Sheap}_{funcstart\_724,1}.\text{p2}, 176).\text{quot}) * asType < int > (\text{Sheap}_{724,1:740,8}.\text{b2}))))
```

```
\rightarrow [simplify]
[57.14] $\text{heap}_{724,1:742,8} == $\text{heap}_{funcstart\_724,1}._\text{replace}(p1 \to ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).quot) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow asType<short int>((172 * div(heapIs
heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p2, 176).rem) - (div(heapIs
\theta_{funcstart_{724,1}}, \theta_{funcstart_{724,1}}, \theta_{funcstart_{724,1}}.p2, 176).quot
asType < int > (\$heap_{724,1;740,8}.b2))))
\rightarrow [from term 53.19, $heap<sub>724,1;740,8</sub> is equal to
heap_{funcstart\ 724.1}._replace(p1 \rightarrow (-2 * div(heapIs \$heap_{funcstart\ 724.1},
heap_{funcstart\_724,1}.p1, 177).quot + (171 * div(heapIs $heap_{funcstart\_724,1}, 177).quot) + (171 * div(heapIs $heap_{funcstart\_724,1}, 17
heap_{funcstart_{-724,1}.p1, 177).rem}
[57.15] $heap<sub>724,1;742,8</sub> == $heap<sub>funcstart_724,1</sub>._replace(p1 \rightarrow ((-2 *
div(heapIs \$heap_{funcstart\_724.1}, \$heap_{funcstart\_724.1}.p1, 177).quot) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow asType<short int>((172 * div(heapIs
\theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}.p2, 176).rem) - (div(heapIs
\theta_{funcstart_{724,1}}, \theta_{funcstart_{724,1},p2,176}.quot *
asType < int > (\$heap_{funcstart\_724,1}.\_replace(p1 \rightarrow ((-2 * div(heapIs))))))
heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p1, 177).quot) + (171 * div(heapIs
heap_{funcstart_{-724,1}}, heap_{funcstart_{-724,1}}.p1, 177).rem)).b2))))
→ [const member of object with modified fields]
[57.16] $heap<sub>724,1;742,8</sub> == $heap<sub>funcstart_724,1</sub>._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 \ *
\operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724,1}, \$ \operatorname{heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow asType<short int>((172 * div(heapIs
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.\text{p2}, 176).\text{rem}) - (\text{div}(\text{heapIs})
heap_{funcstart_{724,1}}, heap_{funcstart_{724,1}}, 2, 176.quot *
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{b2}))))
\rightarrow [const static or extern object]
[57.17] $\text{heap}_{724,1;742,8} == \text{$heap}_{funcstart\_724,1}.$\text{$_-replace}(p1 \to ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 \ *
\operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724,1}, \$ \operatorname{heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow asType<short int>((172 * div(heapIs
\theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}.p2, 176).rem) - \theta_{funcstart\_724,1}.p2, 176).rem
\theta_{funcstart_{724,1}}, \theta_{funcstart_{724,1}}, \theta_{funcstart_{724,1}}, \theta_{funcstart_{724,1}}
asType < int > (\$heap_{init}.b2))))
\rightarrow [expand definition of constant 'b2' at prang.c (22,20)]
[57.18] $\text{heap}_{724,1:742,8} == \text{$heap}_{funcstart\_724,1}._\text{$replace}(p1 \to ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 *
\label{eq:div_heap} \text{div}(\textbf{heapIs} \ \$ \text{heap}_{funcstart\_724,1}, \ \$ \text{heap}_{funcstart\_724,1}.\text{p1},
177).rem)))._replace(p2 \rightarrow asType<short int>((172 * div(heapIs
```

```
\theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}
heap_{funcstart_{724,1}}, heap_{funcstart_{724,1}}.p2, 176).quot*
asType<int>(asType<short int>((int)35)))))
\rightarrow [simplify]
[57.24] $\text{heap}_{724,1;742,8} == \text{$heap}_{funcstart\_724,1}._\text{replace}(p1 \to ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow ((-35 * div(heapIs $heap_{funcstart\_724,1},
\rho_{tuncstart_{724,1},p2,176} + (172 * div(heapIs $heap_{tuncstart_{724,1}})
heap_{funcstart_{-724,1}}.p2, 176).rem)
[Take goal term]
[1.0] minof(int) \leq $heap<sub>724.1:742.8</sub>.r3
\rightarrow [simplify]
[1.1] -32768 \leq $heap<sub>724.1:742.8</sub>.r3
\rightarrow [from term 57.24, $\$heap_{724,1;742,8}$ is equal to
\text{Sheap}_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 * div(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
heap_{funcstart\_724,1}.p1, 177).quot + (171 * div(heapIs p_{funcstart\_724,1})
heap_{funcstart\_724,1}.p1, 177).rem))._replace(p2 \rightarrow (-35 * div(heapIs))
heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p2, 176).quot) + (172 * div(heapIs)
heap_{funcstart_{-724,1}}, heap_{funcstart_{-724,1}}, 2, 176).rem)
[1.2] -32768 \leq $heap<sub>funcstart_724,1</sub>._replace(p1 \rightarrow ((-2 * div(heapIs
\text{Sheap}_{funcstart_{-724.1}}, \text{Sheap}_{funcstart_{-724.1}}, \text{p1}, 177).\text{quot}) + (171 * \text{div}(\text{heapIs}))
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.p1, 177).rem))).\_replace(p2 \rightarrow ((-35))
* div(\mathbf{heapIs} \ \$ heap_{funcstart\_724,1}, \ \$ heap_{funcstart\_724,1}.p2, \ 176).quot) + (172 \ *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p2, \ 176).rem))).r3
→ [const member of object with modified fields]
\textit{[1.4] -32768} \leq \$ heap_{funcstart\_724,1}.r3
\rightarrow [const static or extern object]
[1.5] -32768 \le \text{$heap}_{init}.r3
\rightarrow [expand definition of constant 'r3' at prang.c (25,20)]
[1.6] -32768 \leq asType<short int>((int)170)
\rightarrow [simplify]
[1.9] true
```

**Proof of verification condition:** Type constraint satisfied in implicit conversion from 'short int const' to 'int'

Condition generated at: C:\Escher\Customers\prang\prang.c (60,10)
Condition defined at:

```
To prove: heap_{724.1:742.8}.r3 \leq maxof(int)
Given:
heap_{init}.LIMIT == (int)80
heap_{init}.M1 == asType < short int > ((int)30269)
\theta_{init}.r1 == asType < short int > ((int)171)
heap_{init}.a1 == asType < short int > ((int)177)
\theta
heap_{init}.M2 == asType < short int > ((int)30307)
\theta_{init}.r2 == asType < short int > ((int)172)
heap_{init}.a2 == asType < short int > ((int)176)
\theta == asType<short int>((int)35)
\theta = asType < short int > ((int)30323)
heap_{init}.r3 == asType < short int > ((int)170)
heap_{init}.a3 == asType < short int > ((int)178)
\theta = asType < short int > ((int)63)
\theta = asType < short int > ((int)1)
\theta
\theta = asType < short int > ((int)3)
invariant1(heapIs heap_{funcstart\_724,1})
\operatorname{div1} == \operatorname{div}(\mathbf{heapIs} \ \operatorname{\$heap}_{funcstart\_724,1},
asType < int > (\$heap_{funcstart\_724,1}.p1),
asType < int > (\$heap_{funcstart\_724,1}.a1))
(\mathbf{asType}{<}\mathbf{integer}{>}(\mathbf{asType}{<}\mathbf{int}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{p1})) \ / \\
\mathbf{asType}{<}\mathbf{integer}{>}(\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{a1}))) = =
asType<integer>(div1.quot)
(asType<integer>(asType<int>($heap_{tuncstart\_724.1}.p1)) %
\mathbf{asType}{<}\mathbf{integer}{>}(\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{a1}))) ==
asType<integer>(div1.rem)
!(0 == asType < integer > (div1.rem)) || !(0 ==
asType<integer>(div1.quot))
div2 == div(\mathbf{heapIs} \$ heap_{funcstart\_724,1},
asType < int > (\$heap_{funcstart\_724,1}.p2),
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{a2}))
(\mathbf{asType} < \mathbf{integer} > (\mathbf{asType} < \mathbf{int} > (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p2})) \ / \\
\mathbf{asType}{<}\mathbf{integer}{>}(\mathbf{asType}{<}\mathbf{int}{>}(\$\mathbf{heap}_{funcstart\_724,1}.\mathbf{a2}))) = =
asType<integer>(div2.quot)
```

```
(asType < int > (asType < int > (\$heap_{funcstart\_724,1}.p2)) \%
\mathbf{asType} < \mathbf{integer} > (\mathbf{asType} < \mathbf{int} > (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{a2}))) = =
asType<integer>(div2.rem)
!(0 == asType < integer > (div2.rem)) || !(0 ==
asType<integer>(div2.quot))
div3 == div(\mathbf{heapIs} \$ heap_{funcstart\_724,1},
\mathbf{asType} < \mathbf{int} > (\$ \mathrm{heap}_{funcstart\_724,1}.\mathrm{p3}),
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{a3}))
(\mathbf{asType} < \mathbf{integer} > (\mathbf{asType} < \mathbf{int} > (\$ \mathbf{heap}_{funcstart\_724,1} \cdot \mathbf{p3})) \ / \\
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a3))) = =
asType<integer>(div3.quot)
(asType<integer>(asType<int>($heap_{tuncstart\_724.1}.p3)) %
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a3))) = =
asType<integer>(div3.rem)
!(0 == asType < integer > (div3.rem)) || !(0 ==
asType<integer>(div3.quot))
heap_{724,1;740,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow asType<short
int>((asType<int>(asType<short int>(div1.rem)) *
asType < int > (\$heap_{funcstart\_724,1}.r1)) - (asType < int > (asType < short)
\mathbf{int}{>}(\mathbf{div1.quot})) * \mathbf{asType}{<} \mathbf{int}{>} (\$\mathbf{heap}_{funcstart\_724,1}.\mathbf{b1}))))
-asType<integer const>($heap<sub>724.1:740.8</sub>.M1) <
asType<integer>($heap<sub>724,1:740,8</sub>.p1)
!(0 == asType < integer > (\$heap_{724,1:740.8}.p1))
asType<integer>($heap<sub>724,1;740,8</sub>.p1) <
asType < integer > (\$heap_{724,1;740,8}.M1)
heap_{724,1;742,8} == heap_{724,1;740,8}.replace(p2 \rightarrow asType<short
int>((asType<int>(asType<short int>(div2.rem)) *
asType < int > (\$heap_{724.1:740.8}.r2)) - (asType < int > (asType < short)
int>(div2.quot)) * asType< int>($heap_{724,1;740.8}.b2))))
-asType < integer const > (\$heap_{724,1:742.8}.M2) < 
asType<integer>($heap<sub>724,1:742,8</sub>.p2)
!(0 == asType < integer > (\$heap_{724,1;742,8}.p2))
asType<integer>($heap<sub>724,1:742,8</sub>.p2) <
asType<integer>($heap<sub>724,1:742,8</sub>.M2)
Proof:
[Take given term]
[11.0] \operatorname{div1} == \operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724,1},
asType < int > (\$heap_{funcstart\_724.1}.p1),
asType < int > (\$heap_{funcstart\_724,1}.a1))
```

```
\rightarrow [simplify]
[11.1] \ \mathrm{div1} == \mathrm{div}(\mathbf{heapIs} \ \$ \mathrm{heap}_{funcstart\_724,1}, \ \$ \mathrm{heap}_{funcstart\_724,1}.\mathrm{p1},
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{a1}))
\rightarrow [const static or extern object]
\textit{[11.2]} \ \text{div1} == \text{div}(\mathbf{heapIs} \ \$ \text{heap}_{funcstart\_724,1}, \ \$ \text{heap}_{funcstart\_724,1}.\text{p1},
asType < int > (\$heap_{init}.a1))
\rightarrow [expand definition of constant 'a1' at prang.c (16,20)]
[11.3] \operatorname{div1} == \operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724,1}, \$ \operatorname{heap}_{funcstart\_724,1}.p1,
asType<int>(asType<short int>((int)177)))
\rightarrow [simplify]
[11.6] div1 == div(heapIs \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}.p1, 177)
[Take given term]
[25.0] div2 == div(heapIs heap_{funcstart_724,1},
asType < int > (\$heap_{funcstart\_724,1}.p2),
asType < int > (\$heap_{funcstart\_724,1}.a2))
\rightarrow [simplify]
[25.1] div2 == div(heapIs \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}.p2,
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{a2}))
\rightarrow [const static or extern object]
[25.2] \operatorname{div2} == \operatorname{div}(\mathbf{heapIs} \operatorname{\$heap}_{funcstart\_724,1}, \operatorname{\$heap}_{funcstart\_724,1}.p2,
asType < int > (\$heap_{init}.a2))
\rightarrow [expand definition of constant 'a2' at prang.c (21,20)]
[25.3] \ \mathrm{div2} == \mathrm{div}(\mathbf{heapIs} \ \$ \mathrm{heap}_{funcstart\_724,1}, \ \$ \mathrm{heap}_{funcstart\_724,1}.\mathrm{p2},
asType<int>(asType<short int>((int)176)))
\rightarrow [simplify]
[25.6] \text{ div2} == \text{div}(\mathbf{heapIs} \$ \text{heap}_{funcstart\_724,1}, \$ \text{heap}_{funcstart\_724,1}.\text{p2}, 176)
[Take given term]
[53.0] heap_{724,1:740.8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow asType<short
int>((asType<int>(asType<short int>(div1.rem)) *
asType < int > (\$heap_{funcstart\_724,1}.r1)) - (asType < int > (asType < short)
\mathbf{int}{>}(\mathbf{div1}.\mathbf{quot})) * \mathbf{asType}{<}\mathbf{int}{>}(\$\mathbf{heap}_{funcstart\_724,1}.\mathbf{b1}))))
\rightarrow [from term 11.6, div1 is equal to div(heapIs $heap_{funcstart\_724,1},
heap_{funcstart_{-724,1}}.p1, 177
[53.1] heap_{724,1:740.8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow asType<short
int>((asType<int>(asType<short int>(div(heapIs $heap_{funcstart\_724.1},
\rho_{tuncstart\_724,1.p1, 177}.rem) * asType < int > (\rho_{tuncstart\_724,1.r1}) - (\rho_{tuncstart\_724,1.r1}
(asType<int>(asType<short int>(div1.quot)) *
```

```
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{b1}))))
\rightarrow [simplify]
[53.3] \text{heap}_{724,1;740,8} == \text{heap}_{funcstart\_724,1}._replace(p1 \rightarrow asType<short
int>((div(heapIs \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1, 177).rem *
asType < int > (\$heap_{funcstart\_724,1}.r1)) - (asType < int > (asType < short)
int>(div1.quot)) * asType<int>($heap_{funcstart\_724,1}.b1)))
\rightarrow [const static or extern object]
[53.4] heap_{724,1:740.8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow asType<short
int>((div(heapIs \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1, 177).rem *
asType < int > (\$heap_{init}.r1)) - (asType < int > (asType < short)
int>(div1.quot)) * asType<int>($heap_{funcstart\_724,1}.b1)))
\rightarrow [expand definition of constant 'r1' at prang.c (15,20)]
[53.5] heap_{724,1:740.8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow asType<short
\mathbf{int} > ((\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.\operatorname{p1}, \ 177).\operatorname{rem} \ *
asType<int>(asType<short int>((int)171))) -
(asType<int>(asType<short int>(div1.quot)) *
asType < int > (\$heap_{funcstart\_724,1}.b1))))
\rightarrow [simplify]
[53.8] heap_{724,1;740,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow asType<short
int>((div(heapIs \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1, 177).rem * 171)
- (asType<int>(asType<short int>(div1.quot)) *
asType < int > (\$heap_{funcstart\_724.1}.b1)))
\rightarrow [from term 11.6, div1 is equal to div(heapIs $heap_{funcstart_724,1},
heap_{funcstart_{-724,1}}.p1, 177
[53.9] heap_{724,1;740,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow asType<short
int>((171 * div(heapIs \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1, 177).rem)
- (asType<int>(asType<short int>(div(heapIs $heap_{funcstart_724.1},
heap_{funcstart_{-724,1}}.p1, 177).quot) *
asType < int > (\$heap_{funcstart\_724,1}.b1))))
\rightarrow [simplify]
[53.11] \theta_{13} = \theta_
int > ((171 * div(heapIs \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1, 177).rem)
- (\text{div}(\textbf{heapIs} \$ \text{heap}_{funcstart\_724.1}, \$ \text{heap}_{funcstart\_724.1}. \text{p1}, 177).\text{quot} *
asType < int > (\$heap_{funcstart\_724,1}.b1))))
\rightarrow [const static or extern object]
[53.12] heap_{724,1;740,8} == heap_{funcstart\_724,1}. replace(p1 \rightarrow asType<short
int>((171 * div(heapIs $heap_{funcstart\_724,1}, $heap_{funcstart\_724,1}.p1, 177).rem)
- (\text{div}(\mathbf{heapIs} \$ \text{heap}_{funcstart\_724,1}, \$ \text{heap}_{funcstart\_724,1}.\text{p1}, 177).\text{quot} *
asType < int > (\$heap_{init}.b1)))
```

```
\rightarrow [expand definition of constant 'b1' at prang.c (17,20)]
[53.13] \text{sheap}_{724,1;740.8} == \text{sheap}_{funcstart\_724,1}.replace(p1 \rightarrow asType<short
int>((171 * div(heapIs $heap_{funcstart\_724,1}, $heap_{funcstart\_724,1}.p1, 177).rem)
- (\text{div}(\mathbf{heapIs} \$ \text{heap}_{funcstart\_724,1}, \$ \text{heap}_{funcstart\_724,1}.\text{p1}, 177).\text{quot} *
asType<int>(asType<short int>((int)2))))
\rightarrow [simplify]
[53.19] \text{sheap}_{724,1;740,8} == \text{sheap}_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.\operatorname{p1}, \ 177).\operatorname{rem})))
[Take given term]
[57.0] $\text{heap}_{724,1;742,8} == \text{$heap}_{724,1;740,8}.$\text{$-replace}(p2 \to asType < short)$
int>((asType<int>(asType<short int>(div2.rem)) *
asType < int > (\$heap_{724,1:740,8}.r2)) - (asType < int > (asType < short)
\mathbf{int}{>}(\text{div2.quot})) \ * \ \mathbf{asType}{<} \mathbf{int}{>} (\$\text{heap}_{724,1;740,8}.\text{b2}))))
\rightarrow [from term 53.19, $heap<sub>724,1;740,8</sub> is equal to
heap_{funcstart\_724,1}._replace(p1 \rightarrow (-2 * div(heapIs $heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1}.\text{p1}, 177).\text{quot} + (171 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
heap_{funcstart_{724,1},p1,177,rem})
[57.1] heap_{724,1;742,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}. p1, \ 177). \operatorname{quot}) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1,
(177).rem))._replace(p2 \rightarrow asType<short
int>((asType<int>(asType<short int>(div2.rem)) *
asType < int > (\$heap_{724,1;740,8}.r2)) - (asType < int > (asType < short)
int>(div2.quot)) * asType< int>($heap_{724,1:740,8}.b2))))
\rightarrow [from term 25.6, div2 is equal to div(heap
Is $heap_funcstart_724,1,
heap_{funcstart_{-724,1}}.p2, 176
[57.2] $heap<sub>724,1;742,8</sub> == $heap<sub>funcstart_724,1</sub>._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 \ *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.p1,
(177).rem))._replace(p2 \rightarrow asType<short
int>((asType<int>(asType<short int>(div(heapIs $heap_{funcstart\_724,1},
\text{sheap}_{funcstart\_724,1}.\text{p2}, 176).\text{rem}) * asType < int > (\text{sheap}_{724,1;740,8}.\text{r2})) -
(asType<int>(asType<short int>(div2.quot)) *
asType<int>($heap<sub>724.1:740.8</sub>.b2))))
\rightarrow [simplify]
[57.4] heap_{724,1;742,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 \ *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.p1,
177).rem)))._{\mathbf{replace}}(p2 \rightarrow \mathbf{asType} < \mathbf{short\ int} > ((\operatorname{div}(\mathbf{heapIs}))))
\text{Sheap}_{funcstart\ 724.1}, \text{Sheap}_{funcstart\ 724.1}.p2, 176).rem *
```

```
asType < int > (\$heap_{724.1:740.8}.r2)) - (asType < int > (asType < short)
\mathbf{int}{>}(\text{div2.quot})) \ * \ \mathbf{asType}{<} \mathbf{int}{>} (\$\text{heap}_{724,1;740,8}.\text{b2}))))
\rightarrow [from term 53.19, $heap<sub>724,1:740,8</sub> is equal to
heap_{funcstart\_724.1}._replace(p1 \rightarrow (-2 * div(heapIs heap_{funcstart\_724.1}),
heap_{funcstart_{724,1},p1, 177}, quot) + (171 * div(heapIs p_{funcstart_{724,1},p1, 177}), quot)
\$heap_{funcstart\_724,1}.p1,\ 177).rem))]
[57.5] heap_{724,1;742,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 *
div(\mathbf{heapIs} \ \text{$heap}_{funcstart\_724,1}, \ \text{$heap}_{funcstart\_724,1}.p1, \ 177).quot) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1,
177).rem)))._{\mathbf{replace}}(p2 \rightarrow \mathbf{asType} < \mathbf{short\ int} > ((\operatorname{div}(\mathbf{heapIs}))))
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.p2, 176).rem *
asType < int > (\$heap_{funcstart\_724,1}.\_replace(p1 \rightarrow ((-2 * div(heapIs)))))))
\rho_{tuncstart_{-724,1}}, \rho_{tuncstart_{-724,1}}, 177).quot + (171 * div(heapIs)
\text{Sheap}_{funcstart_{-724,1}}, \text{Sheap}_{funcstart_{-724,1}}.p1, 177).rem))).r2)) -
(asType<int>(asType<short int>(div2.quot)) *
\mathbf{asType}{<}\mathbf{int}{>}(\${\rm heap}_{724,1;740,8}.{\rm b2}))))
→ [const member of object with modified fields]
[57.6] heap_{724,1;742,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}. p1, \ 177). \operatorname{quot}) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.p1,
177).rem)))._{\mathbf{replace}}(p2 \rightarrow \mathbf{asType} < \mathbf{short\ int} > ((\operatorname{div}(\mathbf{heapIs}))))
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.p2, 176).rem *
asType < int > (\$heap_{funcstart\_724,1}.r2)) - (asType < int > (asType < short)
int>(div2.quot)) * asType< int>($heap_{724.1:740.8}.b2))))
\rightarrow [const static or extern object]
[57.7] heap_{724,1;742,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 *
\operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724,1}, \$ \operatorname{heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow asType<short int>((div(heapIs
\theta_{funcstart_{724,1}}, \theta_{funcstart_{724,1}}, \theta_{funcstart_{724,1}}, \theta_{funcstart_{724,1}}
asType < int > (\$heap_{init}.r2)) - (asType < int > (asType < short)
int>(div2.quot)) * asType< int>($heap_{724,1:740,8}.b2))))
\rightarrow [expand definition of constant 'r2' at prang.c (20,20)]
[57.8] $heap<sub>724.1:742.8</sub> == $heap<sub>funcstart_724.1</sub>._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.\operatorname{p1}, \ 177).\operatorname{quot}) + (171 \ *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.p1,
177).rem)))._{\mathbf{replace}}(p2 \rightarrow \mathbf{asType} < \mathbf{short\ int} > ((\operatorname{div}(\mathbf{heapIs}))))
heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p2, 176).rem *
asType<int>(asType<short int>((int)172))) -
(asType<int>(asType<short int>(div2.quot)) *
asType < int > (\$heap_{724,1;740,8}.b2))))
\rightarrow [simplify]
```

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[57.11] $\text{heap}_{724,1;742,8} == \text{$heap}_{funcstart_724,1}._\text{$replace}(p1 \to ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 \ *
\label{eq:div_heap} \text{div}(\textbf{heapIs} \ \$ \text{heap}_{funcstart\_724,1}, \ \$ \text{heap}_{funcstart\_724,1}.\text{p1},
(177).rem))._replace(p2 \rightarrow asType<short int>((div(heapIs)))._replace(p2)
heap_{funcstart_{724,1}}, heap_{funcstart_{724,1}}, p2, 176).rem * 172) -
(asType<int>(asType<short int>(div2.quot)) *
asType<int>($heap<sub>724.1:740.8</sub>.b2))))
\rightarrow [from term 25.6, div2 is equal to div(heapIs $heap_{tuncstart_{724.1}},
heap_{funcstart_{-724,1}}.p2, 176
[57.12] heap_{724,1;742,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow asType<short int>((172 * div(heapIs
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.\text{p2}, 176).\text{rem}) -
(asType < int > (asType < short int > (div(heapIs $heap_{funcstart\_724,1}, 
\text{sheap}_{funcstart\_724,1.p2}, 176).\text{quot}) * asType<int>(\text{sheap}_{724,1;740,8}.\text{b2}))))
\rightarrow [simplify]
[57.14] $\text{heap}_{724,1;742,8} == \text{$heap}_{funcstart\_724,1}._\text{$replace}(p1 \to ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow asType<short int>((172 * div(heapIs
\theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}.p2, 176).rem) - (div(heapIs
heap_{funcstart_{724,1}}, heap_{funcstart_{724,1}}, p2, 176).quot *
asType<int>($heap<sub>724.1:740.8</sub>.b2))))
\rightarrow [from term 53.19, $heap<sub>724,1;740.8</sub> is equal to
heap_{funcstart\_724,1}._replace(p1 \rightarrow (-2 * div(heapIs $heap_{funcstart\_724,1},
heap_{funcstart_{724,1},p1, 177}, quot) + (171 * div(heapIs heap_{funcstart_{724,1},p1, 177})
heap_{funcstart} 724.1.p1, 177).rem))]
[57.15] $\text{heap}_{724,1;742,8} == \text{$heap}_{funcstart\_724,1}._\text{replace}(p1 \to ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.p1,
177).rem)))._{\mathbf{replace}}(p2 \rightarrow \mathbf{asType} < \mathbf{short\ int} > ((172 * div(\mathbf{heapIs}
\theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}.p2, 176).rem) - (div(heapIs
\theta_{funcstart_{724,1}}, \theta_{funcstart_{724,1}}, \theta_{funcstart_{724,1}}.p2, 176).quot
\mathbf{asType}{<}\mathbf{int}{>}(\$\text{heap}_{funcstart\_724,1}.\mathbf{\_replace}(\text{p1} \rightarrow ((\text{-}2 * \text{div}(\mathbf{heapIs}
\text{Sheap}_{funcstart_{-724,1}}, \text{Sheap}_{funcstart_{-724,1}}.\text{p1}, 177).\text{quot}) + (171 * \text{div}(\text{heapIs}))
heap_{funcstart_{724,1}}, heap_{funcstart_{724,1}}, 177).rem)).b2))))
\rightarrow [const member of object with modified fields]
[57.16] $heap<sub>724,1;742,8</sub> == $heap<sub>funcstart_724,1</sub>._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).quot) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow asType<short int>((172 * div(heapIs
```

```
\theta_{funcstart_{-724,1}}, \theta_{funcstart_{-724,1},p2, 176}.rem) - (div(heapIs)
heap_{funcstart_{724,1}}, heap_{funcstart_{724,1}}.p2, 176).quot*
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{b2}))))
\rightarrow [const static or extern object]
[57.17] $\text{heap}_{724,1;742,8} == \text{$heap}_{funcstart\_724,1}._\text{$replace}(p1 \to ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 *
\operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724,1}, \$ \operatorname{heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow asType<short int>((172 * div(heapIs
\theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}.p2, 176).rem) - (div(heapIs
heap_{funcstart_{724,1}}, heap_{funcstart_{724,1}}, 2, 176.quot *
asType < int > (\$heap_{init}.b2))))
\rightarrow [expand definition of constant 'b2' at prang.c (22,20)]
[57.18] $heap<sub>724,1;742,8</sub> == $heap<sub>funcstart_724,1</sub>._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.\operatorname{p1}, \ 177).\operatorname{quot}) + (171 \ *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow asType<short int>((172 * div(heapIs
heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p2, 176).rem) - (div(heapIs
heap_{funcstart_{724,1}}, heap_{funcstart_{724,1}}, 2, 176).quot *
asType<int>(asType<short int>((int)35)))))
\rightarrow [simplify]
[57.24] $heap<sub>724,1;742,8</sub> == $heap<sub>funcstart_724,1</sub>._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 \ *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow ((-35 * div(heapIs $heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1.p2}, 176).\text{quot} + (172 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
heap_{funcstart_{-724,1}.p2, 176).rem)
[Take goal term]
[1.0] $heap<sub>724,1;742,8</sub>.r3 \leq maxof(int)
\rightarrow [from term 57.24, $heap_{724,1;742,8}$ is equal to
heap_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 * div(heapIs p_{funcstart\_724,1}),
\text{Sheap}_{funcstart\_724.1.p1}, 177).\text{quot}) + (171 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724.1},
\rho_{funcstart\_724.1}.p1, 177).rem)._replace\rho_{funcstart\_724.1}.p1, 177).rem)._replace
heap_{funcstart\_724,1}, heap_{funcstart\_724,1}. p2, p2, p2, p3, p3, p4, 
heap_{funcstart_{724,1}}, heap_{funcstart_{724,1}}, 2, 176).rem
[1.1] \text{heap}_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 * div(heapIs \text{heap}_{funcstart\_724,1}),
\theta_{funcstart\_724,1}.p1, 177).quot + (171 * div(heapIs \theta_{funcstart\_724,1}),
\$heap_{funcstart\_724,1}.p1,\ 177).rem))).\_\textbf{replace}(p2 \rightarrow ((-35\ *\ div(\textbf{heapIs}))))).
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.p2, 176).quot) + (172 * div(heapIs)
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.p2, 176).rem)).r3 \leq \text{maxof(int)}
\rightarrow [const member of object with modified fields]
[1.3] $\text{heap}_{funcstart_724,1}.r3 \leq \text{maxof(int)}
```

```
\rightarrow [const static or extern object]
[1.4] $heap<sub>init</sub>.r3 \leq maxof(int)
\rightarrow [expand definition of constant 'r3' at prang.c (25,20)]
[1.5] asType<short int>((int)170) \le maxof(int)
\rightarrow [simplify]
[1.9] true
Proof of verification condition: Arithmetic result of operator '*' is within
limit of type 'int'
Condition generated at: C:\Escher\Customers\prang\prang.c (60,13)
Condition defined at:
To prove: minof(int) \le (asType<int>(asType<short int>(div3.rem)) *
asType<int>($heap<sub>724,1;742,8</sub>.r3))
Given:
heap_{init}.LIMIT == (int)80
heap_{init}.M1 == asType < short int > ((int)30269)
\theta
heap_{init}.a1 == asType < short int > ((int)177)
\theta
heap_{init}.M2 == asType < short int > ((int)30307)
\theta_{init}.r2 == asType < short int > ((int)172)
heap_{init}.a2 == asType < short int > ((int)176)
\theta = asType < short int > ((int)35)
\theta = asType < short int > ((int)30323)
heap_{init}.r3 == asType < short int > ((int)170)
heap_{init}.a3 == asType < short int > ((int)178)
\theta = asType < short int > ((int)63)
\theta = asType < short int > ((int)1)
\theta
\theta = asType < short int > ((int)3)
invariant
1(heap<br/>Is \theta_{funcstart\_724,1}
\operatorname{div1} == \operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724,1},
asType < int > (\$heap_{funcstart\_724.1}.p1),
asType < int > (\$heap_{funcstart\_724,1}.a1))
```

```
(\mathbf{asType}{<}\mathbf{int}{>}(\mathbf{asType}{<}\mathbf{int}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{p1})) \ / \\
\mathbf{asType} < \mathbf{integer} > (\mathbf{asType} < \mathbf{int} > (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{a1}))) = =
asType < integer > (div1.quot)
(asType<integer>(asType<int>($heap_{tuncstart\_724.1}.p1)) %
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a1))) = =
asType<integer>(div1.rem)
!(0 == asType < integer > (div1.rem)) || !(0 ==
asType<integer>(div1.quot))
div2 == div(\mathbf{heapIs} \$ heap_{funcstart\_724,1},
\mathbf{asType} < \mathbf{int} > (\$ \mathrm{heap}_{funcstart\_724,1}.\mathrm{p2}),
asType < int > (\$heap_{funcstart_{-724,1}}.a2))
(asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.p2)) /
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a2))) = =
asType<integer>(div2.quot)
(asType<int>(asType<int>($heap_{tuncstart\_724.1}.p2)) %
\mathbf{asType}{<}\mathbf{integer}{>}(\mathbf{asType}{<}\mathbf{int}{>}(\$\mathbf{heap}_{funcstart\_724,1}.\mathbf{a2}))) = =
asType<integer>(div2.rem)
!(0 == asType < integer > (div2.rem)) || !(0 ==
asType<integer>(div2.quot))
div3 == div(\mathbf{heapIs} \$ heap_{funcstart\_724,1},
asType < int > (\$heap_{funcstart\_724,1}.p3),
asType < int > (\$heap_{funcstart\_724.1}.a3))
(asType<int>(asType<int>($heap_{tuncstart}, 724.1.p3)) /
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a3))) = =
asType<integer>(div3.quot)
(asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.p3)) \%
\mathbf{asType}{<}\mathbf{integer}{>}(\mathbf{asType}{<}\mathbf{int}{>}(\$\mathbf{heap}_{funcstart\_724,1}.\mathbf{a3}))) = =
asType<integer>(div3.rem)
!(0 == asType < integer > (div3.rem)) || !(0 ==
asType<integer>(div3.quot))
heap_{724,1;740,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow asType<short
int>((asType<int>(asType<short int>(div1.rem)) *
\mathbf{asType} \small{<} \mathbf{int} \small{>} (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{r1})) \\ - (\mathbf{asType} \small{<} \mathbf{int} \small{>} (\mathbf{asType} \small{<} \mathbf{short}
int>(div1.quot)) * asType<int>($heap_{funcstart\_724,1}.b1)))
-asType < integer const > (\$heap_{724,1:740.8}.M1) < 
asType<integer>($heap<sub>724.1:740.8</sub>.p1)
!(0 == asType < integer > (\$heap_{724,1;740,8}.p1))
asType<integer>($heap<sub>724.1:740.8</sub>.p1) <
asType<integer>($heap<sub>724.1:740.8</sub>.M1)
```

```
\text{heap}_{724.1:742.8} == \text{heap}_{724.1:740.8}._replace(p2 \rightarrow asType<short)
int>((asType<int>(asType<short int>(div2.rem)) *
asType < int > (\$heap_{724,1:740,8}.r2)) - (asType < int > (asType < short)
int>(div2.quot)) * asType< int>($heap_{724,1;740.8}.b2))))
-asType<integer const>($heap<sub>724.1:742.8</sub>.M2) <
asType<integer>($heap<sub>724.1:742.8</sub>.p2)
!(0 == asType < integer > (\$heap_{724,1;742,8}.p2))
asType < integer > (\$heap_{724,1:742,8}.p2) <
asType<integer>($heap<sub>724,1;742,8</sub>.M2)
Proof:
[Take given term]
[5.0] invariant1(heapIs $heap_{tuncstart_724.1})
\rightarrow [expand definition of function 'invariant1' at prang.c (34,1)]
 \texttt{[5.1]} \left( \left( \left( \left( \left( 0 < \mathbf{asType} < \mathbf{integer} > \left( \$ \mathsf{heap}_{funcstart\_724,1}.\mathsf{p1} \right) \right) \right. \&\& \right. \right. 
(asType<integer>($heap_funcstart_724.1.p1) <
as
Type<integer>(\rho_{funcstart\_724,1}.M1))) & (0 <
asType < integer > (\$heap_{funcstart\_724,1}.p2))) \&\&
(\mathbf{asType} {<} \mathbf{integer} {>} (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p2}) <
asType < integer > (\$heap_{funcstart\_724,1}.M2))) \&\& (0 <
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p3})))\ \&\&
(\mathbf{asType} {<} \mathbf{integer} {>} (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p3}) <
asType < integer > (\$heap_{funcstart_{-724.1}}.M3))
\rightarrow [simplify]
[5.3] (((((0 < $heap_{funcstart_724,1}.p1) && ($heap_{funcstart_724,1}.p1 < footnote{in the content of the c
asType < integer > (\$heap_{funcstart\_724,1}.M1))) \&\& (0 <
asType < integer > (\$heap_{funcstart\_724,1}.p2))) \&\&
(\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{p2}) <
asType < integer > (\$heap_{funcstart\_724,1}.M2))) \&\& (0 <
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p3})))\ \&\&
(asType < integer > (\$heap_{funcstart\_724,1}.p3) < 
asType < integer > (\$heap_{funcstart\_724,1}.M3))
\rightarrow [const static or extern object]
[5.4] \ (((((0 < \text{\$heap}_{funcstart\_724,1}.\text{p1}) \&\& \ (\text{\$heap}_{funcstart\_724,1}.\text{p1} <
asType<integer>($heap<sub>init</sub>.M1))) && (0 <
asType < integer > (\$heap_{funcstart\_724,1}.p2))) \&\&
(\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p2}) <
asType<integer>(heap_{funcstart\_724,1}.M2))) && (0 <
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p3})))\ \&\&
(\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{p3}) <
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{M3}))
```

```
\rightarrow [expand definition of constant 'M1' at prang.c (14,20)]
[5.5] (((((0 < $heap_{funcstart_724,1}.p1) && ($heap_{funcstart_724,1}.p1 < function for the content of the 
asType<integer>(asType<short int>((int)30269)))) && (0 <
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p2})))\ \&\&
(\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{p2}) <
asType<integer>($heap_{funcstart\_724,1}.M2))) && (0 <
asType < integer > (\$heap_{funcstart\_724,1}.p3))) \&\&
(\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{p3}) <
asType < integer > (\$heap_{funcstart\_724.1}.M3))
\rightarrow [simplify]
[5.16] \left( \left( \left( \left( -30269 < -\$ \text{heap}_{funcstart\_724,1}.\text{p1} \right) \right. \wedge \left. \left( 0 < \$ \text{heap}_{funcstart\_724,1}.\text{p1} \right) \right. \wedge \right. \right)
(0 < \text{\$heap}_{funcstart\_724,1}.p2)) \&\& (\text{\$heap}_{funcstart\_724,1}.p2 <
asType<integer>(heap_{funcstart\_724,1}.M2))) && (0 <
asType < integer > (\$heap_{funcstart\_724,1}.p3))) \&\&
(asType<integer>($heap_{tuncstart\_724.1}.p3) <
asType < integer > (\$heap_{funcstart\_724,1}.M3))
\rightarrow [const static or extern object]
[5.17] \left( \left( \left( \left( -30269 < -\$ \text{heap}_{funcstart\_724,1}.\text{p1} \right) \right. \wedge \left. \left( 0 < \$ \text{heap}_{funcstart\_724,1}.\text{p1} \right) \right. \wedge \right. \right)
(0 < \text{\$heap}_{funcstart\_724,1}.p2)) \&\& (\text{\$heap}_{funcstart\_724,1}.p2 <
asType < integer > (\$heap_{init}.M2))) \&\& (0 <
asType < integer > (\$heap_{funcstart\_724,1}.p3))) \&\&
(\mathbf{asType} < \mathbf{integer} > (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p3}) <
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{M3}))
\rightarrow [expand definition of constant 'M2' at prang.c (19,20)]
[5.18] ((((-30269 < -\$heap_{funcstart\_724,1}.p1) \land (0 < \$heap_{funcstart\_724,1}.p1) 
(0 < \mathrm{\$heap}_{funcstart\_724,1}.\mathrm{p2})) && (\mathrm{\$heap}_{funcstart\_724,1}.\mathrm{p2} <
asType<integer>(asType<short int>((int)30307)))) && (0 <
asType < integer > (\$heap_{funcstart\_724,1}.p3))) \&\&
(asType < integer > (\$heap_{funcstart\_724.1}.p3) < 
asType < integer > (\$heap_{funcstart\_724,1}.M3))
\rightarrow [simplify]
[5.30] ((-30307 < -$heap_funcstart_724,1.p2) \land (-30269 <
-\$heap_{funcstart\_724,1}.p1) \land (0 < \$heap_{funcstart\_724,1}.p1) \land (0 < \$heap_{funcstart\_724,1}.p1)
\text{Sheap}_{funcstart_{-724,1}.p2} \land (0 < \text{Sheap}_{funcstart_{-724,1}.p3})) \&\&
(\text{\$heap}_{funcstart\_724,1}.p3 < asType < integer > (\text{\$heap}_{funcstart\_724,1}.M3))
\rightarrow [const static or extern object]
[5.31] ((-30307 < -$heap<sub>funcstart_724,1.</sub>p2) \land (-30269 <
 -\$heap_{funcstart\_724,1}.p1) \land (0 < \$heap_{funcstart\_724,1}.p1) \land (0 < \$heap_{funcstart\_724,1}.p1)
\text{Sheap}_{funcstart\_724,1.p2}) \land (0 < \text{Sheap}_{funcstart\_724,1.p3})) \&\&
(\text{\$heap}_{funcstart\_724.1}.\text{p3} < \text{asType} < \text{integer} > (\text{\$heap}_{init}.\text{M3}))
\rightarrow [expand definition of constant 'M3' at prang.c (24,20)]
```

```
[5.32] ((-30307 < -$heap_funcstart_724,1.p2) \land (-30269 <
-\$heap_{funcstart\_724,1}.p1) \land (0 < \$heap_{funcstart\_724,1}.p1) \land (0 < \$heap_{funcstart\_724,1}.p1)
\text{Sheap}_{funcstart\_724,1}.p2) \land (0 < \text{Sheap}_{funcstart\_724,1}.p3)) \&\&
(\text{sheap}_{funcstart\_724,1}.p3 < asType < integer > (asType < short)
int > ((int)30323)))
\rightarrow [simplify]
[5.40] (-30323 < -$heap<sub>funcstart_724,1.</sub>p3) \land (-30307 <
-\$heap_{funcstart\_724,1}.p2) \wedge (-30269 < -\$heap_{funcstart\_724,1}.p1) \wedge (0 <
\text{Sheap}_{funcstart_{-724,1}.p1} \land (0 < \text{Sheap}_{funcstart_{-724,1}.p2}) \land (0 <
heap_{funcstart_{724,1}.p3}
[Work on sub-term 6 of conjunction in term 5.40]
[10.0]~0 < \$ \mathrm{heap}_{funcstart\_724,1}.\mathrm{p3}
[Take given term]
[11.0] \operatorname{div1} == \operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724,1},
asType < int > (\$heap_{funcstart\_724,1}.p1),
asType < int > (\$heap_{funcstart\_724,1}.a1))
\rightarrow [simplify]
[11.1] \operatorname{div1} == \operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1,
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{a1}))
\rightarrow [const static or extern object]
[11.2] \ \mathrm{div1} == \mathrm{div}(\mathbf{heapIs} \ \$ \mathrm{heap}_{funcstart\_724,1}, \ \$ \mathrm{heap}_{funcstart\_724,1}.\mathrm{p1},
asType < int > (\$heap_{init}.a1))
\rightarrow [expand definition of constant 'a1' at prang.c (16,20)]
[11.3] \operatorname{div1} == \operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724,1}, \$ \operatorname{heap}_{funcstart\_724,1}.p1,
asType<int>(asType<short int>((int)177)))
\rightarrow [simplify]
[11.6] div1 == div(heapIs $heap_{funcstart\_724,1}, $heap_{funcstart\_724,1}.p1, 177)
[Take given term]
[25.0] div2 == div(heapIs $heap_{funcstart\_724,1},
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p2}),
asType < int > (\$heap_{funcstart\_724,1}.a2))
\rightarrow [simplify]
[25.1]~{\rm div2} == {\rm div}(\mathbf{heapIs}~\$ \mathrm{heap}_{funcstart\_724,1},~\$ \mathrm{heap}_{funcstart\_724,1}.\mathrm{p2},
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{a2}))
\rightarrow [const static or extern object]
[25.2] \operatorname{div2} == \operatorname{div}(\mathbf{heapIs} \ \text{$heap}_{funcstart\_724,1}, \ \text{$heap}_{funcstart\_724,1}.p2,
asType < int > (\$heap_{init}.a2))
```

```
\rightarrow [expand definition of constant 'a2' at prang.c (21,20)]
[25.3] div2 == div(heapIs \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}.p2,
asType<int>(asType<short int>((int)176)))
\rightarrow [simplify]
[25.6] \ \mathrm{div2} == \mathrm{div}(\mathbf{heapIs} \ \$ \mathrm{heap}_{funcstart\_724,1}, \ \$ \mathrm{heap}_{funcstart\_724,1}.\mathrm{p2}, \ 176)
[Take given term]
[39.0] div3 == div(heapIs $heap_{funcstart\_724,1},
\mathbf{asType} < \mathbf{int} > (\$ \mathrm{heap}_{funcstart\_724,1}.\mathrm{p3}),
asType < int > (\$heap_{funcstart\_724,1}.a3))
\rightarrow [simplify]
[39.1] \operatorname{div3} == \operatorname{div}(\mathbf{heapIs} \ \operatorname{\$heap}_{funcstart\_724,1}, \ \operatorname{\$heap}_{funcstart\_724,1}.p3,
asType < int > (\$heap_{funcstart\_724,1}.a3))
\rightarrow [const static or extern object]
\label{eq:constant_724,1} \textit{[39.2]} \ \text{div3} == \text{div}(\mathbf{heapIs} \ \$ \text{heap}_{funcstart\_724,1}, \ \$ \text{heap}_{funcstart\_724,1}.\text{p3},
asType < int > (\$heap_{init}.a3))
\rightarrow [expand definition of constant 'a3' at prang.c (26,20)]
[39.3] div3 == div(heapIs heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p3,
asType<int>(asType<short int>((int)178)))
\rightarrow [simplify]
[39.6] div3 == div(heapIs \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}.p3, 178)
[Assume known post-assertion, class invariant or type constraint for term 39.6]
[43.0] (asType<integer>(peq_{funcstart\_724,1}.p3) %
asType<integer>(178)) == asType<integer>(div(heapIs
heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p3, 178).rem
\rightarrow [simplify]
[43.2] ($heap<sub>funcstart_724,1.</sub>p3 % 178) == asType<integer>(div(heapIs)
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.\text{p3}, 178).\text{rem}
→ [expand definition of operator '.%' in class 'int' at built in declaration]
[43.3] ([asType<integer>(heap_{funcstart\_724,1}.p3) < 0]:
-(-asType < integer > (\$heap_{funcstart\_724,1}.p3) \% 178), []:
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p3})~\%~178) ==
\mathbf{asType} < \mathbf{integer} > (\mathbf{div}(\mathbf{heapIs} \$ \mathbf{heap}_{funcstart\_724,1}, \$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p3},
178).rem)
→ [explicitly assert falsehood of skipped guards in subsequent guards]
[43.4] ([asType<integer>($heap_{funcstart\_724,1}.p3) < 0]:
-(-asType < integer > (\$heap_{funcstart\_724.1}.p3) \% 178),
[!(asType < integer > (\$heap_{funcstart\_724,1}.p3) < 0)]:
```

```
asType < integer > (\$heap_{funcstart-724,1}.p3) \% 178) ==
\mathbf{asType} \small{<} \mathbf{integer} \small{>} ( \mathrm{div}(\mathbf{heapIs} \ \$ \mathrm{heap}_{funcstart\_724,1}, \ \$ \mathrm{heap}_{funcstart\_724,1}.\mathrm{p3}, \\
178).rem)
\rightarrow [simplify]
[43.7] ([0 < -$heap<sub>funcstart_724,1</sub>.p3]:
 -(-asType < integer > (\$heap_{funcstart\_724,1}.p3) \% 178),
[!(\mathbf{asType} < \mathbf{integer} > (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p3}) < 0)]:
asType < integer > (\$heap_{funcstart\_724,1}.p3) \% 178) ==
\mathbf{asType} {<} \mathbf{integer} {>} ( \mathbf{div} (\mathbf{heapIs} \ \$ \mathbf{heap}_{funcstart\_724,1}, \ \$ \mathbf{heap}_{funcstart\_724,1}. \mathbf{p3}, \\
178).rem)
\rightarrow [from term 10.0, literala < -$heap<sub>funcstart_724,1</sub>.p3 is false whenever -2 <
(0 + literala)
        Proof of rule precondition:
        [43.7.0] - 2 < (0 + 0)
        \rightarrow [simplify]
        [43.7.2] true
[43.8] \; ([\mathbf{false}]: \; -(-\mathbf{asType} < \mathbf{integer} > (\$ \mathrm{heap}_{funcstart\_724,1}.\mathrm{p3}) \; \% \; 178),
[!(asType < integer > (\$heap_{funcstart\_724,1}.p3) < 0)]:
asType < integer > (\$heap_{funcstart\_724,1}.p3) \% 178) ==
\mathbf{asType} {<} \mathbf{integer} {>} ( \mathrm{div}(\mathbf{heapIs} \ \$ \mathrm{heap}_{funcstart\_724,1}, \ \$ \mathrm{heap}_{funcstart\_724,1}.\mathrm{p3}, \\
178).rem)
\rightarrow [simplify]
[43.11] \; ([\mathbf{false}]: \; -(-\mathbf{asType} < \mathbf{integer} > (\$ heap_{funcstart\_724,1}.p3) \; \% \; 178), \; [!(0.12)] \; ((0.12)) \; ((0.12)) \; ((0.12)) \; ((0.12)) \; ((0.12)) \; ((0.12)) \; ((0.12)) \; ((0.12)) \; ((0.12)) \; ((0.12)) \; ((0.12)) \; ((0.12)) \; ((0.12)) \; ((0.12)) \; ((0.12)) \; ((0.12)) \; ((0.12)) \; ((0.12)) \; ((0.12)) \; ((0.12)) \; ((0.12)) \; ((0.12)) \; ((0.12)) \; ((0.12)) \; ((0.12)) \; ((0.12)) \; ((0.12)) \; ((0.12)) \; ((0.12)) \; ((0.12)) \; ((0.12)) \; ((0.12)) \; ((0.12)) \; ((0.12)) \; ((0.12)) \; ((0.12)) \; ((0.12)) \; ((0.12)) \; ((0.12)) \; ((0.12)) \; ((0.12)) \; ((0.12)) \; ((0.12)) \; ((0.12)) \; ((0.12)) \; ((0.12)) \; ((0.12)) \; ((0.12)) \; ((0.12)) \; ((0.12)) \; ((0.12)) \; ((0.12)) \; ((0.12)) \; ((0.12)) \; ((0.12)) \; ((0.12)) \; ((0.12)) \; ((0.12)) \; ((0.12)) \; ((0.12)) \; ((0.12)) \; ((0.12)) \; ((0.12)) \; ((0.12)) \; ((0.12)) \; ((0.12)) \; ((0.12)) \; ((0.12)) \; ((0.12)) \; ((0.12)) \; ((0.12)) \; ((0.12)) \; ((0.12)) \; ((0.12)) \; ((0.12)) \; ((0.12)) \; ((0.12)) \; ((0.12)) \; ((0.12)) \; ((0.12)) \; ((0.12)) \; ((0.12)) \; ((0.12)) \; ((0.12)) \; ((0.12)) \; ((0.12)) \; ((0.12)) \; ((0.12)) \; ((0.12)) \; ((0.12)) \; ((0.12)) \; ((0.12)) \; ((0.12)) \; ((0.12)) \; ((0.12)) \; ((0.12)) \; ((0.12)) \; ((0.12)) \; ((0.12)) \; ((0.12)) \; ((0.12)) \; ((0.12)) \; ((0.12)) \; ((0.12)) \; ((0.12)) \; ((0.12)) \; ((0.12)) \; ((0.12)) \; ((0.12)) \; ((0.12)) \; ((0.12)) \; ((0.12)) \; ((0.12)) \; ((0.12)) \; ((0.12)) \; ((0.12)) \; ((0.12)) \; ((0.12)) \; ((0.12)) \; ((0.12)) \; ((0.12)) \; ((0.12)) \; ((0.12)) \; ((0.12)) \; ((0.12)) \; ((0.12)) \; ((0.12)) \; ((0.12)) \; ((0.12)) \; ((0.12)) \; ((0.12)) \; ((0.12)) \; ((0.12)) \; ((0.12)) \; ((0.12)) \; ((0.12)) \; ((0.12)) \; ((0.12)) \; ((0.12)) \; ((0.12)) \; ((0.12)) \; ((0.12)) \; ((0.12)) \; ((0.12)) \; ((0.12)) \; ((0.12)) \; ((0.12)) \; ((0.12)) \; ((0.12)) \; ((0.12)) \; ((0.12)) \; ((0.12)) \; ((0.12)) \; ((0.12)) \; ((0.12)) \; ((0.12)) \; ((0.12)) \; ((0.12)) \; ((0.12)) \; ((0.12)) \; ((0.12)) \; ((0.12)) \; ((0.12)) \; ((0.12)) \; ((0.12)) \; ((0.12)) \; ((0.12)) \; ((0.12)) \; ((0.12)) \; ((0.12)) \; ((0.12)) \; ((0.12)) \; ((0.12)) \; ((0.12)) \; ((0.12)) \; ((0.12)) \;
< -$heap<sub>funcstart_724.1</sub>.p3)]: asType<integer>($heap<sub>funcstart_724.1</sub>.p3) %
178) == asType<integer>(div(heapIs $heap_{tuncstart\_724.1},
heap_{funcstart_{-724,1}.p3, 178}.rem
\rightarrow [from term 10.0, literala < -$heap<sub>funcstart_724,1.</sub>p3 is false whenever -2 <
(0 + literala)
        Proof of rule precondition:
        [43.11.0] - 2 < (0 + 0)
        \rightarrow [simplify]
        [43.11.2] true
[43.12] ([false]: -(-asType < integer > (\$heap_{funcstart\_724,1}.p3) \% 178),
[!false]: asType<integer>(peq_{funcstart\_724,1}.p3) % 178) ==
asType<integer>(div(heapIs $heap_{tuncstart\_724.1}, $heap_{tuncstart\_724.1}.p3,
178).rem)
\rightarrow [simplify]
[43.17] \ 0 == (-\text{div}(\mathbf{heapIs} \ \$ \text{heap}_{funcstart\_724,1}, \ \$ \text{heap}_{funcstart\_724,1}.\text{p3},
```

```
178).rem + (\text{$heap}_{funcstart-724,1}.p3 \% 178))
[Take given term]
[53.0] heap_{724,1;740,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow asType<short
int>((asType<int>(asType<short int>(div1.rem)) *
asType < int > (\$heap_{funcstart\_724,1}.r1)) - (asType < int > (asType < short)
int>(div1.quot)) * asType< int>($heap_{funcstart\_724,1}.b1))))
\rightarrow [from term 11.6, div1 is equal to div(heapIs $heap_{funcstart_{724,1}},
heap_{funcstart_{-724,1}}.p1, 177
[53.1] \theta == 
int>((asType<int>(asType<short int>(div(heapIs $heap_{tuncstart\_724.1},
\text{sheap}_{funcstart=724.1}.\text{p1}, 177).\text{rem} ** asType<int>(\text{sheap}_{funcstart=724.1}.\text{r1})) -
(asType<int>(asType<short int>(div1.quot)) *
asType < int > (\$heap_{funcstart\_724,1}.b1)))
\rightarrow [simplify]
[53.3] \theta == 
int>((div(heapIs \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1, 177).rem *
asType < int > (\$heap_{funcstart\_724.1}.r1)) - (asType < int > (asType < short)
int>(div1.quot)) * asType< int>($heap_{funcstart\_724,1}.b1))))
\rightarrow [const static or extern object]
[53.4] heap_{724,1;740,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow asType<short
int>((div(heapIs \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1, 177).rem *
asType < int > (\$heap_{init}.r1)) - (asType < int > (asType < short)
int>(div1.quot)) * asType< int>($heap_{funcstart\_724,1}.b1))))
\rightarrow [expand definition of constant 'r1' at prang.c (15,20)]
[53.5] heap_{724,1;740,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow asType<short
int>((div(heapIs \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1, 177).rem *
asType<int>(asType<short int>((int)171))) -
(asType<int>(asType<short int>(div1.quot)) *
asType < int > (\$heap_{funcstart\_724,1}.b1)))
\rightarrow [simplify]
[53.8] \text{sheap}_{724,1;740,8} == \text{sheap}_{funcstart\_724,1}._replace(p1 \rightarrow asType<short
\mathbf{int} > ((\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.\operatorname{p1}, \ 177).\operatorname{rem} \ * \ 171)
- (asType<int>(asType<short int>(div1.quot)) *
asType < int > (\$heap_{funcstart\ 724.1}.b1))))
\rightarrow [from term 11.6, div1 is equal to div(heapIs $heap_{funcstart\_724,1},
heap_{funcstart\_724,1}.p1, 177)
[53.9] heap_{724,1;740,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow asType<short
int>((171 * div(heapIs $heap_{funcstart\_724,1}, $heap_{funcstart\_724,1}.p1, 177).rem)
- (asType<int>(asType<short int>(div(heapIs $heap_{tuncstart_724.1},
heap_{funcstart_{724,1}}.p1, 177).quot) *
```

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\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{b1}))))
\rightarrow [simplify]
[53.11] \theta == 
int>((171 * div(heapIs \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1, 177).rem)
- (div(heapIs \rho_{funcstart\_724,1}, \rho_{funcstart\_724,1.p1}, 177).quot *
asType < int > (\$heap_{funcstart\_724,1}.b1))))
\rightarrow [const static or extern object]
[53.12] $\text{heap}_{724.1:740.8} == $\text{heap}_{funcstart\_724.1}. \text{replace}(p1 \rightarrow \text{asType} < \text{short}
int > ((171 * div(heapIs \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1, 177).rem)
- (\text{div}(\mathbf{heapIs} \$ \text{heap}_{funcstart\_724,1}, \$ \text{heap}_{funcstart\_724,1}.\text{p1}, 177).\text{quot} *
asType < int > (\$heap_{init}.b1))))
\rightarrow [expand definition of constant 'b1' at prang.c (17,20)]
[53.13] heap_{724,1;740,8} == heap_{funcstart\_724,1}.replace(p1 \rightarrow asType<short
int>((171 * div(heapIs $heap_{funcstart\_724,1}, $heap_{funcstart\_724,1}.p1, 177).rem)
- (\text{div}(\mathbf{heapIs} \$ \text{heap}_{funcstart\_724,1}, \$ \text{heap}_{funcstart\_724,1}.\text{p1}, 177).\text{quot} *
asType<int>(asType<short int>((int)2))))
\rightarrow [simplify]
[53.19] $\text{heap}_{724,1;740,8} == \text{$heap}_{funcstart\_724,1}._\text{$replace}(p1 \to ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).quot) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.\operatorname{p1}, \ 177).\operatorname{rem})))
[Take given term]
[57.0] $\text{heap}_{724,1;742,8} == \text{$heap}_{724,1;740,8}.$_replace(p2 \rightarrow asType < short)
int>((asType<int>(asType<short int>(div2.rem)) *
asType < int > (\$heap_{724.1:740.8}.r2)) - (asType < int > (asType < short)
int>(div2.quot)) * asType< int>($heap_{724.1:740.8}.b2))))
 \rightarrow [from term 53.19, $heap<sub>724,1;740,8</sub> is equal to
heap_{funcstart\_724,1}._replace(p1 \rightarrow (-2 * div(heapIs $heap_{funcstart\_724,1},
heap_{funcstart\_724,1}.p1, 177).quot + (171 * div(heapIs p_{funcstart\_724,1})
heap_{funcstart_{-724,1}}.p1, 177).rem)
[57.1] \theta_{17.1} = \theta_{17.1} \cdot \theta_{17.1} = \theta_{17.1} \cdot \theta_{17.1} \cdot \theta_{17.1} \cdot \theta_{17.1} = \theta_{17.1} \cdot \theta_{17.1} \cdot \theta_{17.1} \cdot \theta_{17.1} = \theta_{17.1} \cdot \theta_{17.1} \cdot \theta_{17.1} \cdot \theta_{17.1} \cdot \theta_{17.1} = \theta_{17.1} \cdot \theta_
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow asType<short
int>((asType<int>(asType<short int>(div2.rem)) *
asType < int > (\$heap_{724,1:740.8}.r2)) - (asType < int > (asType < short)
\mathbf{int}{>}(\text{div2.quot})) \ * \ \mathbf{asType}{<} \mathbf{int}{>} (\$\text{heap}_{724,1;740,8}.\text{b2}))))
\rightarrow [from term 25.6, div2 is equal to div(heapIs $heap_{funcstart\_724,1},
heap_{funcstart_{724,1}}.p2, 176
[57.2] $\text{heap}_{724,1;742,8} == $\text{heap}_{funcstart\_724,1}.$\text{-replace}(p1 \to ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 *
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\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow asType<short
int>((asType<int>(asType<short int>(div(heapIs $heap_{funcstart\_724,1},
\text{sheap}_{funcstart\_724,1.p2, 176}.\text{rem}) * asType < int > (\text{sheap}_{724,1:740,8.r2})) -
(asType<int>(asType<short int>(div2.quot)) *
asType < int > (\$heap_{724,1;740,8}.b2))))
\rightarrow [simplify]
[57.4] heap_{724,1;742,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).quot) + (171 *
\operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724,1}, \$ \operatorname{heap}_{funcstart\_724,1}.p1,
177).rem)))._{\mathbf{replace}}(p2 \rightarrow \mathbf{asType} < \mathbf{short\ int} > ((\operatorname{div}(\mathbf{heapIs}))))
\rho_{funcstart\_724,1}, \rho_{funcstart\_724,1.p2, 176}.rem *
\mathbf{asType} < \mathbf{int} > (\$ \mathrm{heap}_{724,1;740,8}.\mathrm{r2})) - (\mathbf{asType} < \mathbf{int} > (\mathbf{asType} < \mathbf{short}))
int>(div2.quot)) * asType< int>($heap_{724,1;740,8}.b2))))
\rightarrow [from term 53.19, $heap<sub>724.1:740.8</sub> is equal to
heap_{funcstart\_724,1}._replace(p1 \rightarrow (-2 * div(heapIs $heap_{funcstart\_724,1},
heap_{funcstart_{724,1},p1, 177}, quot) + (171 * div(heapIs p_{funcstart_{724,1},p1, 177}), quot)
heap_{funcstart_{-724,1},p1,177,rem}
[57.5] $heap<sub>724,1:742,8</sub> == $heap<sub>funcstart_724,1</sub>._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).quot) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow asType<short int>((div(heapIs
heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p2, 176).rem *
asType < int > (\$heap_{funcstart\_724,1}.\_replace(p1 \rightarrow ((-2 * div(heapIs)))))))
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.\text{p1}, 177).\text{quot}) + (171 * \text{div}(\textbf{heapIs}))
\theta_{funcstart_{724,1}}, \theta_{funcstart_{724,1},p1, 177).rem})).r2)) -
(asType<int>(asType<short int>(div2.quot)) *
asType<int>($heap<sub>724.1:740.8</sub>.b2))))
\rightarrow [const member of object with modified fields]
[57.6] $heap<sub>724,1;742,8</sub> == $heap<sub>funcstart_724,1</sub>._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 \ *
\operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724.1}, \$ \operatorname{heap}_{funcstart\_724.1}.p1,
177).rem)))._{\mathbf{replace}}(p2 \rightarrow \mathbf{asType} < \mathbf{short\ int} > ((\operatorname{div}(\mathbf{heapIs}))))
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.p2, 176).rem *
\mathbf{asType} \hspace{-0.1em}<\hspace{-0.1em} \mathbf{int} \hspace{-0.1em}> \hspace{-0.1em} (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{r2})) - (\mathbf{asType} \hspace{-0.1em}<\hspace{-0.1em} \mathbf{int} \hspace{-0.1em}> \hspace{-0.1em} (\mathbf{asType} \hspace{-0.1em}<\hspace{-0.1em} \mathbf{short})
int>(div2.quot)) * asType< int>($heap_{724.1:740.8}.b2))))
\rightarrow [const static or extern object]
[57.7] heap_{724,1;742,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 \ *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1,
177).rem)))._{\mathbf{replace}}(p2 \rightarrow \mathbf{asType} < \mathbf{short\ int} > ((\operatorname{div}(\mathbf{heapIs}))))
\text{Sheap}_{funcstart_{724,1}}, \text{Sheap}_{funcstart_{724,1}}.p2, 176).rem *
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asType < int > (\$heap_{init}.r2)) - (asType < int > (asType < short)
int>(div2.quot)) * asType< int>($heap_{724.1:740.8}.b2))))
\rightarrow [expand definition of constant 'r2' at prang.c (20,20)]
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).quot) + (171 *
\operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724.1}, \$ \operatorname{heap}_{funcstart\_724.1}.p1,
177).rem)))._replace(p2 \rightarrow asType<short int>((div(heapIs
\text{Sheap}_{funcstart_{-724,1}}, \text{Sheap}_{funcstart_{-724,1}}.p2, 176).rem *
asType<int>(asType<short int>((int)172))) -
(\mathbf{asType}{<}\mathbf{int}{>}(\mathbf{asType}{<}\mathbf{short}\ \mathbf{int}{>}(\mathbf{div2.quot}))\ ^*
\mathbf{asType}{<}\mathbf{int}{>}(\${\rm heap}_{724,1;740,8}.{\rm b2}))))
\rightarrow [simplify]
[57.11] $\text{heap}_{724,1;742,8} == \text{$heap}_{funcstart\_724,1}.$\text{$_{-}$replace}(p1 \to ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 \ *
\operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724,1}, \$ \operatorname{heap}_{funcstart\_724,1}.p1,
(177).rem))._replace(p2 \rightarrow asType<short int>((div(heapIs)
heap_{funcstart_{-724,1}}, heap_{funcstart_{-724,1},p2, 176}.rem * 172) -
(asType<int>(asType<short int>(div2.quot)) *
asType<int>($heap<sub>724.1:740.8</sub>.b2))))
\rightarrow [from term 25.6, div2 is equal to div(heapIs $heap_{tuncstart_{724.1}},
heap_{funcstart_{-724,1}}.p2, 176
[57.12] $heap<sub>724,1;742,8</sub> == $heap<sub>funcstart_724,1</sub>._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).quot) + (171 *
\operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724,1}, \$ \operatorname{heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow asType<short int>((172 * div(heapIs
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.p2, 176).rem) -
(asType<int>(asType<short int>(div(heapIs $heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1.p2}, 176).\text{quot}) * asType<int>(\text{Sheap}_{724,1;740,8.b2}))))
\rightarrow [simplify]
[57.14] $heap<sub>724,1;742,8</sub> == $heap<sub>funcstart_724,1</sub>._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.\operatorname{p1}, \ 177).\operatorname{quot}) + (171 \ *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow asType<short int>((172 * div(heapIs
\theta_{funcstart_{724,1}}, \theta_{funcstart_{724,1},p2,176}.rem) - (div(heapIs
\theta_{funcstart_{724,1}}, \theta_{funcstart_{724,1}}, \theta_{funcstart_{724,1}}.p2, 176).quot
asType<int>($heap<sub>724.1:740.8</sub>.b2))))
\rightarrow [from term 53.19, $heap<sub>724,1;740.8</sub> is equal to
heap_{funcstart\_724,1}._replace(p1 \rightarrow (-2 * div(heapIs heap_{funcstart\_724,1}),
heap_{funcstart\_724.1}.p1, 177).quot + (171 * div(heapIs p_{funcstart\_724.1})
heap_{funcstart_{-724,1}}.p1, 177).rem)
[57.15] $heap<sub>724,1;742,8</sub> == $heap<sub>funcstart_724,1</sub>._replace(p1 \rightarrow ((-2 *
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\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).quot) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow asType<short int>((172 * div(heapIs
\theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}
heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p2, 176).quot *
asType<int>($heap<sub>funcstart_724,1</sub>._replace(p1 \rightarrow ((-2 * div(heapIs
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.p1, 177).quot) + (171 * div(heapIs)
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.p1, 177).rem))).b2))))
\rightarrow [const member of object with modified fields]
[57.16] $\text{heap}_{724,1:742,8} == \text{$heap}_{funcstart\_724,1}._\text{$replace}(p1 \to ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 *
\label{eq:div_heap} \text{div}(\textbf{heapIs} \ \$ \text{heap}_{funcstart\_724,1}, \ \$ \text{heap}_{funcstart\_724,1}.\text{p1},
177).rem)))._replace(p2 \rightarrow asType<short int>((172 * div(heapIs
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.\text{p2}, 176).\text{rem}) - (\text{div}(\text{heapIs})
heap_{funcstart_{-724,1}}, heap_{funcstart_{-724,1}}.p2, 176).quot *
asType < int > (\$heap_{funcstart\_724,1}.b2))))
\rightarrow [const static or extern object]
[57.17] $heap<sub>724,1;742,8</sub> == $heap<sub>funcstart_724,1</sub>._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}. \operatorname{pl},
177).rem)))._replace(p2 \rightarrow asType<short int>((172 * div(heapIs
\theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}.p2, 176).rem) - (div(heapIs
\text{Sheap}_{funcstart_{-724,1}}, \text{Sheap}_{funcstart_{-724,1}}.p2, 176).quot *
asType < int > (\$heap_{init}.b2))))
\rightarrow [expand definition of constant 'b2' at prang.c (22,20)]
[57.18] $heap<sub>724,1;742,8</sub> == $heap<sub>funcstart_724,1</sub>._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 *
\operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724,1}, \$ \operatorname{heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow asType<short int>((172 * div(heapIs
\theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}
e_{funcstart\_724,1}, e_{funcstart\_724,1}.p2, 176).quot *
\mathbf{asType}{<}\mathbf{int}{>}(\mathbf{asType}{<}\mathbf{short}\ \mathbf{int}{>}((\mathbf{int})35)))))
\rightarrow [simplify]
[57.24] $\text{heap}_{724,1;742,8} == \text{$heap}_{funcstart\_724,1}._\text{replace}(p1 \to ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}. p1, \ 177). \operatorname{quot}) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow ((-35 * div(heapIs $heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1}.\text{p2}, 176).\text{quot} + (172 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
heap_{funcstart_{-724,1}}.p2, 176).rem)
[Take goal term]
[1.0] \min of(int) \le (asType < int > (asType < short int > (div3.rem)) *
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asType<int>($heap<sub>724.1:742.8</sub>.r3))
\rightarrow [simplify]
[1.1] -32768 \leq (asType\leqint>(asType\leqshort int>(div3.rem)) *
asType < int > (\$heap_{724,1;742,8}.r3))
\rightarrow [from term 39.6, div3 is equal to div(heapIs $heap_{funcstart_724,1},
heap_{funcstart_{-724,1}}.p3, 178
[1.2] -32768 \le (asType<int>(asType<short int>(div(heapIs
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.p3, 178).rem)) *
asType<int>($heap<sub>724.1:742.8</sub>.r3))
\rightarrow [simplify]
\textit{[1.4] -32768} \leq (\text{div}(\textbf{heapIs} \ \$ \text{heap}_{funcstart\_724,1}, \ \$ \text{heap}_{funcstart\_724,1}.\text{p3},
178).rem * asType<int>($heap<sub>724.1:742.8</sub>.r3))
\rightarrow [from term 57.24, $heap<sub>724,1;742,8</sub> is equal to
heap_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 * div(heapIs $heap_{funcstart\_724,1},
heap_{funcstart\_724,1}.p1, 177).quot + (171 * div(heapIs $heap_{funcstart\_724,1}, 177).quot) + (171 * div(heapIs $heap_{funcstart\_724,1}, 17
\theta_{funcstart\_724,1}.p1, 177).rem))._replace(p2 \rightarrow (-35 * div(\mathbf{heapIs})))
heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p2, 176).quot) + (172 * div(heapIs)
heap_{funcstart_{724,1}}, heap_{funcstart_{724,1}}, 2, 176).rem
[1.5] -32768 \leq (div(heapIs $heap_{funcstart\_724,1}, $heap_{funcstart\_724,1}.p3,
178).rem * asType<int>($heap_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 \ *
\operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724.1}, \$ \operatorname{heap}_{funcstart\_724.1}.p1,
177).rem)))._replace(p2 \rightarrow ((-35 * div(heapIs $heap_{funcstart\_724,1},
\rho_{funcstart\_724,1.p2}, 176).quot) + (172 * div(heapIs \rho_{funcstart\_724,1},
heap_{funcstart_{724,1}.p2, 176).rem})).r3)
\rightarrow [const member of object with modified fields]
[1.7] -32768 \leq (div(heapIs $heap_{funcstart\_724,1}, $heap_{funcstart\_724,1}.p3,
178).rem * asType < int > (\$heap_{funcstart\_724,1}.r3))
\rightarrow [const static or extern object]
[1.8] - 32768 \le (\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.\operatorname{p3},
178).rem * asType < int > (\$heap_{init}.r3))
\rightarrow [expand definition of constant 'r3' at prang.c (25,20)]
\textit{[1.9] -32768} \leq (\text{div}(\textbf{heapIs} \ \$ \text{heap}_{funcstart\_724,1}, \ \$ \text{heap}_{funcstart\_724,1}.\text{p3},
178).rem * asType < int > (asType < short int > ((int)170)))
\rightarrow [simplify]
[1.14] - 32769 < (170 * div(\mathbf{heapIs} \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p3,
178).rem)
\rightarrow [literal comparison of product]
```

```
\label{eq:condition} \textit{[1.15]}\;(\textit{[170}<0\textit{]:}\;(-32769\;/\;-170)<-\text{div}(\textbf{heapIs}\;\$\text{heap}_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1}.\text{p3}, 178).\text{rem}, [0 < 170]: (-32769 / 170) < \text{div}(\textbf{heapIs})
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.\text{p3}, 178).\text{rem}, [0 == 170]: -32769 < 0)
→ [explicitly assert falsehood of skipped guards in subsequent guards]
[1.16] ([170 < 0]: (-32769 / -170) < -\text{div}(\mathbf{heapIs} \ \$ heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724.1.p3}, 178).\text{rem}, [(0 < 170) \land !(170 < 0)]: (-32769 / 170) < 0
div(\mathbf{heapIs} \ \text{$heap}_{funcstart\_724,1}, \ \text{$heap}_{funcstart\_724,1}.p3, \ 178).rem, \ [(0 == 170)]
\land !(0 < 170) \land !(170 < 0)]: -32769 < 0)
\rightarrow [simplify]
[1.24] -193 < div(heapIs $heap_{funcstart_724,1}$, $heap_{funcstart_724,1}$.p3, 178).rem
\rightarrow [negate goal and search for contradiction]
 \label{eq:loss_loss} $$ [1.25] ! (-193 < {\rm div}(\mathbf{heapIs} \ \$ \mathrm{heap}_{funcstart\_724,1}, \ \$ \mathrm{heap}_{funcstart\_724,1}.\mathrm{p3}, 
178).rem)
\rightarrow [simplify]
 \label{eq:loss_funcstart_724,1} 192 < -\text{div}(\mathbf{heapIs} \ \$ heap_{funcstart\_724,1}, \ \$ heap_{funcstart\_724,1}.p3, 
[Create new term from terms 1.27, 43.17 using rule: transitivity 15]
[63.0] (0 + 192) < -($heap_{funcstart_724,1}.p3 % 178)
\rightarrow [simplify]
[63.2] false
Proof of verification condition: Arithmetic result of operator '*' is within
limit of type 'int'
Condition generated at: C:\Escher\Customers\prang\prang.c (60,13)
Condition defined at:
To prove: (asType<int>(asType<short int>(div3.rem)) *
asType < int > (\$heap_{724,1:742,8}.r3)) \le maxof(int)
Given:
heap_{init}.LIMIT == (int)80
\theta sheap<sub>init</sub>.M1 == asType<short int>((int)30269)
\theta_{init}.r1 == asType < short int > ((int)171)
\theta
heap_{init}.M2 == asType < short int > ((int)30307)
\theta_{init}.r2 == asType < short int > ((int)172)
```

```
\theta
\theta
\theta = asType < short int > ((int)30323)
\theta_{init}.r3 == asType < short int > ((int)170)
heap_{init}.a3 == asType < short int > ((int)178)
heap_{init}.b3 == asType<short int>((int)63)
\theta = asType < short int > ((int)1)
\theta
\theta = asType < short int > ((int)3)
invariant
1<br/>( \mathbf{heapIs}\ \$ \mathbf{heap}_{funcstart\_724,1})
\operatorname{div1} == \operatorname{div}(\mathbf{heapIs} \ \operatorname{\$heap}_{funcstart\_724,1},
\mathbf{asType} < \mathbf{int} > (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p1}),
asType < int > (\$heap_{funcstart\_724,1}.a1))
(asType<int>(asType<int>($heap_{tuncstart\_724.1}.p1)) /
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a1))) = =
asType<integer>(div1.quot)
(asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.p1)) \%
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a1))) = =
asType<integer>(div1.rem)
!(0 == asType < integer > (div1.rem)) || !(0 ==
asType<integer>(div1.quot))
\label{eq:div2} \text{div2} == \text{div}(\mathbf{heapIs} \ \$ \text{heap}_{funcstart\_724,1},
\mathbf{asType} < \mathbf{int} > (\$ \mathrm{heap}_{funcstart\_724,1}.\mathrm{p2}),
asType < int > (\$heap_{funcstart\_724,1}.a2))
(asType<integer>(asType<int>($heap_{tuncstart\_724.1}.p2)) /
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a2))) = =
asType<integer>(div2.quot)
(asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.p2)) \%
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a2))) = =
asType<integer>(div2.rem)
!(0 == asType < integer > (div2.rem)) || !(0 ==
asType<integer>(div2.quot))
\mathrm{div3} == \mathrm{div}(\mathbf{heapIs} \ \$ \mathrm{heap}_{funcstart\_724,1},
\mathbf{asType} < \mathbf{int} > (\$ \mathrm{heap}_{funcstart\_724,1}.\mathrm{p3}),
asType < int > (\$heap_{funcstart\_724,1}.a3))
(asType<int>(asType<int>($heap_{tuncstart\_724.1}.p3)) /
\mathbf{asType}{<}\mathbf{integer}{>}(\mathbf{asType}{<}\mathbf{int}{>}(\$\mathbf{heap}_{funcstart\_724,1}.\mathbf{a3}))) = =
asType<integer>(div3.quot)
```

```
(asType < int > (asType < int > (\$heap_{funcstart\_724,1}.p3)) \%
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a3))) = =
asType<integer>(div3.rem)
!(0 == asType < integer > (div3.rem)) || !(0 ==
asType<integer>(div3.quot))
heap_{724,1;740,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow asType<short
int>((asType<int>(asType<short int>(div1.rem)) *
asType < int > (\$heap_{funcstart\_724,1}.r1)) - (asType < int > (asType < short)
int>(div1.quot)) * asType< int>($heap_{funcstart\_724,1}.b1))))
-asType<integer const>($heap<sub>724,1;740,8</sub>.M1) <
asType<integer>($heap<sub>724,1:740,8</sub>.p1)
!(0 == asType < integer > (\$heap_{724,1:740.8}.p1))
asType<integer>($heap<sub>724,1:740,8</sub>.p1) <
asType<integer>($heap<sub>724,1:740,8</sub>.M1)
heap_{724,1;742,8} == heap_{724,1;740,8}.replace(p2 \rightarrow asType<short
int>((asType<int>(asType<short int>(div2.rem)) *
asType < int > (\$heap_{724.1:740.8}.r2)) - (asType < int > (asType < short)
int>(div2.quot)) * asType< int>($heap_{724,1;740,8}.b2))))
-\mathbf{asType}{<}\mathbf{integer\ const}{>}(\$\mathrm{heap}_{724,1;742,8}.\mathrm{M2}) <
asType<integer>($heap<sub>724,1:742,8</sub>.p2)
!(0 == asType < integer > (\$heap_{724,1;742,8}.p2))
asType<integer>($heap<sub>724,1:742,8</sub>.p2) <
asType<integer>($heap<sub>724,1;742,8</sub>.M2)
Proof:
[Take given term]
[5.0] invariant1(heapIs heap_{funcstart_{724.1}})
\rightarrow [expand definition of function 'invariant1' at prang.c (34,1)]
[5.1] (((((0 < asType < integer > ($heap_{funcstart\_724,1}.p1)) &&
(asType < integer > (\$heap_{funcstart\_724,1}.p1) < 
asType < integer > (\$heap_{funcstart\_724,1}.M1))) \&\& (0 <
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{p2})))\ \&\&
(asType < integer > ($heap_{funcstart\_724,1}.p2) < 
asType<integer>($heap_{funcstart\_724,1}.M2))) && (0 <
asType < integer > (\$heap_{funcstart\_724,1}.p3))) \&\&
(\mathbf{asType} {<} \mathbf{integer} {>} (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p3}) <
\mathbf{asType} < \mathbf{integer} > (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{M3}))
\rightarrow [simplify]
[5.3] (((((0 < $heap_{funcstart_724,1}.p1) && ($heap_{funcstart_724,1}.p1 < footnote{in the content of the c
asType < integer > (\$heap_{funcstart\_724,1}.M1))) \&\& (0 <
```

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asType < integer > (\$heap_{funcstart\_724,1}.p2))) \&\&
(asType < integer > (\$heap_{funcstart\_724,1}.p2) < 
\mathbf{asType} {<} \mathbf{integer} {>} (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{M2}))) \ \&\& \ (0 <
asType < integer > (\$heap_{funcstart\_724,1}.p3))) \&\&
(\mathbf{asType} < \mathbf{integer} > (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p3}) <
asType<integer>($heap_funcstart_724,1.M3))
\rightarrow [const static or extern object]
[5.4] (((((0 < \theta_{funcstart\_724,1.p1}) && (\theta_{funcstart\_724,1.p1})
asType<integer>(heap_{init}.M1))) && (0 <
asType < integer > (\$heap_{funcstart\_724,1}.p2))) \&\&
(\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{p2}) <
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{M2})))~\&\&~(0<
asType < integer > (\$heap_{funcstart\_724,1}.p3))) \&\&
(\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{p3}) <
asType < integer > (\$heap_{funcstart\_724,1}.M3))
\rightarrow [expand definition of constant 'M1' at prang.c (14,20)]
[5.5] (((((0 < $heap_{funcstart\_724,1}.p1) && ($heap_{funcstart\_724,1}.p1 < ])
asType<integer>(asType<short int>((int)30269)))) && (0 <
asType < integer > (\$heap_{funcstart\_724,1}.p2))) \&\&
(\mathbf{asType} < \mathbf{integer} > (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p2}) <
as
Type<integer>($heap_{funcstart\_724,1}.M2))) && (0 <
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p3})))\ \&\&
(asType < integer > (\$heap_{funcstart_{-724.1}}.p3) < 
asType < integer > (\$heap_{funcstart_{-724.1}}.M3))
\rightarrow [simplify]
[5.16] \; ((((-30269 < -\$heap_{funcstart\_724,1}.p1) \; \land \; (0 < \$heap_{funcstart\_724,1}.p1) \; \land 
(0 < \mathrm{\$heap}_{funcstart\_724,1}.\mathrm{p2})) && (\mathrm{\$heap}_{funcstart\_724,1}.\mathrm{p2} <
asType < integer > (\$heap_{funcstart\_724,1}.M2))) \&\& (0 < 1)
asType < integer > (\$heap_{funcstart\_724,1}.p3))) \&\&
(\mathbf{asType} < \mathbf{integer} > (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p3}) <
\mathbf{asType} {<} \mathbf{integer} {>} (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{M3}))
\rightarrow [const static or extern object]
\label{eq:final_start_724,1.p1} [(((-30269 < -\$heap_{funcstart\_724,1}.p1) \land (0 < \$heap_{funcstart\_724,1}.p1) \land (0 < \$he
(0 < \text{\$heap}_{funcstart_{724,1},p2})) \&\& (\text{\$heap}_{funcstart_{724,1},p2} <
asType < integer > (\$heap_{init}.M2))) \&\& (0 <
asType < integer > (\$heap_{funcstart\_724,1}.p3))) \&\&
(asType < integer > (\$heap_{funcstart\_724,1}.p3) < 
asType < integer > (\$heap_{funcstart\_724,1}.M3))
\rightarrow [expand definition of constant 'M2' at prang.c (19,20)]
[5.18] ((((-30269 < -\$heap_{funcstart\_724,1}.p1) \land (0 < \$heap_{funcstart\_724,1}.p1) 
(0 < \text{\$heap}_{funcstart\_724,1}.p2)) \&\& (\text{\$heap}_{funcstart\_724,1}.p2 <
```

```
asType<integer>(asType<short int>((int)30307)))) && (0 <
asType < integer > (\$heap_{funcstart\_724,1}.p3))) \&\&
(\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{p3}) <
asType < integer > (\$heap_{funcstart\_724,1}.M3))
\rightarrow [simplify]
[5.30] ((-30307 < -$heap<sub>funcstart_724,1</sub>.p2) \wedge (-30269 <
-\text{\$heap}_{funcstart\_724,1}.\text{p1}) \land (0 < \text{\$heap}_{funcstart\_724,1}.\text{p1}) \land (0 <
\text{Sheap}_{funcstart_{724,1}.p2} \land (0 < \text{Sheap}_{funcstart_{724,1}.p3})) \&\&
(\text{\$heap}_{funcstart\_724,1}.p3 < asType < integer > (\text{\$heap}_{funcstart\_724,1}.M3))
\rightarrow [const static or extern object]
[5.31] ((-30307 < -$heap<sub>funcstart_724.1.</sub>p2) \wedge (-30269 <
-\$heap_{funcstart\_724,1}.p1) \land (0 < \$heap_{funcstart\_724,1}.p1) \land (0 < \$heap_{funcstart\_724,1}.p1)
\text{Sheap}_{funcstart\_724,1}.p2) \land (0 < \text{Sheap}_{funcstart\_724,1}.p3)) \&\&
(\$heap_{funcstart\_724,1}.p3 < \textbf{asType} < \textbf{integer} > (\$heap_{init}.M3))
\rightarrow [expand definition of constant 'M3' at prang.c (24,20)]
[5.32] ((-30307 < -$heap<sub>funcstart_724,1.</sub>p2) \wedge (-30269 <
-\$heap_{funcstart\_724,1}.p1) \land (0 < \$heap_{funcstart\_724,1}.p1) \land (0 < \$heap_{funcstart\_724,1}.p1)
\text{Sheap}_{funcstart\_724,1.p2}) \land (0 < \text{Sheap}_{funcstart\_724,1.p3})) \&\&
(\text{sheap}_{funcstart\_724,1}.\text{p3} < \text{asType} < \text{integer} > (\text{asType} < \text{short})
int > ((int)30323)))
\rightarrow [simplify]
[5.40] (-30323 < -$heap<sub>funcstart_724.1</sub>.p3) \land (-30307 <
-\$heap_{funcstart\_724,1}.p2) \land (-30269 < -\$heap_{funcstart\_724,1}.p1) \land (0 <
\text{Sheap}_{funcstart\_724,1}.\text{p1}) \land (0 < \text{Sheap}_{funcstart\_724,1}.\text{p2}) \land (0 <
heap_{funcstart_{-724,1}.p3}
[Work on sub-term 6 of conjunction in term 5.40]
[10.0] 0 < $\text{heap}_{funcstart_724,1}.p3
[Take given term]
[11.0] \operatorname{div1} == \operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724,1},
asType < int > (\$heap_{funcstart\_724,1}.p1),
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{a1}))
\rightarrow [simplify]
[11.1] \ \mathrm{div1} == \mathrm{div}(\mathbf{heapIs} \ \$ \mathrm{heap}_{funcstart\_724,1}, \ \$ \mathrm{heap}_{funcstart\_724,1}.\mathrm{p1},
asType < int > (\$heap_{funcstart\_724,1}.a1))
\rightarrow [const static or extern object]
[11.2] \ \mathrm{div1} == \mathrm{div}(\mathbf{heapIs} \ \$ \mathrm{heap}_{funcstart\_724,1}, \ \$ \mathrm{heap}_{funcstart\_724,1}.\mathrm{p1},
asType < int > (\$heap_{init}.a1))
\rightarrow [expand definition of constant 'a1' at prang.c (16,20)]
```

```
\textit{[11.3]} \ \text{div1} == \text{div}(\mathbf{heapIs} \ \$ \text{heap}_{funcstart\_724,1}, \ \$ \text{heap}_{funcstart\_724,1}.\text{p1},
asType<int>(asType<short int>((int)177)))
\rightarrow [simplify]
[11.6]~{\rm div1} == {\rm div}(\mathbf{heapIs}~\$ \mathrm{heap}_{funcstart\_724,1},~\$ \mathrm{heap}_{funcstart\_724,1}.\mathrm{p1},~177)
[Take given term]
[25.0] \operatorname{div2} == \operatorname{div}(\mathbf{heapIs} \ \operatorname{\$heap}_{funcstart\_724,1},
asType < int > (\$heap_{funcstart\_724,1}.p2),
asType < int > (\$heap_{funcstart\_724,1}.a2))
\rightarrow [simplify]
[25.1] \operatorname{div2} == \operatorname{div}(\mathbf{heapIs} \operatorname{\$heap}_{funcstart\_724,1}, \operatorname{\$heap}_{funcstart\_724,1}.p2,
asType < int > (\$heap_{funcstart\_724,1}.a2))
\rightarrow [const static or extern object]
\label{eq:continuous} \textit{[25.2]} \ \text{div2} == \ \text{div} (\mathbf{heapIs} \ \$ \text{heap}_{funcstart\_724,1}, \ \$ \text{heap}_{funcstart\_724,1}.\text{p2},
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{init}.\mathrm{a2}))
\rightarrow [expand definition of constant 'a2' at prang.c (21,20)]
[25.3] div2 == div(heapIs $heap_{funcstart\_724.1}, $heap_{funcstart\_724.1}.p2,
asType<int>(asType<short int>((int)176)))
\rightarrow [simplify]
[25.6] div2 == div(heapIs \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}.p2, 176)
[Take given term]
[39.0] \operatorname{div3} == \operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724,1},
asType < int > ($heap_{funcstart\_724,1}.p3),
asType < int > (\$heap_{funcstart\_724,1}.a3))
\rightarrow [simplify]
[39.1] div3 == div(heapIs $heap_{tuncstart\_724.1}, $heap_{tuncstart\_724.1}.p3,
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{a3}))
\rightarrow [const static or extern object]
\label{eq:control_start_724,1} [39.2] \ \mathrm{div3} == \ \mathrm{div}(\mathbf{heapIs} \ \$ \mathrm{heap}_{funcstart\_724,1}, \ \$ \mathrm{heap}_{funcstart\_724,1}.\mathrm{p3},
asType < int > (\$heap_{init}.a3))
\rightarrow [expand definition of constant 'a3' at prang.c (26,20)]
[39.3] \ \mathrm{div3} == \mathrm{div}(\mathbf{heapIs} \ \$ \mathrm{heap}_{funcstart\_724,1}, \ \$ \mathrm{heap}_{funcstart\_724,1}.\mathrm{p3},
asType<int>(asType<short int>((int)178)))
\rightarrow [simplify]
[39.6] div3 == div(heapIs $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}.p3, 178)
[Assume known post-assertion, class invariant or type constraint for term 39.6]
[43.0] (asType<integer>(sheap_{funcstart\_724,1.p3}) %
```

```
asType<integer>(178)) == asType<integer>(div(heapIs
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.\text{p3}, 178).\text{rem}
\rightarrow [simplify]
[43.2] (\text{heap}_{funcstart\_724,1}.p3 % 178) == asType<integer>(div(heapIs
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.\text{p3}, 178).\text{rem}
→ [expand definition of operator '.%' in class 'int' at built in declaration]
[43.3] ([asType<integer>(sheap_{funcstart\_724,1.p3}) < 0]:
-(-asType < integer > (\$heap_{tuncstart\_724.1}.p3) \% 178), []:
asType < integer > (\$heap_{funcstart\_724,1}.p3) \% 178) = =
\mathbf{asType} {<} \mathbf{integer} {>} ( \mathrm{div}(\mathbf{heapIs} \ \$ \mathrm{heap}_{funcstart\_724,1}, \ \$ \mathrm{heap}_{funcstart\_724,1}.\mathrm{p3}, \\
178).rem)
→ [explicitly assert falsehood of skipped guards in subsequent guards]
[43.4] ([asType<integer>(sheap_{funcstart\_724,1}.p3) < 0]:
-(-asType < integer > (\$heap_{funcstart\_724,1}.p3) \% 178),
[!(asType < integer > (\$heap_{funcstart\_724,1}.p3) < 0)]:
asType < integer > (\$heap_{funcstart\_724,1}.p3) \% 178) ==
asType<integer>(div(heapIs heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p3,
178).rem)
\rightarrow [simplify]
[43.7] ([0 < -$heap<sub>funcstart_724,1</sub>.p3]:
-(-asType < integer > (\$heap_{funcstart\_724,1}.p3) \% 178),
[!(asType < integer > (\$heap_{funcstart\_724.1}.p3) < 0)]:
asType < integer > (\$heap_{funcstart\_724,1}.p3) \% 178) = =
asType<integer>(div(heapIs $heap_{funcstart\_724.1}, $heap_{funcstart\_724.1}.p3,
178).rem)
\rightarrow [from term 10.0, literala < -$heap<sub>funcstart_724,1</sub>.p3 is false whenever -2 <
(0 + literala)
   Proof of rule precondition:
   [43.7.0] - 2 < (0 + 0)
   \rightarrow [simplify]
   [43.7.2] true
[43.8] ([false]: -(-asType < integer > (\$heap_{funcstart\_724,1}.p3) \% 178),
[!(asType < integer > (\$heap_{funcstart\_724,1}.p3) < 0)]:
\mathbf{asType} < \mathbf{integer} > (\$ heap_{funcstart\_724,1}.p3) \% 178) = =
asType<integer>(div(heapIs $heap_{tuncstart\_724.1}, $heap_{tuncstart\_724.1}.p3,
178).rem)
\rightarrow [simplify]
[43.11] ([false]: -(-asType < integer > (\$heap_{funcstart\_724,1}.p3) \% 178), [!(0)]
<-$heap<sub>funcstart_724,1.</sub>p3)]: asType<integer>($heap<sub>funcstart_724,1.</sub>p3) %
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178) == asType < integer > (div(heapIs $heap_{funcstart\_724,1},
heap_{funcstart_{-724,1}.p3, 178}.rem
 \rightarrow [from term 10.0, literala < -$heap<sub>funcstart_724,1</sub>.p3 is false whenever -2 <
 (0 + literala)
                    Proof of rule precondition:
                    [43.11.0] - 2 < (0 + 0)
                    \rightarrow [simplify]
                    [43.11.2] true
 [43.12] \; ([\mathbf{false}]: \; -(\mathbf{-asType} < \mathbf{integer} > (\$ \mathrm{heap}_{funcstart\_724,1}.\mathrm{p3}) \; \% \; 178),
 [!false]: asType<integer>(\ensuremath{\text{sheap}}_{funcstart\_724,1}.p3) % 178) ==
\mathbf{asType} < \mathbf{integer} > (\mathbf{div}(\mathbf{heapIs} \ \$\mathbf{heap}_{funcstart\_724,1}, \ \$\mathbf{heap}_{funcstart\_724,1}.\mathbf{p3},
178).rem)
 \rightarrow [simplify]
 [43.17] \ 0 == (-\text{div}(\mathbf{heapIs} \ \$ \text{heap}_{funcstart\_724,1}, \ \$ \text{heap}_{funcstart\_724,1}.\text{p3},
 178).rem + (\text{$heap}_{funcstart\_724,1.p3} \% 178))
[Take given term]
 [53.0] heap_{724,1;740,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow asType<short
int>((asType<int>(asType<short int>(div1.rem)) *
asType < int > (\$heap_{funcstart\_724,1}.r1)) - (asType < int > (asType < short)
int>(div1.quot)) * asType<int>($heap_{funcstart\_724,1}.b1)))
 \rightarrow [from term 11.6, div1 is equal to div(heapIs $heap_{funcstart_724.1},
 heap_{funcstart_{-724,1}}.p1, 177
 [53.1] \theta == 
int>((asType<int>(asType<short int>(div(heapIs $heap_{funcstart\_724,1},
\rho_{uncstart\_724,1.p1, 177}.rem) * asType < int > (\rho_{uncstart\_724,1.r1}) - (\rho_{uncstart\_724,1.
 (asType<int>(asType<short int>(div1.quot)) *
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{b1}))))
 \rightarrow [simplify]
 [53.3] \theta == 
int>((div(heapIs \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1, 177).rem *
asType < int > (\$heap_{funcstart\_724,1}.r1)) - (asType < int > (asType < short)
int>(div1.quot)) * asType< int>($heap_{funcstart\_724,1}.b1))))
 \rightarrow [const static or extern object]
 [53.4] \rho_{13,1;740,8} == \rho_{13,1;740,8} == \rho_{13,1;740,8} =- \rho_{
int>((div(heapIs \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1, 177).rem *
asType < int > (\$heap_{init}.r1)) - (asType < int > (asType < short)
int>(div1.quot)) * asType< int>($heap_{funcstart\_724,1}.b1))))
 \rightarrow [expand definition of constant 'r1' at prang.c (15,20)]
```

```
[53.5] heap_{724,1;740,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow asType<short
int>((div(heapIs \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1, 177).rem *
asType<int>(asType<short int>((int)171))) -
(asType<int>(asType<short int>(div1.quot)) *
asType < int > (\$heap_{funcstart\_724,1}.b1))))
\rightarrow [simplify]
[53.8] heap_{724,1:740,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow asType<short
int>((div(heapIs \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1, 177).rem * 171)
- (asType<int>(asType<short int>(div1.quot)) *
asType < int > (\$heap_{funcstart\ 724.1}.b1))))
\rightarrow [from term 11.6, div1 is equal to div(heapIs $heap_{funcstart\_724,1},
heap_{funcstart_{-724,1}}.p1, 177)
[53.9] \; \$ heap_{724,1;740,8} == \$ heap_{funcstart\_724,1}.\_\mathbf{replace} (p1 \to \mathbf{asType} < \mathbf{short}
\mathbf{int} > ((171 * \operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724,1}, \$ \operatorname{heap}_{funcstart\_724,1}.\operatorname{p1}, 177).\operatorname{rem})
- (asType<int>(asType<short int>(div(heapIs $heap_{funcstart_724,1},))
heap_{funcstart_{-724,1}}.p1, 177).quot)
asType < int > (\$heap_{funcstart\_724,1}.b1))))
\rightarrow [simplify]
[53.11] \theta_{13} = \theta_
int>((171 * div(heapIs $heap_{funcstart\_724,1}, $heap_{funcstart\_724,1}.p1, 177).rem)
- (\text{div}(\textbf{heapIs} \$ \text{heap}_{funcstart\_724,1}, \$ \text{heap}_{funcstart\_724,1}.\text{p1}, 177).\text{quot} *
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{b1}))))
\rightarrow [const static or extern object]
[53.12] \theta_{12} == \theta_{12} 
\mathbf{int} > ((171 * \operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724,1}, \$ \operatorname{heap}_{funcstart\_724,1}.\operatorname{p1}, 177).\operatorname{rem})
- (\text{div}(\mathbf{heapIs} \$ \text{heap}_{funcstart\_724,1}, \$ \text{heap}_{funcstart\_724,1}.\text{p1}, 177).\text{quot} *
asType < int > (\$heap_{init}.b1)))
\rightarrow [expand definition of constant 'b1' at prang.c (17,20)]
[53.13] heap_{724,1;740,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow asType<short
int>((171 * div(heapIs $heap_{funcstart\_724,1}, $heap_{funcstart\_724,1}.p1, 177).rem)
- (\text{div}(\mathbf{heapIs} \$ \text{heap}_{funcstart\_724,1}, \$ \text{heap}_{funcstart\_724,1}.\text{p1}, 177).\text{quot} *
asType<int>(asType<short int>((int)2))))
\rightarrow [simplify]
[53.19] $\text{heap}_{724,1:740,8} == $\text{heap}_{funcstart\_724,1}._\text{replace}(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).rem)))
[Take given term]
[57.0] $\text{heap}_{724,1;742,8} == $\text{heap}_{724,1;740,8}.$\_\text{replace}(p2 \rightarrow \text{asType} < \text{short}
int>((asType<int>(asType<short int>(div2.rem)) *
asType < int > (\$heap_{724,1:740.8}.r2)) - (asType < int > (asType < short)
```

```
int>(div2.quot)) * asType<int>($heap<sub>724.1:740.8</sub>.b2))))
\rightarrow [from term 53.19, $heap<sub>724.1:740.8</sub> is equal to
heap_{funcstart\_724,1}._replace(p1 \rightarrow (-2 * div(heapIs $heap_{funcstart\_724,1},
heap_{funcstart\_724,1}.p1, 177).quot) + (171 * div(heapIs $heap_{funcstart\_724,1}, 1
heap_{funcstart_{-724,1}}.p1, 177).rem)
[57.1] heap_{724,1:742,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).quot) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow asType<short
int>((asType<int>(asType<short int>(div2.rem)) *
asType < int > (\$heap_{724,1:740.8}.r2)) - (asType < int > (asType < short)
\mathbf{int}{>}(\text{div2.quot})) \ * \ \mathbf{asType}{<} \mathbf{int}{>} (\$\text{heap}_{724,1;740,8}.\text{b2}))))
\rightarrow [from term 25.6, div2 is equal to div(heapIs $heap_{tuncstart_{724.1}},
heap_{funcstart_{724,1}}.p2, 176
[57.2] heap_{724,1;742,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 *
\operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724,1}, \$ \operatorname{heap}_{funcstart\_724,1}.p1,
177).rem))).\_replace(p2 \rightarrow asType < short
int>((asType<int>(asType<short int>(div(heapIs $heap_{tuncstart_724.1},
\text{sheap}_{funcstart_724,1}.\text{p2}, 176).\text{rem}) * asType < int > (\text{sheap}_{724,1:740.8}.\text{r2})) -
(asType<int>(asType<short int>(div2.quot)) *
asType<int>($heap<sub>724.1:740.8</sub>.b2))))
\rightarrow [simplify]
[57.4] $heap<sub>724,1:742,8</sub> == $heap<sub>funcstart_724,1</sub>._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 *
\operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724,1}, \$ \operatorname{heap}_{funcstart\_724,1}.p1,
177).rem)))._{\mathbf{replace}}(p2 \rightarrow \mathbf{asType} < \mathbf{short\ int} > ((\operatorname{div}(\mathbf{heapIs}))))
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.p2, 176).rem *
asType < int > (\$heap_{724.1:740.8}.r2)) - (asType < int > (asType < short)
int>(div2.quot)) * asType< int>($heap_{724,1;740,8}.b2))))
\rightarrow [from term 53.19, $heap<sub>724,1;740,8</sub> is equal to
heap_{funcstart\_724,1}._replace(p1 \rightarrow (-2 * div(heapIs heap_{funcstart\_724,1}),
\text{Sheap}_{funcstart\_724,1}.p1, 177).quot) + (171 * div(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
heap_{funcstart_{-724,1}.p1, 177).rem}
[57.5] heap_{724,1;742,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 \ *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow asType<short int>((div(heapIs
heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p2, 176).rem *
asType < int > (\$heap_{funcstart\_724,1}.\_replace(p1 \rightarrow ((-2 * div(heapIs))))))
\theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.p1, 177).rem))).r2)) -
```

```
(asType<int>(asType<short int>(div2.quot)) *
asType < int > (\$heap_{724,1;740,8}.b2))))
→ [const member of object with modified fields]
[57.6] heap_{724,1;742,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).quot) + (171 *
\operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724.1}, \$ \operatorname{heap}_{funcstart\_724.1}.p1,
177).rem)))._replace(p2 \rightarrow asType<short int>((div(heapIs
\rho_{funcstart_{724,1}}, \rho_{funcstart_{724,1}}, \rho_{funcstart_{724,1}}, \rho_{funcstart_{724,1}}, \rho_{funcstart_{724,1}}
\mathbf{asType} < \mathbf{int} > (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{r2})) - (\mathbf{asType} < \mathbf{int} > (\mathbf{asType} < \mathbf{short}))
int>(div2.quot)) * asType<int>($heap<sub>724.1:740.8</sub>.b2))))
\rightarrow [const static or extern object]
[57.7] heap_{724,1;742,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 *
\label{eq:div_heap} \text{div}(\textbf{heapIs} \ \$ \text{heap}_{funcstart\_724,1}, \ \$ \text{heap}_{funcstart\_724,1}.\text{p1},
177).rem)))._replace(p2 \rightarrow asType<short int>((div(heapIs
heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p2, 176).rem *
asType < int > (\$heap_{init}.r2)) - (asType < int > (asType < short)
int > (div2.quot)) * asType < int > (\$heap_{724,1;740,8}.b2))))
\rightarrow [expand definition of constant 'r2' at prang.c (20,20)]
div(\mathbf{heapIs} \ \text{$heap}_{funcstart\_724,1}, \ \text{$heap}_{funcstart\_724,1}.p1, \ 177).quot) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow asType<short int>((div(heapIs
heap_{funcstart_{-724,1}}, heap_{funcstart_{-724,1},p2,176}.rem *
asType<int>(asType<short int>((int)172))) -
(asType<int>(asType<short int>(div2.quot)) *
asType < int > (\$heap_{724,1;740,8}.b2))))
\rightarrow [simplify]
[57.11] $\text{heap}_{724,1;742,8} == \text{$heap}_{funcstart_724,1}._\text{$-replace}(p1 \to ((-2 * )
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).quot) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow asType<short int>((div(heapIs
heap_{funcstart_{724,1}}, heap_{funcstart_{724,1}}.p2, 176).rem * 172) -
(asType<int>(asType<short int>(div2.quot)) *
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{724,1;740,8}.\mathrm{b2}))))
\rightarrow [from term 25.6, div2 is equal to div(heapIs $heap_{funcstart_724,1},
heap_{funcstart_{724,1}}.p2, 176)
[57.12] $heap<sub>724,1;742,8</sub> == $heap<sub>funcstart_724,1</sub>._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).quot) + (171 *
\operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724.1}, \$ \operatorname{heap}_{funcstart\_724.1}.p1,
177).rem)))._replace(p2 \rightarrow asType<short int>((172 * div(heapIs
```

```
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.p2, 176).rem) -
(asType<int>(asType<short int>(div(heapIs $heap_{funcstart_724,1},))
\text{sheap}_{funcstart\_724,1.p2}, 176).\text{quot}) * asType<int>(\text{sheap}_{724,1;740,8}.\text{b2}))))
\rightarrow [simplify]
[57.14] $\text{heap}_{724,1;742,8} == \text{$heap}_{funcstart\_724,1}._\text{replace}(p1 \to ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 *
\operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724,1}, \$ \operatorname{heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow asType<short int>((172 * div(heapIs
\theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}
heap_{funcstart_{724,1}}, heap_{funcstart_{724,1}}, 2, 176.quot *
asType<int>($heap<sub>724.1:740.8</sub>.b2))))
\rightarrow [from term 53.19, $heap<sub>724,1;740,8</sub> is equal to
heap_{funcstart\_724.1}._replace(p1 \rightarrow (-2 * div(heapIs heap_{funcstart\_724.1}),
heap_{funcstart,724,1}.p1, 177).quot + (171 * div(heapIs p_{funcstart,724,1})
heap_{funcstart_{724,1}}.p1, 177).rem)
[57.15] heap_{724,1;742,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 \ *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow asType<short int>((172 * div(heapIs
\theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}
heap_{funcstart_{724,1}}, heap_{funcstart_{724,1}}, p_{176}.quot *
asType < int > (\$heap_{funcstart\_724,1}.\_replace(p1 \rightarrow ((-2 * div(heapIs)))))))
\theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.p1, 177).rem))).b2))))
\rightarrow [const member of object with modified fields]
[57.16] $heap<sub>724,1;742,8</sub> == $heap<sub>funcstart_724,1</sub>._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{$heap}_{funcstart\_724,1}, \ \text{$heap}_{funcstart\_724,1}.p1, \ 177).quot) + (171 *
\operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724,1}, \$ \operatorname{heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow asType<short int>((172 * div(heapIs
\theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}.p2, 176).rem) - (div(heapIs
\theta_{funcstart_{724,1}}, \theta_{funcstart_{724,1}}, \theta_{funcstart_{724,1}}, \theta_{funcstart_{724,1}}
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{b2}))))
\rightarrow [const static or extern object]
[57.17] $\text{heap}_{724.1:742.8} == \text{$heap}_{funcstart_724.1}._\text{replace}(p1 \to ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 \ *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow asType<short int>((172 * div(heapIs
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.\text{p2}, 176).\text{rem}) - (\text{div}(\text{heapIs})
heap_{funcstart_{724,1}}, heap_{funcstart_{724,1}}.p2, 176).quot *
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{init}.\mathrm{b2}))))
\rightarrow [expand definition of constant 'b2' at prang.c (22,20)]
```

```
[57.18] $heap<sub>724,1;742,8</sub> == $heap<sub>funcstart_724,1</sub>._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).quot) + (171 *
\label{eq:div_heap} \text{div}(\textbf{heapIs} \ \$ \text{heap}_{funcstart\_724,1}, \ \$ \text{heap}_{funcstart\_724,1}.\text{p1},
177).rem)))._replace(p2 \rightarrow asType<short int>((172 * div(heapIs
\theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}.p2, 176).rem) - (div(heapIs
\theta_{funcstart_{724,1}}, \theta_{funcstart_{724,1}}, \theta_{funcstart_{724,1}}, \theta_{funcstart_{724,1}}
asType<int>(asType<short int>((int)35)))))
\rightarrow [simplify]
[57.24] $heap<sub>724,1;742,8</sub> == $heap<sub>funcstart_724,1</sub>._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow ((-35 * div(heapIs $heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1.p2}, 176).\text{quot}) + (172 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
\theta_{funcstart\_724,1}.p2, 176).rem))
[Take goal term]
[1.0] (asType<int>(asType<short int>(div3.rem)) *
asType < int > (\$heap_{724,1;742,8}.r3)) \le maxof(int)
\rightarrow [from term 39.6, div3 is equal to div(heapIs $heap_{funcstart\_724,1},
heap_{funcstart_{-724,1}}.p3, 178
[1.1] (asType<int>(asType<short int>(div(heapIs $heap_funcstart_724.1,
\text{sheap}_{funcstart\ 724.1.p3,\ 178.rem} ** asType<int>(\text{sheap}_{724.1.742.8.r3})) <
maxof(int)
\rightarrow [simplify]
[1.3] (div(heapIs \theta_{funcstart_{724,1}}, \theta_{funcstart_{724,1}}, \eta_{73,178}).rem *
asType < int > (\$heap_{724,1:742,8}.r3)) \le maxof(int)
\rightarrow [from term 57.24, $heap<sub>724,1;742,8</sub> is equal to
heap_{funcstart\_724.1}._replace(p1 \rightarrow ((-2 * div(heapIs $heap_{funcstart\_724.1},
\text{Sheap}_{funcstart_{724,1},p1, 177}.\text{quot}) + (171 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart_{724,1}})
\rho_{uncstart_{-724,1},p1,177,rem})._replace\rho_{uncstart_{-724,1},p1,177,rem})._replace
heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p2, 176).quot) + (172 * div(heapIs)
heap_{funcstart_{724,1}}, heap_{funcstart_{724,1},p2, 176}.rem))]
[1.4] (div(heapIs heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p3, 178).rem *
asType < int > (\$heap_{funcstart\_724,1}.\_replace(p1 \rightarrow ((-2 * div(heapIs))))))
\$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1, 177).quot) + (171 * div(\textbf{heapIs}) + (171 * div(\textbf{heapIs})) + (171
\rho_{funcstart\_724,1}, \rho_{funcstart\_724,1}
* div(heapIs heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p2, 176).quot) + (172 *
\operatorname{div}(\mathbf{heapIs} \ \text{$heap}_{funcstart\_724,1}, \ \text{$heap}_{funcstart\_724,1}.p2, \ 176).rem))).r3)) \le
maxof(int)
→ [const member of object with modified fields]
[1.6] (div(heapIs heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p3, 178).rem *
```

 $asType < int > (\$heap_{funcstart\_724,1}.r3)) \le maxof(int)$ 

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\rightarrow [const static or extern object]
[1.7] (div(heapIs \theta_{funcstart_{-724,1}}, \theta_{funcstart_{-724,1},p3}, 178).rem *
asType < int > (\$heap_{init}.r3)) \le maxof(int)
\rightarrow [expand definition of constant 'r3' at prang.c (25,20)]
[1.8] (div(heapIs heap_{funcstart_{-724,1}}, heap_{funcstart_{-724,1}}.p3, 178).rem *
asType < int > (asType < short int > ((int)170))) \le maxof(int)
\rightarrow [simplify]
[1.21] -32768 < (-170 * div(heapIs $heap_{funcstart\_724,1},
heap_{funcstart_{-724,1}.p3, 178).rem
\rightarrow [literal comparison of product]
[1.22] ([-170 < 0]: (-32768 / 170) < -\text{div}(\mathbf{heapIs} \$ \text{heap}_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1}.\text{p3}, 178).\text{rem}, [0 < -170]: (-32768 / -170) < \text{div}(\textbf{heapIs})
0)
→ [explicitly assert falsehood of skipped guards in subsequent guards]
[1.23] ([-170 < 0]: (-32768 / 170) < -\text{div}(\mathbf{heapIs} \$ \mathbf{heap}_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1.p3}, 178).\text{rem}, [(0 < -170) \land !(-170 < 0)]: (-32768 / -170) < 0
div(\mathbf{heapIs} \ \$heap_{funcstart\_724,1}, \ \$heap_{funcstart\_724,1}.p3, \ 178).rem, \ [(-170 ==
0) \wedge !(-170 < 0) \wedge !(0 < -170)]: -32768 < 0)
\rightarrow [simplify]
[1.27] -193 < -\text{div}(\mathbf{heapIs} \$ \text{heap}_{funcstart\_724,1}, \$ \text{heap}_{funcstart\_724,1}.\text{p3},
\rightarrow [negate goal and search for contradiction]
[1.28] ! (-193 < -\text{div}(\textbf{heapIs} \$ \text{heap}_{funcstart\_724,1}, \$ \text{heap}_{funcstart\_724,1}.\text{p3},
178).rem)
\rightarrow [simplify]
[1.31] 192 < \text{div}(\mathbf{heapIs} \$ \text{heap}_{funcstart\_724,1}, \$ \text{heap}_{funcstart\_724,1}.\text{p3}, 178).\text{rem}
[Create new term from terms 1.31, 43.17 using rule: transitivity 16]
[63.0] (0 + 192) < ($heap_funcstart_724,1.p3 % 178)
\rightarrow [simplify]
[63.2] false
```

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

Condition generated at: C:\Escher\Customers\prang\prang.c (60,40) Condition defined at:

```
To prove: minof(short int) < div3.quot
Given:
heap_{init}.LIMIT == (int)80
heap_{init}.M1 == asType < short int > ((int)30269)
\theta_{init}.r1 == asType < short int > ((int)171)
heap_{init}.a1 == asType < short int > ((int)177)
\theta
heap_{init}.M2 == asType < short int > ((int)30307)
\theta_{init}.r2 == asType < short int > ((int)172)
heap_{init}.a2 == asType < short int > ((int)176)
\theta sheap<sub>init</sub>.b2 == asType<short int>((int)35)
\theta = asType < short int > ((int)30323)
heap_{init}.r3 == asType < short int > ((int)170)
heap_{init}.a3 == asType < short int > ((int)178)
\theta = asType < short int > ((int)63)
\theta = asType < short int > ((int)1)
\theta
\theta = asType < short int > ((int)3)
invariant1(heapIs heap_{funcstart\_724,1})
\operatorname{div1} == \operatorname{div}(\mathbf{heapIs} \ \operatorname{\$heap}_{funcstart\_724,1},
asType < int > (\$heap_{funcstart\_724,1}.p1),
asType < int > (\$heap_{funcstart\_724,1}.a1))
(\mathbf{asType}{<}\mathbf{integer}{>}(\mathbf{asType}{<}\mathbf{int}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{p1})) \ / \\
\mathbf{asType}{<}\mathbf{integer}{>}(\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{a1}))) = =
asType<integer>(div1.quot)
(asType<integer>(asType<int>($heap_{tuncstart\_724.1}.p1)) %
\mathbf{asType}{<}\mathbf{integer}{>}(\mathbf{asType}{<}\mathbf{int}{>}(\$\mathbf{heap}_{funcstart\_724,1}.\mathbf{a1}))) = =
asType<integer>(div1.rem)
!(0 == asType < integer > (div1.rem)) || !(0 ==
asType<integer>(div1.quot))
div2 == div(\mathbf{heapIs} \$ heap_{funcstart\_724,1},
asType < int > (\$heap_{funcstart\_724,1}.p2),
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{a2}))
(\mathbf{asType}{<}\mathbf{integer}{>}(\mathbf{asType}{<}\mathbf{int}{>}(\$\mathbf{heap}_{funcstart\_724,1}.\mathbf{p2})) \ / \\
\mathbf{asType}{<}\mathbf{integer}{>}(\mathbf{asType}{<}\mathbf{int}{>}(\$\mathbf{heap}_{funcstart\_724,1}.\mathbf{a2}))) = =
asType<integer>(div2.quot)
```

```
(asType < int > (asType < int > (\$heap_{funcstart\_724,1}.p2)) \%
\mathbf{asType} < \mathbf{integer} > (\mathbf{asType} < \mathbf{int} > (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{a2}))) = =
asType<integer>(div2.rem)
!(0 == asType < integer > (div2.rem)) || !(0 ==
asType<integer>(div2.quot))
div3 == div(\mathbf{heapIs} \$ heap_{funcstart\_724,1},
\mathbf{asType} < \mathbf{int} > (\$ \mathrm{heap}_{funcstart\_724,1}.\mathrm{p3}),
asType < int > (\$heap_{funcstart\_724,1}.a3))
(\mathbf{asType}{<}\mathbf{integer}{>}(\mathbf{asType}{<}\mathbf{int}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{p3}))\ /
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a3))) = =
asType<integer>(div3.quot)
(asType<integer>(asType<int>($heap_{tuncstart\_724.1}.p3)) %
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a3))) = =
asType<integer>(div3.rem)
!(0 == asType < integer > (div3.rem)) || !(0 ==
asType<integer>(div3.quot))
heap_{724,1;740,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow asType<short
int>((asType<int>(asType<short int>(div1.rem)) *
asType < int > (\$heap_{funcstart\_724,1}.r1)) - (asType < int > (asType < short)
\mathbf{int}{>}(\mathbf{div1.quot})) * \mathbf{asType}{<} \mathbf{int}{>} (\$\mathbf{heap}_{funcstart\_724,1}.\mathbf{b1}))))
-asType<integer const>($heap<sub>724.1:740.8</sub>.M1) <
asType<integer>($heap<sub>724,1:740,8</sub>.p1)
!(0 == asType < integer > (\$heap_{724,1:740.8}.p1))
asType<integer>($heap<sub>724,1;740,8</sub>.p1) <
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathrm{heap}_{724,1;740,8}.\mathrm{M1})
heap_{724,1;742,8} == heap_{724,1;740,8}.replace(p2 \rightarrow asType<short
int>((asType<int>(asType<short int>(div2.rem)) *
asType < int > (\$heap_{724.1:740.8}.r2)) - (asType < int > (asType < short)
int>(div2.quot)) * asType< int>($heap_{724,1;740,8}.b2))))
-asType < integer const > (\$heap_{724,1:742,8}.M2) < 
asType<integer>($heap<sub>724,1;742,8</sub>.p2)
!(0 == asType < integer > (\$heap_{724,1;742,8}.p2))
asType<integer>($heap<sub>724,1:742,8</sub>.p2) <
asType<integer>($heap<sub>724,1:742,8</sub>.M2)
Proof:
[Take given term]
[5.0] invariant1(heapIs heap_{funcstart\_724,1})
\rightarrow [expand definition of function 'invariant1' at prang.c (34,1)]
```

```
 \texttt{[5.1]} \left( \left( \left( \left( \left( 0 < \mathbf{asType} < \mathbf{integer} > \left( \$ \mathsf{heap}_{funcstart\_724,1}.\mathsf{p1} \right) \right) \right. \&\& \right. \right. 
(asType < integer > (\$heap_{funcstart\_724,1}.p1) < 
asType<integer>($heap_{funcstart\_724,1}.M1))) && (0 <
asType < integer > (\$heap_{funcstart\_724,1}.p2))) \&\&
(\mathbf{asType} < \mathbf{integer} > (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p2}) <
asType < integer > (\$heap_{funcstart\_724,1}.M2))) \&\& (0 <
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{p3})))\ \&\&
(asType < integer > (\$heap_{funcstart\_724,1}.p3) < 
asType < integer > (\$heap_{funcstart\_724,1}.M3))
\rightarrow [simplify]
[5.3] (((((0 < \theta_{funcstart\_724,1.p1) && (\theta_{funcstart\_724,1.p1)
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{M1})))~\&\&~(0<
asType < integer > ($heap_{funcstart\_724,1}.p2))) &&
(\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{p2}) <
asType < integer > (\$heap_{funcstart\_724,1}.M2))) \&\& (0 <
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{p3})))\ \&\&
(\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{p3}) <
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{M3}))
\rightarrow [const static or extern object]
[5.4] (((((0 < $heap_{funcstart_{724,1}}.p1) && ($heap_{funcstart_{724,1}}.p1 < 
asType < integer > (\$heap_{init}.M1))) \&\& (0 <
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p2})))\ \&\&
(\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{p2}) <
asType<integer>(heap_{funcstart\_724,1}.M2))) && (0 <
asType < integer > (\$heap_{funcstart\_724,1}.p3))) \&\&
(\mathbf{asType} {<} \mathbf{integer} {>} (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p3}) <
asType < integer > (\$heap_{funcstart\_724,1}.M3))
\rightarrow [expand definition of constant 'M1' at prang.c (14,20)]
[5.5] (((((0 < $heap_{funcstart_{724,1}}.p1) && ($heap_{funcstart_{724,1}}.p1 < 
asType < integer > (asType < short int > ((int)30269)))) && (0 < footnote{integer}) && (0 < footnote
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p2})))\ \&\&
(asType < integer > (\$heap_{funcstart\_724,1}.p2) <
asType < integer > (\$heap_{funcstart\_724,1}.M2))) \&\& (0 <
asType < integer > (\$heap_{funcstart\_724,1}.p3))) \&\&
(\mathbf{asType} {<} \mathbf{integer} {>} (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p3}) <
asType < integer > (\$heap_{funcstart_{-724.1}}.M3))
\rightarrow [simplify]
[5.16] \; ((((-30269 < -\$heap_{funcstart\_724,1}.p1) \land (0 < \$heap_{funcstart\_724,1}.p1) \land (0 < \$heap_{funcstart\_724,1}.p1
(0 < \text{\$heap}_{funcstart\_724,1}.\text{p2})) && ($\text{$heap}_{funcstart\_724,1}.\text{$p2} < 0
as
Type<integer>(\rho_{funcstart\_724,1}.M2))) & (0 <
asType < integer > (\$heap_{funcstart\_724,1}.p3))) \&\&
(asType < integer > ($heap_{funcstart\_724,1}.p3) <
```

```
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{M3}))
\rightarrow [const static or extern object]
[5.17] ((((-30269 < -\$heap_{funcstart\_724,1}.p1) \land (0 < \$heap_{funcstart\_724,1}.p1) 
(0 < \mathrm{\$heap}_{funcstart\_724,1}.\mathrm{p2})) && (\mathrm{\$heap}_{funcstart\_724,1}.\mathrm{p2} <
asType < integer > (\$heap_{init}.M2))) \&\& (0 <
asType < integer > (\$heap_{funcstart\_724,1}.p3))) \&\&
(\mathbf{asType} < \mathbf{integer} > (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p3}) <
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{M3}))
\rightarrow [expand definition of constant 'M2' at prang.c (19,20)]
[5.18] ((((-30269 < -\$heap_{funcstart\_724,1}.p1) \land (0 < \$heap_{funcstart\_724,1}.p1) 
(0 < \text{\$heap}_{funcstart_{-724,1},p2})) \&\& (\text{\$heap}_{funcstart_{-724,1},p2} <
asType<integer>(asType<short int>((int)30307)))) && (0 <
asType < integer > (\$heap_{funcstart\_724,1}.p3))) \&\&
(\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{p3}) <
asType < integer > (\$heap_{funcstart\_724,1}.M3))
\rightarrow [simplify]
[5.30] ((-30307 < -$heap_{funcstart\_724,1}.p2) \land (-30269 <
-\$heap_{funcstart\_724,1}.p1) \land (0 < \$heap_{funcstart\_724,1}.p1) \land (0 < \$heap_{funcstart\_724,1}.p1)
\text{Sheap}_{funcstart\_724,1}.p2) \land (0 < \text{Sheap}_{funcstart\_724,1}.p3)) \&\&
(\text{\$heap}_{funcstart\_724,1}.p3 < asType < integer > (\text{\$heap}_{funcstart\_724,1}.M3))
\rightarrow [const static or extern object]
[5.31] ((-30307 < -$heap_funcstart_724.1.p2) \land (-30269 <
-\$ heap_{funcstart\_724,1}.p1) \land (0 < \$ heap_{funcstart\_724,1}.p1) \land (0 < \$ heap_{funcstart\_724,1}.p1) \land (0 < \$ heap_{funcstart\_724,1}.p1)
\text{Sheap}_{funcstart_{724,1}.p2} \land (0 < \text{Sheap}_{funcstart_{724,1}.p3})) \&\&
(\text{\$heap}_{funcstart\_724,1}.p3 < asType < integer > (\text{\$heap}_{init}.M3))
\rightarrow [expand definition of constant 'M3' at prang.c (24,20)]
[5.32] ((-30307 < -$heap<sub>funcstart_724,1.</sub>p2) \land (-30269 <
 -\$heap_{funcstart\_724,1}.p1) \land (0 < \$heap_{funcstart\_724,1}.p1) \land (0 < \$heap_{funcstart\_724,1}.p1)
\text{Sheap}_{funcstart_{724,1}.p2} \land (0 < \text{Sheap}_{funcstart_{724,1}.p3})) \&\&
(\text{sheap}_{funcstart\_724,1}.\text{p3} < \text{asType} < \text{integer} > (\text{asType} < \text{short})
int > ((int)30323)))
\rightarrow [simplify]
[5.40] (-30323 < -\text{$heap_{funcstart\_724,1.p3}$}) \land (-30307 <
-\$heap_{funcstart\_724,1.p2}) \land (-30269 < -\$heap_{funcstart\_724,1.p1}) \land (0 < -\$heap_{funcstart\_724,1.p2})
\text{Sheap}_{funcstart\_724,1}.\text{p1}) \land (0 < \text{Sheap}_{funcstart\_724,1}.\text{p2}) \land (0 <
\$ heap_{funcstart\_724,1}.p3)
[Work on sub-term 6 of conjunction in term 5.40]
[10.0]~0 < \$ \mathrm{heap}_{funcstart\_724,1}.\mathrm{p3}
[Take given term]
```

```
[39.0] div3 == div(heapIs heap_{funcstart\_724,1},
asType < int > (\$heap_{funcstart\_724,1}.p3),
\mathbf{asType} < \mathbf{int} > (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{a3}))
\rightarrow [simplify]
[39.1] \operatorname{div3} == \operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724,1}, \$ \operatorname{heap}_{funcstart\_724,1}.p3,
asType < int > (\$heap_{funcstart\_724,1}.a3))
\rightarrow [const static or extern object]
[39.2] div3 == div(heapIs $heap_{funcstart\_724,1}, $heap_{funcstart\_724,1}.p3,
asType < int > (\$heap_{init}.a3))
\rightarrow [expand definition of constant 'a3' at prang.c (26,20)]
[39.3] \ \mathrm{div3} == \mathrm{div}(\mathbf{heapIs} \ \$ \mathrm{heap}_{funcstart\_724,1}, \ \$ \mathrm{heap}_{funcstart\_724,1}.\mathrm{p3},
asType<int>(asType<short int>((int)178)))
\rightarrow [simplify]
[39.6] div3 == div(heapIs \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}.p3, 178)
[Assume known post-assertion, class invariant or type constraint for term 39.6]
[42.0] (asType<integer>($heap_{tuncstart\_724,1}.p3) /
asType < integer > (178)) == asType < integer > (div(heapIs))
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.p3, 178).quot
\rightarrow [simplify]
[42.2] ($heap<sub>funcstart_724,1.</sub>p3 / 178) == asType<integer>(div(heapIs)
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.\text{p3}, 178).\text{quot}
→ [expand definition of operator './' in class 'int' at built in declaration]
[42.3] ([asType<integer>($heap_{funcstart\_724,1}.p3) < 0]:
-(-asType < integer > (\$heap_{funcstart\_724,1}.p3) / 178), []:
asType < integer > ($heap_{funcstart\_724,1}.p3) / 178) ==
asType<integer>(div(heapIs p_{funcstart\_724,1}, p_{funcstart\_724,1}, p_{funcstart\_724,1}),
178).quot)
→ [explicitly assert falsehood of skipped guards in subsequent guards]
[42.4] ([asType<integer>($heap_{funcstart\_724,1}.p3) < 0]:
-(-asType < integer > (\$heap_{funcstart\_724,1}.p3) / 178),
[!(\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{p3}) < 0)]:
asType < integer > (\$heap_{funcstart\_724,1}.p3) / 178) ==
\mathbf{asType} < \mathbf{integer} > (\mathbf{div}(\mathbf{heapIs} \ \$ \mathbf{heap}_{funcstart\_724,1}, \ \$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p3}, \\
178).quot)
\rightarrow [simplify]
[42.7] ([0 < -$heap<sub>funcstart_724,1.</sub>p3]:
-(-asType < integer > (\$heap_{funcstart\_724,1}.p3) / 178),
[!(asType < integer > (\$heap_{funcstart\_724,1}.p3) < 0)]:
```

```
asType < integer > (\$heap_{funcstart\_724,1}.p3) / 178) = =
\mathbf{asType} {<} \mathbf{integer} {>} ( \mathrm{div}(\mathbf{heapIs} \ \$ \mathrm{heap}_{funcstart\_724,1}, \ \$ \mathrm{heap}_{funcstart\_724,1}.\mathrm{p3}, \\
178).quot)
\rightarrow [from term 10.0, literala < -$heap<sub>funcstart_724,1</sub>.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 > (\$heap_{funcstart\_724,1}.p3) / 178),
[!(asType < integer > (\$heap_{funcstart\_724,1}.p3) < 0)]:
\mathbf{asType} < \mathbf{integer} > (\$ heap_{funcstart\_724,1}.p3) \ / \ 178) = =
\mathbf{asType} < \mathbf{integer} > (\mathbf{div}(\mathbf{heapIs} \ \$ \mathbf{heap}_{funcstart\_724,1}, \ \$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p3}, \\
178).quot)
\rightarrow [simplify]
[42.11] ([false]: -(-asType < integer > (\$heap_{funcstart\_724,1}.p3) / 178), [!(0 <
-\$heap_{funcstart\_724,1}.p3)]: \ \mathbf{asType} < \mathbf{integer} > (\$heap_{funcstart\_724,1}.p3) \ / \ 178)
== asType < integer > (div(heapIs $heap_{funcstart\_724,1},
heap_{funcstart_{-724,1}.p3, 178}, quot
\rightarrow [from term 10.0, literala < -$heap<sub>funcstart_724,1</sub>.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] \; ([{\bf false}]: \; -({\bf -asType} < {\bf integer} > (\$ {\bf heap}_{funcstart\_724,1}.{\bf p3}) \; / \; 178),
[!false]: asType<integer>($heap<sub>funcstart_724,1.</sub>p3) / 178) ==
\mathbf{asType} \small{<} \mathbf{integer} \small{>} ( \mathrm{div}(\mathbf{heapIs} \ \$ \mathrm{heap}_{funcstart\_724,1}, \ \$ \mathrm{heap}_{funcstart\_724,1}.\mathrm{p3}, \\
178).quot)
\rightarrow [simplify]
[42.17] \ 0 == (-\text{div}(\mathbf{heapIs} \ \$ \text{heap}_{funcstart\_724,1}, \ \$ \text{heap}_{funcstart\_724,1}.\text{p3},
178).quot + (\text{$heap}_{funcstart\_724,1}.p3 / 178))
[Assume known post-assertion, class invariant or type constraint for term
42.17
[48.0] \operatorname{minof(int)} \leq \operatorname{div}(\operatorname{heapIs} \operatorname{\$heap}_{funcstart\_724,1}, \operatorname{\$heap}_{funcstart\_724,1}.p3,
178).quot
\rightarrow [simplify]
```

```
[48.3] -32769 < div(heapIs $heap<sub>funcstart_724,1</sub>, $heap<sub>funcstart_724,1</sub>.p3,
178).quot
[Take goal term]
[1.0] minof(short int) \leq div3.quot
\rightarrow [simplify]
[1.1] -32768 \le \text{div} 3.\text{quot}
\rightarrow [from term 39.6, div3 is equal to div(heapIs $heap_{tuncstart\_724.1},
heap_{funcstart_{-724,1}}.p3, 178
[1.2] \ -32768 \le \mathrm{div}(\mathbf{heapIs} \ \$ \mathrm{heap}_{funcstart\_724,1}, \ \$ \mathrm{heap}_{funcstart\_724,1}.\mathrm{p3},
178).quot
\rightarrow [simplify]
[1.4] -32769 < div(heapIs $heap_{funcstart_{-724,1}}, $heap_{funcstart_{-724,1}}.p3,
178).quot
\rightarrow [from term 48.3, literala < div(heapIs $heap_{funcstart\_724,1},
heap_{funcstart\_724,1}.p3, 178, quot is true whenever (-1 + literala) < -32769
   Proof of rule precondition:
   [1.4.0](-32769 + -1) < -32769
   \rightarrow [simplify]
   [1.4.2] true
[1.5] true
Proof of verification condition: Type constraint satisfied in explicit
conversion from 'int' to 'short int'
Condition generated at: C:\Escher\Customers\prang\prang.c (60,40)
Condition defined at:
To prove: div3.quot \le maxof(short int)
Given:
heap_{init}.LIMIT == (int)80
\theta
\theta
heap_{init}.a1 == asType < short int > ((int)177)
\theta
\theta sheap<sub>init</sub>.M2 == asType<short int>((int)30307)
\rho_{init}.r2 == asType < short int > ((int)172)
```

```
\theta
\theta
\theta = asType < short int > ((int)30323)
\theta_{init}.r3 == asType < short int > ((int)170)
heap_{init}.a3 == asType < short int > ((int)178)
heap_{init}.b3 == asType<short int>((int)63)
\theta = asType < short int > ((int)1)
\theta
\theta = asType < short int > ((int)3)
invariant
1<br/>( \mathbf{heapIs}\ \$ \mathbf{heap}_{funcstart\_724,1})
\operatorname{div1} == \operatorname{div}(\mathbf{heapIs} \ \operatorname{\$heap}_{funcstart\_724,1},
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p1}),
asType < int > (\$heap_{funcstart\_724,1}.a1))
(asType<int>(asType<int>($heap_{tuncstart\_724.1}.p1)) /
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a1))) = =
asType<integer>(div1.quot)
(asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.p1)) \%
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a1))) = =
asType<integer>(div1.rem)
!(0 == asType < integer > (div1.rem)) || !(0 ==
asType<integer>(div1.quot))
\label{eq:div2} \text{div2} == \text{div}(\mathbf{heapIs} \ \$ \text{heap}_{funcstart\_724,1},
\mathbf{asType} < \mathbf{int} > (\$ \mathrm{heap}_{funcstart\_724,1}.\mathrm{p2}),
asType < int > (\$heap_{funcstart\_724,1}.a2))
(asType<integer>(asType<int>($heap_{tuncstart\_724.1}.p2)) /
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a2))) = =
asType<integer>(div2.quot)
(asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.p2)) \%
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a2))) = =
asType<integer>(div2.rem)
!(0 == asType < integer > (div2.rem)) || !(0 ==
asType<integer>(div2.quot))
\mathrm{div3} == \mathrm{div}(\mathbf{heapIs} \ \$ \mathrm{heap}_{funcstart\_724,1},
\mathbf{asType} < \mathbf{int} > (\$ \mathrm{heap}_{funcstart\_724,1}.\mathrm{p3}),
asType < int > (\$heap_{funcstart\_724,1}.a3))
(asType<int>(asType<int>($heap_{tuncstart\_724.1}.p3)) /
\mathbf{asType}{<}\mathbf{integer}{>}(\mathbf{asType}{<}\mathbf{int}{>}(\$\mathbf{heap}_{funcstart\_724,1}.\mathbf{a3}))) = =
asType<integer>(div3.quot)
```

```
(asType < int > (asType < int > (\$heap_{funcstart\_724,1}.p3)) \%
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a3))) = =
asType<integer>(div3.rem)
!(0 == asType < integer > (div3.rem)) || !(0 ==
asType<integer>(div3.quot))
heap_{724,1;740,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow asType<short
int>((asType<int>(asType<short int>(div1.rem)) *
asType < int > (\$heap_{funcstart\_724,1}.r1)) - (asType < int > (asType < short)
int>(div1.quot)) * asType< int>($heap_{funcstart\_724,1}.b1))))
-asType<integer const>($heap<sub>724,1;740,8</sub>.M1) <
asType<integer>($heap<sub>724,1:740,8</sub>.p1)
!(0 == asType < integer > (\$heap_{724,1:740.8}.p1))
asType<integer>($heap<sub>724,1:740,8</sub>.p1) <
asType<integer>($heap<sub>724,1:740,8</sub>.M1)
heap_{724,1;742,8} == heap_{724,1;740,8}.replace(p2 \rightarrow asType<short
int>((asType<int>(asType<short int>(div2.rem)) *
asType < int > (\$heap_{724.1:740.8}.r2)) - (asType < int > (asType < short)
int>(div2.quot)) * asType< int>($heap_{724,1;740,8}.b2))))
-\mathbf{asType}{<}\mathbf{integer}\ \mathbf{const}{>}(\$\mathrm{heap}_{724,1;742,8}.\mathrm{M2}) <
asType<integer>($heap<sub>724,1:742,8</sub>.p2)
!(0 == asType < integer > (\$heap_{724,1;742,8}.p2))
asType<integer>($heap<sub>724,1:742,8</sub>.p2) <
asType<integer>($heap<sub>724,1;742,8</sub>.M2)
Proof:
[Take given term]
[5.0] invariant1(heapIs heap_{funcstart_{724.1}})
\rightarrow [expand definition of function 'invariant1' at prang.c (34,1)]
[5.1] (((((0 < asType < integer > ($heap_{funcstart\_724,1}.p1)) &&
(asType < integer > (\$heap_{funcstart\_724,1}.p1) < 
asType < integer > (\$heap_{funcstart\_724,1}.M1))) \&\& (0 <
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{p2})))\ \&\&
(asType < integer > ($heap_{funcstart\_724,1}.p2) < 
asType<integer>($heap_{funcstart\_724,1}.M2))) && (0 <
asType < integer > (\$heap_{funcstart\_724,1}.p3))) \&\&
(\mathbf{asType} < \mathbf{integer} > (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p3}) <
\mathbf{asType} < \mathbf{integer} > (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{M3}))
\rightarrow [simplify]
[5.3] (((((0 < $heap_{funcstart_724,1}.p1) && ($heap_{funcstart_724,1}.p1 < footnote{in the content of the c
asType < integer > (\$heap_{funcstart\_724,1}.M1))) \&\& (0 <
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asType < integer > (\$heap_{funcstart\_724,1}.p2))) \&\&
(asType < integer > (\$heap_{funcstart\_724,1}.p2) < 
\mathbf{asType} {<} \mathbf{integer} {>} (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{M2}))) \ \&\& \ (0 <
asType < integer > (\$heap_{funcstart\_724,1}.p3))) \&\&
(\mathbf{asType} < \mathbf{integer} > (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p3}) <
asType<integer>($heap_funcstart_724,1.M3))
\rightarrow [const static or extern object]
[5.4] (((((0 < \theta_{funcstart\_724,1.p1}) && (\theta_{funcstart\_724,1.p1})
asType<integer>(heap_{init}.M1))) && (0 <
asType < integer > (\$heap_{funcstart\_724,1}.p2))) \&\&
(\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{p2}) <
\mathbf{asType} \small{<} \mathbf{integer} \small{>} (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{M2}))) \ \&\& \ (0 <
asType < integer > (\$heap_{funcstart\_724,1}.p3))) \&\&
(\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{p3}) <
asType < integer > (\$heap_{funcstart\_724,1}.M3))
\rightarrow [expand definition of constant 'M1' at prang.c (14,20)]
[5.5] (((((0 < $heap_{funcstart\_724,1}.p1) && ($heap_{funcstart\_724,1}.p1 < ])
asType<integer>(asType<short int>((int)30269)))) && (0 <
asType < integer > (\$heap_{funcstart\_724,1}.p2))) \&\&
(\mathbf{asType} < \mathbf{integer} > (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p2}) <
as
Type<integer>($heap_{funcstart\_724,1}.M2))) && (0 <
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p3})))\ \&\&
(asType < integer > (\$heap_{funcstart_{-724.1}}.p3) < 
asType < integer > (\$heap_{funcstart_{-724.1}}.M3))
\rightarrow [simplify]
[5.16] \; ((((-30269 < -\$heap_{funcstart\_724,1}.p1) \; \land \; (0 < \$heap_{funcstart\_724,1}.p1) \; \land 
(0 < \mathrm{\$heap}_{funcstart\_724,1}.\mathrm{p2})) && (\mathrm{\$heap}_{funcstart\_724,1}.\mathrm{p2} <
asType < integer > (\$heap_{funcstart\_724,1}.M2))) \&\& (0 < 1)
asType < integer > (\$heap_{funcstart\_724,1}.p3))) \&\&
(\mathbf{asType} < \mathbf{integer} > (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p3}) <
\mathbf{asType} {<} \mathbf{integer} {>} (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{M3}))
\rightarrow [const static or extern object]
\label{eq:final_start_724,1.p1} [(((-30269 < -\$heap_{funcstart\_724,1}.p1) \land (0 < \$heap_{funcstart\_724,1}.p1) \land (0 < \$he
(0 < \text{\$heap}_{funcstart_{724,1},p2})) \&\& (\text{\$heap}_{funcstart_{724,1},p2} <
asType < integer > (\$heap_{init}.M2))) \&\& (0 <
asType < integer > (\$heap_{funcstart\_724,1}.p3))) \&\&
(asType < integer > (\$heap_{funcstart\_724,1}.p3) < 
asType < integer > (\$heap_{funcstart\_724,1}.M3))
\rightarrow [expand definition of constant 'M2' at prang.c (19,20)]
[5.18] ((((-30269 < -\$heap_{funcstart\_724,1}.p1) \land (0 < \$heap_{funcstart\_724,1}.p1) 
(0 < \text{\$heap}_{funcstart\_724,1}.p2)) \&\& (\text{\$heap}_{funcstart\_724,1}.p2 <
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asType<integer>(asType<short int>((int)30307)))) && (0 <
asType < integer > (\$heap_{funcstart\_724,1}.p3))) \&\&
(\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{p3}) <
asType < integer > (\$heap_{funcstart\_724,1}.M3))
\rightarrow [simplify]
[5.30] ((-30307 < -$heap<sub>funcstart_724,1</sub>.p2) \wedge (-30269 <
-\text{\$heap}_{funcstart\_724,1}.\text{p1}) \land (0 < \text{\$heap}_{funcstart\_724,1}.\text{p1}) \land (0 <
\text{Sheap}_{funcstart_{724,1}.p2} \land (0 < \text{Sheap}_{funcstart_{724,1}.p3})) \&\&
(\text{\$heap}_{funcstart\_724,1}.p3 < asType < integer > (\text{\$heap}_{funcstart\_724,1}.M3))
\rightarrow [const static or extern object]
[5.31] ((-30307 < -$heap<sub>funcstart_724.1.</sub>p2) \wedge (-30269 <
-\$heap_{funcstart\_724,1}.p1) \land (0 < \$heap_{funcstart\_724,1}.p1) \land (0 < \$heap_{funcstart\_724,1}.p1)
\text{Sheap}_{funcstart\_724,1}.p2) \land (0 < \text{Sheap}_{funcstart\_724,1}.p3)) \&\&
(\$heap_{funcstart\_724,1}.p3 < \textbf{asType} < \textbf{integer} > (\$heap_{init}.M3))
\rightarrow [expand definition of constant 'M3' at prang.c (24,20)]
[5.32] ((-30307 < -$heap<sub>funcstart_724,1.</sub>p2) \land (-30269 <
-\$heap_{funcstart_{-724,1}.p1}) \land (0 < \$heap_{funcstart_{-724,1}.p1}) \land (0 < \$heap_{funcstart_{-724,1}.p1})
\text{Sheap}_{funcstart\_724,1.p2}) \land (0 < \text{Sheap}_{funcstart\_724,1.p3})) \&\&
(\text{sheap}_{funcstart\_724,1}.\text{p3} < \text{asType} < \text{integer} > (\text{asType} < \text{short})
int > ((int)30323)))
\rightarrow [simplify]
[5.40] (-30323 < -$heap<sub>funcstart_724,1.</sub>p3) \land (-30307 <
-\$heap_{funcstart\_724,1}.p2) \land (-30269 < -\$heap_{funcstart\_724,1}.p1) \land (0 <
\text{Sheap}_{funcstart\_724,1}.\text{p1}) \land (0 < \text{Sheap}_{funcstart\_724,1}.\text{p2}) \land (0 <
heap_{funcstart_{-724,1}.p3}
[Work on sub-term 6 of conjunction in term 5.40]
[10.0] 0 < $\text{heap}_{funcstart_724,1}.p3
[Take given term]
[39.0] div3 == div(heapIs $heap_{funcstart\_724,1},
asType < int > (\$heap_{funcstart\_724,1}.p3),
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{a3}))
\rightarrow [simplify]
[39.1]~{\rm div3} == {\rm div}(\mathbf{heapIs}~\$ \mathrm{heap}_{funcstart\_724,1},~\$ \mathrm{heap}_{funcstart\_724,1}.\mathrm{p3},
asType < int > (\$heap_{funcstart\_724,1}.a3))
\rightarrow [const static or extern object]
[39.2] \ \mathrm{div3} == \ \mathrm{div}(\mathbf{heapIs} \ \$ \mathrm{heap}_{funcstart\_724,1}, \ \$ \mathrm{heap}_{funcstart\_724,1}.\mathrm{p3},
asType < int > (\$heap_{init}.a3))
\rightarrow [expand definition of constant 'a3' at prang.c (26,20)]
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[39.3] \operatorname{div3} == \operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724,1}, \$ \operatorname{heap}_{funcstart\_724,1}.p3,
asType<int>(asType<short int>((int)178)))
\rightarrow [simplify]
[39.6] div3 == div(heapIs heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p3, 178)
[Assume known post-assertion, class invariant or type constraint for term 39.6]
[42.0] \; (\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathbf{heap}_{funcstart\_724,1}.\mathbf{p3}) \; / \\
asType < integer > (178)) == asType < integer > (div(heapIs))
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.p3, 178).quot)
\rightarrow [simplify]
[42.2] ($heap<sub>funcstart_724,1</sub>.p3 / 178) == asType<integer>(div(heapIs)
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.p3, 178).quot
→ [expand definition of operator './' in class 'int' at built in declaration]
[42.3] \; ([\mathbf{asType} < \mathbf{integer} > (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p3}) < 0] :
-(-asType < integer > (\$heap_{funcstart\_724,1}.p3) / 178), []:
asType < integer > (\$heap_{funcstart\_724,1}.p3) / 178) = =
asType<integer>(div(heapIs heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p3,
178).quot)
\rightarrow [explicitly assert falsehood of skipped guards in subsequent guards]
[42.4] ([asType<integer>($heap_{funcstart\_724,1}.p3) < 0]:
-(-asType < integer > (\$heap_{funcstart\_724,1}.p3) / 178),
[!(asType < integer > (\$heap_{funcstart\_724,1}.p3) < 0)]:
\mathbf{asType} < \mathbf{integer} > (\$ heap_{funcstart\_724,1}.p3) \ / \ 178) = =
\mathbf{asType} {<} \mathbf{integer} {>} ( \mathrm{div}(\mathbf{heapIs} \ \$ \mathrm{heap}_{funcstart\_724,1}, \ \$ \mathrm{heap}_{funcstart\_724,1}.\mathrm{p3}, \\
178).quot)
\rightarrow [simplify]
[42.7] ([0 < -$heap<sub>funcstart_724,1.</sub>p3]:
-(-asType < integer > (\$heap_{funcstart\_724,1}.p3) / 178),
[!(asType < integer > (\$heap_{funcstart\_724,1}.p3) < 0)]:
\mathbf{asType} < \mathbf{integer} > (\$ heap_{funcstart\_724,1}.p3) \ / \ 178) = =
asType < integer > (div(heapIs \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p3,
178).quot)
\rightarrow [from term 10.0, literala < -$heap<sub>funcstart_724,1</sub>.p3 is false whenever -2 <
(0 + literala)
    Proof of rule precondition:
    [42.7.0] - 2 < (0 + 0)
    \rightarrow [simplify]
    [42.7.2] true
[42.8] ([false]: -(-asType < integer > (\$heap_{funcstart\_724,1}.p3) / 178),
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[!(asType < integer > (\$heap_{funcstart\_724,1}.p3) < 0)]:
asType < integer > (\$heap_{funcstart\_724,1}.p3) / 178) = =
\mathbf{asType} {<} \mathbf{integer} {>} ( \mathbf{div} (\mathbf{heapIs} \ \$ \mathbf{heap}_{funcstart\_724,1}, \ \$ \mathbf{heap}_{funcstart\_724,1}. \mathbf{p3}, \\
178).quot)
\rightarrow [simplify]
[42.11] ([false]: -(-asType < integer > (\$heap_{funcstart\_724,1}.p3) / 178), [!(0 <
-\text{$heap}_{funcstart\_724,1}.p3): asType<integer>($heap_{funcstart\_724,1}.p3) / 178)
== asType<integer>(div(heapIs $heap_{tuncstart\_724,1},
heap_{funcstart_{-724,1}}.p3, 178).quot
\rightarrow [from term 10.0, literala < -$heap<sub>funcstart_724,1</sub>.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] \; ([\mathbf{false}]: \; -(-\mathbf{asType} < \mathbf{integer} > (\$ \mathrm{heap}_{funcstart\_724,1}.\mathrm{p3}) \; / \; 178),
[!false]: asType<integer>(\theta_{tal}) (\theta_{tal}) | 178) ==
\mathbf{asType} < \mathbf{integer} > (\mathbf{div}(\mathbf{heapIs} \ \$ \mathbf{heap}_{funcstart\_724,1}, \ \$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p3}, \\
178).quot)
\rightarrow [simplify]
[42.17] \ 0 == (-\text{div}(\mathbf{heapIs} \ \$ \text{heap}_{funcstart\_724,1}, \ \$ \text{heap}_{funcstart\_724,1}.\text{p3},
178).quot + (heap_{funcstart\_724,1}.p3 / 178)
[Assume known post-assertion, class invariant or type constraint for term
42.17
[49.0] div(heapIs heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p3, 178).quot \leq
maxof(int)
\rightarrow [simplify]
[49.9] -32768 < -\text{div}(\mathbf{heapIs} \$ \text{heap}_{funcstart\_724,1}, \$ \text{heap}_{funcstart\_724,1}.\text{p3},
178).quot
[Take goal term]
[1.0] div3.quot \leq maxof(short int)
\rightarrow [from term 39.6, div3 is equal to div(heapIs $heap_{funcstart\_724,1},
heap_{funcstart_{-724,1}}.p3, 178
[1.1] div(heapIs heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p3, 178).quot \leq
maxof(short int)
\rightarrow [simplify]
\label{eq:continuous} \mbox{[1.10] -32768} < -\mbox{div}(\mbox{\bf heapIs $\$heap}_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p3,
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178).quot
\rightarrow [from term 49.9, literala < -\text{div}(\text{heapIs } \text{\$heap}_{funcstart\_724,1},
heap_{funcstart-724,1}.p3, 178).quot is true whenever (-1 + literala) < -32768
   Proof of rule precondition:
   [1.10.0](-32768 + -1) < -32768
   \rightarrow [simplify]
   [1.10.2] true
[1.11] true
Proof of verification condition: Type constraint satisfied in implicit
conversion from 'short int' to 'int'
Condition generated at: C:\Escher\Customers\prang\prang.c (60,40)
Condition defined at:
To prove: minof(int) \le asType < short int > (div3.quot)
Given:
heap_{init}.LIMIT == (int)80
\theta sheap<sub>init</sub>.M1 == asType<short int>((int)30269)
\theta_{init}.r1 == asType < short int > ((int)171)
heap_{init}.a1 == asType < short int > ((int)177)
\theta
\theta sheap<sub>init</sub>.M2 == asType<short int>((int)30307)
\theta_{init}.r2 == asType < short int > ((int)172)
heap_{init}.a2 == asType < short int > ((int)176)
\theta = asType < short int > ((int)35)
heap_{init}.M3 == asType < short int > ((int)30323)
\theta_{init}.r3 == asType<short int>((int)170)
heap_{init}.a3 == asType<short int>((int)178)
\theta = asType < short int > ((int)63)
\theta = asType < short int > ((int)1)
\theta
\theta = asType < short int > ((int)3)
invariant1(heapIs $heap_{tuncstart_724.1})
\operatorname{div1} == \operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1},
```

```
asType < int > (\$heap_{funcstart\_724,1}.p1),
asType < int > (\$heap_{funcstart\_724,1}.a1))
(\mathbf{asType}{<}\mathbf{integer}{>}(\mathbf{asType}{<}\mathbf{int}{>}(\$\mathbf{heap}_{funcstart\_724,1}.\mathbf{p1})) \ / \\
asType<integer>(asType<int>($heap_{tuncstart\_724.1}.a1))) ==
asType<integer>(div1.quot)
(\mathbf{asType} < \mathbf{integer} > (\mathbf{asType} < \mathbf{int} > (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p1})) \ \%
\mathbf{asType}{<}\mathbf{int}{>}(\mathbf{\$heap}_{funcstart\_724,1}.\mathbf{a1}))) ==
asType < integer > (div1.rem)
!(0 == asType < integer > (div1.rem)) || !(0 ==
asType<integer>(div1.quot))
div2 == div(\mathbf{heapIs} \$ heap_{funcstart_{-724.1}},
asType < int > (\$heap_{funcstart\_724.1}.p2),
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{a2}))
(\mathbf{asType}{<}\mathbf{integer}{>}(\mathbf{asType}{<}\mathbf{int}{>}(\$\mathbf{heap}_{funcstart\_724,1}.\mathbf{p2})) \ / \\
asType<integer>(asType<int>($heap_{tuncstart\_724.1}.a2))) ==
asType<integer>(div2.quot)
(asType < int > (asType < int > (\$heap_{funcstart\_724,1}.p2)) \%
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a2))) = =
asType<integer>(div2.rem)
!(0 == asType < integer > (div2.rem)) || !(0 ==
asType<integer>(div2.quot))
div3 == div(\mathbf{heapIs} \$heap_{funcstart\_724,1},
asType < int > (\$heap_{funcstart\_724,1}.p3),
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{a3}))
(\mathbf{asType}{<}\mathbf{integer}{>}(\mathbf{asType}{<}\mathbf{int}{>}(\$\mathbf{heap}_{funcstart\_724,1}.\mathbf{p3})) \ / \\
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a3))) = =
asType<integer>(div3.quot)
(asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.p3)) \%
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a3))) = =
asType<integer>(div3.rem)
!(0 == asType < integer > (div3.rem)) || !(0 ==
asType<integer>(div3.quot))
heap_{724,1:740.8} == heap_{funcstart_{724,1}}._replace(p1 \rightarrow asType<short
int>((asType<int>(asType<short int>(div1.rem)) *
asType < int > (\$heap_{funcstart\_724,1}.r1)) - (asType < int > (asType < short)
int>(div1.quot)) * asType< int>($heap_{funcstart\_724,1}.b1))))
-asType < integer\ const > (\$heap_{724,1;740,8}.M1) < 1
asType < integer > ($heap_{724,1;740,8}.p1)
!(0 == asType < integer > (\$heap_{724,1;740,8}.p1))
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asType<integer>($heap<sub>724.1:740.8</sub>.p1) <
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathrm{heap}_{724,1;740,8}.\mathrm{M1})
heap_{724,1:742,8} == heap_{724,1:740,8}.replace(p2 \rightarrow asType<short
int>((asType<int>(asType<short int>(div2.rem)) *
asType < int > (\$heap_{724.1:740.8}.r2)) - (asType < int > (asType < short)
int>(div2.quot)) * asType< int>($heap_{724,1;740,8}.b2))))
-asType < integer const > (\$heap_{724,1:742,8}.M2) < 
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathrm{heap}_{724,1;742,8}.\mathrm{p2})
!(0 == \mathbf{asType} {<} \mathbf{integer} {>} (\$ \mathrm{heap}_{724,1;742,8}.\mathrm{p2}))
asType<integer>($heap<sub>724.1:742.8</sub>.p2) <
asType<integer>($heap<sub>724.1:742.8</sub>.M2)
Proof:
[Take given term]
[5.0] invariant1(heapIs heap_{funcstart\_724.1})
\rightarrow [expand definition of function 'invariant1' at prang.c (34,1)]
[5.1] ((((((0 < asType < integer > (heap_{funcstart_{-724,1}}.p1)) &&
(asType < integer > (\$heap_{funcstart\_724,1}.p1) < 
as
Type<integer>($heap_{funcstart\_724,1}.M1))) && (0 <
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p2})))\ \&\&
(asType < integer > ($heap_{funcstart\_724,1}.p2) < 
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{M2})))~\&\&~(0<
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{p3})))\ \&\&
(asType < integer > ($heap_{funcstart\_724,1}.p3) < 
asType < integer > (\$heap_{funcstart\_724,1}.M3))
\rightarrow [simplify]
[5.3] (((((0 < \text{heap}_{funcstart\_724,1}.p1) && (\text{heap}_{funcstart\_724,1}.p1 <
asType < integer > (\$heap_{funcstart\_724,1}.M1))) \&\& (0 <
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{p2})))\ \&\&
(asType < integer > (\$heap_{funcstart\_724,1}.p2) <
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{M2})))~\&\&~(0<
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{p3})))\ \&\&
(\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{p3}) <
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{M3}))
\rightarrow [const static or extern object]
[5.4] \ (((((0 < \$heap_{funcstart\_724,1}.p1) \&\& \ (\$heap_{funcstart\_724,1}.p1 < 
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathrm{heap}_{init}.\mathrm{M1})))~\&\&~(0<
asType < integer > (\$heap_{funcstart\_724,1}.p2))) \&\&
(asType < integer > (\$heap_{funcstart\_724,1}.p2) <
asType < integer > (\$heap_{funcstart\_724,1}.M2))) \&\& (0 <
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p3})))\ \&\&
```

```
(\mathbf{asType} {<} \mathbf{integer} {>} (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p3}) <
asType < integer > (\$heap_{funcstart\_724,1}.M3))
\rightarrow [expand definition of constant 'M1' at prang.c (14,20)]
[5.5] (((((0 < $heap_{funcstart_{724,1}}.p1) && ($heap_{funcstart_{724,1}}.p1 < 
asType<integer>(asType<short int>((int)30269)))) && (0 <
asType < integer > (\$heap_{funcstart\_724,1}.p2))) \&\&
(\mathbf{asType} < \mathbf{integer} > (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p2}) <
asType < integer > (\$heap_{funcstart\_724,1}.M2))) \&\& (0 <
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{p3})))\ \&\&
(asType < integer > (\$heap_{funcstart\_724,1}.p3) < 
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{M3}))
\rightarrow [simplify]
[5.16] \; ((((-30269 < -\$heap_{funcstart\_724,1}.p1) \; \land \; (0 < \$heap_{funcstart\_724,1}.p1) \; \land 
(0 < \text{\$heap}_{funcstart\_724,1}.p2)) \&\& (\text{\$heap}_{funcstart\_724,1}.p2 <
asType < integer > (\$heap_{funcstart\_724,1}.M2))) \&\& (0 <
asType < integer > (\$heap_{funcstart\_724,1}.p3))) \&\&
(asType < integer > (\$heap_{funcstart\_724,1}.p3) < 
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{M3}))
\rightarrow [const static or extern object]
[5.17] \left( \left( \left( \left( -30269 < -\$ \text{heap}_{funcstart\_724,1}.\text{p1} \right) \right. \wedge \left. \left( 0 < \$ \text{heap}_{funcstart\_724,1}.\text{p1} \right) \right. \wedge \right. \right) \\
(0 < \text{$heap}_{funcstart\_724,1}.p2)) \&\& (\text{$heap}_{funcstart\_724,1}.p2 <
asType < integer > (\$heap_{init}.M2))) \&\& (0 <
asType < integer > (\$heap_{funcstart\_724,1}.p3))) \&\&
(asType < integer > ($heap_{funcstart\_724,1}.p3) < 
asType < integer > (\$heap_{funcstart\_724,1}.M3))
\rightarrow [expand definition of constant 'M2' at prang.c (19,20)]
[5.18] ((((-30269 < -\$heap_{funcstart\_724,1}.p1) \land (0 < \$heap_{funcstart\_724,1}.p1) 
(0 < \text{\$heap}_{funcstart\_724,1}.p2)) \&\& (\text{\$heap}_{funcstart\_724,1}.p2 <
asType < integer > (asType < short int > ((int)30307)))) && (0 < integer) && (0 < integer
asType < integer > (\$heap_{funcstart\_724,1}.p3))) \&\&
(\mathbf{asType} < \mathbf{integer} > (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p3}) <
\mathbf{asType} < \mathbf{integer} > (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{M3}))
\rightarrow [simplify]
[5.30] ((-30307 < -$heap_{funcstart\_724,1}.p2) \land (-30269 <
-\$heap_{funcstart\_724,1}.p1) \land (0 < \$heap_{funcstart\_724,1}.p1) \land (0 < \$heap_{funcstart\_724,1}.p1)
\text{Sheap}_{funcstart_{-724,1}.p2} \land (0 < \text{Sheap}_{funcstart_{-724,1}.p3})) \&\&
(\text{\$heap}_{funcstart\_724,1}.\text{p3} < \text{asType} < \text{integer} > (\text{\$heap}_{funcstart\_724,1}.\text{M3}))
\rightarrow [const static or extern object]
[5.31] ((-30307 < -\$heap_{funcstart\_724,1}.p2) \land (-30269 <
-\$heap_{funcstart\_724,1}.p1) \land (0 < \$heap_{funcstart\_724,1}.p1) \land (0 < \$heap_{funcstart\_724,1}.p1)
\text{Sheap}_{funcstart_{724,1}.p2} \land (0 < \text{Sheap}_{funcstart_{724,1}.p3})) \&\&
```

```
(\text{\$heap}_{funcstart\_724,1}.p3 < asType < integer > (\text{\$heap}_{init}.M3))
\rightarrow [expand definition of constant 'M3' at prang.c (24,20)]
[5.32] ((-30307 < -$heap_funcstart_724,1.p2) \land (-30269 <
-\$ heap_{funcstart\_724,1}.p1) \land (0 < \$ heap_{funcstart\_724,1}.p1) \land (0 < \$ heap_{funcstart\_724,1}.p1) \land (0 < \$ heap_{funcstart\_724,1}.p1)
\text{Sheap}_{funcstart\_724,1.p2} \land (0 < \text{Sheap}_{funcstart\_724,1.p3})) \&\&
(\text{sheap}_{funcstart\_724.1}.p3 < asType < integer > (asType < short)
int > ((int)30323)))
\rightarrow [simplify]
[5.40] (-30323 < -$heap_{funcstart\_724,1}.p3) \land (-30307 <
-\$heap_{funcstart\_724,1}.p2) \land (-30269 < -\$heap_{funcstart\_724,1}.p1) \land (0 < -\$heap_{funcstart\_724,1}.p1)
\text{Sheap}_{funcstart_{-724,1},p1} \land (0 < \text{Sheap}_{funcstart_{-724,1},p2}) \land (0 <
heap_{funcstart_{-724,1}.p3}
[Work on sub-term 6 of conjunction in term 5.40]
[10.0] 0 < $\text{heap}_{funcstart_724,1.p3}$
[Take given term]
[39.0] div3 == div(heapIs $heap_{funcstart\_724,1},
asType < int > (\$heap_{funcstart\_724,1}.p3),
asType < int > (\$heap_{funcstart\_724,1}.a3))
\rightarrow [simplify]
[39.1] \operatorname{div3} == \operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724,1}, \$ \operatorname{heap}_{funcstart\_724,1}.p3,
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{a3}))
\rightarrow [const static or extern object]
[39.2] div3 == div(heapIs $heap_{funcstart\_724,1}, $heap_{funcstart\_724,1}.p3,
asType < int > (\$heap_{init}.a3))
\rightarrow [expand definition of constant 'a3' at prang.c (26,20)]
[39.3] div3 == div(heapIs \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}.p3,
asType<int>(asType<short int>((int)178)))
\rightarrow [simplify]
[39.6] \text{ div3} == \text{div}(\text{heapIs } \text{$heap}_{funcstart\_724,1}, \text{$heap}_{funcstart\_724,1}.\text{p3}, 178)
[Assume known post-assertion, class invariant or type constraint for term 39.6]
[42.0] (asType<integer>($heap<sub>funcstart_724,1.</sub>p3) /
asType < integer > (178)) == asType < integer > (div(heapIs))
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.p3, 178).quot
\rightarrow [simplify]
[42.2] (\theta_{funcstart\_724,1.p3} / 178) == asType<integer>(div(heapIs
\text{$heap}_{funcstart\_724,1}, \text{$heap}_{funcstart\_724,1}.\text{p3}, 178).\text{quot}
→ [expand definition of operator './' in class 'int' at built in declaration]
```

```
[42.3] ([asType<integer>($heap_{funcstart\_724,1}.p3) < 0]:
-(-asType < integer > (\$heap_{funcstart\_724,1}.p3) / 178), []:
asType < integer > (\$heap_{funcstart\_724,1}.p3) / 178) = =
asType<integer>(div(heapIs p_{funcstart\_724,1}, p_{funcstart\_724,1}, p_{funcstart\_724,1}),
178).quot)
→ [explicitly assert falsehood of skipped guards in subsequent guards]
[42.4] \; ([\mathbf{asType} < \mathbf{integer} > (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p3}) < 0] :
-(-\mathbf{asType} < \mathbf{integer} > (\$ heap_{funcstart\_724,1}.p3) \ / \ 178),
[!(asType < integer > (\$heap_{funcstart\_724,1}.p3) < 0)]:
asType < integer > (\$heap_{funcstart\_724,1}.p3) / 178) = =
asType<integer>(div(heapIs $heap_{tuncstart\_724.1}, $heap_{tuncstart\_724.1}.p3,
178).quot)
\rightarrow [simplify]
[42.7] ([0 < -$heap<sub>funcstart_724,1</sub>.p3]:
-(-asType < integer > (\$heap_{funcstart\_724,1}.p3) / 178),
[!(\mathbf{asType} < \mathbf{integer} > (\$ heap_{funcstart\_724,1}.p3) < 0)]:
asType < integer > (\$heap_{funcstart\_724,1}.p3) / 178) ==
asType<integer>(div(heapIs p_{funcstart\_724,1}, p_{funcstart\_724,1}, p_{funcstart\_724,1}),
178).quot)
\rightarrow [from term 10.0, literala < -$heap<sub>funcstart_724.1</sub>.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 > (\$heap_{funcstart\_724,1}.p3) / 178),
[!(asType < integer > (\$heap_{funcstart\_724,1}.p3) < 0)]:
asType < integer > (\$heap_{funcstart-724.1}.p3) / 178) = =
asType<integer>(div(heapIs heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p3,
178).quot)
\rightarrow [simplify]
[42.11] ([false]: -(-asType < integer > (\$heap_{funcstart\_724,1}.p3) / 178), [!(0 < integer > (\$heap_{funcstart\_724,1}.p3) / 178)]
-\text{\$heap}_{funcstart\_724.1}.\text{p3}): asType<integer>(\text{\$heap}_{funcstart\_724.1}.\text{p3}) / 178)
== asType<integer>(div(heapIs $heap_funcstart_724,1,
heap_{funcstart_{-724,1}}.p3, 178).quot
\rightarrow [from term 10.0, literala < –$heap_funcstart_724,1.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] \; ([{\bf false}]: \; -({\bf -asType} < {\bf integer} > (\$ {\bf heap}_{funcstart\_724,1}.p3) \; / \; 178),
[!false]: asType<integer>($heap<sub>funcstart_724,1.</sub>p3) / 178) ==
asType<integer>(div(heapIs heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p3,
178).quot)
\rightarrow [simplify]
[42.17] 0 == (-\operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724,1}, \$ \operatorname{heap}_{funcstart\_724,1}.\operatorname{p3},
178).quot + (\text{$heap}_{funcstart\_724,1}.p3 / 178))
[Assume known post-assertion, class invariant or type constraint for term
42.17
[48.0] \ \mathbf{minof(int)} \leq \mathrm{div}(\mathbf{heapIs} \ \$ \mathrm{heap}_{funcstart\_724,1}, \ \$ \mathrm{heap}_{funcstart\_724,1}.\mathrm{p3},
178).quot
\rightarrow [simplify]
\textit{[48.3] -32769} < \text{div}(\textbf{heapIs} \ \$ \text{heap}_{funcstart\_724,1}, \ \$ \text{heap}_{funcstart\_724,1}.\text{p3},
178).quot
[Take goal term]
[1.0] minof(int) \leq asType<short int>(div3.quot)
\rightarrow [simplify]
[1.1] -32768 \leq asType<short int>(div3.quot)
\rightarrow [from term 39.6, div3 is equal to div(heapIs $heap_{funcstart\_724,1},
heap_{funcstart_{-724,1}}.p3, 178
[1.2] -32768 \leq asType<short int>(div(heapIs $heap_{tuncstart\_724,1},)
heap_{funcstart_{-724,1}}.p3, 178).quot
\rightarrow [simplify]
[1.5] -32769 < div(heapIs $heap_{funcstart_724,1}, $heap_{funcstart_724,1}.p3,
178).quot
\rightarrow [from term 48.3, literala < div(heapIs $heap<sub>funcstart_724,1</sub>,
heap_{funcstart_{-724,1}}.p3, 178).quot is true whenever (-1 + literala) < -32769
    Proof of rule precondition:
    [1.5.0](-32769 + -1) < -32769
    \rightarrow [simplify]
    [1.5.2] true
[1.6] true
```

**Proof of verification condition:** Type constraint satisfied in implicit

```
conversion from 'short int' to 'int'
Condition generated at: C:\Escher\Customers\prang\prang.c (60,40)
Condition defined at:
To prove: asType<short int>(div3.quot) \le maxof(int)
Given:
heap_{init}.LIMIT == (int)80
\theta sheap<sub>init</sub>.M1 == asType<short int>((int)30269)
\theta_{init}.r1 == asType < short int > ((int)171)
\theta
\theta
\theta_{init}.M2 == asType < short int > ((int)30307)
\theta_{init}.r2 == asType < short int > ((int)172)
heap_{init}.a2 == asType < short int > ((int)176)
\theta = asType < short int > ((int)35)
heap_{init}.M3 == asType < short int > ((int)30323)
\theta_{init}.r3 == asType<short int>((int)170)
heap_{init}.a3 == asType<short int>((int)178)
\theta = asType < short int > ((int)63)
\theta = asType < short int > ((int)1)
\theta
\theta = asType < short int > ((int)3)
invariant1(heapIs heap_{funcstart_{-724.1}})
div1 == div(\mathbf{heapIs} \$ heap_{funcstart_{-724.1}},
\mathbf{asType} < \mathbf{int} > (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p1}),
asType < int > (\$heap_{funcstart\_724,1}.a1))
(\mathbf{asType} < \mathbf{integer} > (\mathbf{asType} < \mathbf{int} > (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p1})) \ / \ 
\mathbf{asType}{<}\mathbf{integer}{>}(\mathbf{asType}{<}\mathbf{int}{>}(\$\mathbf{heap}_{funcstart\_724,1}.\mathbf{a1}))) = =
asType<integer>(div1.quot)
(asType<integer>(asType<int>($heap_funcstart_724,1.p1)) %
\mathbf{asType} < \mathbf{integer} > (\mathbf{asType} < \mathbf{int} > (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{a1}))) = =
asType<integer>(div1.rem)
!(0 == asType < integer > (div1.rem)) || !(0 ==
asType<integer>(div1.quot))
div2 == div(\mathbf{heapIs} \$ heap_{funcstart\_724,1},
asType < int > (\$heap_{funcstart\_724,1}.p2),
```

```
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{a2}))
(asType<integer>(asType<int>($heap_{tuncstart_724.1}.p2)) /
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a2))) = =
asType<integer>(div2.quot)
(asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.p2)) \%
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a2))) = =
asType<integer>(div2.rem)
!(0 == asType < integer > (div2.rem)) || !(0 ==
asType<integer>(div2.quot))
div3 == div(\mathbf{heapIs} \$heap_{funcstart\_724,1},
asType < int > (\$heap_{funcstart\_724.1}.p3),
asType < int > (\$heap_{funcstart_{-724.1}}.a3))
(asType<integer>(asType<int>($heap_{funcstart\_724,1}.p3)) /
\mathbf{asType}{<}\mathbf{integer}{>}(\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{a3}))) ==
asType<integer>(div3.quot)
(asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.p3)) \%
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a3))) = =
asType<integer>(div3.rem)
!(0 == asType < integer > (div3.rem)) || !(0 ==
asType<integer>(div3.quot))
\$heap_{724,1;740,8} == \$heap_{funcstart\_724,1}.\_\textbf{replace}(p1 \rightarrow \textbf{asType} < \textbf{short}
int>((asType<int>(asType<short int>(div1.rem)) *
asType < int > (\$heap_{funcstart\_724,1}.r1)) - (asType < int > (asType < short)
int>(div1.quot)) * asType< int>($heap_{funcstart\_724,1}.b1))))
-asType<integer const>($heap<sub>724,1:740,8</sub>.M1) <
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathrm{heap}_{724,1;740,8}.\mathrm{p1})
!(0 == asType < integer > (\$heap_{724,1:740.8}.p1))
asType<integer>($heap<sub>724.1:740.8</sub>.p1) <
asType<integer>($heap<sub>724.1:740.8</sub>.M1)
\text{sheap}_{724,1:742.8} == \text{sheap}_{724,1:740.8}._replace(p2 \rightarrow asType<short
int>((asType<int>(asType<short int>(div2.rem))
\mathbf{asType} < \mathbf{int} > (\$ heap_{724,1;740,8}.r2)) - (\mathbf{asType} < \mathbf{int} > (\mathbf{asType} < \mathbf{short})
int>(div2.quot)) * asType<int>($heap<sub>724.1:740.8</sub>.b2))))
-asType<integer const>($heap<sub>724,1:742,8</sub>.M2) <
asType<integer>($heap<sub>724.1:742.8</sub>.p2)
!(0 == asType < integer > (\$heap_{724\ 1.742\ 8.p2}))
asType<integer>($heap<sub>724,1:742,8</sub>.p2) <
asType<integer>($heap<sub>724,1:742,8</sub>.M2)
Proof:
```

```
[Take given term]
[5.0] invariant1(heapIs heap_{funcstart\_724,1})
\rightarrow [expand definition of function 'invariant1' at prang.c (34,1)]
[5.1] ((((((0 < asType < integer > ($heap_{funcstart\_724,1}.p1)) &&
(\mathbf{asType} < \mathbf{integer} > (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p1}) <
asType < integer > (\$heap_{funcstart\_724,1}.M1))) \&\& (0 <
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p2})))~\&\&
(\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{p2}) <
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{M2})))~\&\&~(0<
asType < integer > (\$heap_{funcstart\_724,1}.p3))) \&\&
(asType < integer > ($heap_{funcstart\_724,1}.p3) < 
asType < integer > (\$heap_{funcstart\_724,1}.M3))
\rightarrow [simplify]
[5.3] (((((0 < $heap_{funcstart_724,1}.p1) && ($heap_{funcstart_724,1}.p1 < function for the content of the 
asType<integer>(sheap_{funcstart\_724,1}.M1))) && (0 <
asType < integer > (\$heap_{funcstart_{-724,1}}.p2))) \&\&
(\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{p2}) <
asType < integer > (\$heap_{funcstart\_724,1}.M2))) \&\& (0 < funcstart\_724,1.M2))
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p3})))\ \&\&
(asType < integer > (\$heap_{funcstart\_724.1}.p3) < 
\mathbf{asType} < \mathbf{integer} > (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{M3}))
\rightarrow [const static or extern object]
[5.4] (((((0 < $heap_{funcstart_{724,1}}.p1) && ($heap_{funcstart_{724,1}}.p1 < 
asType < integer > (\$heap_{init}.M1))) \&\& (0 <
asType < integer > (\$heap_{funcstart\_724,1}.p2))) \&\&
(\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{p2}) <
asType < integer > (\$heap_{funcstart\_724,1}.M2))) \&\& (0 <
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p3})))\ \&\&
(asType<integer>($heap_funcstart_724.1.p3) <
asType < integer > (\$heap_{funcstart\_724,1}.M3))
\rightarrow [expand definition of constant 'M1' at prang.c (14,20)]
[5.5] (((((0 < $heap_{funcstart_{724,1}}.p1) && ($heap_{funcstart_{724,1}}.p1 < 
asType<integer>(asType<short int>((int)30269)))) && (0 <
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p2})))\ \&\&
(\mathbf{asType} {<} \mathbf{integer} {>} (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p2}) <
asType < integer > (\$heap_{funcstart\_724,1}.M2))) \&\& (0 <
asType < integer > (\$heap_{funcstart\_724,1}.p3))) \&\&
(\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{p3}) <
asType < integer > (\$heap_{funcstart\_724,1}.M3))
\rightarrow [simplify]
[5.16] ((((-30269 < -$heap_{funcstart\_724,1}.p1) \lambda (0 < $heap_{funcstart\_724,1}.p1) \lambda
```

```
(0 < \text{\$heap}_{funcstart_{-724,1}.p2})) \&\& (\text{\$heap}_{funcstart_{-724,1}.p2} <
asType < integer > (\$heap_{funcstart\_724,1}.M2))) \&\& (0 <
asType < integer > (\$heap_{funcstart\_724,1}.p3))) \&\&
(asType < integer > ($heap_{funcstart\_724,1}.p3) < 
\mathbf{asType} < \mathbf{integer} > (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{M3}))
\rightarrow [const static or extern object]
[5.17] ((((-30269 < -$heap_{funcstart\_724,1}.p1) \lambda (0 < $heap_{funcstart\_724,1}.p1) \lambda
(0 < \text{\$heap}_{funcstart\_724,1}.p2)) \&\& (\text{\$heap}_{funcstart\_724,1}.p2 <
asType<integer>(heap_{init}.M2))) && (0 <
asType<integer>($heap_tuncstart_724.1.p3))) &&
(\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{p3}) <
asType < integer > (\$heap_{funcstart\_724,1}.M3))
\rightarrow [expand definition of constant 'M2' at prang.c (19,20)]
[5.18] \; ((((-30269 < -\$heap_{funcstart\_724,1}.p1) \; \land \; (0 < \$heap_{funcstart\_724,1}.p1) \; \land 
(0 < \text{Sheap}_{funcstart_{724,1},p2})) \&\& (\text{Sheap}_{funcstart_{724,1},p2} < 0
asType<integer>(asType<short int>((int)30307)))) && (0 <
asType < integer > (\$heap_{funcstart\_724,1}.p3))) \&\&
(\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{p3}) <
asType < integer > (\$heap_{tuncstart_{-724,1}}.M3))
\rightarrow [simplify]
[5.30] ((-30307 < -$heap_funcstart_724,1.p2) \land (-30269 <
-$heap_{funcstart\_724,1}.p1) \land (0 < $heap_{funcstart\_724,1}.p1) \land (0 <
\text{Sheap}_{funcstart\_724,1.p2} \land (0 < \text{Sheap}_{funcstart\_724,1.p3})) \&\&
(\text{\$heap}_{funcstart\_724,1}.p3 < asType < integer > (\text{\$heap}_{funcstart\_724,1}.M3))
\rightarrow [const static or extern object]
[5.31] ((-30307 < -$heap<sub>funcstart_724,1</sub>.p2) \wedge (-30269 <
-\$heap_{funcstart\_724,1}.p1) \land (0 < \$heap_{funcstart\_724,1}.p1) \land (0 < \$heap_{funcstart\_724,1}.p1)
\text{Sheap}_{funcstart\_724,1.p2}) \land (0 < \text{Sheap}_{funcstart\_724,1.p3})) \&\&
(\text{\$heap}_{funcstart\_724,1}.\text{p3} < \mathbf{asType} < \mathbf{integer} > (\text{\$heap}_{init}.\text{M3}))
\rightarrow [expand definition of constant 'M3' at prang.c (24,20)]
[5.32] ((-30307 < -$heap_funcstart_724,1.p2) \land (-30269 <
-\$heap_{funcstart\_724,1}.p1) \land (0 < \$heap_{funcstart\_724,1}.p1) \land (0 < \$heap_{funcstart\_724,1}.p1)
\$heap_{funcstart\_724,1}.p2) \land (0 < \$heap_{funcstart\_724,1}.p3)) \&\&
(\text{sheap}_{funcstart\_724,1}.\text{p3} < \text{asType} < \text{integer} > (\text{asType} < \text{short})
int > ((int)30323)))
\rightarrow [simplify]
[5.40] (-30323 < -\$heap_{funcstart\_724,1}.p3) \land (-30307 < -30307)
-\$heap_{funcstart\_724,1}.p2) \land (-30269 < -\$heap_{funcstart\_724,1}.p1) \land (0 < -\$heap_{funcstart\_724,1}.p1)
\text{Sheap}_{funcstart\_724,1}.\text{p1}) \land (0 < \text{Sheap}_{funcstart\_724,1}.\text{p2}) \land (0 <
heap_{funcstart_{-724,1}.p3}
```

```
[Work on sub-term 6 of conjunction in term 5.40]
[10.0] 0 < $heap_{tuncstart_{724,1}}.p3
[Take given term]
[39.0] \operatorname{div3} == \operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1},
asType < int > (\$heap_{funcstart\_724,1}.p3),
asType < int > (\$heap_{funcstart\_724,1}.a3))
\rightarrow [simplify]
[39.1] div3 == div(heapIs \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}.p3,
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{a3}))
\rightarrow [const static or extern object]
[39.2] \ \mathrm{div3} == \mathrm{div}(\mathbf{heapIs} \ \$ \mathrm{heap}_{funcstart\_724,1}, \ \$ \mathrm{heap}_{funcstart\_724,1}.\mathrm{p3},
asType < int > (\$heap_{init}.a3))
\rightarrow [expand definition of constant 'a3' at prang.c (26,20)]
[39.3] \operatorname{div3} == \operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.p3,
asType < int > (asType < short int > ((int)178)))
\rightarrow [simplify]
[39.6] div3 == div(heapIs heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p3, 178)
[Assume known post-assertion, class invariant or type constraint for term 39.6]
[42.0] (asType<integer>($heap_{tuncstart\_724.1}.p3) /
asType<integer>(178)) == asType<integer>(div(heapIs
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.p3, 178).quot
\rightarrow [simplify]
[42.2] ($heap<sub>funcstart_724,1.</sub>p3 / 178) == asType<integer>(div(heapIs)
\text{$heap}_{funcstart\_724,1}, \text{$heap}_{funcstart\_724,1}.\text{p3}, 178).\text{quot}
→ [expand definition of operator './' in class 'int' at built in declaration]
[42.3] ([asType<integer>($heap_{funcstart\_724,1}.p3) < 0]:
-(-asType < integer > (\$heap_{funcstart\_724,1}.p3) / 178), []:
asType < integer > (\$heap_{funcstart\_724,1}.p3) / 178) = =
\mathbf{asType} {<} \mathbf{integer} {>} ( \mathrm{div}(\mathbf{heapIs} \ \$ \mathrm{heap}_{funcstart\_724,1}, \ \$ \mathrm{heap}_{funcstart\_724,1}.\mathrm{p3},
178).quot)
→ [explicitly assert falsehood of skipped guards in subsequent guards]
[42.4] ([asType<integer>(heap_{funcstart\_724,1}.p3) < 0]:
-(-asType < integer > (\$heap_{funcstart\_724,1}.p3) / 178),
[!(\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{p3}) < 0)]:
asType < integer > (\$heap_{funcstart\_724,1}.p3) / 178) = =
\mathbf{asType} < \mathbf{integer} > (\mathbf{div}(\mathbf{heapIs} \ \$ \mathbf{heap}_{funcstart\_724,1}, \ \$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p3}, \\
178).quot)
```

```
\rightarrow [simplify]
[42.7] ([0 < -$heap<sub>funcstart_724,1.</sub>p3]:
-(-asType < integer > (\$heap_{funcstart\_724,1}.p3) / 178),
[!(\mathbf{asType} < \mathbf{integer} > (\$ heap_{funcstart\_724,1}.p3) < 0)]:
asType < integer > (\$heap_{funcstart\_724.1}.p3) / 178) = =
asType<integer>(div(heapIs heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p3,
178).quot)
\rightarrow [from term 10.0, literala < -$heap<sub>funcstart_724,1</sub>.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 > (\$heap_{funcstart\_724,1}.p3) / 178),
[!(asType < integer > (\$heap_{funcstart\_724,1}.p3) < 0)]:
asType < integer > ($heap_{funcstart\_724,1}.p3) / 178) ==
asType<integer>(div(heapIs $heap_{tuncstart\_724.1}, $heap_{tuncstart\_724.1}.p3,
178).quot)
\rightarrow [simplify]
[42.11] ([false]: -(-asType < integer > (\$heap_{funcstart\_724,1}.p3) / 178), [!(0 < integer > (\$heap_{funcstart\_724,1}.p3) / 178)]
-\$heap_{funcstart\_724,1}.p3)]: asType<integer>(\$heap_{funcstart\_724,1}.p3) / 178)
== asType<integer>(div(heapIs $heap_{tuncstart\_724,1},
heap_{funcstart_{-724,1}}.p3, 178).quot
\rightarrow [from term 10.0, literala < -$heap<sub>funcstart_724.1</sub>.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] \; ([\mathbf{false}]: \; -(\mathbf{-asType} < \mathbf{integer} > (\$ \mathrm{heap}_{funcstart\_724,1}.\mathrm{p3}) \; / \; 178),
[!false]: asType<integer>(\ensuremath{\text{sheap}}_{funcstart\_724,1}.p3) / 178) ==
\mathbf{asType} < \mathbf{integer} > (\mathbf{div}(\mathbf{heapIs} \ \$ \mathbf{heap}_{funcstart\_724,1}, \ \$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p3}, \\
178).quot)
\rightarrow [simplify]
[42.17] \ 0 == (-\text{div}(\mathbf{heapIs} \ \$ \text{heap}_{funcstart\_724,1}, \ \$ \text{heap}_{funcstart\_724,1}.\text{p3},
178).quot + (\text{$heap}_{funcstart\_724,1}.p3 / 178))
[Assume known post-assertion, class invariant or type constraint for term
42.17
```

```
[49.0] div(heapIs heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p3, 178).quot \leq
maxof(int)
\rightarrow [simplify]
\label{eq:condition} \mbox{$[49.9]$ -32768} < -{\rm div}(\mathbf{heapIs} \ \$ \mbox{$heap}_{funcstart\_724,1}, \ \$ \mbox{$heap}_{funcstart\_724,1}.\mbox{$p$},
178).quot
[Take goal term]
[1.0] asType<short int>(div3.quot) \le maxof(int)
\rightarrow [from term 39.6, div3 is equal to div(heapIs $heap_{funcstart_{724,1}},
heap_{funcstart_{-724,1}}.p3, 178
[1.1] asType<short int>(div(heapIs heap_{funcstart\_724,1},
\text{$heap}_{funcstart\_724,1.p3, 178}.\text{quot}) \leq \text{maxof(int)}
\rightarrow [simplify]
\label{eq:continuous} \mbox{[1.11] -32768} < -\mbox{div}(\mbox{\bf heapIs $\$heap}_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p3,
178).quot
\rightarrow [from term 49.9, literala < -div(\mathbf{heapIs} \ \$heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1}.p3, 178).quot is true whenever (-1 + \text{literala}) < -32768]
   Proof of rule precondition:
   [1.11.0](-32768 + -1) < -32768
   \rightarrow [simplify]
   [1.11.2] true
[1.12] true
Proof of verification condition: Type constraint satisfied in implicit
conversion from 'short int const' to 'int'
Condition generated at: C:\Escher\Customers\prang\prang.c (60,35)
Condition defined at:
To prove: minof(int) \le \$heap_{724,1:742.8}.b3
Given:
heap_{init}.LIMIT == (int)80
heap_{init}.M1 == asType < short int > ((int)30269)
heap_{init}.r1 == asType < short int > ((int)171)
heap_{init}.a1 == asType < short int > ((int)177)
\theta
\theta
\theta_{init}.r2 == asType < short int > ((int)172)
```

```
\theta
\theta
\theta = asType < short int > ((int)30323)
\theta_{init}.r3 == asType < short int > ((int)170)
heap_{init}.a3 == asType < short int > ((int)178)
heap_{init}.b3 == asType<short int>((int)63)
\theta = asType < short int > ((int)1)
\theta
\theta = asType < short int > ((int)3)
invariant
1<br/>( \mathbf{heapIs}\ \$ \mathbf{heap}_{funcstart\_724,1})
\operatorname{div1} == \operatorname{div}(\mathbf{heapIs} \ \operatorname{\$heap}_{funcstart\_724,1},
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p1}),
asType < int > (\$heap_{funcstart\_724,1}.a1))
(asType<int>(asType<int>($heap_{tuncstart\_724.1}.p1)) /
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a1))) = =
asType<integer>(div1.quot)
(asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.p1)) \%
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a1))) = =
asType<integer>(div1.rem)
!(0 == asType < integer > (div1.rem)) || !(0 ==
asType<integer>(div1.quot))
\label{eq:div2} \text{div2} == \text{div}(\mathbf{heapIs} \ \$ \text{heap}_{funcstart\_724,1},
\mathbf{asType} < \mathbf{int} > (\$ \mathrm{heap}_{funcstart\_724,1}.\mathrm{p2}),
asType < int > (\$heap_{funcstart\_724,1}.a2))
(asType<integer>(asType<int>($heap_{tuncstart\_724.1}.p2)) /
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a2))) = =
asType<integer>(div2.quot)
(asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.p2)) \%
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a2))) = =
asType<integer>(div2.rem)
!(0 == asType < integer > (div2.rem)) || !(0 ==
asType<integer>(div2.quot))
\mathrm{div3} == \mathrm{div}(\mathbf{heapIs} \ \$ \mathrm{heap}_{funcstart\_724,1},
\mathbf{asType} < \mathbf{int} > (\$ \mathrm{heap}_{funcstart\_724,1}.\mathrm{p3}),
asType < int > (\$heap_{funcstart\_724,1}.a3))
(asType<int>(asType<int>($heap_{tuncstart\_724.1}.p3)) /
\mathbf{asType}{<}\mathbf{integer}{>}(\mathbf{asType}{<}\mathbf{int}{>}(\$\mathbf{heap}_{funcstart\_724,1}.\mathbf{a3}))) = =
asType<integer>(div3.quot)
```

```
(\mathbf{asType}{<}\mathbf{int}{>}(\mathbf{asType}{<}\mathbf{int}{>}(\$\mathbf{heap}_{funcstart\_724,1}.\mathbf{p3}))~\%
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a3))) = =
asType<integer>(div3.rem)
!(0 == asType < integer > (div3.rem)) || !(0 ==
asType < integer > (div3.quot))
$heap_{724,1;740,8} == $heap_{funcstart\_724,1}.\_replace(p1 \rightarrow asType < short)
int>((asType<int>(asType<short int>(div1.rem)) *
asType < int > (\$heap_{funcstart\_724,1}.r1)) - (asType < int > (asType < short)
int>(div1.quot)) * asType< int>($heap_{funcstart\_724,1}.b1))))
-asType<integer const>($heap<sub>724,1;740,8</sub>.M1) <
asType<integer>($heap<sub>724,1:740,8</sub>.p1)
!(0 == asType < integer > (\$heap_{724,1:740.8}.p1))
asType<integer>($heap<sub>724,1:740,8</sub>.p1) <
asType<integer>($heap<sub>724,1:740,8</sub>.M1)
heap_{724,1;742,8} == heap_{724,1;740,8}.replace(p2 \rightarrow asType<short
int>((asType<int>(asType<short int>(div2.rem)) *
asType < int > (\$heap_{724.1:740.8}.r2)) - (asType < int > (asType < short)
\mathbf{int}{>}(\text{div2.quot})) * \mathbf{asType}{<} \mathbf{int}{>} (\$\text{heap}_{724,1;740,8}.\text{b2}))))
-\mathbf{asType}{<}\mathbf{integer\ const}{>}(\$\mathrm{heap}_{724,1;742,8}.\mathrm{M2}) <
asType<integer>($heap<sub>724,1:742,8</sub>.p2)
!(0 == asType < integer > (\$heap_{724,1;742,8}.p2))
asType<integer>($heap<sub>724,1:742,8</sub>.p2) <
asType<integer>($heap<sub>724,1;742,8</sub>.M2)
Proof:
[Take given term]
[11.0] \operatorname{div1} == \operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724,1},
asType < int > (\$heap_{funcstart\_724,1}.p1),
asType < int > (\$heap_{funcstart\_724,1}.a1))
\rightarrow [simplify]
[11.1] \text{ div1} == \text{div}(\mathbf{heapIs} \$ heap_{funcstart\_724,1}, \$ heap_{funcstart\_724,1}.p1,
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{a1}))
\rightarrow [const static or extern object]
[11.2] \ \mathrm{div1} == \mathrm{div}(\mathbf{heapIs} \ \$ \mathrm{heap}_{funcstart\_724,1}, \ \$ \mathrm{heap}_{funcstart\_724,1}.\mathrm{p1},
asType < int > (\$heap_{init}.a1))
\rightarrow [expand definition of constant 'a1' at prang.c (16,20)]
[11.3] \ \mathrm{div1} == \mathrm{div}(\mathbf{heapIs} \ \$ \mathrm{heap}_{funcstart\_724,1}, \ \$ \mathrm{heap}_{funcstart\_724,1}.\mathrm{p1},
asType<int>(asType<short int>((int)177)))
\rightarrow [simplify]
```

```
[11.6] div1 == div(heapIs \theta_{funcstart_{-724,1}}, \theta_{funcstart_{-724,1}}, p1, 177)
[Take given term]
[25.0] div2 == div(heapIs $heap_{funcstart\_724,1},
asType < int > (\$heap_{funcstart\_724,1}.p2),
asType < int > (\$heap_{funcstart\_724,1}.a2))
\rightarrow [simplify]
[25.1] div2 == div(heapIs \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}.p2,
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{a2}))
\rightarrow [const static or extern object]
[25.2] \operatorname{div2} == \operatorname{div}(\mathbf{heapIs} \operatorname{\$heap}_{funcstart\_724,1}, \operatorname{\$heap}_{funcstart\_724,1}.p2,
asType < int > (\$heap_{init}.a2))
\rightarrow [expand definition of constant 'a2' at prang.c (21,20)]
[25.3] div2 == div(heapIs $heap_{funcstart\_724.1}, $heap_{funcstart\_724.1}.p2,
asType<int>(asType<short int>((int)176)))
\rightarrow [simplify]
[25.6] \ \mathrm{div2} == \mathrm{div}(\mathbf{heapIs} \ \$ \mathrm{heap}_{funcstart\_724,1}, \ \$ \mathrm{heap}_{funcstart\_724,1}.\mathrm{p2}, \ 176)
[Take given term]
[53.0] heap_{724,1:740.8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow asType<short
int>((asType<int>(asType<short int>(div1.rem)) *
asType < int > (\$heap_{funcstart\_724,1}.r1)) - (asType < int > (asType < short)
int>(div1.quot)) * asType< int>($heap_{funcstart\_724,1}.b1))))
\rightarrow [from term 11.6, div1 is equal to div(heapIs $heap_{funcstart\_724,1},
heap_{funcstart_{-724,1}}.p1, 177
[53.1] \theta == 
int>((asType<int>(asType<short int>(div(heapIs $heap_{funcstart\_724,1},
\rho_{tuncstart\_724,1.p1, 177}.rem) * asType < int > (\rho_{tuncstart\_724,1.r1}) - (\rho_{tuncstart\_724,1.r1}
(asType<int>(asType<short int>(div1.quot)) *
asType < int > (\$heap_{funcstart\_724,1}.b1)))
\rightarrow [simplify]
[53.3] heap_{724,1;740,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow asType<short
int>((div(heapIs \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1, 177).rem *
asType < int > (\$heap_{funcstart\_724,1}.r1)) - (asType < int > (asType < short)
int>(div1.quot)) * asType< int>($heap_{funcstart\_724,1}.b1))))
\rightarrow [const static or extern object]
[53.4] \rho_{13,1;740,8} == \rho_{13,1;740,8} == \rho_{13,1;740,8} =- \rho_{
int>((div(heapIs \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1, 177).rem *
asType < int > (\$heap_{init}.r1)) - (asType < int > (asType < short)
int>(div1.quot)) * asType< int>($heap_{funcstart\_724,1}.b1))))
```

```
\rightarrow [expand definition of constant 'r1' at prang.c (15,20)]
[53.5] heap_{724,1:740,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow asType<short
int>((\text{div}(\mathbf{heapIs} \$ \text{heap}_{funcstart\_724,1}, \$ \text{heap}_{funcstart\_724,1}.\text{p1}, 177).\text{rem} *
asType<int>(asType<short int>((int)171))) -
(asType < int > (asType < short int > (div1.quot)) *
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{b1}))))
\rightarrow [simplify]
[53.8] heap_{724,1;740,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow asType<short
int>((div(heapIs \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1, 177).rem * 171)
- (asType<int>(asType<short int>(div1.quot)) *
asType < int > (\$heap_{funcstart\_724,1}.b1))))
\rightarrow [from term 11.6, div1 is equal to div(heapIs $heap_{tuncstart_724.1},
heap_{funcstart_{-724,1}}.p1, 177
[53.9] heap_{724,1:740,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow asType<short
int>((171 * div(heapIs $heap_{funcstart\_724,1}, $heap_{funcstart\_724,1}.p1, 177).rem)
- (asType<int>(asType<short int>(div(heapIs $heap_{funcstart_724.1},
heap_{funcstart_{724,1}}.p1, 177).quot) *
asType < int > (\$heap_{funcstart\_724,1}.b1))))
\rightarrow [simplify]
[53.11] heap_{724,1;740,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow asType<short
int>((171 * div(heapIs $heap_{funcstart\_724,1}, $heap_{funcstart\_724,1}.p1, 177).rem)
- (\text{div}(\mathbf{heapIs} \$ \text{heap}_{funcstart\_724,1}, \$ \text{heap}_{funcstart\_724,1}.\text{p1}, 177).\text{quot} *
asType < int > (\$heap_{funcstart\_724,1}.b1))))
\rightarrow [const static or extern object]
[53.12] \theta_{12} = \theta_{124,1;740,8} = \theta_{124,1;74
int>((171 * div(heapIs $heap_{funcstart\_724,1}, $heap_{funcstart\_724,1}.p1, 177).rem)
- (\text{div}(\mathbf{heapIs} \$ \text{heap}_{funcstart\_724.1}, \$ \text{heap}_{funcstart\_724.1}. \text{p1}, 177).\text{quot} *
asType < int > (\$heap_{init}.b1)))
\rightarrow [expand definition of constant 'b1' at prang.c (17,20)]
[53.13] \theta_{13} = \theta_
int>((171 * div(heapIs $heap_{funcstart\_724,1}, $heap_{funcstart\_724,1}.p1, 177).rem)
- (\text{div}(\mathbf{heapIs} \$ \text{heap}_{funcstart\_724,1}, \$ \text{heap}_{funcstart\_724,1}.\text{p1}, 177).\text{quot} *
asType<int>(asType<short int>((int)2))))
\rightarrow [simplify]
[53.19] \text{Sheap}_{724,1;740,8} == \text{Sheap}_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.\operatorname{p1}, \ 177).\operatorname{rem})))
[Take given term]
[57.0] $\text{heap}_{724,1:742,8} == $\text{heap}_{724,1:740.8}._\text{replace}(p2 \to \text{asType} < \text{short}
```

```
int>((asType<int>(asType<short int>(div2.rem)) *
asType < int > (\$heap_{724,1:740,8}.r2)) - (asType < int > (asType < short)
int>(div2.quot)) * asType<int>($heap<sub>724,1:740,8</sub>.b2))))
\rightarrow [from term 53.19, $heap<sub>724.1:740.8</sub> is equal to
heap_{funcstart\_724.1}._replace(p1 \rightarrow (-2 * div(heapIs heap_{funcstart\_724.1}),
heap_{funcstart\_724,1}.p1, 177).quot + (171 * div(heapIs $heap_{funcstart\_724,1}, 177).quot) + (171 * div(heapIs $heap_{funcstart\_724,1}, 17
heap_{funcstart\_724,1}.p1, 177).rem))
[57.1] heap_{724,1;742,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).quot) + (171 *
\operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724,1}, \$ \operatorname{heap}_{funcstart\_724,1}.p1,
177).rem))).\_replace(p2 \rightarrow asType < short
int>((asType<int>(asType<short int>(div2.rem)) *
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{724,1;740,8}.\mathrm{r2})) - (\mathbf{asType}{<}\mathbf{int}{>}(\mathbf{asType}{<}\mathbf{short}
int > (div2.quot)) * asType < int > ($heap_{724,1:740.8}.b2))))
\rightarrow [from term 25.6, div2 is equal to div(heapIs $heap_{funcstart\_724,1},
heap_{funcstart_{-724,1}}.p2, 176)
[57.2] $\text{heap}_{724,1;742,8} == $\text{heap}_{funcstart\_724,1}.$\text{-replace}(p1 \to ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 \ *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart} \ 724.1, \ \$ \operatorname{heap}_{funcstart} \ 724.1, \ p1,
177).rem)))._replace(p2 \rightarrow asType<short
int>((asType<int>(asType<short int>(div(heapIs $heap_{funcstart\_724.1},
\text{sheap}_{funcstart\_724,1.p2, 176}.\text{rem}) * asType < int > (\text{sheap}_{724,1.740,8.r2})) -
(asType<int>(asType<short int>(div2.quot)) *
asType<int>($heap<sub>724.1:740.8</sub>.b2))))
\rightarrow [simplify]
[57.4] heap_{724,1;742,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{$heap}_{funcstart\_724,1}, \ \text{$heap}_{funcstart\_724,1}.p1, \ 177).quot) + (171 *
\operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724,1}, \$ \operatorname{heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow asType<short int>((div(heapIs
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.p2, 176).rem *
asType < int > (\$heap_{724.1:740.8}.r2)) - (asType < int > (asType < short)
int>(div2.quot)) * asType<int>($heap<sub>724.1:740.8</sub>.b2))))
\rightarrow [from term 53.19, $heap<sub>724,1:740,8</sub> is equal to
heap_{funcstart\_724,1}._replace(p1 \rightarrow (-2 * div(heapIs $heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1}.\text{p1}, 177).\text{quot} + (171 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
$heap_{funcstart\_724,1}.p1, 177).rem))]
[57.5] $heap<sub>724,1;742,8</sub> == $heap<sub>funcstart_724,1</sub>._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow asType<short int>((div(heapIs
\theta_{funcstart_{724,1}}, \theta_{funcstart_{724,1},p2, 176}.rem *
asType<int>($heap<sub>funcstart_724,1</sub>._replace(p1 \rightarrow ((-2 * div(heapIs
```

```
\theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}
\text{Sheap}_{funcstart_{724,1}}, \text{Sheap}_{funcstart_{724,1},p1, 177).rem})).r2)) -
(asType<int>(asType<short int>(div2.quot)) *
asType < int > (\$heap_{724,1;740,8}.b2))))
→ [const member of object with modified fields]
[57.6] heap_{724,1;742,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).quot) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow asType<short int>((div(heapIs
\text{Sheap}_{funcstart_{-724,1}}, \text{Sheap}_{funcstart_{-724,1}}.p2, 176).rem *
asType < int > (\$heap_{funcstart\_724,1}.r2)) - (asType < int > (asType < short)
int>(div2.quot)) * asType<int>($heap<sub>724,1:740,8</sub>.b2))))
\rightarrow [const static or extern object]
[57.7] \rho_{17,742,8} == \rho_{17,742,1}.\_replace(p1 \rightarrow ((-2 * p1 + p1)))
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 \ *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow asType<short int>((div(heapIs
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.\text{p2}, 176).\text{rem} *
asType < int > (\$heap_{init}.r2)) - (asType < int > (asType < short)
int>(div2.quot)) * asType< int>($heap_{724.1:740.8}.b2))))
\rightarrow [expand definition of constant 'r2' at prang.c (20,20)]
[57.8] heap_{724,1;742,8} == heap_{funcstart\_724,1}.\_replace(p1 \to ((-2 * 
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 *
\operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724,1}, \$ \operatorname{heap}_{funcstart\_724,1}.p1,
(177).rem)._replace(p2 \rightarrow asType<short int>((div(heapIs))
heap_{funcstart_{-724,1}}, heap_{funcstart_{-724,1}}, 176).rem *
asType<int>(asType<short int>((int)172))) -
(asType < int > (asType < short int > (div2.quot)) *
asType<int>($heap<sub>724.1:740.8</sub>.b2))))
\rightarrow [simplify]
[57.11] $\text{heap}_{724,1:742,8} == \text{$heap}_{funcstart\_724,1}._\text{$replace}(p1 \to ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).quot) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow asType<short int>((div(heapIs
heap_{funcstart_{724,1}}, heap_{funcstart_{724,1}}.p2, 176).rem * 172) -
(asType<int>(asType<short int>(div2.quot)) *
asType<int>($heap<sub>724.1:740.8</sub>.b2))))
\rightarrow [from term 25.6, div2 is equal to div(heapIs $heap_{tuncstart\_724.1},
$heap_{tuncstart_{724,1}}.p2, 176)]
[57.12] $\text{heap}_{724,1;742,8} == \text{$heap}_{funcstart\_724,1}._\text{replace}(p1 \to ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 *
```

```
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow asType<short int>((172 * div(heapIs
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.p2, 176).rem) -
(asType<int>(asType<short int>(div(heapIs $heap_{funcstart_724,1},))
\text{Sheap}_{funcstart\_724,1}.\text{p2}, 176).\text{quot}) * asType<int>(\text{Sheap}_{724,1:740.8}.\text{b2}))))
\rightarrow [simplify]
[57.14] $\text{heap}_{724,1:742,8} == \text{$heap}_{funcstart\_724,1}._\text{$replace}(p1 \to ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).quot) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow asType<short int>((172 * div(heapIs
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.\text{p2}, 176).\text{rem}) - (\text{div}(\text{heapIs})
heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p2, 176).quot *
asType < int > (\$heap_{724,1;740,8}.b2))))
\rightarrow [from term 53.19, $heap<sub>724.1:740.8</sub> is equal to
heap_{funcstart\_724.1}._replace(p1 \rightarrow (-2 * div(heapIs heap_{funcstart\_724.1}),
heap_{funcstart\_724,1}.p1, 177).quot + (171 * div(heapIs p_{funcstart\_724,1}),
heap_{funcstart_{724,1}}.p1, 177).rem)
[57.15] $heap<sub>724,1;742,8</sub> == $heap<sub>funcstart_724,1</sub>._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}. p1, \ 177). \operatorname{quot}) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow asType<short int>((172 * div(heapIs
\theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}.p2, 176).rem) - (div(heapIs
\text{Sheap}_{funcstart_{-724,1}}, \text{Sheap}_{funcstart_{-724,1}}.p2, 176).quot *
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathbf{\_replace}(\mathrm{p1} \rightarrow ((\text{-}2 * \mathrm{div}(\mathbf{heapIs}
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.\text{p1}, 177).\text{quot}) + (171 * \text{div}(\text{heapIs}))
heap_{funcstart_{-724,1}}, heap_{funcstart_{-724,1}}, 177).rem)).b2))))
\rightarrow [const member of object with modified fields]
[57.16] heap_{724,1;742,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 \ *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow asType<short int>((172 * div(heapIs
\theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}.p2, 176).rem) - (div(heapIs
\theta_{funcstart_{724,1}}, \theta_{funcstart_{724,1}}, \theta_{funcstart_{724,1}}.p2, 176).quot
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{b2}))))
\rightarrow [const static or extern object]
[57.17] $heap<sub>724,1;742,8</sub> == $heap<sub>funcstart_724,1</sub>._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 *
\operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724.1}, \$ \operatorname{heap}_{funcstart\_724.1}.p1,
177).rem)))._replace(p2 \rightarrow asType<short int>((172 * div(heapIs
\theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}.p2, 176).rem) - (div(heapIs
heap_{funcstart_{724,1}}, heap_{funcstart_{724,1}}.p2, 176).quot *
asType < int > (\$heap_{init}.b2))))
```

```
\rightarrow [expand definition of constant 'b2' at prang.c (22,20)]
[57.18] $\text{heap}_{724,1:742,8} == \text{$heap}_{funcstart\_724,1}._\text{$replace}(p1 \to ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).quot) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow asType<short int>((172 * div(heapIs
\theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}
\theta_{funcstart_{724,1}}, \theta_{funcstart_{724,1}}, \theta_{funcstart_{724,1}}.p2, 176).quot
asType<int>(asType<short int>((int)35)))))
\rightarrow [simplify]
[57.24] $\text{heap}_{724,1;742,8} == \text{$heap}_{funcstart\_724,1}._\text{replace}(p1 \to ((-2 *
div(\mathbf{heapIs} \ \$heap_{funcstart\_724,1}, \ \$heap_{funcstart\_724,1}.p1, \ 177).quot) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow ((-35 * div(heapIs $heap_{tuncstart_724.1},
\text{Sheap}_{funcstart\_724.1.p2}, 176).\text{quot}) + (172 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724.1},
heap_{funcstart_{724,1}}.p2, 176).rem)
[Take goal term]
[1.0] minof(int) \leq $heap<sub>724.1:742.8</sub>.b3
\rightarrow [simplify]
[1.1] -32768 \leq $heap<sub>724.1:742.8</sub>.b3
\rightarrow [from term 57.24, $heap_{724,1;742,8}$ is equal to
heap_{funcstart\_724.1}._replace(p1 \rightarrow ((-2 * div(heapIs heap_{funcstart\_724.1}),
\text{Sheap}_{funcstart_{-724,1},p1, 177}.\text{quot}) + (171 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart_{-724,1}})
heap_{funcstart\_724,1}.p1, 177).rem))._replace(p2 \rightarrow (-35 * div(heapIs))
heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p2, 176).quot) + (172 * div(heapIs)
heap_{funcstart_{724,1}}, heap_{funcstart_{724,1}}, p2, 176).rem)
[1.2] -32768 \leq $heap<sub>funcstart_724,1</sub>._replace(p1 \rightarrow ((-2 * div(heapIs
\text{Sheap}_{funcstart\_724.1}, \text{Sheap}_{funcstart\_724.1}, \text{p1}, 177).\text{quot}) + (171 * \text{div}(\text{heapIs}))
\rho_{tuncstart}, \rho_{t
* div(heapIs heap_{funcstart_{724,1}}, heap_{funcstart_{724,1}}, 176).quot) + (172 *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.p2, \ 176).rem))).b3
\rightarrow [const member of object with modified fields]
[1.4] -32768 \leq $heap<sub>funcstart_724,1</sub>.b3
\rightarrow [const static or extern object]
[1.5] -32768 \le \text{$heap}_{init}.b3
\rightarrow [expand definition of constant 'b3' at prang.c (27,20)]
[1.6] -32768 \leq asType<short int>((int)63)
\rightarrow [simplify]
[1.9] true
```

```
conversion from 'short int const' to 'int'
Condition generated at: C:\Escher\Customers\prang\prang.c (60,35)
Condition defined at:
To prove: heap_{724,1;742,8}.b3 \le maxof(int)
Given:
heap_{init}.LIMIT == (int)80
\theta
\theta_{init}.r1 == asType < short int > ((int)171)
\theta sheap<sub>init</sub>.a1 == asType<short int>((int)177)
\theta
heap_{init}.M2 == asType < short int > ((int)30307)
\rho_{init}.r2 == asType < short int > ((int)172)
heap_{init}.a2 == asType < short int > ((int)176)
\theta = asType < short int > ((int)35)
heap_{init}.M3 == asType < short int > ((int)30323)
\theta
heap_{init}.a3 == asType < short int > ((int)178)
\theta = asType < short int > ((int)63)
\theta = asType < short int > ((int)1)
\theta
\theta = asType < short int > ((int)3)
invariant1(heapIs heap_{funcstart\_724,1})
\operatorname{div1} == \operatorname{div}(\mathbf{heapIs} \ \operatorname{\$heap}_{funcstart\_724,1},
asType < int > (\$heap_{funcstart\_724,1}.p1),
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{a1}))
(\mathbf{asType}{<}\mathbf{int}{>}(\mathbf{asType}{<}\mathbf{int}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{p1})) \ / \\
asType < integer > (asType < int > (\$heap_{funcstart\_724.1}.a1))) = =
asType<integer>(div1.quot)
(\mathbf{asType} {<} \mathbf{int} {>} (\mathbf{asType} {<} \mathbf{int} {>} (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p1})) \ \%
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a1))) = =
asType<integer>(div1.rem)
!(0 == asType < integer > (div1.rem)) || !(0 ==
asType<integer>(div1.quot))
div2 == div(\mathbf{heapIs} \$heap_{funcstart\_724,1},
```

**Proof of verification condition:** Type constraint satisfied in implicit

```
asType < int > (\$heap_{funcstart\_724,1}.p2),
asType < int > (\$heap_{funcstart\_724,1}.a2))
(\mathbf{asType}{<}\mathbf{integer}{>}(\mathbf{asType}{<}\mathbf{int}{>}(\$\mathbf{heap}_{funcstart\_724,1}.\mathbf{p2})) \ / \\
asType<integer>(asType<int>($heap_{tuncstart\_724.1}.a2))) ==
asType<integer>(div2.quot)
(asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.p2)) \%
\mathbf{asType} {<} \mathbf{integer} {>} (\mathbf{asType} {<} \mathbf{int} {>} (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{a2}))) = =
asType<integer>(div2.rem)
!(0 == asType < integer > (div2.rem)) || !(0 ==
asType<integer>(div2.quot))
div3 == div(\mathbf{heapIs} \$ heap_{funcstart_{-724.1}},
asType < int > (\$heap_{funcstart_{-724.1}}.p3),
asType < int > (\$heap_{funcstart\_724,1}.a3))
(\mathbf{asType}{<}\mathbf{int}{>}(\mathbf{asType}{<}\mathbf{int}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{p3}))\ /
asType < integer > (asType < int > (\$heap_{funcstart\_724.1}.a3))) = =
asType<integer>(div3.quot)
(asType < int > (asType < int > (\$heap_{funcstart\_724,1}.p3)) \%
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a3))) = =
asType<integer>(div3.rem)
!(0 == asType < integer > (div3.rem)) || !(0 ==
asType<integer>(div3.quot))
heap_{724,1:740.8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow asType<short
int>((asType<int>(asType<short int>(div1.rem)) *
asType < int > (\$heap_{funcstart\_724,1}.r1)) - (asType < int > (asType < short)
\mathbf{int}{>}(\mathbf{div1.quot})) * \mathbf{asType}{<} \mathbf{int}{>} (\$\mathbf{heap}_{funcstart\_724,1}.\mathbf{b1}))))
-asType < integer\ const > (\$heap_{724,1;740,8}.M1) < 1
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathrm{heap}_{724,1;740,8}.\mathrm{p1})
!(0 == asType < integer > (\$heap_{724,1:740.8}.p1))
asType<integer>($heap<sub>724.1:740.8</sub>.p1) <
asType<integer>($heap<sub>724.1:740.8</sub>.M1)
\text{$heap}_{724,1;742,8} == \text{$heap}_{724,1;740,8}.replace(p2 \to asType < short)
int>((asType<int>(asType<short int>(div2.rem)) *
\mathbf{asType} < \mathbf{int} > (\$ heap_{724,1;740,8}.r2)) - (\mathbf{asType} < \mathbf{int} > (\mathbf{asType} < \mathbf{short})
int>(div2.quot)) * asType<int>($heap<sub>724.1:740.8</sub>.b2))))
-asType<integer const>($heap_{724,1:742,8}.M2) <
asType < integer > ($heap_{724,1;742,8}.p2)
!(0 == asType < integer > (\$heap_{724,1;742,8}.p2))
asType<integer>($heap<sub>724,1:742,8</sub>.p2) <
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathrm{heap}_{724,1;742,8}.\mathrm{M2})
```

## **Proof:**

```
[Take given term]
[11.0] \text{ div1} == \text{div}(\mathbf{heapIs} \$ \text{heap}_{funcstart\_724,1},
asType < int > (\$heap_{funcstart\_724,1}.p1),
asType < int > (\$heap_{funcstart\_724,1}.a1))
\rightarrow [simplify]
[11.1] \operatorname{div1} == \operatorname{div}(\mathbf{heapIs} \operatorname{\$heap}_{funcstart\_724,1}, \operatorname{\$heap}_{funcstart\_724,1}.p1,
asType < int > (\$heap_{funcstart\_724,1}.a1))
\rightarrow [const static or extern object]
[11.2] \ \mathrm{div1} == \mathrm{div}(\mathbf{heapIs} \ \$ \mathrm{heap}_{funcstart\_724,1}, \ \$ \mathrm{heap}_{funcstart\_724,1}.\mathrm{p1},
asType < int > (\$heap_{init}.a1))
\rightarrow [expand definition of constant 'a1' at prang.c (16,20)]
[11.3] \ \mathrm{div1} == \mathrm{div}(\mathbf{heapIs} \ \$ \mathrm{heap}_{funcstart\_724,1}, \ \$ \mathrm{heap}_{funcstart\_724,1}.\mathrm{p1},
asType<int>(asType<short int>((int)177)))
\rightarrow [simplify]
[11.6] \text{ div1} == \text{div}(\mathbf{heapIs} \$ heap_{funcstart\_724,1}, \$ heap_{funcstart\_724,1}.p1, 177)
[Take given term]
[25.0] div2 == div(heapIs $heap_{funcstart\_724,1},
asType < int > (\$heap_{funcstart\_724,1}.p2),
asType < int > (\$heap_{funcstart\_724,1}.a2))
\rightarrow [simplify]
[25.1] div2 == div(heapIs \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}.p2,
asType < int > (\$heap_{funcstart\_724,1}.a2))
\rightarrow [const static or extern object]
[25.2] div2 == div(heapIs $heap_{funcstart\_724.1}, $heap_{funcstart\_724.1}.p2,
asType < int > (\$heap_{init}.a2))
\rightarrow [expand definition of constant 'a2' at prang.c (21,20)]
[25.3] \operatorname{div2} == \operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.p2,
asType<int>(asType<short int>((int)176)))
\rightarrow [simplify]
[25.6] \text{ div2} == \text{div}(\text{heapIs } \text{$heap}_{funcstart\_724,1}, \text{$heap}_{funcstart\_724,1}.p2, 176)
[Take given term]
[53.0] \text{sheap}_{724,1;740,8} == \text{sheap}_{funcstart\_724,1}.\_replace(p1 \rightarrow asType < short)
int>((asType<int>(asType<short int>(div1.rem)) *
\mathbf{asType} \small{<} \mathbf{int} \small{>} (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{r1})) - (\mathbf{asType} \small{<} \mathbf{int} \small{>} (\mathbf{asType} \small{<} \mathbf{short}
\mathbf{int}{>}(\mathbf{div1}.\mathbf{quot})) \ * \ \mathbf{asType}{<} \mathbf{int}{>}(\$\mathbf{heap}_{funcstart\_724,1}.\mathbf{b1}))))
```

```
\rightarrow [from term 11.6, div1 is equal to div(heapIs $heap_{funcstart\_724,1},
heap_{funcstart_{-724,1}}.p1, 177)
[53.1] heap_{724,1:740,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow asType<short
int>((asType<int>(asType<short int>(div(heapIs $heap_{tuncstart\_724.1},
\theta_{tuncstart_{-724,1},p1,177,rem} * asType<int>($\text{heap}_{tuncstart_{-724,1},r1}$) -
(asType<int>(asType<short int>(div1.quot)) *
asType < int > (\$heap_{funcstart\_724,1}.b1))))
\rightarrow [simplify]
[53.3] \theta == 
int>((div(heapIs \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1, 177).rem *
asType < int > (\$heap_{tuncstart\_724.1}.r1)) - (asType < int > (asType < short)
int>(div1.quot)) * asType<int>($heap_{funcstart\_724,1}.b1)))
\rightarrow [const static or extern object]
[53.4] heap_{724,1:740,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow asType<short
int>((div(heapIs \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1, 177).rem *
asType < int > (\$heap_{init}.r1)) - (asType < int > (asType < short)
\mathbf{int}{>}(\mathbf{div1.quot})) * \mathbf{asType}{<} \mathbf{int}{>} (\$\mathbf{heap}_{funcstart\_724,1}.\mathbf{b1}))))
\rightarrow [expand definition of constant 'r1' at prang.c (15,20)]
[53.5] \rho_{1740,8} == \rho_{1740,8} == \rho_{1740,8} == \rho_{1740,8} - \rho_{1740,8} == \rho_{1740,8} == \rho_{1740,8} - \rho_{1740,8} == \rho_{1740,8} 
int>((div(heapIs \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1, 177).rem *
asType<int>(asType<short int>((int)171))) -
(asType<int>(asType<short int>(div1.quot)) *
asType < int > (\$heap_{funcstart\_724.1}.b1))))
\rightarrow [simplify]
[53.8] \text{sheap}_{724,1;740,8} == \text{sheap}_{funcstart\_724,1}.\_replace(p1 \rightarrow asType < short)
int > ((div(heapIs \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1, 177).rem * 171)
- (asType<int>(asType<short int>(div1.quot)) *
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{b1}))))
\rightarrow [from term 11.6, div1 is equal to div(heapIs $heap_{funcstart_724,1},
heap_{funcstart_{724,1}}.p1, 177
[53.9] \rho_{13,1;740,8} == \rho_{13,1;740,8} == \rho_{13,1;740,8} =- \rho_{
int>((171 * div(heapIs \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1, 177).rem)
- (asType<int>(asType<short int>(div(heapIs $heap_{funcstart_724.1},
heap_{funcstart_{724,1}}.p1, 177).quot) *
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{b1}))))
\rightarrow [simplify]
[53.11] \$ heap_{724,1;740,8} == \$ heap_{funcstart\_724,1}.\_\mathbf{replace} (p1 \to \mathbf{asType} < \mathbf{short})
int>((171 * div(heapIs $heap_{funcstart\_724,1}, $heap_{funcstart\_724,1}.p1, 177).rem)
- (\text{div}(\mathbf{heapIs} \$ \text{heap}_{funcstart\_724,1}, \$ \text{heap}_{funcstart\_724,1}.\text{p1}, 177).\text{quot} *
asType < int > (\$heap_{funcstart\_724,1}.b1))))
```

```
\rightarrow [const static or extern object]
[53.12] \rho_{12} \rho_{13} == 
int>((171 * div(heapIs $heap_{funcstart\_724,1}, $heap_{funcstart\_724,1}.p1, 177).rem)
- (div(heapIs heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p1, 177).quot *
asType < int > (\$heap_{init}.b1)))
\rightarrow [expand definition of constant 'b1' at prang.c (17,20)]
[53.13] $\text{heap}_{724,1:740.8} == $\text{heap}_{funcstart\_724,1}._\text{replace}(p1 \rightarrow \text{asType} < \text{short}
\mathbf{int} > ((171 * \operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724,1}, \$ \operatorname{heap}_{funcstart\_724,1}.\operatorname{p1}, 177).\operatorname{rem})
- (\text{div}(\mathbf{heapIs} \$ \text{heap}_{funcstart\_724,1}, \$ \text{heap}_{funcstart\_724,1}.\text{p1}, 177).\text{quot} *
asType < int > (asType < short int > ((int)2))))
\rightarrow [simplify]
[53.19] \text{Sheap}_{724,1;740,8} == \text{Sheap}_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \text{$heap}_{funcstart\_724,1}, \ \text{$heap}_{funcstart\_724,1}.p1, \ 177).rem)))
[Take given term]
[57.0] $\text{heap}_{724,1:742,8} == $\text{heap}_{724,1:740.8}.$\text{-replace}(p2 \to asType < short)
int>((asType<int>(asType<short int>(div2.rem)) *
asType < int > (\$heap_{724.1:740.8}.r2)) - (asType < int > (asType < short)
int>(div2.quot)) * asType<int>($heap<sub>724,1:740,8</sub>.b2))))
\rightarrow [from term 53.19, $heap_{724,1;740,8}$ is equal to
heap_{funcstart\_724.1}._replace(p1 \rightarrow (-2 * div(heapIs heap_{funcstart\_724.1}),
heap_{funcstart_{724,1},p1, 177}, quot) + (171 * div(heapIs p_{funcstart_{724,1},p1, 177}), quot)
heap_{funcstart_{724,1}.p1, 177).rem}
[57.1] $\text{heap}_{724,1;742,8} == $\text{heap}_{funcstart\_724,1}.$\text{-replace}(p1 \to ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 *
\label{eq:div_heap} \text{div}(\textbf{heapIs} \ \$ \text{heap}_{funcstart\_724,1}, \ \$ \text{heap}_{funcstart\_724,1}.\text{p1},
(177).rem))._replace(p2 \rightarrow asType<short
int>((asType<int>(asType<short int>(div2.rem)) *
\mathbf{asType} \small{<} \mathbf{int} \small{>} (\$ \mathrm{heap}_{724,1;740,8}.\mathrm{r2})) \\ - (\mathbf{asType} \small{<} \mathbf{int} \small{>} (\mathbf{asType} \small{<} \mathbf{short}
int>(div2.quot)) * asType<int>($heap<sub>724.1:740.8</sub>.b2))))
\rightarrow [from term 25.6, div2 is equal to div(heapIs $heap_{funcstart_724,1},
heap_{funcstart_{-724,1},p2,176}
[57.2] $\text{heap}_{724,1;742,8} == $\text{heap}_{funcstart\_724,1}._\text{replace}(p1 \to ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).quot) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1,
(177).rem))._replace(p2 \rightarrow asType < short)
int>((asType<int>(asType<short int>(div(heapIs $heap_{funcstart\_724,1},))
\text{sheap}_{funcstart\_724,1}.\text{p2}, 176).\text{rem}) * asType < int > (\text{sheap}_{724,1;740,8}.\text{r2})) -
(asType<int>(asType<short int>(div2.quot)) *
asType<int>($heap<sub>724.1:740.8</sub>.b2))))
\rightarrow [simplify]
```

```
[57.4] heap_{724,1;742,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 \ *
\label{eq:div_heap} \text{div}(\textbf{heapIs} \ \$ \text{heap}_{funcstart\_724,1}, \ \$ \text{heap}_{funcstart\_724,1}.\text{p1},
(177).rem))._replace(p2 \rightarrow asType<short int>((div(heapIs)))._replace(p2 \rightarrow asType
\theta_{funcstart_{724,1}}, \theta_{funcstart_{724,1}}, \theta_{funcstart_{724,1}}.p2, 176).rem *
asType < int > (\$heap_{724,1:740.8}.r2)) - (asType < int > (asType < short)
int>(div2.quot)) * asType<int>($heap<sub>724.1:740.8</sub>.b2))))
\rightarrow [from term 53.19, $heap<sub>724,1;740,8</sub> is equal to
heap_{funcstart\_724.1}._replace(p1 \rightarrow (-2 * div(heapIs $heap_{funcstart\_724.1},
heap_{funcstart\_724,1}.p1, 177).quot + (171 * div(heapIs $heap_{funcstart\_724,1}, 177).quot) + (171 * div(heapIs $heap_{funcstart\_724,1}, 17
heap_{funcstart_{-724,1}.p1, 177).rem}
[57.5] \rho_{17.5} = \rho_
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 \ *
\operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724,1}, \$ \operatorname{heap}_{funcstart\_724,1}.p1,
177).rem)))._{\mathbf{replace}}(p2 \rightarrow \mathbf{asType} < \mathbf{short\ int} > ((\operatorname{div}(\mathbf{heapIs}))))
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.\text{p2}, 176).\text{rem} *
asType < int > (\$heap_{funcstart\_724,1}.\_replace(p1 \rightarrow ((-2 * div(heapIs)))))))
heap_{funcstart_{724,1}}, heap_{funcstart_{724,1}}, 177).quot) + (171 * div(heapIs)
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.p1, 177).rem))).r2)) -
(asType<int>(asType<short int>(div2.quot)) *
asType<int>($heap<sub>724.1:740.8</sub>.b2))))
\rightarrow [const member of object with modified fields]
[57.6] heap_{724,1;742,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.p1,
177).rem)))._{\mathbf{replace}}(p2 \rightarrow \mathbf{asType} < \mathbf{short\ int} > ((\operatorname{div}(\mathbf{heapIs}))))
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.p2, 176).rem *
asType < int > (\$heap_{funcstart\_724,1}.r2)) - (asType < int > (asType < short)
int>(div2.quot)) * asType<int>($heap<sub>724.1:740.8</sub>.b2))))
\rightarrow [const static or extern object]
[57.7] heap_{724,1;742,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724.1}, \ \$ \operatorname{heap}_{funcstart\_724.1}.p1,
177).rem)))._{\mathbf{replace}}(p2 \rightarrow \mathbf{asType} < \mathbf{short\ int} > ((\operatorname{div}(\mathbf{heapIs}))))
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.p2, 176).rem *
asType < int > (\$heap_{init}.r2)) - (asType < int > (asType < short)
int > (div2.quot)) * asType < int > (\$heap_{724,1;740,8}.b2))))
\rightarrow [expand definition of constant 'r2' at prang.c (20,20)]
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).quot) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow asType<short int>((div(heapIs
```

```
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.p2, 176).rem *
asType<int>(asType<short int>((int)172))) -
(asType<int>(asType<short int>(div2.quot)) *
asType < int > (\$heap_{724,1;740,8}.b2))))
\rightarrow [simplify]
[57.11] $heap<sub>724,1;742,8</sub> == $heap<sub>funcstart_724,1</sub>._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).quot) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow asType<short int>((div(heapIs
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.p2, 176).rem * 172) -
(asType<int>(asType<short int>(div2.quot)) *
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{724,1;740,8}.\mathrm{b2}))))
\rightarrow [from term 25.6, div2 is equal to div(heapIs $heap_{tuncstart_{724.1}},
heap_{funcstart_{-724,1}}.p2, 176
[57.12] $heap<sub>724,1;742,8</sub> == $heap<sub>funcstart_724,1</sub>._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 *
\operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724,1}, \$ \operatorname{heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow asType<short int>((172 * div(heapIs
heap_{funcstart_{-724,1}}, heap_{funcstart_{-724,1}}, p_{176}.rem) -
(asType < int > (asType < short int > (div(heapIs $heap_{funcstart\_724,1}, 
\text{sheap}_{funcstart\_724,1.p2}, 176).\text{quot}) * asType<int>(\text{sheap}_{724,1;740,8}.\text{b2}))))
\rightarrow [simplify]
[57.14] $heap<sub>724,1;742,8</sub> == $heap<sub>funcstart_724,1</sub>._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 *
\operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724,1}, \$ \operatorname{heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow asType<short int>((172 * div(heapIs
\theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}.
heap_{funcstart_{724,1}}, heap_{funcstart_{724,1}}, 2, 176).quot *
asType<int>($heap<sub>724.1:740.8</sub>.b2))))
\rightarrow [from term 53.19, $heap<sub>724,1;740,8</sub> is equal to
heap_{funcstart\_724,1}._replace(p1 \rightarrow (-2 * div(heapIs $heap_{funcstart\_724,1},
heap_{funcstart_{724,1},p1, 177}, quot) + (171 * div(heapIs p_{funcstart_{724,1},p1, 177}).
heap_{funcstart_{724,1},p1,177,rem})
[57.15] $\text{heap}_{724.1:742.8} == \text{$heap}_{funcstart_724.1}._\text{replace}(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}. p1, \ 177). \operatorname{quot}) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow asType<short int>((172 * div(heapIs
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.\text{p2}, 176).\text{rem}) - (\text{div}(\text{heapIs}))
heap_{funcstart_{724,1}}, heap_{funcstart_{724,1}}, 2, 176).quot *
asType < int > (\$heap_{funcstart\_724,1}.\_replace(p1 \rightarrow ((-2 * div(heapIs))))))
\theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.p1, 177).rem))).b2))))
```

```
\rightarrow [const member of object with modified fields]
[57.16] $\text{heap}_{724,1:742,8} == \text{$heap}_{funcstart\_724,1}._\text{$replace}(p1 \to ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).quot) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow asType<short int>((172 * div(heapIs
heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p2, 176).rem) - (div(heapIs
\theta_{funcstart_{724,1}}, \theta_{funcstart_{724,1}}, \theta_{funcstart_{724,1}}.p2, 176).quot
\mathbf{asType} < \mathbf{int} > (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{b2}))))
\rightarrow [const static or extern object]
[57.17] $\text{heap}_{724,1;742,8} == \text{$heap}_{funcstart\_724,1}._\text{replace}(p1 \to ((-2 *
div(\mathbf{heapIs} \ \$heap_{funcstart\_724,1}, \ \$heap_{funcstart\_724,1}.p1, \ 177).quot) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow asType<short int>((172 * div(heapIs
\theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}.p2, 176).rem) - (div(heapIs
\text{Sheap}_{funcstart_{724,1}}, \text{Sheap}_{funcstart_{724,1}}, p2, 176).quot *
asType < int > (\$heap_{init}.b2))))
\rightarrow [expand definition of constant 'b2' at prang.c (22,20)]
[57.18] heap_{724,1;742,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).quot) + (171 *
\operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724.1}, \$ \operatorname{heap}_{funcstart\_724.1}.p1,
177).rem)))._replace(p2 \rightarrow asType<short int>((172 * div(heapIs
\theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}.p2, 176).rem) - (div(heapIs
\theta_{funcstart_{724,1}}, \theta_{funcstart_{724,1},p2}, 176).quot *
asType<int>(asType<short int>((int)35)))))
\rightarrow [simplify]
[57.24] $\text{heap}_{724,1;742,8} == \text{$heap}_{funcstart\_724,1}._\text{$replace}(p1 \to ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow ((-35 * div(heapIs $heap_{funcstart_724.1},
\text{Sheap}_{funcstart\_724,1.p2}, 176).\text{quot} + (172 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
heap_{funcstart_{-724,1}.p2, 176).rem)
[Take goal term]
[1.0] $heap<sub>724,1;742,8</sub>.b3 \leq maxof(int)
\rightarrow [from term 57.24, $heap_{724,1;742,8} is equal to
heap_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 * div(heapIs $heap_{funcstart\_724,1},
heap_{funcstart_{724,1},p1, 177}, quot) + (171 * div(heapIs p_{funcstart_{724,1},p1, 177}).
heap_{funcstart\_724,1}.p1, 177).rem))).\_replace(p2 \rightarrow (-35 * div(heapIs))).
heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p2, 176).quot) + (172 * div(heapIs)
heap_{funcstart_{724,1}}, heap_{funcstart_{724,1}}, 2, 176).rem
[1.1] \text{heap}_{funcstart\_724.1}._replace(p1 \rightarrow ((-2 * div(heapIs \text{heap}_{funcstart\_724.1}),
\text{Sheap}_{funcstart\_724,1.p1}, 177).\text{quot} + (171 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
```

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\rho_{funcstart\_724,1.p1, 177}.rem).-replace(p2 \rightarrow ((-35 * div(heapIs
heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p2, 176).quot) + (172 * div(heapIs
\theta_{funcstart_{724,1}}, \theta_{funcstart_{724,1},p2, 176}.rem)).b3 \theta_{funcstart_{724,1}}.p2, 176).rem
\rightarrow [const member of object with modified fields]
[1.3] heap_{funcstart\_724,1}.b3 \leq maxof(int)
\rightarrow [const static or extern object]
[1.4] heap_{init}.b3 \leq maxof(int)
\rightarrow [expand definition of constant 'b3' at prang.c (27,20)]
[1.5] asType<short int>((int)63) \le maxof(int)
\rightarrow [simplify]
[1.9] true
Proof of verification condition: Arithmetic result of operator '*' is within
limit of type 'int'
Condition generated at: C:\Escher\Customers\prang\prang.c (60,38)
Condition defined at:
To prove: minof(int) \le (asType<int>(asType<short int>(div3.quot)) *
asType < int > (\$heap_{724,1;742,8}.b3))
Given:
heap_{init}.LIMIT == (int)80
heap_{init}.M1 == asType < short int > ((int)30269)
\theta_{init}.r1 == asType < short int > ((int)171)
heap_{init}.a1 == asType < short int > ((int)177)
heap_{init}.M2 == asType < short int > ((int)30307)
\theta_{init}.r2 == asType<short int>((int)172)
\theta_{init}.a2 == asType<short int>((int)176)
heap_{init}.b2 == asType<short int>((int)35)
heap_{init}.M3 == asType < short int > ((int)30323)
heap_{init}.r3 == asType < short int > ((int)170)
heap_{init}.a3 == asType < short int > ((int)178)
\theta = asType < short int > ((int)63)
\theta = asType < short int > ((int)1)
\theta
```

```
\theta = asType < short int > ((int)3)
invariant1(heapIs $heap_{tuncstart_724.1})
\operatorname{div1} == \operatorname{div}(\mathbf{heapIs} \ \operatorname{\$heap}_{funcstart\_724,1},
asType < int > (\$heap_{funcstart\_724,1}.p1),
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{a1}))
(\mathbf{asType}{<}\mathbf{integer}{>}(\mathbf{asType}{<}\mathbf{int}{>}(\$\mathbf{heap}_{funcstart\_724,1}.\mathbf{p1})) \ / \\
\mathbf{asType}{<}\mathbf{integer}{>}(\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{a1}))) = =
asType<integer>(div1.quot)
(\mathbf{asType} < \mathbf{integer} > (\mathbf{asType} < \mathbf{int} > (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p1})) \ \%
asType<integer>(asType<int>($heap_{tuncstart\_724.1}.a1))) ==
asType<integer>(div1.rem)
!(0 == asType < integer > (div1.rem)) || !(0 ==
asType<integer>(div1.quot))
div2 == div(\mathbf{heapIs} \$heap_{funcstart\_724,1},
asType < int > (\$heap_{funcstart\_724,1}.p2),
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{a2}))
(\mathbf{asType}{<}\mathbf{integer}{>}(\mathbf{asType}{<}\mathbf{int}{>}(\$\mathbf{heap}_{funcstart\_724,1}.\mathbf{p2})) \ / \\
asType < integer > (asType < int > (\$heap_{funcstart_{-724,1}}.a2))) = =
asType<integer>(div2.quot)
(\mathbf{asType} < \mathbf{integer} > (\mathbf{asType} < \mathbf{int} > (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p2})) \ \%
asType < integer > (asType < int > (\$heap_{funcstart\_724.1}.a2))) = =
asType<integer>(div2.rem)
!(0 == asType < integer > (div2.rem)) || !(0 ==
asType<integer>(div2.quot))
div3 == div(\mathbf{heapIs} \$heap_{funcstart\_724,1},
asType < int > (\$heap_{funcstart\_724,1}.p3),
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{a3}))
(asType < int > (sheap_{funcstart\_724,1}.p3)) / 
asType < integer > (asType < int > (\$heap_{funcstart_{-724,1}}.a3))) = =
asType<integer>(div3.quot)
(\mathbf{asType} < \mathbf{integer} > (\mathbf{asType} < \mathbf{int} > (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p3})) \%
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a3))) = =
asType<integer>(div3.rem)
!(0 == asType < integer > (div3.rem)) || !(0 ==
asType<integer>(div3.quot))
$heap_{724,1;740,8} == $heap_{funcstart\_724,1}.\_replace(p1 \rightarrow asType < short)
int>((asType<int>(asType<short int>(div1.rem)) *
asType < int > (\$heap_{funcstart\_724,1}.r1)) - (asType < int > (asType < short)
int>(div1.quot)) * asType< int>($heap_{tuncstart\_724.1}.b1))))
```

```
-asType<integer const>($heap<sub>724.1:740.8</sub>.M1) <
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathrm{heap}_{724,1;740,8}.\mathrm{p1})
!(0 == \mathbf{asType} {<} \mathbf{integer} {>} (\$ \mathrm{heap}_{724,1;740,8}.\mathrm{p1}))
asType<integer>($heap<sub>724,1;740,8</sub>.p1) <
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathrm{heap}_{724,1;740,8}.\mathrm{M1})
heap_{724,1:742,8} == heap_{724,1:740,8}.replace(p2 \rightarrow asType<short
int>((asType<int>(asType<short int>(div2.rem)) *
asType < int > (\$heap_{724,1:740,8}.r2)) - (asType < int > (asType < short)
int>(div2.quot)) * asType<int>($heap<sub>724,1:740,8</sub>.b2))))
-asType<integer const>($heap<sub>724.1:742.8</sub>.M2) <
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathrm{heap}_{724,1;742,8}.\mathrm{p2})
!(0 == asType < integer > (\$heap_{724,1:742.8}.p2))
asType < integer > ($heap_{724,1;742,8}.p2) < 
asType<integer>($heap<sub>724,1.742,8</sub>.M2)
Proof:
[Take given term]
[5.0] invariant1(heapIs heap_{funcstart\_724,1})
\rightarrow [expand definition of function 'invariant1' at prang.c (34,1)]
 \texttt{[5.1]} \left( \left( \left( \left( \left( 0 < \mathbf{asType} < \mathbf{integer} > \left( \$ \mathsf{heap}_{funcstart\_724,1}.\mathsf{p1} \right) \right) \right. \&\& \right. \right. 
(asType < integer > (\$heap_{funcstart\_724,1}.p1) < 
asType < integer > (\$heap_{funcstart_{-724,1}}.M1))) \&\& (0 <
asType < integer > (\$heap_{funcstart\_724,1}.p2))) \&\&
(\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{p2}) <
asType<integer>(sheap_{funcstart\_724,1}.M2)) && (0 <
asType < integer > (\$heap_{funcstart\_724,1}.p3))) \&\&
(\mathbf{asType} < \mathbf{integer} > (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p3}) <
asType<integer>($heap_funcstart_724,1.M3))
\rightarrow [simplify]
[5.3] (((((0 < $heap_{funcstart\_724,1}.p1) && ($heap_{funcstart\_724,1}.p1 < 
asType < integer > (\$heap_{funcstart\_724,1}.M1))) \&\& (0 <
\mathbf{asType} < \mathbf{integer} > (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p2}))) \&\&
(\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{p2}) <
\mathbf{asType} \small{<} \mathbf{integer} \small{>} (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{M2}))) \ \&\& \ (0 <
asType < integer > (\$heap_{funcstart\_724,1}.p3))) \&\&
(asType < integer > ($heap_{funcstart\_724,1}.p3) < 
asType < integer > (\$heap_{funcstart\_724,1}.M3))
\rightarrow [const static or extern object]
[5.4] (((((0 < $heap_{funcstart\_724,1}.p1) && ($heap_{funcstart\_724,1}.p1 <
asType < integer > (\$heap_{init}.M1))) \&\& (0 <
```

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asType < integer > (\$heap_{funcstart\_724,1}.p2))) \&\&
 (asType < integer > (\$heap_{funcstart\_724,1}.p2) < 
\mathbf{asType} {<} \mathbf{integer} {>} (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{M2}))) \ \&\& \ (0 <
asType < integer > (\$heap_{funcstart\_724,1}.p3))) \&\&
 (asType<integer>($heap_{tuncstart\_724,1}.p3) <
asType<integer>($heap_funcstart_724,1.M3))
 \rightarrow [expand definition of constant 'M1' at prang.c (14,20)]
 [5.5] (((((0 < $heap_{funcstart_724,1}.p1) && ($heap_{funcstart_724,1}.p1 < footnote{in the content of the c
asType<integer>(asType<short int>((int)30269)))) && (0 <
asType < integer > (\$heap_{funcstart\_724,1}.p2))) \&\&
 (\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{p2}) <
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{M2})))~\&\&~(0<
asType < integer > (\$heap_{funcstart\_724,1}.p3))) \&\&
 (\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{p3}) <
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{M3}))
 \rightarrow [simplify]
 [5.16] \; ((((-30269 < -\$ heap_{funcstart\_724,1}.p1) \; \land \; (0 < \$ heap_{funcstart\_724
 (0 < \text{\$heap}_{funcstart\_724,1}.p2)) \&\& (\text{\$heap}_{funcstart\_724,1}.p2 <
asType < integer > (\$heap_{funcstart\_724,1}.M2))) \&\& (0 <
asType < integer > (\$heap_{funcstart\_724,1}.p3))) \&\&
 (\mathbf{asType} < \mathbf{integer} > (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p3}) <
\mathbf{asType} < \mathbf{integer} > (\$ \mathrm{heap}_{funcstart\_724,1}.\mathrm{M3}))
 \rightarrow [const static or extern object]
 |5.17| \; ((((-30269 < -\$heap_{funcstart\_724,1}.p1) \; \land \; (0 < \$heap_{funcstart\_724,1}.p1) \; \land 
 (0 < \text{$heap}_{funcstart\_724,1}.p2)) \&\& (\text{$heap}_{funcstart\_724,1}.p2 <
asType < integer > (\$heap_{init}.M2))) \&\& (0 <
asType < integer > (\$heap_{funcstart\_724,1}.p3))) \&\&
 (\mathbf{asType} < \mathbf{integer} > (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p3}) <
asType < integer > (\$heap_{funcstart\_724,1}.M3))
 \rightarrow [expand definition of constant 'M2' at prang.c (19,20)]
 [5.18] ((((-30269 < -\$heap_{funcstart\_724,1}.p1) \land (0 < \$heap_{funcstart\_724,1}.p1) 
(0 < \text{$heap}_{funcstart\_724,1}.p2)) \&\& (\text{$heap}_{funcstart\_724,1}.p2 <
asType < integer > (asType < short int > ((int)30307)))) && (0 < integer) && (0 < integer
asType < integer > (\$heap_{funcstart\_724,1}.p3))) \&\&
 (\mathbf{asType} {<} \mathbf{integer} {>} (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p3}) <
\mathbf{asType} < \mathbf{integer} > (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{M3}))
 \rightarrow [simplify]
 [5.30] ((-30307 < -$heap_{funcstart\_724,1}.p2) \land (-30269 <
 -\$heap_{funcstart\_724,1}.p1) \land (0 < \$heap_{funcstart\_724,1}.p1) \land (0 < \$heap_{funcstart\_724,1}.p1)
\text{Sheap}_{funcstart_{724,1},p2} \land (0 < \text{Sheap}_{funcstart_{724,1},p3})) \&\&
 (\text{\$heap}_{funcstart\_724,1}.p3 < asType < integer > (\text{\$heap}_{funcstart\_724,1}.M3))
```

```
\rightarrow [const static or extern object]
[5.31] ((-30307 < -$heap_funcstart_724,1.p2) \land (-30269 <
-\$heap_{funcstart\_724,1}.p1) \land (0 < \$heap_{funcstart\_724,1}.p1) \land (0 < \$heap_{funcstart\_724,1}.p1)
\text{Sheap}_{funcstart\_724,1.p2} \land (0 < \text{Sheap}_{funcstart\_724,1.p3})) \&\&
(\$heap_{funcstart\_724,1}.p3 < \textbf{asType} < \textbf{integer} > (\$heap_{init}.M3))
\rightarrow [expand definition of constant 'M3' at prang.c (24,20)]
[5.32] ((-30307 < -$heap_funcstart_724,1.p2) \land (-30269 <
-\$heap_{funcstart\_724,1}.p1) \land (0 < \$heap_{funcstart\_724,1}.p1) \land (0 < \$heap_{funcstart\_724,1}.p1)
\text{Sheap}_{funcstart\_724,1}.p2) \land (0 < \text{Sheap}_{funcstart\_724,1}.p3)) \&\&
(\text{sheap}_{funcstart\_724,1}.\text{p3} < \text{asType} < \text{integer} > (\text{asType} < \text{short})
int > ((int)30323)))
\rightarrow [simplify]
[5.40] (-30323 < -\$heap_{funcstart\_724,1}.p3) \land (-30307 < -30307)
-\$heap_{funcstart\_724,1}.p2) \land (-30269 < -\$heap_{funcstart\_724,1}.p1) \land (0 < -\$heap_{funcstart\_724,1}.p1)
\text{Sheap}_{funcstart\_724,1}.\text{p1}) \land (0 < \text{Sheap}_{funcstart\_724,1}.\text{p2}) \land (0 <
heap_{funcstart_{724.1}.p3}
[Work on sub-term 6 of conjunction in term 5.40]
[10.0] 0 < $heap_{tuncstart_724,1}.p3
[Take given term]
[11.0] \operatorname{div1} == \operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724,1},
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p1}),
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{a1}))
\rightarrow [simplify]
[11.1] \ \mathrm{div1} == \mathrm{div}(\mathbf{heapIs} \ \$ \mathrm{heap}_{funcstart\_724,1}, \ \$ \mathrm{heap}_{funcstart\_724,1}.\mathrm{p1},
asType < int > (\$heap_{funcstart\_724,1}.a1))
\rightarrow [const static or extern object]
[11.2] div1 == div(heapIs heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p1,
asType < int > (\$heap_{init}.a1))
\rightarrow [expand definition of constant 'a1' at prang.c (16,20)]
\textit{[11.3]} \ \text{div1} == \text{div}(\mathbf{heapIs} \ \$ \text{heap}_{funcstart\_724,1}, \ \$ \text{heap}_{funcstart\_724,1}.\text{p1},
asType < int > (asType < short int > ((int)177)))
\rightarrow [simplify]
[11.6] \ \mathrm{div1} == \mathrm{div}(\mathbf{heapIs} \ \$ \mathrm{heap}_{funcstart\_724,1}, \ \$ \mathrm{heap}_{funcstart\_724,1}.\mathrm{p1}, \ 177)
[Take given term]
[25.0] \operatorname{div2} == \operatorname{div}(\mathbf{heapIs} \ \operatorname{\$heap}_{funcstart\_724,1},
asType < int > (\$heap_{funcstart\_724,1}.p2),
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{a2}))
```

```
\rightarrow [simplify]
[25.1] \ \mathrm{div2} == \mathrm{div}(\mathbf{heapIs} \ \$ \mathrm{heap}_{funcstart\_724,1}, \ \$ \mathrm{heap}_{funcstart\_724,1}.\mathrm{p2},
asType < int > (\$heap_{funcstart\_724,1}.a2))
\rightarrow [const static or extern object]
\label{eq:continuous} \mbox{\sc [25.2] div2} == \mbox{\sc div}(\mathbf{heapIs} \ \$\mbox{\sc heap}_{funcstart\_724,1}, \ \$\mbox{\sc heap}_{funcstart\_724,1}.\mbox{\sc p2},
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{init}.\mathrm{a2}))
\rightarrow [expand definition of constant 'a2' at prang.c (21,20)]
[25.3] div2 == div(heapIs $heap_{funcstart\_724.1}, $heap_{funcstart\_724.1}.p2,
asType<int>(asType<short int>((int)176)))
\rightarrow [simplify]
[25.6] div2 == div(heapIs $heap_{funcstart\_724,1}, $heap_{funcstart\_724,1}.p2, 176)
[Take given term]
[39.0] \operatorname{div3} == \operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724,1},
asType < int > (\$heap_{funcstart\_724,1}.p3),
asType < int > (\$heap_{funcstart\_724,1}.a3))
\rightarrow [simplify]
[39.1] \text{div3} == \text{div}(\mathbf{heapIs} \$ \text{heap}_{funcstart\_724,1}, \$ \text{heap}_{funcstart\_724,1}.\text{p3},
asType < int > (\$heap_{funcstart\_724,1}.a3))
\rightarrow [const static or extern object]
[39.2] \operatorname{div3} == \operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724,1}, \$ \operatorname{heap}_{funcstart\_724,1}.p3,
asType < int > (\$heap_{init}.a3))
\rightarrow [expand definition of constant 'a3' at prang.c (26,20)]
[39.3] div3 == div(heapIs \theta_{funcstart_{-724,1}}, \theta_{funcstart_{-724,1}}.p3,
asType<int>(asType<short int>((int)178)))
\rightarrow [simplify]
[39.6] \text{ div3} == \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_724,1}, \text{\$heap}_{funcstart\_724,1}.\text{p3}, 178)
[Assume known post-assertion, class invariant or type constraint for term 39.6]
[42.0] (asType<integer>($heap_{funcstart\_724,1}.p3) /
asType < integer > (178)) == asType < integer > (div(heapIs))
\$heap_{funcstart\_724,1},\,\$heap_{funcstart\_724,1}.p3,\,178).quot)
\rightarrow [simplify]
[42.2] ($heap<sub>funcstart_724.1.</sub>p3 / 178) == asType<integer>(div(heapIs)
heap_{funcstart_{724,1}}, heap_{funcstart_{724,1}}, 178).quot
→ [expand definition of operator './' in class 'int' at built in declaration]
[42.3] ([asType<integer>(heap_{funcstart}_724.1.p3) < 0]:
-(-asType < integer > (\$heap_{funcstart\_724,1}.p3) / 178), []:
```

```
asType < integer > (\$heap_{funcstart\_724,1}.p3) / 178) = =
asType<integer>(div(heapIs heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p3,
178).quot)
→ [explicitly assert falsehood of skipped guards in subsequent guards]
[42.4] ([asType<integer>(heap_{funcstart\_724,1}.p3) < 0]:
-(-asType < integer > (\$heap_{funcstart\_724,1}.p3) / 178),
[!(asType < integer > (\$heap_{funcstart\_724,1}.p3) < 0)]:
asType < integer > (\$heap_{funcstart\_724,1}.p3) / 178) = =
\mathbf{asType} {<} \mathbf{integer} {>} ( \mathbf{div} (\mathbf{heapIs} \ \$ \mathbf{heap}_{funcstart\_724,1}, \ \$ \mathbf{heap}_{funcstart\_724,1}. \mathbf{p3}, \\
178).quot)
\rightarrow [simplify]
[42.7] ([0 < -$heap<sub>funcstart_724,1</sub>.p3]:
-(-asType < integer > (\$heap_{funcstart\_724,1}.p3) / 178),
[!(\mathbf{asType} < \mathbf{integer} > (\$ heap_{funcstart\_724,1}.p3) < 0)]:
asType < integer > (\$heap_{funcstart\_724,1}.p3) / 178) = =
asType<integer>(div(heapIs heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p3,
178).quot)
\rightarrow [from term 10.0, literala < -$heap<sub>funcstart_724.1</sub>.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 > (\$heap_{funcstart\_724.1}.p3) / 178),
[!(asType < integer > (\$heap_{funcstart\_724,1}.p3) < 0)]:
asType < integer > (\$heap_{funcstart\_724,1}.p3) / 178) = =
\mathbf{asType} \small{<} \mathbf{integer} \small{>} ( \mathrm{div}(\mathbf{heapIs} \ \$ \mathrm{heap}_{funcstart\_724,1}, \ \$ \mathrm{heap}_{funcstart\_724,1}.\mathrm{p3}, \\
178).quot)
\rightarrow [simplify]
[42.11] ([false]: -(-asType < integer > (\$heap_{funcstart\_724,1}.p3) / 178), [!(0 <
-\$heap_{funcstart\_724,1}.p3)]: \ \mathbf{asType} < \mathbf{integer} > (\$heap_{funcstart\_724,1}.p3) \ / \ 178)
== asType < integer > (div(heapIs $heap_{funcstart\_724,1},
heap_{funcstart_{-724.1}}.p3, 178).quot
\rightarrow [from term 10.0, literala < -$heap<sub>funcstart_724,1</sub>.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 > (\$heap_{funcstart\_724.1}.p3) / 178),
[!false]: asType<integer>($heap<sub>funcstart_724,1.</sub>p3) / 178) ==
\mathbf{asType} < \mathbf{integer} > (\mathbf{div}(\mathbf{heapIs} \ \$ \mathbf{heap}_{funcstart\_724,1}, \ \$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p3}, \\
178).quot)
\rightarrow [simplify]
[42.17] 0 == (-\text{div}(\mathbf{heapIs} \$ \text{heap}_{funcstart\_724,1}, \$ \text{heap}_{funcstart\_724,1}.\text{p3},
178).quot + (\text{$heap}_{funcstart\_724,1}.p3 / 178))
[Take given term]
[53.0] \text{sheap}_{724,1;740,8} == \text{sheap}_{funcstart\_724,1}._replace(p1 \rightarrow asType<short
int>((asType<int>(asType<short int>(div1.rem)) *
asType < int > (\$heap_{funcstart\_724,1}.r1)) - (asType < int > (asType < short)
\mathbf{int}{>}(\mathbf{div1.quot})) * \mathbf{asType}{<} \mathbf{int}{>} (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{b1}))))
 \rightarrow [from term 11.6, div1 is equal to div(heapIs $heap_{funcstart_724.1},
heap_{funcstart_{-724,1}}.p1, 177
[53.1] heap_{724,1:740,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow asType<short
\mathbf{int}{>}((\mathbf{asType}{<}\mathbf{int}{>}(\mathbf{asType}{<}\mathbf{short}\ \mathbf{int}{>}(\mathbf{div}(\mathbf{heapIs}\ \$\mathbf{heap}_{funcstart\_724,1},
\theta_{funcstart\_724,1.p1, 177}.rem) * asType < int > (\theta_{funcstart\_724,1.r1}) - (\theta_{funcstart\_724,1.r1}
(asType<int>(asType<short int>(div1.quot)) *
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{b1}))))
\rightarrow [simplify]
[53.3] heap_{724,1;740,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow asType<short
int>((div(heapIs \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1, 177).rem *
asType < int > (\$heap_{funcstart\_724,1}.r1)) - (asType < int > (asType < short)
int>(div1.quot)) * asType< int>($heap_{funcstart\_724,1}.b1))))
\rightarrow [const static or extern object]
[53.4] heap_{724,1:740,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow asType<short
int>((\text{div}(\mathbf{heapIs} \$ \text{heap}_{funcstart\_724,1}, \$ \text{heap}_{funcstart\_724,1}.\text{p1}, 177).\text{rem} *
asType < int > (\$heap_{init}.r1)) - (asType < int > (asType < short)
\mathbf{int}{>}(\mathbf{div1}.\mathbf{quot})) \ * \ \mathbf{asType}{<} \mathbf{int}{>} (\$\mathbf{heap}_{funcstart\_724,1}.\mathbf{b1}))))
\rightarrow [expand definition of constant 'r1' at prang.c (15,20)]
[53.5] \rho_{1740,8} == \rho_{1740,8} == \rho_{1740,8} == \rho_{1740,8} - \rho_{1740,8} == \rho_{1740,8} == \rho_{1740,8} - \rho_{1740,8} == \rho_{1740,8} 
int>((div(heapIs \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1, 177).rem *
asType<int>(asType<short int>((int)171))) -
(asType<int>(asType<short int>(div1.quot)) *
asType < int > (\$heap_{funcstart\_724,1}.b1))))
\rightarrow [simplify]
[53.8] heap_{724,1;740,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow asType<short
int>((div(heapIs \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1, 177).rem * 171)
```

```
- (asType<int>(asType<short int>(div1.quot)) *
asType < int > (\$heap_{funcstart\_724,1}.b1))))
\rightarrow [from term 11.6, div1 is equal to div(heapIs $heap_{funcstart\_724,1},
heap_{funcstart_{-724,1}}.p1, 177
[53.9] heap_{724,1;740,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow asType<short
int>((171 * div(heapIs $heap_{tuncstart_724.1}, $heap_{tuncstart_724.1}.p1, 177).rem)
- (asType<int>(asType<short int>(div(heapIs $heap_{funcstart\_724,1},
heap_{funcstart_{724,1},p1,177}, quot)) *
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{b1}))))
\rightarrow [simplify]
[53.11] \theta == 
int>((171 * div(heapIs \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1, 177).rem)
- (\text{div}(\mathbf{heapIs} \$ \text{heap}_{funcstart\_724,1}, \$ \text{heap}_{funcstart\_724,1}.\text{p1}, 177).\text{quot} *
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{b1}))))
\rightarrow [const static or extern object]
[53.12] heap_{724,1;740,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow asType<short
int>((171 * div(heapIs \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1, 177).rem)
- (\text{div}(\mathbf{heapIs} \$ \text{heap}_{funcstart\_724,1}, \$ \text{heap}_{funcstart\_724,1}.\text{p1}, 177).\text{quot} *
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{init}.\mathrm{b1}))))
\rightarrow [expand definition of constant 'b1' at prang.c (17,20)]
[53.13] \$ heap_{724,1;740,8} == \$ heap_{funcstart\_724,1}.\_\mathbf{replace} (p1 \to \mathbf{asType} < \mathbf{short})
int>((171 * div(heapIs $heap_{funcstart\_724,1}, $heap_{funcstart\_724,1}.p1, 177).rem)
- (\text{div}(\mathbf{heapIs} \$ \text{heap}_{funcstart\_724,1}, \$ \text{heap}_{funcstart\_724,1}.\text{p1}, 177).\text{quot} *
asType < int > (asType < short int > ((int)2))))
\rightarrow [simplify]
[53.19] \text{$heap}_{724,1;740,8} == \text{$heap}_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).quot) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}. p1, 177).rem)))
[Take given term]
[57.0] $heap<sub>724.1:742.8</sub> == $heap<sub>724.1:740.8</sub>._replace(p2 \rightarrow asType<short
int>((asType<int>(asType<short int>(div2.rem)) *
\mathbf{asType} < \mathbf{int} > (\$ heap_{724,1;740,8}.r2)) - (\mathbf{asType} < \mathbf{int} > (\mathbf{asType} < \mathbf{short})
int>(div2.quot)) * asType<int>($heap<sub>724.1:740.8</sub>.b2))))
\rightarrow [from term 53.19, $heap<sub>724,1:740.8</sub> is equal to
heap_{funcstart\_724,1}._replace(p1 \rightarrow (-2 * div(heapIs \$heap_{funcstart\_724,1},
heap_{funcstart_{724,1},p1, 177}, quot) + (171 * div(heapIs p_{funcstart_{724,1},p1, 177}).
heap_{funcstart_{-724,1}}.p1, 177).rem)
[57.1] \theta_{17.42,8} = \theta_{17.42,8} = \theta_{17.42,8} = \theta_{17.42,8} = \theta_{17.42,8}._replace(p1 \theta_{17.42,8} = \theta_{17.42,8}
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).quot) + (171 *
\operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724,1}, \$ \operatorname{heap}_{funcstart\_724,1}.p1,
```

```
(177).rem))._replace(p2 \rightarrow asType<short
int>((asType<int>(asType<short int>(div2.rem)) *
asType < int > (\$heap_{724,1:740,8}.r2)) - (asType < int > (asType < short)
int>(div2.quot)) * asType< int>($heap_{724,1;740.8}.b2))))
\rightarrow [from term 25.6, div2 is equal to div(heapIs $heap_{tuncstart_{724.1}},
heap_{funcstart_{-724,1}}.p2, 176
[57.2] $heap<sub>724,1:742,8</sub> == $heap<sub>funcstart_724,1</sub>._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).quot) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.p1,
(177).rem))._replace(p2 \rightarrow asType<short
int>((asType<int>(asType<short int>(div(heapIs $heap_{funcstart\_724.1},
\text{sheap}_{funcstart\_724,1.p2, 176}.\text{rem}) * asType < int > (\text{sheap}_{724,1:740,8}.\text{r2})) -
(asType<int>(asType<short int>(div2.quot)) *
asType < int > (\$heap_{724,1;740,8}.b2))))
\rightarrow [simplify]
[57.4] $heap<sub>724,1;742,8</sub> == $heap<sub>funcstart_724,1</sub>._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 \ *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1,
177).rem)))._{\mathbf{replace}}(p2 \rightarrow \mathbf{asType} < \mathbf{short\ int} > ((\operatorname{div}(\mathbf{heapIs}))))
\rho_{funcstart_{724,1}}, \rho_{funcstart_{724,1}}, \rho_{funcstart_{724,1}}
asType < int > (\$heap_{724,1:740,8}.r2)) - (asType < int > (asType < short)
int>(div2.quot)) * asType<int>($heap<sub>724.1:740.8</sub>.b2))))
\rightarrow [from term 53.19, $heap<sub>724,1;740,8</sub> is equal to
heap_{funcstart\_724,1}._replace(p1 \rightarrow (-2 * div(heapIs $heap_{funcstart\_724,1},
heap_{funcstart_{724,1},p1, 177}, quot) + (171 * div(heapIs p_{funcstart_{724,1},p1, 177}), quot)
heap_{funcstart_{724,1},p1,177,rem}
[57.5] heap_{724,1;742,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.p1,
(177).rem))._replace(p2 \rightarrow asType<short int>((div(heapIs)
heap_{funcstart_{-724,1}}, heap_{funcstart_{-724,1}}, 176).rem *
asType < int > (\$heap_{funcstart\_724,1}.\_replace(p1 \rightarrow ((-2 * div(heapIs)))))))
heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p1, 177).quot) + (171 * div(heapIs)
\text{Sheap}_{funcstart_{-724,1}}, \text{Sheap}_{funcstart_{-724,1}.p1, 177).rem})).r2)) -
(asType<int>(asType<short int>(div2.quot)) *
asType < int > (\$heap_{724.1:740.8}.b2))))
\rightarrow [const member of object with modified fields]
[57.6] heap_{724,1;742,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 \ *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.p1,
177).rem)))._{\mathbf{replace}}(p2 \rightarrow \mathbf{asType} < \mathbf{short\ int} > ((\operatorname{div}(\mathbf{heapIs}))))
\text{Sheap}_{funcstart_{724,1}}, \text{Sheap}_{funcstart_{724,1}}.p2, 176).rem *
```

```
asType < int > (\$heap_{tuncstart\_724.1}.r2)) - (asType < int > (asType < short)
\mathbf{int}{>}(\text{div2.quot})) \ * \ \mathbf{asType}{<} \mathbf{int}{>} (\$\text{heap}_{724,1;740,8}.\text{b2}))))
\rightarrow [const static or extern object]
[57.7] heap_{724,1;742,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 \ *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724.1}, \ \$ \operatorname{heap}_{funcstart\_724.1}.p1,
177).rem)))._replace(p2 \rightarrow asType<short int>((div(heapIs
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.\text{p2}, 176).\text{rem} *
asType < int > (\$heap_{init}.r2)) - (asType < int > (asType < short)
int>(div2.quot)) * asType<int>($heap<sub>724.1:740.8</sub>.b2))))
\rightarrow [expand definition of constant 'r2' at prang.c (20,20)]
[57.8] heap_{724,1;742,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1,
177).rem))).replace(p2 \rightarrow asType < short int > ((div(heapIs)))
heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p2, 176).rem *
asType<int>(asType<short int>((int)172))) -
(asType<int>(asType<short int>(div2.quot)) *
asType<int>($heap<sub>724.1:740.8</sub>.b2))))
\rightarrow [simplify]
[57.11] $\text{heap}_{724,1:742,8} == $\text{heap}_{funcstart_724,1}._\text{replace}(p1 \to ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).quot) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow asType<short int>((div(heapIs
\text{Sheap}_{funcstart_{-724,1}}, \text{Sheap}_{funcstart_{-724,1}}.p2, 176).rem * 172) -
(asType<int>(asType<short int>(div2.quot)) *
\mathbf{asType}{<}\mathbf{int}{>}(\${\rm heap}_{724,1;740,8}.{\rm b2}))))
\rightarrow [from term 25.6, div2 is equal to div(heapIs $heap_{tuncstart_724.1},
heap_{funcstart_{-724,1},p2,176}
[57.12] heap_{724,1;742,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow asType<short int>((172 * div(heapIs
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.p2, 176).rem) -
(asType<int>(asType<short int>(div(heapIs $heap_{tuncstart_{724.1}}),
\text{Sheap}_{funcstart\_724,1.p2}, 176).\text{quot}) * asType<int>(\text{Sheap}_{724,1;740,8.b2}))))
\rightarrow [simplify]
[57.14] $heap<sub>724,1;742,8</sub> == $heap<sub>funcstart_724,1</sub>._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).quot) + (171 *
\operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724.1}, \$ \operatorname{heap}_{funcstart\_724.1}.p1,
177).rem)))._replace(p2 \rightarrow asType<short int>((172 * div(heapIs
```

```
\theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.p2, 176).quot *
asType < int > (\$heap_{724,1;740,8}.b2))))
\rightarrow [from term 53.19, $heap_{724,1;740,8}$ is equal to
heap_{funcstart\_724.1}._replace(p1 \rightarrow (-2 * div(heapIs heap_{funcstart\_724.1}),
\text{Sheap}_{funcstart\_724,1}.\text{p1}, 177).\text{quot} + (171 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
heap_{funcstart_{-724,1},p1,177,rem}
[57.15] $heap<sub>724,1;742,8</sub> == $heap<sub>funcstart_724,1</sub>._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).quot) + (171 *
\operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724,1}, \$ \operatorname{heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow asType<short int>((172 * div(heapIs
heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p2, 176).rem) - (div(heapIs)
heap_{funcstart_{724,1}}, heap_{funcstart_{724,1}}, 2, 176.quot *
asType < int > (\$heap_{funcstart\_724,1}.\_replace(p1 \rightarrow ((-2 * div(heapIs))))))
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.\text{p1}, 177).\text{quot}) + (171 * \text{div}(\text{heapIs}))
heap_{funcstart_{-724,1}}, heap_{funcstart_{-724,1}}.p1, 177).rem)).b2))))
\rightarrow [const member of object with modified fields]
[57.16] $\text{heap}_{724,1;742,8} == \text{$heap}_{funcstart\_724,1}._\text{$replace}(p1 \to ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}. \operatorname{pl},
177).rem)))._replace(p2 \rightarrow asType<short int>((172 * div(heapIs
\theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}.p2, 176).rem) - (div(heapIs
\text{Sheap}_{funcstart_{-724,1}}, \text{Sheap}_{funcstart_{-724,1}}.p2, 176).quot *
asType < int > (\$heap_{funcstart\_724,1}.b2))))
\rightarrow [const static or extern object]
[57.17] heap_{724,1;742,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 \ *
\operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724,1}, \$ \operatorname{heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow asType<short int>((172 * div(heapIs
\theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}.p2, 176).rem) - (div(heapIs
e_{funcstart\_724,1}, e_{funcstart\_724,1}.p2, 176).quot *
asType < int > (\$heap_{init}.b2))))
\rightarrow [expand definition of constant 'b2' at prang.c (22,20)]
[57.18] heap_{724,1;742,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}. p1, \ 177). \operatorname{quot}) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow asType<short int>((172 * div(heapIs
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.\text{p2}, 176).\text{rem}) - (\text{div}(\text{heapIs})
heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p2, 176).quot *
asType<int>(asType<short int>((int)35)))))
\rightarrow [simplify]
```

```
[57.24] $heap<sub>724,1;742,8</sub> == $heap<sub>funcstart_724,1</sub>._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).quot) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow ((-35 * div(heapIs $heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1}.\text{p2}, 176).\text{quot} + (172 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
heap_{funcstart_{-724,1}}.p2, 176).rem))
[Take goal term]
[1.0] minof(int) \leq (asType<int>(asType<short int>(div3.quot)) *
asType < int > (\$heap_{724,1;742,8}.b3))
\rightarrow [simplify]
[1.1] -32768 \leq (asType<int>(asType<short int>(div3.quot)) *
asType < int > (\$heap_{724,1;742,8}.b3))
\rightarrow [from term 39.6, div3 is equal to div(heapIs $heap_{funcstart_724,1},
heap_{funcstart_{-724,1}}.p3, 178
[1.2] -32768 \leq (asType<int>(asType<short int>(div(heapIs
\text{Sheap}_{funcstart_{-724,1}}, \text{Sheap}_{funcstart_{-724,1}}.p3, 178).quot)) *
asType < int > (\$heap_{724,1;742,8}.b3))
\rightarrow [simplify]
[1.4] -32768 \leq (div(heapIs $heap_{funcstart\_724,1}, $heap_{funcstart\_724,1}.p3,
178).quot * asType<int>($heap<sub>724,1;742,8</sub>.b3))
\rightarrow [from term 57.24, $heap<sub>724,1:742,8</sub> is equal to
heap_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 * div(heapIs $heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1}.p1, 177).quot) + (171 * div(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
heap_{funcstart\_724,1}.p1, 177).rem))._replace(p2 \rightarrow (-35 * div(heapIs)))._
heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p2, 176).quot) + (172 * div(heapIs)
\$heap_{funcstart\_724,1},\,\$heap_{funcstart\_724,1}.p2,\,176).rem))]
\label{eq:constant_724,1} \text{-}32768 \leq (\text{div}(\mathbf{heapIs} \ \$ \text{heap}_{funcstart\_724,1}, \ \$ \text{heap}_{funcstart\_724,1}.\text{p3},
178).quot * asType<int>(heap_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 *
div(\mathbf{heapIs} \ \$heap_{funcstart\_724,1}, \ \$heap_{funcstart\_724,1}.p1, \ 177).quot) + (171 *
\operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724,1}, \$ \operatorname{heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow ((-35 * div(heapIs $heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1}.\text{p2}, 176).\text{quot} + (172 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
heap_{funcstart_{-724,1}.p2, 176).rem})).b3)
\rightarrow [const member of object with modified fields]
[1.7] - 32768 \le (\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.\operatorname{p3},
178).quot * asType < int > (\$heap_{funcstart\_724,1}.b3))
\rightarrow [const static or extern object]
\label{eq:constant_724,1} \text{-}32768 \leq (\text{div}(\mathbf{heapIs} \ \$ \text{heap}_{funcstart\_724,1}, \ \$ \text{heap}_{funcstart\_724,1}.\text{p3},
178).quot * asType<int>($heap<sub>init</sub>.b3))
```

```
\rightarrow [expand definition of constant 'b3' at prang.c (27,20)]
[1.9] \ -32768 \leq (\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.\operatorname{p3},
178). \texttt{quot} * \mathbf{asType} < \mathbf{int} > (\mathbf{asType} < \mathbf{short} \ \mathbf{int} > ((\mathbf{int}) 63)))
\rightarrow [simplify]
[1.14] -32769 < (63 * div(heapIs \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p3,
178).quot)
\rightarrow [literal comparison of product]
[1.15] ([63 < 0]: (-32769 / -63) < -\text{div}(\mathbf{heapIs} \$ \text{heap}_{funcstart\_724,1},
\rho_{tuncstart_{724,1},p3,178}, quot, [0 < 63]: (-32769 / 63) < \text{div}(\textbf{heapIs})
\$ heap_{funcstart\_724,1}, \$ heap_{funcstart\_724,1}.p3, \ 178).quot, \ [0 == 63]: \ -32769 < 0)
→ [explicitly assert falsehood of skipped guards in subsequent guards]
[1.16] ([63 < 0]: (-32769 / -63) < -\text{div}(\mathbf{heapIs} \$ \text{heap}_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1}.\text{p3}, 178).\text{quot}, [(0 < 63) \land !(63 < 0)]: (-32769 / 63) < 0
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p3, 178).\operatorname{quot}, \ [(0 == 63)]
\land !(0 < 63) \land !(63 < 0)]: -32769 < 0)
\rightarrow [simplify]
\label{eq:continuous} \textit{[1.24] -521} < \operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.p3,
178).quot
\rightarrow [negate goal and search for contradiction]
 \label{eq:continuous} \textit{[1.25] !} (-521 < \operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.\operatorname{p3}, 
178).quot)
\rightarrow [simplify]
[1.27] 520 < -\text{div}(\mathbf{heapIs} \$ \text{heap}_{funcstart\_724,1}, \$ \text{heap}_{funcstart\_724,1}.\text{p3},
178).quot
[Create new term from terms 1.27, 42.17 using rule: transitivity 15]
[63.0] \; (0 + 520) < -(\$ heap_{funcstart\_724,1}.p3 \; / \; 178)
\rightarrow [simplify]
[63.7] \ 92560 < -\$ heap_{funcstart\_724,1}.p3
\rightarrow [from term 10.0, literala < –$heap_funcstart_724,1.p3 is false whenever -2 <
(0 + literala)
    Proof of rule precondition:
    [63.7.0] - 2 < (0 + 92560)
    \rightarrow [simplify]
    [63.7.2] true
[63.8] false
```

```
limit of type 'int'
Condition generated at: C:\Escher\Customers\prang\prang.c (60,38)
Condition defined at:
To prove: (asType<int>(asType<short int>(div3.quot)) *
asType < int > (\$heap_{724,1;742,8}.b3)) \le maxof(int)
Given:
heap_{init}.LIMIT == (int)80
\theta
\theta_{init}.r1 == asType < short int > ((int)171)
heap_{init}.a1 == asType < short int > ((int)177)
\theta
heap_{init}.M2 == asType < short int > ((int)30307)
\theta_{init}.r2 == asType < short int > ((int)172)
heap_{init}.a2 == asType < short int > ((int)176)
\theta sheap<sub>init</sub>.b2 == asType<short int>((int)35)
\theta
\theta_{init}.r3 == asType < short int > ((int)170)
\theta = asType < short int > ((int)178)
\theta = asType < short int > ((int)63)
\theta = asType < short int > ((int)1)
\theta
\theta = asType < short int > ((int)3)
invariant1(heapIs $heap_{tuncstart_724.1})
\operatorname{div1} == \operatorname{div}(\mathbf{heapIs} \ \operatorname{\$heap}_{funcstart\_724,1},
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p1}),
asType < int > (\$heap_{funcstart\_724,1}.a1))
(asType<integer>(asType<int>($heap_{tuncstart\_724.1}.p1)) /
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a1))) = =
asType<integer>(div1.quot)
(asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.p1)) \%
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a1))) = =
asType<integer>(div1.rem)
!(0 == asType < integer > (div1.rem)) || !(0 ==
```

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

asType<integer>(div1.quot))

```
div2 == div(\mathbf{heapIs} \$heap_{funcstart\_724,1},
asType < int > (\$heap_{funcstart\_724,1}.p2),
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{a2}))
(asType<int>(asType<int>($heap_{tuncstart\_724.1}.p2)) /
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a2))) = =
asType<integer>(div2.quot)
(asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.p2)) \%
\mathbf{asType}{<}\mathbf{integer}{>}(\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{a2}))) ==
asType<integer>(div2.rem)
!(0 == asType < integer > (div2.rem)) || !(0 ==
asType<integer>(div2.quot))
div3 == div(\mathbf{heapIs} \$heap_{funcstart\_724,1},
asType < int > (\$heap_{funcstart\_724,1}.p3),
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{a3}))
(asType<integer>(asType<int>($heap_{tuncstart\_724.1}.p3)) /
asType < integer > (asType < int > (\$heap_{funcstart\_724.1}.a3))) = =
asType<integer>(div3.quot)
(asType < integer > (asType < int > (\$heap_{tuncstart\_724,1}.p3)) \%
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a3))) = =
asType<integer>(div3.rem)
!(0 == asType < integer > (div3.rem)) || !(0 ==
asType<integer>(div3.quot))
heap_{724,1:740,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow asType<short
int>((asType<int>(asType<short int>(div1.rem)) *
asType < int > (\$heap_{funcstart\_724,1}.r1)) - (asType < int > (asType < short)
int>(div1.quot)) * asType< int>($heap_{funcstart\_724,1}.b1))))
-asType < integer\ const > (\$heap_{724,1;740,8}.M1) < 1
asType < integer > ($heap_{724,1;740,8}.p1)
!(0 == asType < integer > (\$heap_{724,1:740.8}.p1))
asType<integer>($heap<sub>724.1:740.8</sub>.p1) <
asType<integer>($heap<sub>724,1:740,8</sub>.M1)
\text{$heap}_{724,1;742,8} == \text{$heap}_{724,1;740,8}. replace(p2 \rightarrow asType < short
int>((asType<int>(asType<short int>(div2.rem)) *
asType < int > (\$heap_{724.1:740.8}.r2)) - (asType < int > (asType < short)
int>(div2.quot)) * asType<int>($heap<sub>724.1:740.8</sub>.b2))))
-asType<integer const>($heap_{724,1:742,8}.M2) <
asType<integer>($heap<sub>724,1;742,8</sub>.p2)
!(0 == asType < integer > (\$heap_{724,1;742,8}.p2))
asType<integer>($heap<sub>724,1:742,8</sub>.p2) <
```

```
asType<integer>($heap<sub>724.1:742.8</sub>.M2)
Proof:
[Take given term]
[5.0] invariant1(heapIs heap_{funcstart\_724,1}
\rightarrow [expand definition of function 'invariant1' at prang.c (34,1)]
[5.1] ((((((0 < asType < integer > ($heap_{funcstart\_724,1}.p1)) &&
(asType < integer > (\$heap_{funcstart\_724,1}.p1) < 
asType<integer>(heap_{funcstart\_724,1}.M1))) && (0 <
\mathbf{asType} < \mathbf{integer} > (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p2}))) \&\&
(asType < integer > (\$heap_{funcstart\_724,1}.p2) < 
as
Type<integer>($heap_{funcstart\_724,1}.M2))) && (0 <
asType < integer > (\$heap_{funcstart\_724,1}.p3))) \&\&
(asType < integer > (\$heap_{funcstart\_724,1}.p3) < 
asType < integer > (\$heap_{funcstart\_724,1}.M3))
\rightarrow [simplify]
[5.3] (((((0 < $heap_{funcstart_724,1}.p1) && ($heap_{funcstart_724,1}.p1 < footnote{in the content of the c
asType < integer > (\$heap_{funcstart\_724,1}.M1))) \&\& (0 <
asType < integer > (\$heap_{funcstart\_724,1}.p2))) \&\&
(\mathbf{asType} < \mathbf{integer} > (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p2}) <
asType<integer>(sheap_{funcstart-724,1}.M2)) && (0 <
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p3})))\ \&\&
(asType < integer > (\$heap_{funcstart\_724,1}.p3) < 
\mathbf{asType} < \mathbf{integer} > (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{M3}))
\rightarrow [const static or extern object]
[5.4] (((((0 < $heap_{funcstart\_724,1}.p1) && ($heap_{funcstart\_724,1}.p1 < 
asType < integer > (\$heap_{init}.M1))) \&\& (0 <
asType < integer > (\$heap_{funcstart\_724,1}.p2))) \&\&
(\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{p2}) <
asType < integer > (\$heap_{funcstart\_724,1}.M2))) \&\& (0 <
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p3})))\ \&\&
(asType<integer>($heap_funcstart_724.1.p3) <
\mathbf{asType} < \mathbf{integer} > (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{M3}))
\rightarrow [expand definition of constant 'M1' at prang.c (14,20)]
[5.5] (((((0 < $heap_{funcstart_{724,1}}.p1) && ($heap_{funcstart_{724,1}}.p1 < 
asType<integer>(asType<short int>((int)30269)))) && (0 <
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{p2})))\ \&\&
(asType < integer > (\$heap_{funcstart\_724,1}.p2) < 
asType<integer>(heap_{funcstart\_724,1}.M2))) && (0 <
asType < integer > (\$heap_{funcstart\_724,1}.p3))) \&\&
(asType < integer > (\$heap_{funcstart\_724,1}.p3) < 
asType < integer > (\$heap_{funcstart\_724,1}.M3))
```

```
\rightarrow [simplify]
[5.16] \; ((((-30269 < -\$heap_{funcstart\_724,1}.p1) \land (0 < \$heap_{funcstart\_724,1}.p1) \land (0 < \$heap_{funcstart\_724,1}.p1
(0 < \text{\$heap}_{funcstart\_724,1}.p2)) \&\& (\text{\$heap}_{funcstart\_724,1}.p2 <
asType<integer>($heap_{funcstart\_724,1}.M2))) && (0 <
asType < integer > (\$heap_{funcstart\_724,1}.p3))) \&\&
(\mathbf{asType} {<} \mathbf{integer} {>} (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p3}) <
asType < integer > (\$heap_{funcstart\_724,1}.M3))
\rightarrow [const static or extern object]
[5.17] \; ((((-30269 < -\$heap_{funcstart\_724,1}.p1) \; \land \; (0 < \$heap_{funcstart\_724,1}.p1) \; \land 
(0 < \text{\$heap}_{funcstart\_724,1}.p2)) \&\& (\text{\$heap}_{funcstart\_724,1}.p2 < 0
asType < integer > (\$heap_{init}.M2))) \&\& (0 <
\mathbf{asType} < \mathbf{integer} > (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p3}))) \&\&
(asType<integer>($heap_funcstart_724.1.p3) <
asType < integer > (\$heap_{funcstart\_724.1}.M3))
\rightarrow [expand definition of constant 'M2' at prang.c (19,20)]
[5.18] \left( \left( \left( \left( -30269 < -\$ \text{heap}_{funcstart\_724,1}.\text{p1} \right) \right. \wedge \left. \left( 0 < \$ \text{heap}_{funcstart\_724,1}.\text{p1} \right) \right. \wedge \right. \right)
(0 < \text{$heap}_{funcstart_{724,1}.p2})) \&\& (\text{$heap}_{funcstart_{724,1}.p2} <
asType < integer > (asType < short int > ((int)30307)))) && (0 < integer) && (0 < integer
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p3})))\ \&\&
(asType < integer > (\$heap_{funcstart\_724.1}.p3) < 
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{M3}))
\rightarrow [simplify]
[5.30] ((-30307 < -$heap_{funcstart\_724,1}.p2) \land (-30269 <
-\$ heap_{funcstart\_724,1}.p1) \land (0 < \$ heap_{funcstart\_724,1}.p1) \land (0 < \$ heap_{funcstart\_724,1}.p1) \land (0 < \$ heap_{funcstart\_724,1}.p1)
\text{Sheap}_{funcstart\_724,1}.p2) \land (0 < \text{Sheap}_{funcstart\_724,1}.p3)) \&\&
(\$heap_{funcstart\_724,1}.p3 < \mathbf{asType} < \mathbf{integer} > (\$heap_{funcstart\_724,1}.M3))
\rightarrow [const static or extern object]
[5.31] ((-30307 < -$heap_{tuncstart_724.1}.p2) \land (-30269 <
-\$heap_{funcstart\_724,1}.p1) \land (0 < \$heap_{funcstart\_724,1}.p1) \land (0 < \$heap_{funcstart\_724,1}.p1)
\text{Sheap}_{funcstart\_724,1.p2}) \land (0 < \text{Sheap}_{funcstart\_724,1.p3})) \&\&
(\text{\$heap}_{funcstart\_724.1}.\text{p3} < \text{asType} < \text{integer} > (\text{\$heap}_{init}.\text{M3}))
\rightarrow [expand definition of constant 'M3' at prang.c (24,20)]
[5.32] ((-30307 < -$heap_{funcstart_724,1}.p2) \land (-30269 <
-\$heap_{funcstart\_724,1}.p1) \land (0 < \$heap_{funcstart\_724,1}.p1) \land (0 < \$heap_{funcstart\_724,1}.p1)
\text{Sheap}_{funcstart\_724,1.p2}) \land (0 < \text{Sheap}_{funcstart\_724,1.p3})) \&\&
(\text{sheap}_{funcstart\_724,1}.\text{p3} < \text{asType} < \text{integer} > (\text{asType} < \text{short})
int > ((int)30323)))
\rightarrow [simplify]
[5.40] (-30323 < -$heap<sub>funcstart_724,1.</sub>p3) \wedge (-30307 <
 -\$heap_{funcstart\_724,1}.p2) \land (-30269 < -\$heap_{funcstart\_724,1}.p1) \land (0 < -\$heap_{funcstart\_724,1}.p1)
```

```
\text{Sheap}_{funcstart\_724,1}.\text{p1}) \land (0 < \text{Sheap}_{funcstart\_724,1}.\text{p2}) \land (0 <
heap_{funcstart_{-724,1}.p3}
\rightarrow [separate conjunction and work on first sub-term]
[5.41] -30323 < -\$heap_{funcstart\_724,1}.p3
[Work on sub-term 6 of conjunction in term 5.40]
[10.0]~0 < \$ \mathrm{heap}_{funcstart\_724,1}.\mathrm{p3}
[Take given term]
[11.0] \operatorname{div1} == \operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724,1},
asType < int > (\$heap_{funcstart\_724,1}.p1),
asType < int > (\$heap_{funcstart\_724.1}.a1))
\rightarrow [simplify]
[11.1] \operatorname{div1} == \operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724,1}, \$ \operatorname{heap}_{funcstart\_724,1}.p1,
asType < int > (\$heap_{funcstart\_724,1}.a1))
\rightarrow [const static or extern object]
[11.2] \ \mathrm{div1} == \mathrm{div}(\mathbf{heapIs} \ \$ \mathrm{heap}_{funcstart\_724,1}, \ \$ \mathrm{heap}_{funcstart\_724,1}.\mathrm{p1},
asType < int > (\$heap_{init}.a1))
\rightarrow [expand definition of constant 'a1' at prang.c (16,20)]
[11.3] \operatorname{div1} == \operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724,1}, \$ \operatorname{heap}_{funcstart\_724,1}.p1,
asType<int>(asType<short int>((int)177)))
\rightarrow [simplify]
[11.6] div1 == div(heapIs \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}.p1, 177)
[Take given term]
[25.0] div2 == div(heapIs heap_{funcstart\_724,1},
asType < int > (\$heap_{funcstart\_724,1}.p2),
asType < int > (\$heap_{funcstart\_724.1}.a2))
\rightarrow [simplify]
[25.1] \operatorname{div2} == \operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p2,
asType < int > (\$heap_{funcstart\_724,1}.a2))
\rightarrow [const static or extern object]
[25.2]~{\rm div2} == {\rm div}(\mathbf{heapIs}~\$ \mathrm{heap}_{funcstart\_724,1},\,\$ \mathrm{heap}_{funcstart\_724,1}.\mathrm{p2},
asType < int > (\$heap_{init}.a2))
\rightarrow [expand definition of constant 'a2' at prang.c (21,20)]
[25.3]~{\rm div2} == {\rm div}(\mathbf{heapIs}~\$ \mathrm{heap}_{funcstart\_724,1},\,\$ \mathrm{heap}_{funcstart\_724,1}.\mathrm{p2},
asType<int>(asType<short int>((int)176)))
\rightarrow [simplify]
[25.6] div2 == div(heapIs $heap_{funcstart\_724,1}, $heap_{funcstart\_724,1}.p2, 176)
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[Take given term]
[39.0] \operatorname{div3} == \operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1},
asType < int > (\$heap_{funcstart\_724,1}.p3),
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{a3}))
\rightarrow [simplify]
[39.1] div3 == div(heapIs $heap_{funcstart\_724.1}, $heap_{funcstart\_724.1}.p3,
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{a3}))
\rightarrow [const static or extern object]
[39.2] div3 == div(heapIs $heap_{funcstart\_724.1}, $heap_{funcstart\_724.1}.p3,
asType < int > (\$heap_{init}.a3))
\rightarrow [expand definition of constant 'a3' at prang.c (26,20)]
[39.3] div3 == div(heapIs \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}.p3,
asType<int>(asType<short int>((int)178)))
\rightarrow [simplify]
[39.6] \text{ div3} == \text{div}(\text{heapIs } \text{$heap}_{funcstart\_724,1}, \text{$heap}_{funcstart\_724,1}.p3, 178)
[Assume known post-assertion, class invariant or type constraint for term 39.6]
[42.0] (asType<integer>($heap_{tuncstart\_724.1}.p3) /
asType<integer>(178)) == asType<integer>(div(heapIs
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.p3, 178).quot
\rightarrow [simplify]
[42.2] (\theta_{funcstart\_724,1}.p3 / 178) == asType<integer>(div(heapIs
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.p3, 178).quot
→ [expand definition of operator './' in class 'int' at built in declaration]
[42.3] ([asType<integer>(heap_{funcstart\_724,1}.p3) < 0]:
-(-asType < integer > (\$heap_{funcstart\_724.1}.p3) / 178), []:
asType < integer > ($heap_{funcstart\_724,1}.p3) / 178) ==
asType<integer>(div(heapIs heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p3,
178).quot)
→ [explicitly assert falsehood of skipped guards in subsequent guards]
[42.4] ([asType<integer>(sheap_{funcstart_{-724,1}.p3}) < 0]:
-(-asType < integer > (\$heap_{funcstart\_724,1}.p3) / 178),
[!(\mathbf{asType} < \mathbf{integer} > (\$ heap_{funcstart\_724,1}.p3) < 0)]:
asType < integer > (\$heap_{funcstart\_724,1}.p3) / 178) = =
asType<integer>(div(heapIs heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p3,
178).quot)
\rightarrow [simplify]
[42.7] ([0 < -\$heap_{funcstart\_724,1.p3}]:
-(-asType < integer > (\$heap_{funcstart\_724,1}.p3) / 178),
```

```
[!(\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{p3}) < 0)]:
asType < integer > (\$heap_{funcstart\_724,1}.p3) / 178) = =
\mathbf{asType} {<} \mathbf{integer} {>} ( \mathbf{div} (\mathbf{heapIs} \ \$ \mathbf{heap}_{funcstart\_724,1}, \ \$ \mathbf{heap}_{funcstart\_724,1}. \mathbf{p3}, \\
178).quot)
\rightarrow [from term 10.0, literala < -$heap<sub>funcstart_724.1</sub>.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 > (\$heap_{funcstart\_724,1}.p3) / 178),
[!(\mathbf{asType} < \mathbf{integer} > (\$ heap_{funcstart\_724,1}.p3) < 0)]:
asType < integer > (\$heap_{funcstart\_724.1}.p3) / 178) = =
asType<integer>(div(heapIs heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p3,
178).quot)
\rightarrow [simplify]
[42.11] \; ([{\bf false}]: \; -({\bf -asType}{<} {\bf integer}{>} (\$ {\rm heap}_{funcstart\_724,1}.{\rm p3}) \; / \; 178), \; [!(0 < {\rm part})] \; ([{\bf false}]: \; -({\bf -asType}{<} {\bf integer}{>} (\$ {\rm heap}_{funcstart\_724,1}.{\rm p3}) \; / \; 178), \; [!(0 < {\bf -asType}{<} {\bf integer}{>} (\$ {\bf -asType}{<} {\bf -
-\$heap_{funcstart\_724,1}.p3)]: asType<integer>(\$heap_{funcstart\_724,1}.p3) / 178)
== asType < integer > (div(heapIs $heap_{funcstart\_724,1},
heap_{funcstart_{-724,1}}.p3, 178.quot
\rightarrow [from term 10.0, literala < -$heap<sub>funcstart_724,1</sub>.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 > (\$heap_{funcstart\_724,1}.p3) / 178),
[!false]: asType<integer>($heap<sub>funcstart_724,1.</sub>p3) / 178) ==
\mathbf{asType} \small{<} \mathbf{integer} \small{>} ( \mathrm{div}(\mathbf{heapIs} \ \$ \mathrm{heap}_{funcstart\_724,1}, \ \$ \mathrm{heap}_{funcstart\_724,1}.\mathrm{p3}, \\
178).quot)
\rightarrow [simplify]
[42.17] \ 0 == (-\text{div}(\mathbf{heapIs} \ \$ \text{heap}_{funcstart\_724,1}, \ \$ \text{heap}_{funcstart\_724,1}.\text{p3},
178).quot + (\text{$heap}_{funcstart\_724,1.p3} / 178))
[Take given term]
[53.0] \rho_{1740,8} == \rho_{1740
int>((asType<int>(asType<short int>(div1.rem)) *
asType < int > (\$heap_{funcstart\_724,1}.r1)) - (asType < int > (asType < short)
\mathbf{int}{>}(\mathbf{div1}.\mathbf{quot})) * \mathbf{asType}{<} \mathbf{int}{>}(\$\mathbf{heap}_{funcstart\_724,1}.\mathbf{b1}))))
```

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\rightarrow [from term 11.6, div1 is equal to div(heapIs $heap_{funcstart\_724,1},
heap_{funcstart_{-724,1}}.p1, 177)
[53.1] heap_{724,1:740,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow asType<short
int>((asType<int>(asType<short int>(div(heapIs $heap_{tuncstart\_724.1},
\theta_{tuncstart_{-724,1},p1,177,rem} * asType<int>($\text{heap}_{tuncstart_{-724,1},r1}$) -
(asType<int>(asType<short int>(div1.quot)) *
asType < int > (\$heap_{funcstart\_724,1}.b1))))
\rightarrow [simplify]
[53.3] \theta == 
int>((div(heapIs \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1, 177).rem *
asType < int > (\$heap_{tuncstart\_724.1}.r1)) - (asType < int > (asType < short)
int>(div1.quot)) * asType<int>($heap_{funcstart\_724,1}.b1)))
\rightarrow [const static or extern object]
[53.4] heap_{724,1:740,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow asType<short
int>((div(heapIs \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1, 177).rem *
asType < int > (\$heap_{init}.r1)) - (asType < int > (asType < short)
\mathbf{int}{>}(\mathbf{div1.quot})) * \mathbf{asType}{<} \mathbf{int}{>} (\$\mathbf{heap}_{funcstart\_724,1}.\mathbf{b1}))))
\rightarrow [expand definition of constant 'r1' at prang.c (15,20)]
[53.5] \rho_{1740,8} == \rho_{1740,8} == \rho_{1740,8} == \rho_{1740,8} - \rho_{1740,8} == \rho_{1740,8} == \rho_{1740,8} - \rho_{1740,8} == \rho_{1740,8} 
int>((div(heapIs \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1, 177).rem *
asType<int>(asType<short int>((int)171))) -
(asType<int>(asType<short int>(div1.quot)) *
asType < int > (\$heap_{funcstart\_724.1}.b1))))
\rightarrow [simplify]
[53.8] \rho_{724,1;740,8} == \rho_{funcstart\_724,1}.\_replace(p1 \rightarrow asType < short)
int > ((div(heapIs \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1, 177).rem * 171)
- (asType<int>(asType<short int>(div1.quot)) *
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{b1}))))
\rightarrow [from term 11.6, div1 is equal to div(heapIs $heap_{funcstart_724,1},
heap_{funcstart_{-724,1}}.p1, 177
[53.9] \rho_{13,1;740,8} == \rho_{13,1;740,8} == \rho_{13,1;740,8} =- \rho_{
int>((171 * div(heapIs \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1, 177).rem)
- (asType<int>(asType<short int>(div(heapIs $heap_{funcstart_724.1},
heap_{funcstart_{724,1}}.p1, 177).quot) *
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{b1}))))
\rightarrow [simplify]
[53.11] \$ heap_{724,1;740,8} == \$ heap_{funcstart\_724,1}.\_\mathbf{replace} (p1 \to \mathbf{asType} < \mathbf{short})
int>((171 * div(heapIs $heap_{funcstart\_724,1}, $heap_{funcstart\_724,1}.p1, 177).rem)
- (\text{div}(\mathbf{heapIs} \$ \text{heap}_{funcstart\_724,1}, \$ \text{heap}_{funcstart\_724,1}.\text{p1}, 177).\text{quot} *
asType < int > (\$heap_{funcstart\_724,1}.b1))))
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\rightarrow [const static or extern object]
[53.12] \rho_{12} \rho_{13} == 
int>((171 * div(heapIs $heap_{funcstart\_724,1}, $heap_{funcstart\_724,1}.p1, 177).rem)
- (div(heapIs heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p1, 177).quot *
asType < int > (\$heap_{init}.b1)))
\rightarrow [expand definition of constant 'b1' at prang.c (17,20)]
[53.13] heap_{724,1;740,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow asType<short
\mathbf{int} > ((171 * \operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724,1}, \$ \operatorname{heap}_{funcstart\_724,1}.\operatorname{p1}, 177).\operatorname{rem})
 — (div(heapIs $heap_{funcstart\_724,1}, $heap_{funcstart\_724,1}.p1, 177).quot *
asType < int > (asType < short int > ((int)2))))
\rightarrow [simplify]
[53.19] \text{Sheap}_{724,1;740,8} == \text{Sheap}_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \text{$heap}_{funcstart\_724,1}, \ \text{$heap}_{funcstart\_724,1}.p1, \ 177).rem)))
[Take given term]
[57.0] $\text{heap}_{724,1:742,8} == $\text{heap}_{724,1:740.8}.$\text{-replace}(p2 \to asType < short)
\mathbf{int}{>}((\mathbf{asType}{<}\mathbf{int}{>}(\mathbf{asType}{<}\mathbf{short}\ \mathbf{int}{>}(\mathbf{div}2.\mathbf{rem}))\ *
asType < int > (\$heap_{724.1:740.8}.r2)) - (asType < int > (asType < short)
int>(div2.quot)) * asType<int>($heap<sub>724,1:740,8</sub>.b2))))
\rightarrow [from term 53.19, $heap_{724,1;740,8}$ is equal to
heap_{funcstart\_724.1}._replace(p1 \rightarrow (-2 * div(heapIs heap_{funcstart\_724.1}),
heap_{funcstart_{724,1},p1, 177}, quot) + (171 * div(heapIs p_{funcstart_{724,1},p1, 177}), quot)
heap_{funcstart_{724,1}.p1, 177).rem}
[57.1] $\text{heap}_{724,1;742,8} == $\text{heap}_{funcstart\_724,1}.$\text{-replace}(p1 \to ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 *
\label{eq:div_heap} \text{div}(\textbf{heapIs} \ \$ \text{heap}_{funcstart\_724,1}, \ \$ \text{heap}_{funcstart\_724,1}.\text{p1},
(177).rem))._replace(p2 \rightarrow asType<short
int>((asType<int>(asType<short int>(div2.rem)) *
\mathbf{asType} \small{<} \mathbf{int} \small{>} (\$ \mathrm{heap}_{724,1;740,8}.\mathrm{r2})) \\ - (\mathbf{asType} \small{<} \mathbf{int} \small{>} (\mathbf{asType} \small{<} \mathbf{short}
int>(div2.quot)) * asType<int>($heap<sub>724.1:740.8</sub>.b2))))
\rightarrow [from term 25.6, div2 is equal to div(heapIs $heap_{funcstart_724,1},
heap_{funcstart_{-724,1},p2,176}
[57.2] $\text{heap}_{724,1;742,8} == $\text{heap}_{funcstart\_724,1}._\text{replace}(p1 \to ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).quot) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1,
(177).rem))._replace(p2 \rightarrow asType < short)
int>((asType<int>(asType<short int>(div(heapIs $heap_{funcstart\_724,1},))
\text{sheap}_{funcstart\_724,1}.\text{p2}, 176).\text{rem}) * asType < int > (\text{sheap}_{724,1;740,8}.\text{r2})) -
(asType<int>(asType<short int>(div2.quot)) *
asType < int > (\$heap_{724,1;740,8}.b2))))
\rightarrow [simplify]
```

```
[57.4] heap_{724,1;742,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 \ *
\label{eq:div_heap} \text{div}(\textbf{heapIs} \ \$ \text{heap}_{funcstart\_724,1}, \ \$ \text{heap}_{funcstart\_724,1}.\text{p1},
(177).rem))._replace(p2 \rightarrow asType<short int>((div(heapIs)))._replace(p2 \rightarrow asType
\theta_{funcstart_{724,1}}, \theta_{funcstart_{724,1}}, \theta_{funcstart_{724,1}}.p2, 176).rem *
asType < int > (\$heap_{724,1:740.8}.r2)) - (asType < int > (asType < short)
int>(div2.quot)) * asType<int>($heap<sub>724.1:740.8</sub>.b2))))
\rightarrow [from term 53.19, $heap<sub>724,1;740,8</sub> is equal to
heap_{funcstart\_724.1}._replace(p1 \rightarrow (-2 * div(heapIs $heap_{funcstart\_724.1},
heap_{funcstart\_724,1}.p1, 177).quot + (171 * div(heapIs $heap_{funcstart\_724,1}, 177).quot) + (171 * div(heapIs $heap_{funcstart\_724,1}, 17
heap_{funcstart_{-724,1}.p1, 177).rem}
[57.5] \rho_{17.5} = \rho_
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 \ *
\operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724,1}, \$ \operatorname{heap}_{funcstart\_724,1}.p1,
177).rem)))._{\mathbf{replace}}(p2 \rightarrow \mathbf{asType} < \mathbf{short\ int} > ((\operatorname{div}(\mathbf{heapIs}))))
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.\text{p2}, 176).\text{rem} *
asType < int > (\$heap_{funcstart\_724,1}.\_replace(p1 \rightarrow ((-2 * div(heapIs)))))))
heap_{funcstart_{724,1}}, heap_{funcstart_{724,1}}, 177).quot) + (171 * div(heapIs)
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.p1, 177).rem))).r2)) -
(asType<int>(asType<short int>(div2.quot)) *
asType<int>($heap<sub>724.1:740.8</sub>.b2))))
\rightarrow [const member of object with modified fields]
[57.6] heap_{724,1;742,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.p1,
177).rem)))._{\mathbf{replace}}(p2 \rightarrow \mathbf{asType} < \mathbf{short\ int} > ((\operatorname{div}(\mathbf{heapIs}))))
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.p2, 176).rem *
asType < int > (\$heap_{funcstart\_724,1}.r2)) - (asType < int > (asType < short)
int>(div2.quot)) * asType<int>($heap<sub>724.1:740.8</sub>.b2))))
\rightarrow [const static or extern object]
[57.7] heap_{724,1;742,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724.1}, \ \$ \operatorname{heap}_{funcstart\_724.1}.p1,
177).rem)))._{\mathbf{replace}}(p2 \rightarrow \mathbf{asType} < \mathbf{short\ int} > ((\operatorname{div}(\mathbf{heapIs}))))
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.p2, 176).rem *
asType < int > (\$heap_{init}.r2)) - (asType < int > (asType < short)
int > (div2.quot)) * asType < int > (\$heap_{724,1;740,8}.b2))))
\rightarrow [expand definition of constant 'r2' at prang.c (20,20)]
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).quot) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow asType<short int>((div(heapIs
```

```
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.p2, 176).rem *
asType<int>(asType<short int>((int)172))) -
(asType<int>(asType<short int>(div2.quot)) *
asType < int > (\$heap_{724,1;740,8}.b2))))
\rightarrow [simplify]
[57.11] $heap<sub>724,1;742,8</sub> == $heap<sub>funcstart_724,1</sub>._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).quot) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow asType<short int>((div(heapIs
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.p2, 176).rem * 172) -
(asType<int>(asType<short int>(div2.quot)) *
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{724,1;740,8}.\mathrm{b2}))))
\rightarrow [from term 25.6, div2 is equal to div(heapIs $heap_{tuncstart_{724.1}},
heap_{funcstart_{-724,1}}.p2, 176
[57.12] $heap<sub>724,1;742,8</sub> == $heap<sub>funcstart_724,1</sub>._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 *
\operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724,1}, \$ \operatorname{heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow asType<short int>((172 * div(heapIs
heap_{funcstart_{-724,1}}, heap_{funcstart_{-724,1}}, p_{176}.rem) -
(asType < int > (asType < short int > (div(heapIs $heap_{funcstart\_724,1}, 
\text{sheap}_{funcstart\_724,1.p2}, 176).\text{quot}) * asType<int>(\text{sheap}_{724,1;740,8}.\text{b2}))))
\rightarrow [simplify]
[57.14] $heap<sub>724,1;742,8</sub> == $heap<sub>funcstart_724,1</sub>._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 *
\operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724,1}, \$ \operatorname{heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow asType<short int>((172 * div(heapIs
\theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}.
\theta_{funcstart_{724,1}}, \theta_{funcstart_{724,1},p2,176}.quot *
asType<int>($heap<sub>724.1:740.8</sub>.b2))))
\rightarrow [from term 53.19, $heap<sub>724,1;740,8</sub> is equal to
heap_{funcstart\_724,1}._replace(p1 \rightarrow (-2 * div(heapIs $heap_{funcstart\_724,1},
heap_{funcstart_{724,1},p1, 177}, quot) + (171 * div(heapIs heap_{funcstart_{724,1},p1, 177})
heap_{funcstart_{724,1},p1,177,rem})
[57.15] $\text{heap}_{724.1:742.8} == \text{$heap}_{funcstart_724.1}._\text{replace}(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}. p1, \ 177). \operatorname{quot}) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow asType<short int>((172 * div(heapIs
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.\text{p2}, 176).\text{rem}) - (\text{div}(\text{heapIs}))
heap_{funcstart_{724,1}}, heap_{funcstart_{724,1}}, 2, 176).quot *
asType < int > (\$heap_{funcstart\_724,1}.\_replace(p1 \rightarrow ((-2 * div(heapIs))))))
\theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.p1, 177).rem))).b2))))
```

```
\rightarrow [const member of object with modified fields]
[57.16] $\text{heap}_{724,1:742,8} == \text{$heap}_{funcstart\_724,1}._\text{$replace}(p1 \to ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).quot) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow asType<short int>((172 * div(heapIs
heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p2, 176).rem) - (div(heapIs
\theta_{funcstart_{724,1}}, \theta_{funcstart_{724,1}}, \theta_{funcstart_{724,1}}.p2, 176).quot
\mathbf{asType} < \mathbf{int} > (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{b2}))))
\rightarrow [const static or extern object]
[57.17] $\text{heap}_{724,1;742,8} == \text{$heap}_{funcstart\_724,1}._\text{$replace}(p1 \to ((-2 *
div(\mathbf{heapIs} \ \$heap_{funcstart\_724,1}, \ \$heap_{funcstart\_724,1}.p1, \ 177).quot) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow asType<short int>((172 * div(heapIs
\text{Sheap}_{funcstart\_724.1}, \text{Sheap}_{funcstart\_724.1}.p2, 176).rem) - (div(heapIs)
\text{Sheap}_{funcstart_{724,1}}, \text{Sheap}_{funcstart_{724,1}}, p2, 176).quot *
asType < int > (\$heap_{init}.b2))))
\rightarrow [expand definition of constant 'b2' at prang.c (22,20)]
[57.18] $\text{heap}_{724,1;742,8} == \text{$heap}_{funcstart\_724,1}._\text{replace}(p1 \to ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).quot) + (171 *
\operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724.1}, \$ \operatorname{heap}_{funcstart\_724.1}.p1,
177).rem)))._replace(p2 \rightarrow asType<short int>((172 * div(heapIs
\theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}.p2, 176).rem) - (div(heapIs
\theta_{funcstart_{724,1}}, \theta_{funcstart_{724,1},p2}, 176).quot *
asType<int>(asType<short int>((int)35)))))
\rightarrow [simplify]
[57.24] $\text{heap}_{724,1;742,8} == \text{$heap}_{funcstart\_724,1}._\text{$replace}(p1 \to ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 \ *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow ((-35 * div(heapIs $heap_{funcstart_724.1},
\text{Sheap}_{funcstart_{724,1},p2}, 176).\text{quot} + (172 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart_{724,1}},
heap_{funcstart_{-724,1}.p2, 176).rem)
[Take goal term]
[1.0] (asType<int>(asType<short int>(div3.quot)) *
asType < int > (\$heap_{724,1;742,8}.b3)) \le maxof(int)
\rightarrow [from term 39.6, div3 is equal to div(heapIs $heap_{tuncstart\_724.1},
heap_{funcstart_{-724,1}}.p3, 178
[1.1] (asType<int>(asType<short int>(div(heapIs $heap_{funcstart\_724,1},))
\text{sheap}_{funcstart\_724.1.p3}, 178).\text{quot}) * asType<int>(\text{sheap}_{724.1:742.8.b3})) \leq
maxof(int)
\rightarrow [simplify]
```

```
asType < int > (\$heap_{724,1;742,8}.b3)) \le maxof(int)
\rightarrow [from term 57.24, $heap<sub>724,1;742,8</sub> is equal to
heap_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 * div(heapIs $heap_{funcstart\_724,1},
heap_{funcstart_{-724,1},p1, 177}, quot) + (171 * div(heapIs heap_{funcstart_{-724,1}})
\rho_{funcstart\_724.1}.p1, 177).rem)._replace\rho_{funcstart\_724.1}.p1, 177).rem)._replace
heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p2, 176).quot) + (172 * div(heapIs)
heap_{funcstart_{724,1}}, heap_{funcstart_{724,1}}, p2, 176).rem)
[1.4] (div(heapIs heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p3, 178).quot *
asType < int > (\$heap_{funcstart\_724,1}.\_replace(p1 \rightarrow ((-2 * div(heapIs)))))))
\theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}.p1, 177).quot) + (171 * div(heapIs
* div(\mathbf{heapIs} \ \$ heap_{funcstart\_724,1}, \ \$ heap_{funcstart\_724,1}.p2, \ 176).quot) + (172 \ *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p2, \ 176).rem))).b3)) \le
maxof(int)
→ [const member of object with modified fields]
[1.6] (div(heapIs heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p3, 178).quot *
asType < int > (\$heap_{funcstart\_724,1}.b3)) \le maxof(int)
\rightarrow [const static or extern object]
[1.7] (div(heapIs heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p3, 178).quot *
asType < int > (\$heap_{init}.b3)) \le maxof(int)
\rightarrow [expand definition of constant 'b3' at prang.c (27,20)]
[1.8] (div(heapIs heap_{funcstart_{724,1}}, heap_{funcstart_{724,1},p3}, 178).quot *
asType < int > (asType < short int > ((int)63))) \le maxof(int)
\rightarrow [simplify]
 \label{eq:continuous} \mbox{[1.21] -32768} < (-63 * \mbox{div}(\mathbf{heapIs} \ \$ \mbox{heap}_{funcstart\_724,1}, \ \$ \mbox{heap}_{funcstart\_724,1}.\mbox{p3}, 
178).quot)
\rightarrow [literal comparison of product]
[1.22] ([-63 < 0]: (-32768 / 63) < -\text{div}(\mathbf{heapIs} \$ \mathbf{heap}_{funcstart\_724,1},
\rho_{funcstart_724.1.p3}, 178).quot, [0 < -63]: (-32768 / -63) < \text{div}(\text{heapIs})
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.\text{p3}, 178).\text{quot}, [-63 == 0]: -32768 < 0)
→ [explicitly assert falsehood of skipped guards in subsequent guards]
[1.23] ([-63 < 0]: (-32768 / 63) < -\text{div}(\mathbf{heapIs} \$ \text{heap}_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1}.\text{p3}, 178).\text{quot}, [(0 < -63) \land !(-63 < 0)]: (-32768 / -63) < 0
div(\mathbf{heapIs} \ \$heap_{funcstart\_724.1}, \ \$heap_{funcstart\_724.1}.p3, \ 178).quot, \ [(-63 == 0)]
\wedge !(-63 < 0) \wedge !(0 < -63)]: -32768 < 0)
\rightarrow [simplify]
 \label{eq:continuous} \mbox{$[1.27]$ -521} < -\mbox{div}(\mathbf{heapIs} \ \mbox{$$ $heap_{funcstart\_724,1}$, $$ $heap_{funcstart\_724,1}$.p3, }
178).quot
```

[1.3] (div(heapIs  $heap_{funcstart-724,1}$ ,  $heap_{funcstart-724,1}$ .p3, 178).quot \*

```
\rightarrow [negate goal and search for contradiction]
[1.28]!(-521 < -\text{div}(\text{heapIs } \text{$heap}_{funcstart\_724,1}, \text{$heap}_{funcstart\_724,1}.p3,
178).quot)
\rightarrow [simplify]
[1.31] 520 < div(heapIs $heap_{funcstart\_724,1}, $heap_{funcstart\_724,1}.p3, 178).quot
[Create new term from terms 1.31, 42.17 using rule: transitivity 16]
[63.0] (0 + 520) < (\text{$heap_{funcstart\_724,1.p3} / 178})
\rightarrow [simplify]
[63.8] \ 92737 < \$ heap_{funcstart\_724,1}.p3
\rightarrow [from term 5.41, literala < $heap_{funcstart\_724,1}.p3 is false whenever -2 <
(-30323 + literala)
   Proof of rule precondition:
   [63.8.0] - 2 < (-30323 + 92737)
   \rightarrow [simplify]
   [63.8.2] true
[63.9] false
Proof of verification condition: Type constraint satisfied in implicit
conversion from 'int' to 'short int'
Condition generated at: C:\Escher\Customers\prang\prang.c (60,33)
Condition defined at:
To prove: minof(short\ int) \le ((asType < int > (asType < short\ int))
int > (div3.rem)) * asType < int > (\$heap_{724,1;742,8}.r3)) -
(asType<int>(asType<short int>(div3.quot)) *
asType < int > (\$heap_{724,1;742,8}.b3)))
Given:
heap_{init}.LIMIT == (int)80
heap_{init}.M1 == asType < short int > ((int)30269)
\theta_{init}.r1 == asType < short int > ((int)171)
\theta
\theta
\theta
\theta
heap_{init}.a2 == asType < short int > ((int)176)
```

```
\theta sheap<sub>init</sub>.b2 == asType<short int>((int)35)
heap_{init}.M3 == asType < short int > ((int)30323)
\theta_{init}.r3 == asType<short int>((int)170)
heap_{init}.a3 == asType < short int > ((int)178)
heap_{init}.b3 == asType < short int > ((int)63)
\theta
\theta
\theta = asType < short int > ((int)3)
invariant
1(heap<br/>Is \theta_{funcstart\_724,1}
div1 == div(\mathbf{heapIs} \$heap_{funcstart\_724,1},
asType < int > (\$heap_{funcstart\_724,1}.p1),
asType < int > (\$heap_{funcstart\_724,1}.a1))
(\mathbf{asType}{<}\mathbf{integer}{>}(\mathbf{asType}{<}\mathbf{int}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{p1})) \ / \\
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a1))) = =
asType<integer>(div1.quot)
(\mathbf{asType} < \mathbf{integer} > (\mathbf{asType} < \mathbf{int} > (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p1})) \%
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a1))) = =
asType<integer>(div1.rem)
!(0 == asType < integer > (div1.rem)) || !(0 ==
asType<integer>(div1.quot))
div2 == div(\mathbf{heapIs} \$heap_{funcstart\_724,1},
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p2}),
asType < int > (\$heap_{funcstart\_724,1}.a2))
(asType<int>(sheap<sub>funcstart 724.1</sub>.p2)) /
\mathbf{asType}{<}\mathbf{integer}{>}(\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{a2}))) ==
asType<integer>(div2.quot)
(asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.p2)) \%
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a2))) = =
asType<integer>(div2.rem)
!(0 == asType < integer > (div2.rem)) || !(0 ==
asType<integer>(div2.quot))
div3 == div(\mathbf{heapIs} \$heap_{funcstart\_724,1},
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p3}),
asType < int > (\$heap_{funcstart\_724,1}.a3))
(asType<integer>(asType<int>($heap_{tuncstart\_724.1}.p3)) /
\mathbf{asType}{<}\mathbf{integer}{>}(\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{a3}))) ==
asType<integer>(div3.quot)
(\mathbf{asType} < \mathbf{integer} > (\mathbf{asType} < \mathbf{int} > (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p3})) \%
```

```
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a3))) = =
asType<integer>(div3.rem)
!(0 == asType < integer > (div3.rem)) || !(0 ==
asType<integer>(div3.quot))
\$heap_{724,1;740,8} == \$heap_{funcstart\_724,1}.\_\mathbf{replace}(p1 \to \mathbf{asType} < \mathbf{short}
int>((asType<int>(asType<short int>(div1.rem)) *
asType < int > (\$heap_{funcstart\_724,1}.r1)) - (asType < int > (asType < short)
int>(div1.quot)) * asType< int>($heap_{funcstart\_724,1}.b1))))
-asType<integer const>($heap<sub>724,1:740,8</sub>.M1) <
asType<integer>($heap<sub>724.1:740.8</sub>.p1)
!(0 == asType < integer > (\$heap_{724,1:740.8}.p1))
asType<integer>($heap<sub>724,1;740,8</sub>.p1) <
asType<integer>($heap<sub>724,1:740,8</sub>.M1)
\text{heap}_{724.1:742.8} == \text{heap}_{724.1:740.8}._replace(p2 \rightarrow asType<short)
int>((asType<int>(asType<short int>(div2.rem)) *
asType < int > (\$heap_{724,1;740,8}.r2)) - (asType < int > (asType < short)
int > (div2.quot)) * asType < int > ($heap_{724,1;740,8}.b2))))
-asType<integer const>($heap<sub>724,1:742,8</sub>.M2) <
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathrm{heap}_{724,1;742,8}.\mathrm{p2})
!(0 == asType < integer > (\$heap_{724,1;742,8}.p2))
{\bf asType}{<} {\bf integer}{>} (\$ {\rm heap}_{724,1;742,8}.{\rm p2}) <
asType<integer>($heap<sub>724,1:742,8</sub>.M2)
Proof:
[Take given term]
[5.0] invariant1(heapIs heap_{funcstart_724.1})
\rightarrow [expand definition of function 'invariant1' at prang.c (34,1)]
[5.1] ((((((0 < asType < integer > (\theta_{funcstart\_724,1.p1)) &&
(asType < integer > ($heap_{funcstart\_724,1}.p1) < 
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{M1})))~\&\&~(0<
asType < integer > (\$heap_{funcstart\_724,1}.p2))) \&\&
(asType < integer > (\$heap_{funcstart\_724,1}.p2) <
asType < integer > (\$heap_{funcstart\_724,1}.M2))) \&\& (0 < 1)
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p3})))\ \&\&
(\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{p3}) <
\mathbf{asType} < \mathbf{integer} > (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{M3}))
\rightarrow [simplify]
[5.3] (((((0 < $heap_{funcstart_{724,1}}.p1) && ($heap_{funcstart_{724,1}}.p1 < 
asType < integer > (\$heap_{funcstart\_724.1}.M1))) \&\& (0 <
asType < integer > (\$heap_{funcstart\_724,1}.p2))) \&\&
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(\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{p2}) <
asType < integer > (\$heap_{funcstart\_724,1}.M2))) \&\& (0 <
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{p3})))\ \&\&
(asType < integer > ($heap_{funcstart\_724,1}.p3) < 
\mathbf{asType} < \mathbf{integer} > (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{M3}))
\rightarrow [const static or extern object]
[5.4] (((((0 < $heap_{funcstart_724,1}.p1) && ($heap_{funcstart_724,1}.p1 < 
asType < integer > (\$heap_{init}.M1))) \&\& (0 <
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p2})))\ \&\&
(\mathbf{asType} < \mathbf{integer} > (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p2}) <
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{M2})))~\&\&~(0<
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{p3})))\ \&\&
(asType < integer > ($heap_{funcstart\_724,1}.p3) < 
asType < integer > (\$heap_{funcstart\_724,1}.M3))
\rightarrow [expand definition of constant 'M1' at prang.c (14,20)]
[5.5] (((((0 < $heap_{funcstart\_724,1}.p1) && ($heap_{funcstart\_724,1}.p1 < ])
asType<integer>(asType<short int>((int)30269)))) && (0 <
asType < integer > (\$heap_{funcstart\_724,1}.p2))) \&\&
(\mathbf{asType} < \mathbf{integer} > (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p2}) <
asType < integer > (\$heap_{funcstart\_724,1}.M2))) \&\& (0 <
asType < integer > (\$heap_{funcstart\_724,1}.p3))) \&\&
(\mathbf{asType} < \mathbf{integer} > (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p3}) <
asType < integer > (\$heap_{funcstart_{-724.1}}.M3))
\rightarrow [simplify]
[5.16] \; ((((-30269 < -\$heap_{funcstart\_724,1}.p1) \land (0 < \$heap_{funcstart\_724,1}.p1) \land (0 < \$heap_{funcstart\_724,1}.p1
(0 < \text{\$heap}_{funcstart\_724,1}.p2)) \&\& (\text{\$heap}_{funcstart\_724,1}.p2 <
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{M2})))~\&\&~(0<
asType < integer > (\$heap_{funcstart\_724,1}.p3))) \&\&
(asType<integer>($heap_funcstart_724,1.p3) <
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{M3}))
\rightarrow [const static or extern object]
[5.17] ((((-30269 < -$heap_{tuncstart\_724,1}.p1) \lambda (0 < $heap_{tuncstart\_724,1}.p1) \lambda
(0 < \text{\$heap}_{funcstart\_724,1}.p2)) \&\& (\text{\$heap}_{funcstart\_724,1}.p2 <
asType < integer > (\$heap_{init}.M2))) \&\& (0 <
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p3})))\ \&\&
(asType < integer > (\$heap_{funcstart\_724,1}.p3) < 
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{M3}))
\rightarrow [expand definition of constant 'M2' at prang.c (19,20)]
[5.18] ((((-30269 < -\$heap_{funcstart\_724,1}.p1) \land (0 < \$heap_{funcstart\_724,1}.p1) 
(0 < \text{\$heap}_{funcstart_{724,1},p2})) \&\& (\text{\$heap}_{funcstart_{724,1},p2} <
asType<integer>(asType<short int>((int)30307)))) && (0 <
```

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\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p3})))\ \&\&
(\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{p3}) <
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{M3}))
\rightarrow [simplify]
[5.30] ((-30307 < -$heap_{funcstart\_724,1}.p2) \land (-30269 <
-\$heap_{funcstart\_724,1}.p1) \land (0 < \$heap_{funcstart\_724,1}.p1) \land (0 < \$heap_{funcstart\_724,1}.p1)
\text{Sheap}_{funcstart_{724,1}.p2} \land (0 < \text{Sheap}_{funcstart_{724,1}.p3})) \&\&
(\text{\$heap}_{funcstart\_724,1}.p3 < asType < integer > (\text{\$heap}_{funcstart\_724,1}.M3))
\rightarrow [const static or extern object]
[5.31] ((-30307 < -$heap_{funcstart\_724,1}.p2) \land (-30269 <
-\$heap_{funcstart\_724.1}.p1) \land (0 < \$heap_{funcstart\_724.1}.p1) \land (0 < \$heap_{funcstart\_724.1}.p1)
\text{Sheap}_{funcstart_{-724,1},p2} \land (0 < \text{Sheap}_{funcstart_{-724,1},p3})) \&\&
(\text{\$heap}_{funcstart\_724,1}.\text{p3} < \mathbf{asType} < \mathbf{integer} > (\text{\$heap}_{init}.\text{M3}))
\rightarrow [expand definition of constant 'M3' at prang.c (24,20)]
[5.32] ((-30307 < -$heap<sub>funcstart_724,1.</sub>p2) \wedge (-30269 <
-\$heap_{funcstart\_724,1}.p1) \land (0 < \$heap_{funcstart\_724,1}.p1) \land (0 < \$heap_{funcstart\_724,1}.p1)
\text{Sheap}_{funcstart_{-724,1}.p2} \land (0 < \text{Sheap}_{funcstart_{-724,1}.p3})) \&\&
(\text{sheap}_{funcstart\_724,1}.p3 < asType < integer > (asType < short)
int > ((int)30323)))
\rightarrow [simplify]
[5.40] (-30323 < -$heap_{funcstart\_724,1}.p3) \land (-30307 <
-\$heap_{funcstart\_724.1}.p2) \wedge (-30269 < -\$heap_{funcstart\_724.1}.p1) \wedge (0 <
\text{Sheap}_{funcstart_{724,1}.p1} \land (0 < \text{Sheap}_{funcstart_{724,1}.p2}) \land (0 <
heap_{funcstart_{-724,1}.p3}
\rightarrow [separate conjunction and work on first sub-term]
[5.41] -30323 < -\$heap_{funcstart\_724,1}.p3
[Work on sub-term 6 of conjunction in term 5.40]
[10.0] 0 < $\text{heap}_{funcstart_724,1}.p3
[Take given term]
[11.0] \operatorname{div1} == \operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724,1},
asType < int > (\$heap_{funcstart\_724,1}.p1),
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{a1}))
\rightarrow [simplify]
[11.1]~{\rm div1} == {\rm div}(\mathbf{heapIs}~\$ \mathrm{heap}_{funcstart\_724,1},\,\$ \mathrm{heap}_{funcstart\_724,1}.\mathrm{p1},
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{a1}))
\rightarrow [const static or extern object]
[11.2] \operatorname{div1} == \operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724,1}, \$ \operatorname{heap}_{funcstart\_724,1}.p1,
asType < int > (\$heap_{init}.a1))
```

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\rightarrow [expand definition of constant 'a1' at prang.c (16,20)]
[11.3] \ \mathrm{div1} == \mathrm{div}(\mathbf{heapIs} \ \$ \mathrm{heap}_{funcstart\_724,1}, \ \$ \mathrm{heap}_{funcstart\_724,1}.\mathrm{p1},
asType<int>(asType<short int>((int)177)))
\rightarrow [simplify]
[11.6] div1 == div(heapIs $heap_{funcstart\_724,1}, $heap_{funcstart\_724,1}.p1, 177)
[Take given term]
[25.0] div2 == div(heapIs $heap_{funcstart\_724,1},
\mathbf{asType} < \mathbf{int} > (\$ \mathrm{heap}_{funcstart\_724,1}.\mathrm{p2}),
asType < int > (\$heap_{funcstart\_724,1}.a2))
\rightarrow [simplify]
[25.1] \operatorname{div2} == \operatorname{div}(\mathbf{heapIs} \ \operatorname{\$heap}_{funcstart\_724,1}, \ \operatorname{\$heap}_{funcstart\_724,1}.p2,
asType < int > (\$heap_{funcstart\_724,1}.a2))
\rightarrow [const static or extern object]
[25.2]~{\rm div2} == {\rm div}(\mathbf{heapIs}~\$ \mathrm{heap}_{funcstart\_724,1},\,\$ \mathrm{heap}_{funcstart\_724,1}.\mathrm{p2},
asType < int > (\$heap_{init}.a2))
\rightarrow [expand definition of constant 'a2' at prang.c (21,20)]
[25.3] div2 == div(heapIs $heap_{funcstart\_724.1}, $heap_{funcstart\_724.1}.p2,
asType<int>(asType<short int>((int)176)))
\rightarrow [simplify]
[25.6] div2 == div(heapIs \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, p2, 176)
[Take given term]
[39.0] \operatorname{div3} == \operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724,1},
asType < int > (\$heap_{funcstart\_724,1}.p3),
asType < int > (\$heap_{funcstart\_724,1}.a3))
\rightarrow [simplify]
[39.1] div3 == div(heapIs \theta_{funcstart_{-724,1}}, \theta_{funcstart_{-724,1}}.p3,
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{a3}))
\rightarrow [const static or extern object]
[39.2] \ \mathrm{div3} == \mathrm{div}(\mathbf{heapIs} \ \$ \mathrm{heap}_{funcstart\_724,1}, \ \$ \mathrm{heap}_{funcstart\_724,1}.\mathrm{p3},
asType < int > (\$heap_{init}.a3))
\rightarrow [expand definition of constant 'a3' at prang.c (26,20)]
[39.3] \ \mathrm{div3} == \mathrm{div}(\mathbf{heapIs} \ \$ \mathrm{heap}_{funcstart\_724,1}, \ \$ \mathrm{heap}_{funcstart\_724,1}.\mathrm{p3},
asType<int>(asType<short int>((int)178)))
\rightarrow [simplify]
[39.6] div3 == div(heapIs heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p3, 178)
[Assume known post-assertion, class invariant or type constraint for term 39.6]
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[42.0] (asType<integer>(\theta_{funcstart\_724,1}.p3) /
asType<integer>(178)) == asType<integer>(div(heapIs
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.p3, 178).quot)
\rightarrow [simplify]
[42.2] ($heap<sub>funcstart_724,1</sub>.p3 / 178) == asType<integer>(div(heapIs)
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.p3, 178).quot)
→ [expand definition of operator './' in class 'int' at built in declaration]
[42.3] ([asType<integer>(sheap_{funcstart\_724,1.p3}) < 0]:
-(-asType < integer > (\$heap_{funcstart\_724,1}.p3) / 178), []:
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p3})~/~178) ==
asType<integer>(div(heapIs $heap_{tuncstart_724.1}, $heap_{tuncstart_724.1.p3},
→ [explicitly assert falsehood of skipped guards in subsequent guards]
[42.4] ([asType<integer>(heap_{funcstart\_724,1}.p3) < 0]:
-(-asType < integer > (\$heap_{funcstart\_724,1}.p3) / 178),
[!(\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathbf{heap}_{funcstart\_724,1}.\mathbf{p3})<0)]:
asType < integer > (\$heap_{funcstart\_724,1}.p3) / 178) = =
asType<integer>(div(heapIs heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p3,
178).quot)
\rightarrow [simplify]
[42.7] ([0 < -$heap<sub>funcstart_724,1.</sub>p3]:
-(-asType < integer > (\$heap_{funcstart\_724,1}.p3) / 178),
[!(asType < integer > (\$heap_{funcstart\_724,1}.p3) < 0)]:
asType < integer > (\$heap_{funcstart\_724,1}.p3) / 178) ==
\mathbf{asType} \small{<} \mathbf{integer} \small{>} ( \mathrm{div}(\mathbf{heapIs} \ \$ \mathrm{heap}_{funcstart\_724,1}, \ \$ \mathrm{heap}_{funcstart\_724,1}.\mathrm{p3}, \\
178).quot)
\rightarrow [from term 10.0, literala < -$heap<sub>funcstart_724.1</sub>.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] \; ([\mathbf{false}]: \; -(-\mathbf{asType} < \mathbf{integer} > (\$ \mathrm{heap}_{funcstart\_724,1}.\mathrm{p3}) \; / \; 178),
[!(\mathbf{asType} < \mathbf{integer} > (\$ heap_{funcstart\_724,1}.p3) < 0)]:
asType < integer > (\$heap_{funcstart\_724.1}.p3) / 178) = =
asType<integer>(div(heapIs $heap_{tuncstart\_724.1}, $heap_{tuncstart\_724.1}.p3,
178).quot)
\rightarrow [simplify]
[42.11] \; ([{\bf false}]: \; -({\bf -asType}{<} {\bf integer}{>} (\$ {\rm heap}_{funcstart\_724,1}.{\rm p3}) \; / \; 178), \; [!(0 <
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-\$heap_{funcstart\_724,1}.p3)]: asType<integer>(\$heap_{funcstart\_724,1}.p3) / 178)
== asType < integer > (div(heapIs $heap_{funcstart\_724,1},
heap_{funcstart_{-724,1}}.p3, 178).quot
\rightarrow [from term 10.0, literala < -$heap<sub>funcstart_724.1</sub>.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 > (\$heap_{funcstart\_724,1}.p3) / 178),
[!false]: asType<integer>($heap<sub>funcstart_724,1.</sub>p3) / 178) ==
\mathbf{asType} < \mathbf{integer} > (\mathbf{div}(\mathbf{heapIs} \ \$ \mathbf{heap}_{funcstart\_724,1}, \ \$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p3},
178).quot)
\rightarrow [simplify]
\label{eq:continuous} \textit{[42.17] }0 == (-\text{div}(\mathbf{heapIs} \ \$ \text{heap}_{funcstart\_724,1}, \ \$ \text{heap}_{funcstart\_724,1}.\text{p3},
178).quot + (heap_{funcstart\_724,1}.p3 / 178))
[Assume known post-assertion, class invariant or type constraint for term 39.6]
[43.0] (asType<integer>(sheap_{funcstart\_724,1}.p3) %
asType<integer>(178)) == asType<integer>(div(heapIs
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.\text{p3}, 178).\text{rem}
\rightarrow [simplify]
[43.2] ($heap<sub>funcstart_724,1.</sub>p3 % 178) == asType<integer>(div(heapIs)
\theta_{funcstart_{724,1}}, \theta_{funcstart_{724,1},p3,178}.rem
→ [expand definition of operator '.%' in class 'int' at built in declaration]
[43.3] ([asType<integer>(sheap_{funcstart\_724.1}.p3) < 0]:
-(-asType < integer > (\$heap_{funcstart\_724,1}.p3) \% 178), []:
asType < integer > (\$heap_{funcstart\_724,1}.p3) \% 178) ==
asType<integer>(div(heapIs $heap_funcstart_724,1, $heap_funcstart_724,1.p3,
178).rem)
→ [explicitly assert falsehood of skipped guards in subsequent guards]
[43.4] \; ([\mathbf{asType} < \mathbf{integer} > (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p3}) < 0]:
-(-asType < integer > (\$heap_{funcstart\_724,1}.p3) \% 178),
[!(asType < integer > (\$heap_{funcstart\_724,1}.p3) < 0)]:
asType < integer > (\$heap_{funcstart\_724,1}.p3) \% 178) ==
asType<integer>(div(heapIs $heap_{tuncstart\_724.1}, $heap_{tuncstart\_724.1}.p3,
178).rem)
\rightarrow [simplify]
[43.7] ([0 < -$heap<sub>funcstart_724,1</sub>.p3]:
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-(-asType < integer > (\$heap_{funcstart\_724,1}.p3) \% 178),
[!(\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{p3})<0)]:
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p3})~\%~178) ==
asType<integer>(div(heapIs $heap_funcstart_724,1, $heap_funcstart_724,1.p3,
178).rem)
\rightarrow [from term 10.0, literala < -$heap<sub>funcstart_724.1</sub>.p3 is false whenever -2 <
(0 + literala)
        Proof of rule precondition:
        [43.7.0] - 2 < (0 + 0)
        \rightarrow [simplify]
        [43.7.2] true
[43.8] ([false]: -(-asType < integer > (\$heap_{funcstart\_724,1}.p3) \% 178),
[!(asType < integer > (\$heap_{funcstart\_724,1}.p3) < 0)]:
asType < integer > (\$heap_{funcstart\_724.1}.p3) \% 178) = =
\mathbf{asType} {<} \mathbf{integer} {>} ( \mathrm{div}(\mathbf{heapIs} \ \$ \mathrm{heap}_{funcstart\_724,1}, \ \$ \mathrm{heap}_{funcstart\_724,1}.\mathrm{p3}, \\
178).rem)
\rightarrow [simplify]
[43.11] ([false]: -(-asType < integer > (\$heap_{funcstart\_724,1}.p3) \% 178), [!(0)]
<-$heap<sub>funcstart_724,1.</sub>p3)]: asType<integer>($heap<sub>funcstart_724,1.</sub>p3) %
178) == asType < integer > (div(heapIs $heap_{funcstart\_724,1},
heap_{funcstart_{-724,1}.p3, 178}.rem
\rightarrow [from term 10.0, literala < -$heap<sub>funcstart_724,1</sub>.p3 is false whenever -2 <
(0 + literala)
        Proof of rule precondition:
        [43.11.0] - 2 < (0 + 0)
        \rightarrow [simplify]
        [43.11.2] true
[43.12] ([false]: -(-asType < integer > (\$heap_{funcstart\_724,1}.p3) \% 178),
[!false]: asType<integer>($heap_{funcstart\_724,1}.p3) % 178) ==
\mathbf{asType} < \mathbf{integer} > (\mathbf{div}(\mathbf{heapIs} \$ \mathbf{heap}_{funcstart\_724,1}, \$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p3},
178).rem)
\rightarrow [simplify]
[43.17] 0 == (-\operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724,1}, \$ \operatorname{heap}_{funcstart\_724,1}.\operatorname{p3},
178).rem + (\text{$heap}_{funcstart\_724,1}.p3 \% 178))
[Take given term]
[53.0] \rho_{1740,8} == \rho_{1740
int>((asType<int>(asType<short int>(div1.rem)) *
asType < int > (\$heap_{funcstart\_724,1}.r1)) - (asType < int > (asType < short)
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int>(div1.quot)) * asType< int>($heap_{tuncstart\_724.1}.b1))))
\rightarrow [from term 11.6, div1 is equal to div(heapIs $heap_{funcstart\_724,1},
heap_{funcstart_{-724,1}}.p1, 177
[53.1] \theta == 
int>((asType<int>(asType<short int>(div(heapIs $heap_{funcstart\_724,1},))
\rho_{uncstart_{-724,1},p1,177} ** asType<int>($\leftrightarred{heap}_{funcstart_{-724,1},r1}) -
(asType<int>(asType<short int>(div1.quot)) *
asType < int > (\$heap_{funcstart\_724,1}.b1))))
\rightarrow [simplify]
[53.3] \text{heap}_{724,1;740,8} == \text{heap}_{funcstart\_724,1}._replace(p1 \rightarrow asType<short
int>((div(heapIs \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1, 177).rem *
asType < int > (\$heap_{funcstart\_724.1}.r1)) - (asType < int > (asType < short)
int>(div1.quot)) * asType< int>($heap_{funcstart\_724,1}.b1))))
\rightarrow [const static or extern object]
[53.4] heap_{724,1;740,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow asType<short
\mathbf{int} > ((\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.\operatorname{p1}, \ 177).\operatorname{rem} \ *
asType < int > (\$heap_{init}.r1)) - (asType < int > (asType < short)
\mathbf{int}{>}(\mathbf{div1.quot})) * \mathbf{asType}{<} \mathbf{int}{>} (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{b1}))))
\rightarrow [expand definition of constant 'r1' at prang.c (15,20)]
[53.5] heap_{724,1;740,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow asType<short
int>((div(heapIs \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1, 177).rem *
asType<int>(asType<short int>((int)171))) -
(asType<int>(asType<short int>(div1.quot)) *
asType < int > (\$heap_{funcstart\_724,1}.b1)))
\rightarrow [simplify]
[53.8] heap_{724,1;740,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow asType<short
int>((div(heapIs \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1, 177).rem * 171)
- (asType<int>(asType<short int>(div1.quot))
asType < int > (\$heap_{funcstart\_724,1}.b1))))
\rightarrow [from term 11.6, div1 is equal to div(heapIs $heap_{funcstart\_724,1},
heap_{funcstart_{-724,1}}.p1, 177
[53.9] heap_{724,1;740,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow asType<short
int>((171 * div(heapIs \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1, 177).rem)
- (asType<int>(asType<short int>(div(heapIs $heap_{tuncstart}, 724.1),
heap_{funcstart_{-724,1}}.p1, 177).quot) *
asType < int > (\$heap_{funcstart\_724,1}.b1))))
\rightarrow [simplify]
[53.11] \theta == 
int>((171 * div(heapIs \$heap_{funcstart\_724.1}, \$heap_{funcstart\_724.1}, p1, 177).rem)
- (\text{div}(\textbf{heapIs} \$ \text{heap}_{funcstart\_724,1}, \$ \text{heap}_{funcstart\_724,1}.\text{p1}, 177).\text{quot} *
```

```
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{b1}))))
\rightarrow [const static or extern object]
[53.12] heap_{724,1;740,8} == heap_{funcstart\_724,1}. replace(p1 \rightarrow asType<short
int>((171 * div(heapIs $heap_{funcstart\_724,1}, $heap_{funcstart\_724,1}.p1, 177).rem)
- (\text{div}(\mathbf{heapIs} \$ \text{heap}_{funcstart\_724,1}, \$ \text{heap}_{funcstart\_724,1}.\text{p1}, 177).\text{quot} *
asType < int > (\$heap_{init}.b1)))
\rightarrow [expand definition of constant 'b1' at prang.c (17,20)]
[53.13] $\text{heap}_{724.1:740.8} == \text{$heap}_{funcstart\_724.1}._\text{replace}(p1 \rightarrow \text{asType} < \text{short}
int > ((171 * div(heapIs \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1, 177).rem)
- (\text{div}(\mathbf{heapIs} \$ \text{heap}_{funcstart\_724,1}, \$ \text{heap}_{funcstart\_724,1}.\text{p1}, 177).\text{quot} *
asType<int>(asType<short int>((int)2))))
\rightarrow [simplify]
[53.19] $\text{heap}_{724.1:740.8} == $\text{heap}_{funcstart\_724.1}._\text{replace}(p1 \to ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).quot) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.\operatorname{p1}, \ 177).\operatorname{rem})))
[Take given term]
[57.0] $\text{heap}_{724,1;742,8} == $\text{heap}_{724,1;740,8}._\text{replace}(p2 \to \text{asType} < \text{short}
int>((asType<int>(asType<short int>(div2.rem)) *
asType < int > (\$heap_{724.1:740.8}.r2)) - (asType < int > (asType < short)
int>(div2.quot)) * asType< int>($heap_{724,1;740,8}.b2))))
\rightarrow [from term 53.19, $heap<sub>724,1:740.8</sub> is equal to
heap_{funcstart\_724,1}._replace(p1 \rightarrow (-2 * div(heapIs heap_{funcstart\_724,1}),
heap_{funcstart_{724,1},p1, 177}, quot) + (171 * div(heapIs p_{funcstart_{724,1},p1, 177}).
heap_{funcstart_{-724,1}}.p1, 177).rem)
[57.1] \theta_{17.1} = \theta_{17.1} \cdot \theta_{17.1} = \theta_{17.1} \cdot \theta_{17.1} \cdot \theta_{17.1} \cdot \theta_{17.1} \cdot \theta_{17.1} = \theta_{17.1} \cdot \theta_
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).quot) + (171 *
\operatorname{div}(\mathbf{heapIs}\ \$ \operatorname{heap}_{funcstart\_724,1},\ \$ \operatorname{heap}_{funcstart\_724,1}.\operatorname{pl},
(177).rem))._replace(p2 \rightarrow asType<short
int>((asType<int>(asType<short int>(div2.rem)) *
asType < int > (\$heap_{724,1;740,8}.r2)) - (asType < int > (asType < short)
int>(div2.quot)) * asType<int>($heap<sub>724,1:740,8</sub>.b2))))
\rightarrow [from term 25.6, div2 is equal to div(heapIs $heap_{tuncstart_{724.1}},
heap_{funcstart_{-724,1}}.p2, 176
[57.2] $heap<sub>724,1:742,8</sub> == $heap<sub>funcstart_724,1</sub>._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).quot) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.p1,
(177).rem))._replace(p2 \rightarrow asType < short)
int>((asType<int>(asType<short int>(div(heapIs $heap_{funcstart\_724,1},
\text{sheap}_{funcstart\_724,1.p2, 176}.\text{rem}) * \mathbf{asType} < \mathbf{int} > (\text{sheap}_{724,1;740,8.r2})) -
(asType<int>(asType<short int>(div2.quot)) *
asType < int > (\$heap_{724,1;740,8}.b2))))
```

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\rightarrow [simplify]
[57.4] $heap<sub>724,1:742,8</sub> == $heap<sub>funcstart_724,1</sub>._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).quot) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow asType<short int>((div(heapIs
\theta_{funcstart_{724,1}}, \theta_{funcstart_{724,1}}, \theta_{funcstart_{724,1}}.p2, 176).rem *
\mathbf{asType} \small{<} \mathbf{int} \small{>} (\$ \mathrm{heap}_{724,1;740,8}.\mathrm{r2})) \\ - (\mathbf{asType} \small{<} \mathbf{int} \small{>} (\mathbf{asType} \small{<} \mathbf{short}
int>(div2.quot)) * asType<int>($heap<sub>724.1:740.8</sub>.b2))))
\rightarrow [from term 53.19, $heap<sub>724,1:740,8</sub> is equal to
heap_{funcstart\ 724.1}._replace(p1 \rightarrow (-2 * div(heapIs \$heap_{funcstart\ 724.1},
heap_{funcstart\_724,1}.p1, 177).quot + (171 * div(heapIs $heap_{funcstart\_724,1}, 177).quot) + (171 * div(heapIs $heap_{funcstart\_724,1}, 17
heap_{funcstart_{724,1}.p1, 177).rem}
[57.5] heap_{724,1;742,8} == heap_{funcstart\_724,1}.\_replace(p1 \to ((-2 * 
div(heapIs \$heap_{funcstart\_724.1}, \$heap_{funcstart\_724.1}.p1, 177).quot) + (171 *
\operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724.1}, \$ \operatorname{heap}_{funcstart\_724.1}.p1,
177).rem))).replace(p2 \rightarrow asType < short int > ((div(heapIs)))
\rho_{funcstart_{-724,1}}, \rho_{funcstart_{-724,1},p2, 176}.rem *
asType < int > (\$heap_{funcstart\_724.1}.\_replace(p1 \rightarrow ((-2 * div(heapIs))))))
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.\text{p1}, 177).\text{quot}) + (171 * \text{div}(\text{heapIs})
\label{eq:heap-funcstart_724,1} \$ heap_{funcstart\_724,1}.p1,\ 177).rem))).r2)) \ -
(asType<int>(asType<short int>(div2.quot)) *
asType < int > (\$heap_{724,1;740,8}.b2))))
→ [const member of object with modified fields]
[57.6] heap_{724,1;742,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 \ *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow asType<short int>((div(heapIs
\rho_{funcstart_{724,1}}, \rho_{funcstart_{724,1}}, \rho_{funcstart_{724,1}}, \rho_{funcstart_{724,1}}, \rho_{funcstart_{724,1}}
\mathbf{asType} < \mathbf{int} > (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{r2})) - (\mathbf{asType} < \mathbf{int} > (\mathbf{asType} < \mathbf{short}))
int>(div2.quot)) * asType<int>($heap<sub>724,1:740,8</sub>.b2))))
\rightarrow [const static or extern object]
[57.7] \rho_{17,742,8} == \rho_{17,742,1}.\_replace(p1 \rightarrow ((-2 * p1 + p1)))
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.p1,
177).rem)))._{\mathbf{replace}}(p2 \rightarrow \mathbf{asType} < \mathbf{short\ int} > ((\operatorname{div}(\mathbf{heapIs}))))
\rho_{funcstart_{-724,1}}, \rho_{funcstart_{-724,1}}, \rho_{funcstart_{-724,1}}, \rho_{funcstart_{-724,1}}, \rho_{funcstart_{-724,1}}
asType < int > (\$heap_{init}.r2)) - (asType < int > (asType < short)
int>(div2.quot)) * asType<int>($heap<sub>724.1:740.8</sub>.b2))))
\rightarrow [expand definition of constant 'r2' at prang.c (20,20)]
[57.8] heap_{724,1;742,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 *
\operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724,1}, \$ \operatorname{heap}_{funcstart\_724,1}.p1,
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177).rem)))._{replace(p2 \rightarrow asType < short int > ((div(heapIs))))}
\text{Sheap}_{funcstart_{-724,1}}, \text{Sheap}_{funcstart_{-724,1}}.p2, 176).rem *
asType<int>(asType<short int>((int)172))) -
(asType<int>(asType<short int>(div2.quot)) *
asType < int > (\$heap_{724,1;740,8}.b2))))
\rightarrow [simplify]
[57.11] $\text{heap}_{724,1:742,8} == \text{$heap}_{funcstart\_724,1}._\text{$replace}(p1 \to ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).quot) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow asType<short int>((div(heapIs
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.p2, 176).rem * 172) -
(asType<int>(asType<short int>(div2.quot)) *
asType < int > (\$heap_{724,1;740,8}.b2))))
\rightarrow [from term 25.6, div2 is equal to div(heapIs $heap_{tuncstart_{724.1}},
heap_{funcstart_{724,1}}.p2, 176
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 \ *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow asType<short int>((172 * div(heapIs
\text{Sheap}_{funcstart_{-724,1}}, \text{Sheap}_{funcstart_{-724,1}}.p2, 176).rem) -
(asType<int>(asType<short int>(div(heapIs $heap_{funcstart\_724.1},
\rho_{uncstart_{724,1},p2,176}(0) * asType < int > (\rho_{uncstart_{724,1},p2,176}(0)) * asType < int > (\rho_{uncstart_{724,1},p2,176}(0)))
\rightarrow [simplify]
[57.14] $\text{heap}_{724,1:742,8} == $\text{heap}_{funcstart\_724,1}._\text{replace}(p1 \to ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 *
\operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724,1}, \$ \operatorname{heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow asType<short int>((172 * div(heapIs
\theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}.p2, 176).rem) - (div(heapIs
\theta_{funcstart_{724,1}}, \theta_{funcstart_{724,1},p2,176}.quot *
asType < int > (\$heap_{724,1;740,8}.b2))))
\rightarrow [from term 53.19, heap_{724,1;740,8} is equal to
heap_{funcstart\_724,1}._replace(p1 \rightarrow (-2 * div(heapIs heap_{funcstart\_724,1}),
\text{Sheap}_{funcstart\_724,1}.p1, 177).quot) + (171 * div(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
heap_{funcstart_{-724,1}}.p1, 177).rem)
[57.15] heap_{724,1;742,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 \ *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow asType<short int>((172 * div(heapIs
heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p2, 176).rem) - (div(heapIs)
\theta_{funcstart_{724,1}}, \theta_{funcstart_{724,1},p2,176}.quot *
\mathbf{asType}{<}\mathbf{int}{>}(\$\text{heap}_{funcstart\_724,1}.\mathbf{\_replace}(\text{p1} \rightarrow ((\text{-}2 * \text{div}(\mathbf{heapIs}
\theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}
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\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.p1, 177).rem))).b2))))
\rightarrow [const member of object with modified fields]
[57.16] $heap<sub>724,1;742,8</sub> == $heap<sub>funcstart_724,1</sub>._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).quot) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow asType<short int>((172 * div(heapIs
\theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}.p2, 176).rem) - (div(heapIs
p_{funcstart_{724,1}}, p_{funcstart_{724,1},p_{724,1}}, p_{724,1}, p_{724,1
\mathbf{asType} < \mathbf{int} > (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{b2}))))
\rightarrow [const static or extern object]
[57.17] $heap<sub>724,1;742,8</sub> == $heap<sub>funcstart_724,1</sub>._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).quot) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow asType<short int>((172 * div(heapIs
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.\text{p2}, 176).\text{rem}) - (\text{div}(\text{heapIs})
heap_{funcstart_{-724,1}}, heap_{funcstart_{-724,1}}, 2, 176).quot *
asType < int > (\$heap_{init}.b2))))
\rightarrow [expand definition of constant 'b2' at prang.c (22,20)]
[57.18] heap_{724,1;742,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 \ *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart} \ 724.1, \ \$ \operatorname{heap}_{funcstart} \ 724.1.p1,
177).rem)))._replace(p2 \rightarrow asType<short int>((172 * div(heapIs
\theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}
heap_{funcstart_{724,1}}, heap_{funcstart_{724,1}}, 2, 176).quot *
asType<int>(asType<short int>((int)35)))))
\rightarrow [simplify]
[57.24] $\text{heap}_{724,1;742,8} == \text{$heap}_{funcstart\_724,1}._\text{$-replace}(p1 \to ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 \ *
\operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724,1}, \$ \operatorname{heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow ((-35 * div(heapIs $heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1}.\text{p2}, 176).\text{quot} + (172 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
heap_{funcstart_{-724,1}}.p2, 176).rem))
[Take goal term]
[1.0] minof(short int) \le ((asType<int>(asType<short int>(div3.rem)) *
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{724,1;742,8}.\mathrm{r3})) - (\mathbf{asType}{<}\mathbf{int}{>}(\mathbf{asType}{<}\mathbf{short}
int>(div3.quot)) * asType<int>($heap<sub>724,1:742,8</sub>.b3)))
\rightarrow [simplify]
[1.1] -32768 \leq ((asType\leqint>(asType\leqshort int>(div3.rem)) *
asType < int > (\$heap_{724,1:742,8}.r3)) - (asType < int > (asType < short)
int>(div3.quot)) * asType< int>($heap_{724,1:742.8}.b3)))
```

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\rightarrow [from term 39.6, div3 is equal to div(heapIs $heap_{funcstart\_724,1},
heap_{funcstart_{-724,1}}.p3, 178
[1.2] -32768 \leq ((asType\leqint>(asType\leqshort int>(div(heapIs
\theta_{funcstart_{724,1}}, \theta_{funcstart_{724,1},p3,178}.rem)) *
asType < int > (\$heap_{724.1:742.8}.r3)) - (asType < int > (asType < short)
int>(div3.quot)) * asType<int>($heap<sub>724.1:742.8</sub>.b3)))
\rightarrow [simplify]
[1.4] -32768 \leq ((\operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724,1}, \$ \operatorname{heap}_{funcstart\_724,1}.\operatorname{p3},
178).rem * asType<int>($heap<sub>724,1;742,8</sub>.r3)) -
(asType<int>(asType<short int>(div3.quot)) *
asType < int > (\$heap_{724.1:742.8}.b3)))
\rightarrow [from term 57.24, $heap<sub>724.1:742.8</sub> is equal to
heap_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 * div(heapIs $heap_{funcstart\_724,1},
heap_{funcstart\_724,1}.p1, 177).quot + (171 * div(heapIs p_{funcstart\_724,1})
\theta_{funcstart\_724,1}.p1, 177).rem))._replace(p2 \rightarrow (-35 * div(\mathbf{heapIs})))
heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p2, 176).quot) + (172 * div(heapIs)
heap_{funcstart_{-724,1}}, heap_{funcstart_{-724,1}}, p2, 176).rem)
[1.5] - 32768 \leq ((\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.\operatorname{p3},
178).rem * asType<int>(heap_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 *
div(\mathbf{heapIs} \ \$heap_{funcstart\_724.1}, \ \$heap_{funcstart\_724.1}.p1, \ 177).quot) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow ((-35 * div(heapIs $heap_{funcstart_724,1},
\text{Sheap}_{funcstart\_724,1}.\text{p2}, 176).\text{quot} + (172 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
\theta_{funcstart=724,1.p2, 176,rem})).r3)) - (asType < int > (asType < short)
int>(div3.quot)) * asType< int>($heap_{724,1;742,8}.b3)))
\rightarrow [const member of object with modified fields]
[1.7] - 32768 \leq ((\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.\operatorname{p3},
178).rem * asType < int > (\$heap_{funcstart\_724,1}.r3)) -
(asType<int>(asType<short int>(div3.quot)) *
asType<int>($heap<sub>724.1:742.8</sub>.b3)))
\rightarrow [const static or extern object]
[1.8] -32768 \leq ((div(heapIs $heap_{funcstart\_724,1}, $heap_{funcstart\_724,1}.p3,
178).rem * asType < int > (\$heap_{init}.r3)) - (asType < int > (asType < short)
int > (div3.quot)) * asType < int > ($heap_{724,1;742,8}.b3)))
\rightarrow [expand definition of constant 'r3' at prang.c (25,20)]
[1.9] -32768 \le ((\operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724,1}, \$ \operatorname{heap}_{funcstart\_724,1}.\operatorname{p3},
178).rem * asType<int>(asType<short int>((int)170))) -
(asType<int>(asType<short int>(div3.quot)) *
asType<int>($heap<sub>724.1:742.8</sub>.b3)))
\rightarrow [simplify]
```

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 \label{eq:continuous} \textit{[1.12] -32768} \leq ((\text{div}(\mathbf{heapIs}\ \$\text{heap}_{funcstart\_724,1},\ \$\text{heap}_{funcstart\_724,1}.\text{p3},
178).rem * 170) - (asType<int>(asType<short int>(div3.quot))
asType < int > (\$heap_{724,1;742,8}.b3)))
\rightarrow [from term 39.6, div3 is equal to div(heapIs $heap_{tuncstart_{724.1}},
heap_{funcstart_{-724,1}}.p3, 178
[1.13] -32768 \leq ((170 * div(heapIs $heap_{funcstart\_724,1},
\theta_{funcstart\_724,1}.p3, 178).rem - (asType < int > (asType < short)
int>(div(heapIs \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p3, 178).quot)) *
asType < int > (\$heap_{724,1;742,8}.b3)))
\rightarrow [simplify]
[1.15] -32768 \leq ((170 * div(heapIs $heap_{funcstart\_724,1},)
\text{Sheap}_{funcstart\_724,1}.\text{p3}, 178).\text{rem}) - (\text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1}.\text{p3}, 178).\text{quot} * \mathbf{asType} < \mathbf{int} > (\text{Sheap}_{724,1;742,8}.\text{b3})))
\rightarrow [from term 57.24, $heap<sub>724,1;742,8</sub> is equal to
heap_{funcstart\_724.1}._replace(p1 \rightarrow ((-2 * div(heapIs heap_{funcstart\_724.1}),
heap_{funcstart_{-724,1},p1, 177}, quot) + (171 * div(heapIs heap_{funcstart_{-724,1},p1, 177})
\rho_{funcstart\_724.1}.p1, 177).rem)._replace\rho_{funcstart\_724.1}.p1, 177).rem)._replace
heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p2, 176).quot) + (172 * div(heapIs)
heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p2, 176).rem))]
[1.16] -32768 \leq ((170 * div(heapIs $heap_{funcstart\_724,1},
\rho_{funcstart\_724,1.p3}, 178).rem) - (div(heapIs \rho_{funcstart\_724,1},
heap_{funcstart_{-724,1}.p3, 178}.quot *
asType < int > (\$heap_{funcstart\_724,1}.\_replace(p1 \rightarrow ((-2 * div(heapIs)))))))
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.p1, 177).quot) + (171 * div(heapIs)
\theta_{funcstart_{724,1}}, \theta_{funcstart_{724,1},p1, 177}.rem))).replace(p2 \rightarrow ((-35))
* div(\mathbf{heapIs} \ \$ heap_{funcstart\_724,1}, \ \$ heap_{funcstart\_724,1}.p2, \ 176).quot) + (172 \ *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.p2, \ 176).rem))).b3)))
\rightarrow [const member of object with modified fields]
[1.18] -32768 \leq ((170 * div(heapIs $heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1}.\text{p3}, 178).\text{rem}) - (\text{div}(\text{heapIs }\text{Sheap}_{funcstart\_724,1},
\theta_{funcstart\_724,1.p3}, 178).quot * asType<int>(\theta_{funcstart\_724,1.p3})))
\rightarrow [const static or extern object]
[1.19] -32768 \leq ((170 * div(heapIs $heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1}.\text{p3}, 178).\text{rem} – (\text{div}(\text{heapIs }\text{Sheap}_{funcstart\_724,1},
\theta_{init} = \theta_{init} - \theta_{init} 
\rightarrow [expand definition of constant 'b3' at prang.c (27,20)]
 \label{eq:condition} \mbox{[1.20] -32768} \leq ((170 * \mbox{div}(\mathbf{heapIs} \ \$ \mbox{heap}_{funcstart\_724,1}, \ \$ \mbox{heap}_{funcstart\_724,1}.\mbox{p3}, 
178).rem) – (\text{div}(\mathbf{heapIs} \$ \text{heap}_{funcstart\_724,1}, \$ \text{heap}_{funcstart\_724,1}.p3,
178).quot * asType<int>(asType<short int>((int)63))))
\rightarrow [simplify]
```

```
[1.27] -32769 < ((-63 * div(heapIs $heap<sub>funcstart-724,1</sub>, $heap<sub>funcstart-724,1</sub>.p3,
178).quot) + (170 * div(heapIs heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p3,
178).rem))
\rightarrow [negate goal and search for contradiction]
[1.28] !(-32769 < ((-63 * div(heapIs $heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1}.\text{p3}, 178).\text{quot}) + (170 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
heap_{funcstart_{724,1}.p3, 178.rem}
\rightarrow [simplify]
 [1.33] \ 32768 < ((63 * \operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.\operatorname{p3}, 
178).quot) + (-170 * \text{div}(\textbf{heapIs} \$ \text{heap}_{funcstart\_724,1}, \$ \text{heap}_{funcstart\_724,1}.\text{p3},
178).rem))
[Copy term 1.33]
[66.0] 32768 < ((-170 * div(heapIs $heap_{funcstart\_724,1},
\text{Sheap}_{funcstart_724,1.p3}, 178).\text{rem} + (63 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart_724,1},
heap_{funcstart_{-724,1}}.p3, 178).quot)
\rightarrow [from\ term\ 43.17,\ div(\textbf{heapIs}\ \$heap_{funcstart\_724,1},\ \$heap_{funcstart\_724,1}.p3,
178).rem is equal to heap_{funcstart\_724,1}.p3 \% 178
[66.1] 32768 < ((-170 * (\text{$heap}_{funcstart\_724,1}.p3 \% 178)) + (63 * div(\textbf{heapIs}))
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.p3, 178).quot)
[Create new term from term 42.17 using rule: condition for equality of division]
[97.0] ((178 * (0 + -(-\text{div}(\mathbf{heapIs} \$ \text{heap}_{funcstart\_724,1},
\text{Sheap}_{funcstart_{724,1}.p3}, 178).\text{quot}))) < (1 + \text{Sheap}_{funcstart_{724,1}.p3})) \land
(\text{\$heap}_{funcstart\_724.1}.p3 < (178 * (0 + 1 + -(-div(\mathbf{heapIs}))))
\text{Sheap}_{funcstart_{-724,1}}, \text{Sheap}_{funcstart_{-724,1}}.p3, 178).quot))))
\rightarrow [simplify]
[97.15] (-1 < ((-178 * div(heapIs $heap_{funcstart\_724.1}, $heap_{funcstart\_724.1}.p3,
178).quot) + \text{$heap}_{funcstart\_724,1}.p3)) \land (-178 < (-\text{$heap}_{funcstart\_724,1}.p3 + \text{$heap}_{funcstart\_724,1}.p3)
(178 * div(\mathbf{heapIs} \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p3, 178).quot)))
[Work on sub-term 2 of conjunction in term 97.15]
[98.0] -1 < ((-178 * div(heapIs $heap_{funcstart\_724,1}, $heap_{funcstart\_724,1}.p3,
178).quot) + $heap<sub>funcstart_724,1</sub>.p3)
[Create new term from terms 98.0, 5.41 using rule: transitivity 2]
[109.0] (-30323 + -1 + 1) < (-178 * div(heapIs $heap_{tuncstart\_724.1},
heap_{funcstart_{-724,1}.p3, 178}, quot
\rightarrow [simplify]
[109.1] -30323 < (-178 * div(heapIs $heap_{funcstart\_724,1},
heap_{funcstart_{-724,1}}.p3, 178).quot
\rightarrow [literal comparison of product]
```

```
[109.2] ([-178 < 0]: (-30323 / 178) < -\text{div}(\mathbf{heapIs} \$ \text{heap}_{funcstart\_724,1},
\theta_{funcstart\_724,1}.p3, 178, quot, [0 < -178]: (-30323 / -178) < \text{div}(\hat{heapIs})
→ [explicitly assert falsehood of skipped guards in subsequent guards]
[109.3] ([-178 < 0]: (-30323 / 178) < -\text{div}(\mathbf{heapIs} \$ \text{heap}_{funcstart\_724,1},
\theta_{uncstart_{724,1}.p3, 178}.quot, [(0 < -178) \land !(-178 < 0)]: (-30323 / -178)
< \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_724,1}, \text{\$heap}_{funcstart\_724,1}.\text{p3}, 178).\text{quot}, [(-178)]
==0) \wedge !(-178 < 0) \wedge !(0 < -178)]: -30323 < 0)
\rightarrow [simplify]
[109.7] - 171 < -\text{div}(\text{heapIs } \text{$heap}_{funcstart\_724,1}, \text{$heap}_{funcstart\_724,1}.\text{p3},
[Create new term from terms 109.7, 66.1 using rule: transitivity 5]
[111.0] 32768 < ((-170 * (\text{$heap}_{funcstart\_724.1}.p3 \% 178)) + (63 * -(-171 + 1)))
\rightarrow [simplify]
[111.5] 22058 < (-170 * ($heap_{funcstart\_724,1}.p3 % 178))
\rightarrow [literal comparison of product]
[111.6] ([-170 < 0]: (22058 / 170) < –($heap _{funcstart\_724,1}.p3 % 178), [0 <
-170]: (22058 / -170) < (\text{$heap}_{funcstart\_724,1}.\text{p3} \% 178), [-170 == 0]: 22058 <
0)
→ [explicitly assert falsehood of skipped guards in subsequent guards]
[111.7] ([-170 < 0]: (22058 / 170) < -(\text{\$heap}_{funcstart\_724,1}.\text{p3 } \% 178), [(0 <
-170) \wedge !(-170 < 0)]: (22058 / -170) < ($heap_{funcstart_724,1}.p3 % 178), [(-170)]
==0) \land !(-170 < 0) \land !(0 < -170)]: 22058 < 0)
\rightarrow [simplify]
[111.12] false
Proof of verification condition: Type constraint satisfied in implicit
conversion from 'int' to 'short int'
Condition generated at: C:\Escher\Customers\prang\prang.c (60,33)
Condition defined at:
To prove: ((asType<int>(asType<short int>(div3.rem)) *
asType < int > (\$heap_{724,1:742,8}.r3)) - (asType < int > (asType < short)
int>(div3.quot)) * asType< int>($heap_{724,1;742,8}.b3))) \le maxof(short int)
Given:
heap_{init}.LIMIT == (int)80
\theta sheap<sub>init</sub>.M1 == asType<short int>((int)30269)
```

```
\rho_{init}.r1 == asType < short int > ((int)171)
heap_{init}.a1 == asType < short int > ((int)177)
\theta = asType < short int > ((int)2)
heap_{init}.M2 == asType < short int > ((int)30307)
\theta_{init}.r2 == asType<short int>((int)172)
heap_{init}.a2 == asType < short int > ((int)176)
\theta = asType < short int > ((int)35)
heap_{init}.M3 == asType < short int > ((int)30323)
\theta_{init}.r3 == asType<short int>((int)170)
heap_{init}.a3 == asType < short int > ((int)178)
\theta = asType < short int > ((int)63)
\theta = asType < short int > ((int)1)
\theta
\theta = asType < short int > ((int)3)
invariant1(heapIs heap_{funcstart_{724.1}})
div1 == div(\mathbf{heapIs} \$heap_{funcstart\_724,1},
\mathbf{asType} < \mathbf{int} > (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p1}),
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{a1}))
(asType<integer>(asType<int>($heap_{tuncstart\_724.1}.p1)) /
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a1))) = =
asType<integer>(div1.quot)
(\mathbf{asType} {<} \mathbf{integer} {>} (\mathbf{asType} {<} \mathbf{int} {>} (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p1})) \ \%
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a1))) = =
asType<integer>(div1.rem)
!(0 == asType < integer > (div1.rem)) || !(0 ==
asType<integer>(div1.quot))
div2 == div(\mathbf{heapIs} \$heap_{funcstart\_724,1},
asType < int > ($heap_{funcstart\_724,1}.p2),
asType < int > (\$heap_{funcstart\_724,1}.a2))
(asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.p2)) /
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a2))) = =
asType<integer>(div2.quot)
(\mathbf{asType} < \mathbf{int} > (\mathbf{asType} < \mathbf{int} > (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p2})) \ \%
asType < integer > (asType < int > (\$heap_{funcstart, 724,1}.a2))) = =
asType<integer>(div2.rem)
!(0 == asType < integer > (div2.rem)) || !(0 ==
```

```
asType<integer>(div2.quot))
div3 == div(\mathbf{heapIs} \$ heap_{funcstart\_724,1},
asType < int > (\$heap_{funcstart\_724,1}.p3),
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{a3}))
(asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.p3)) /
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a3))) = =
asType<integer>(div3.quot)
(\mathbf{asType} {<} \mathbf{integer} {>} (\mathbf{asType} {<} \mathbf{int} {>} (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p3})) \ \%
\mathbf{asType} < \mathbf{integer} > (\mathbf{asType} < \mathbf{int} > (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{a3}))) = =
asType<integer>(div3.rem)
!(0 == asType < integer > (div3.rem)) || !(0 ==
asType<integer>(div3.quot))
\$heap_{724,1;740,8} == \$heap_{funcstart\_724,1}.\_\mathbf{replace}(p1 \to \mathbf{asType} < \mathbf{short}
int>((asType<int>(asType<short int>(div1.rem)) *
asType < int > (\$heap_{funcstart\_724,1}.r1)) - (asType < int > (asType < short)
int>(div1.quot)) * asType<int>($heap_{funcstart\_724,1}.b1)))
-asType < integer const > (\$heap_{724.1:740.8}.M1) < 
asType<integer>($heap<sub>724,1:740,8</sub>.p1)
!(0 == asType < integer > (\$heap_{724,1:740.8}.p1))
asType<integer>($heap<sub>724.1:740.8</sub>.p1) <
asType<integer>($heap<sub>724.1:740.8</sub>.M1)
\$heap_{724,1;742,8} == \$heap_{724,1;740,8}.\mathbf{\_replace}(p2 \rightarrow \mathbf{asType} {<} \mathbf{short}
int>((asType<int>(asType<short int>(div2.rem)) *
asType < int > (\$heap_{724,1:740.8}.r2)) - (asType < int > (asType < short)
int>(div2.quot)) * asType< int>($heap_{724,1;740,8}.b2))))
-{\bf asType}{<}{\bf integer~const}{>}(\${\rm heap}_{724,1;742,8}.{\rm M2})<
asType<integer>($heap<sub>724.1:742.8</sub>.p2)
!(0 == asType < integer > (\$heap_{724,1:742.8}.p2))
asType<integer>($heap<sub>724.1:742.8</sub>.p2) <
asType<integer>($heap<sub>724.1:742.8</sub>.M2)
Proof:
[Take given term]
[5.0] invariant1(heapIs heap_{funcstart\_724,1}
\rightarrow [expand definition of function 'invariant1' at prang.c (34,1)]
|5.1| (((((0 < asType<integer>($heap_{funcstart\_724,1}.p1)) &&
(asType < integer > (\$heap_{funcstart\_724,1}.p1) < 
asType < integer > (\$heap_{funcstart\_724,1}.M1))) \&\& (0 <
asType < integer > (\$heap_{funcstart_{-724,1},p2}))) \&\&
```

```
(\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{p2}) <
asType < integer > (\$heap_{funcstart\_724,1}.M2))) \&\& (0 < funcstart\_724,1)
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{p3})))\ \&\&
(asType < integer > ($heap_{funcstart\_724,1}.p3) < 
\mathbf{asType} < \mathbf{integer} > (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{M3}))
\rightarrow [simplify]
[5.3] (((((0 < $heap_{funcstart_724,1}.p1) && ($heap_{funcstart_724,1}.p1 < function for the content of the 
asType < integer > (\$heap_{funcstart\_724,1}.M1))) \&\& (0 <
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p2})))\ \&\&
(asType < integer > ($heap_{funcstart\_724,1}.p2) < 
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{M2})))~\&\&~(0<
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{p3})))\ \&\&
(asType < integer > (\$heap_{funcstart\_724,1}.p3) <
asType < integer > (\$heap_{funcstart\_724,1}.M3))
\rightarrow [const static or extern object]
[5.4] (((((0 < $heap_{funcstart\_724,1}.p1) && ($heap_{funcstart\_724,1}.p1 < ])
asType < integer > (\$heap_{init}.M1))) \&\& (0 <
asType < integer > (\$heap_{funcstart\_724,1}.p2))) \&\&
(\mathbf{asType} < \mathbf{integer} > (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p2}) <
asType < integer > (\$heap_{funcstart\_724,1}.M2))) \&\& (0 <
asType < integer > (\$heap_{funcstart\_724,1}.p3))) \&\&
(\mathbf{asType} {<} \mathbf{integer} {>} (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p3}) <
asType < integer > (\$heap_{funcstart\_724,1}.M3))
\rightarrow [expand definition of constant 'M1' at prang.c (14,20)]
[5.5] (((((0 < $heap_{funcstart_{724,1}}.p1) && ($heap_{funcstart_{724,1}}.p1 < 
asType<integer>(asType<short int>((int)30269)))) && (0 <
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{p2})))\ \&\&
(asType < integer > ($heap_{funcstart\_724,1}.p2) < 
asType < integer > (\$heap_{funcstart\_724,1}.M2))) \&\& (0 <
asType < integer > (\$heap_{funcstart\_724,1}.p3))) \&\&
(asType<integer>($heap_funcstart_724.1.p3) <
asType < integer > (\$heap_{funcstart\_724.1}.M3))
\rightarrow [simplify]
[5.16] \left( \left( \left( \left( -30269 < -\$ \text{heap}_{funcstart\_724,1}.\text{p1} \right) \right. \wedge \left. \left( 0 < \$ \text{heap}_{funcstart\_724,1}.\text{p1} \right) \right. \wedge \right. \right)
(0 < \mathrm{\$heap}_{funcstart\_724,1}.\mathrm{p2})) && (\mathrm{\$heap}_{funcstart\_724,1}.\mathrm{p2} <
asType < integer > (\$heap_{funcstart\_724,1}.M2))) \&\& (0 <
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p3})))\ \&\&
(asType < integer > (\$heap_{funcstart\_724.1}.p3) < 
asType < integer > (\$heap_{funcstart\_724,1}.M3))
\rightarrow [const static or extern object]
[5.17] ((((-30269 < -$heap_{funcstart\_724,1}.p1) \lambda (0 < $heap_{funcstart\_724,1}.p1) \lambda
```

```
(0 < \text{$heap}_{funcstart\_724,1}.p2)) \&\& (\text{$heap}_{funcstart\_724,1}.p2 <
asType < integer > (\$heap_{init}.M2))) \&\& (0 <
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{p3})))\ \&\&
(asType < integer > ($heap_{funcstart\_724,1}.p3) < 
asType < integer > (\$heap_{funcstart\_724,1}.M3))
\rightarrow [expand definition of constant 'M2' at prang.c (19,20)]
[5.18] ((((-30269 < -\$heap_{funcstart\_724,1}.p1) \land (0 < \$heap_{funcstart\_724,1}.p1) 
(0 < \text{\$heap}_{funcstart\_724,1}.p2)) \&\& (\text{\$heap}_{funcstart\_724,1}.p2 <
asType < integer > (asType < short int > ((int)30307)))) && (0 < integer) && (0 < integer
asType < integer > (\$heap_{funcstart\_724,1}.p3))) \&\&
(asType < integer > (\$heap_{funcstart\_724,1}.p3) < 
asType < integer > (\$heap_{funcstart\_724,1}.M3))
\rightarrow [simplify]
[5.30] ((-30307 < -\$heap_{funcstart\_724,1}.p2) \land (-30269 <
-\$heap_{funcstart\_724,1}.p1) \land (0 < \$heap_{funcstart\_724,1}.p1) \land (0 < \$heap_{funcstart\_724,1}.p1)
\text{Sheap}_{funcstart\_724,1.p2}) \land (0 < \text{Sheap}_{funcstart\_724,1.p3})) \&\&
(\text{\$heap}_{funcstart\_724,1}.\text{p3} < \text{asType} < \text{integer} > (\text{\$heap}_{funcstart\_724,1}.\text{M3}))
\rightarrow [const static or extern object]
[5.31] ((-30307 < -$heap_{funcstart\_724,1}.p2) \land (-30269 <
-\$heap_{funcstart\_724,1}.p1) \land (0 < \$heap_{funcstart\_724,1}.p1) \land (0 < \$heap_{funcstart\_724,1}.p1)
\text{Sheap}_{funcstart\ 724.1.p2} \land (0 < \text{Sheap}_{funcstart\ 724.1.p3})) \&\&
(\$heap_{funcstart\_724,1}.p3 < \mathbf{asType} < \mathbf{integer} > (\$heap_{init}.M3))
\rightarrow [expand definition of constant 'M3' at prang.c (24,20)]
[5.32] ((-30307 < -$heap_funcstart_724,1.p2) \land (-30269 <
-\$heap_{funcstart\_724,1}.p1) \land (0 < \$heap_{funcstart\_724,1}.p1) \land (0 < \$heap_{funcstart\_724,1}.p1)
\text{Sheap}_{funcstart_{724,1}.p2} \land (0 < \text{Sheap}_{funcstart_{724,1}.p3})) \&\&
(\text{sheap}_{funcstart\_724,1}.p3 < asType < integer > (asType < short)
int > ((int)30323)))
\rightarrow [simplify]
[5.40] (-30323 < -\$heap_{funcstart\_724,1}.p3) \land (-30307 < -30307)
 -\$heap_{funcstart\_724,1}.p2) \land (-30269 < -\$heap_{funcstart\_724,1}.p1) \land (0 < -\$heap_{funcstart\_724,1}.p1)
\text{Sheap}_{funcstart_{-724,1}.p1} \land (0 < \text{Sheap}_{funcstart_{-724,1}.p2}) \land (0 <
heap_{funcstart_{724,1}.p3}
[Work on sub-term 6 of conjunction in term 5.40]
[10.0]~0 < \$ \mathrm{heap}_{funcstart\_724,1}.\mathrm{p3}
[Take given term]
[11.0] \operatorname{div1} == \operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724,1},
asType < int > (\$heap_{funcstart\_724,1}.p1),
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{a1}))
```

```
\rightarrow [simplify]
[11.1] \operatorname{div1} == \operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724,1}, \$ \operatorname{heap}_{funcstart\_724,1}.p1,
asType < int > (\$heap_{funcstart\_724,1}.a1))
\rightarrow [const static or extern object]
[11.2] \operatorname{div1} == \operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1,
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{init}.\mathtt{a1}))
\rightarrow [expand definition of constant 'a1' at prang.c (16,20)]
[11.3] \operatorname{div1} == \operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724,1}, \$ \operatorname{heap}_{funcstart\_724,1}.p1,
asType<int>(asType<short int>((int)177)))
\rightarrow [simplify]
[11.6] div1 == div(heapIs \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}.p1, 177)
[Take given term]
[25.0] div2 == div(heapIs \theta_{funcstart_724,1},
asType < int > (\$heap_{funcstart\_724,1}.p2),
asType < int > (\$heap_{funcstart\_724,1}.a2))
\rightarrow [simplify]
[25.1] \operatorname{div2} == \operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p2,
asType < int > (\$heap_{funcstart\_724,1}.a2))
\rightarrow [const static or extern object]
[25.2] \operatorname{div2} == \operatorname{div}(\mathbf{heapIs} \operatorname{\$heap}_{funcstart\_724,1}, \operatorname{\$heap}_{funcstart\_724,1}.p2,
asType < int > (\$heap_{init}.a2))
\rightarrow [expand definition of constant 'a2' at prang.c (21,20)]
[25.3] div2 == div(heapIs \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}.p2,
asType<int>(asType<short int>((int)176)))
\rightarrow [simplify]
[25.6] \operatorname{div2} == \operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724,1}, \$ \operatorname{heap}_{funcstart\_724,1}.p2, 176)
[Take given term]
[39.0] \operatorname{div3} == \operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724,1},
\mathbf{asType} < \mathbf{int} > (\$ \mathrm{heap}_{funcstart\_724,1}.\mathrm{p3}),
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{a3}))
\rightarrow [simplify]
[39.1] div3 == div(heapIs \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}.p3,
asType < int > (\$heap_{funcstart\_724,1}.a3))
\rightarrow [const static or extern object]
[39.2] \ \mathrm{div3} == \mathrm{div}(\mathbf{heapIs} \ \$ \mathrm{heap}_{funcstart\_724,1}, \ \$ \mathrm{heap}_{funcstart\_724,1}.\mathrm{p3},
asType < int > (\$heap_{init}.a3))
```

```
\rightarrow [expand definition of constant 'a3' at prang.c (26,20)]
[39.3] div3 == div(heapIs \theta_{funcstart_{-724,1}}, \theta_{funcstart_{-724,1}}.p3,
asType<int>(asType<short int>((int)178)))
\rightarrow [simplify]
[39.6]~{\rm div3} == {\rm div}(\mathbf{heapIs}~\$ \mathrm{heap}_{funcstart\_724,1},\,\$ \mathrm{heap}_{funcstart\_724,1}.\mathrm{p3},\,178)
[Assume known post-assertion, class invariant or type constraint for term 39.6]
\textit{[42.0]} \ (\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p3}) \ / \\
asType<integer>(178)) == asType<integer>(div(heapIs
heap_{funcstart_{-724,1}}, heap_{funcstart_{-724,1}}, 178).quot
\rightarrow [simplify]
[42.2] ($heap<sub>funcstart_724,1.</sub>p3 / 178) == asType<integer>(div(heapIs)
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.p3, 178).quot)
→ [expand definition of operator './' in class 'int' at built in declaration]
[42.3] ([asType<integer>(sheap_{funcstart\_724,1}.p3) < 0]:
-(-asType < integer > (\$heap_{funcstart\_724,1}.p3) / 178), []:
asType < integer > (\$heap_{funcstart-724.1}.p3) / 178) = =
\mathbf{asType} \small{<} \mathbf{integer} \small{>} ( \mathrm{div}(\mathbf{heapIs} \ \$ \mathrm{heap}_{funcstart\_724,1}, \ \$ \mathrm{heap}_{funcstart\_724,1}.\mathrm{p3}, \\
178).quot)
\rightarrow [explicitly assert falsehood of skipped guards in subsequent guards]
[42.4] \; ([\mathbf{asType} < \mathbf{integer} > (\$ heap_{funcstart\_724,1}.p3) < 0]:
-(-asType < integer > (\$heap_{funcstart\_724.1}.p3) / 178),
[!(asType < integer > (\$heap_{funcstart\_724,1}.p3) < 0)]:
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p3})~/~178) ==
\mathbf{asType} {<} \mathbf{integer} {>} ( \mathrm{div}(\mathbf{heapIs} \ \$ \mathrm{heap}_{funcstart\_724,1}, \ \$ \mathrm{heap}_{funcstart\_724,1}.\mathrm{p3}, \\
178).quot)
\rightarrow [simplify]
[42.7] ([0 < -$heap<sub>funcstart_724,1</sub>.p3]:
-(-asType < integer > (\$heap_{funcstart\_724,1}.p3) / 178),
[!(\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{p3}) < 0)]:
asType < integer > ($heap_{funcstart\_724,1}.p3) / 178) ==
asType<integer>(div(heapIs $heap_{funcstart\_724,1}, $heap_{funcstart\_724,1}.p3,
178).quot)
\rightarrow [from term 10.0, literala < -$heap<sub>funcstart_724,1</sub>.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] \; ([\mathbf{false}]: \; -(-\mathbf{asType} < \mathbf{integer} > (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p3}) \; / \; 178),
[!(\mathbf{asType} < \mathbf{integer} > (\$ heap_{funcstart\_724,1}.p3) < 0)]:
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p3})~/~178) ==
asType<integer>(div(heapIs $heap_funcstart_724,1, $heap_funcstart_724,1.p3,
178).quot)
\rightarrow [simplify]
[42.11] ([false]: -(-asType < integer > (\$heap_{funcstart\_724,1}.p3) / 178), [!(0 <
-\$heap_{funcstart\_724,1}.p3): asType<integer>(\$heap_{funcstart\_724,1}.p3) / 178)
== asType < integer > (div(heapIs $heap_{funcstart\_724,1},
heap_{funcstart_{-724,1}}.p3, 178).quot
\rightarrow [from term 10.0, literala < -$heap<sub>funcstart_724.1</sub>.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 > (\$heap_{funcstart\_724,1}.p3) / 178),
[!false]: asType<integer>(\theta_{funcstart\_724,1.p3}) / 178) ==
\mathbf{asType} < \mathbf{integer} > (\mathbf{div}(\mathbf{heapIs} \ \$ \mathbf{heap}_{funcstart\_724,1}, \ \$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p3}, \\
178).quot)
\rightarrow [simplify]
[42.17] \ 0 == (-\text{div}(\mathbf{heapIs} \ \$ \text{heap}_{funcstart\_724,1}, \ \$ \text{heap}_{funcstart\_724,1}.\text{p3},
178).quot + (\text{$heap}_{funcstart\_724,1.p3} / 178))
[Assume known post-assertion, class invariant or type constraint for term 39.6]
[43.0] (as
Type<integer>($heap_{funcstart\_724,1}.p3) \%
asType<integer>(178)) == asType<integer>(div(heapIs
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.\text{p3}, 178).\text{rem}
\rightarrow [simplify]
[43.2] ($heap_{funcstart\_724,1}.p3 % 178) == asType<integer>(div(heapIs
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.\text{p3}, 178).\text{rem}
→ [expand definition of operator '.%' in class 'int' at built in declaration]
\textit{[43.3]} \; ([\mathbf{asType} < \mathbf{integer} > (\$ heap_{funcstart\_724,1}.p3) < 0]:
-(-asType < integer > (\$heap_{funcstart\_724,1}.p3) \% 178), []:
asType < integer > (\$heap_{funcstart\_724,1}.p3) \% 178) ==
asType<integer>(div(heapIs $heap_{tuncstart\_724.1}, $heap_{tuncstart\_724.1}.p3,
178).rem)
→ [explicitly assert falsehood of skipped guards in subsequent guards]
[43.4] ([asType<integer>(sheap_{funcstart\_724.1}.p3) < 0]:
```

```
-(-asType < integer > (\$heap_{funcstart\_724,1}.p3) \% 178),
[!(\mathbf{asType} < \mathbf{integer} > (\$ heap_{funcstart\_724,1}.p3) < 0)]:
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p3})~\%~178) ==
asType<integer>(div(heapIs heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p3,
178).rem)
\rightarrow [simplify]
[43.7] ([0 < -$heap<sub>funcstart_724,1</sub>.p3]:
-(-asType < integer > (\$heap_{funcstart\_724.1}.p3) \% 178),
[!(asType < integer > (\$heap_{funcstart\_724,1}.p3) < 0)]:
asType < integer > (\$heap_{funcstart\_724,1}.p3) \% 178) = =
\mathbf{asType} < \mathbf{integer} > (\mathbf{div}(\mathbf{heapIs} \$ \mathbf{heap}_{funcstart\_724,1}, \$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p3},
178).rem)
\rightarrow [from term 10.0, literala < -$heap<sub>funcstart_724.1</sub>.p3 is false whenever -2 <
(0 + literala)
    Proof of rule precondition:
    [43.7.0] - 2 < (0 + 0)
    \rightarrow [simplify]
    [43.7.2] true
[43.8] ([false]: -(-asType < integer > (\$heap_{funcstart\_724,1}.p3) \% 178),
[!(asType < integer > (\$heap_{funcstart\_724,1}.p3) < 0)]:
asType < integer > (\$heap_{funcstart\_724,1}.p3) \% 178) ==
\mathbf{asType} < \mathbf{integer} > (\mathbf{div}(\mathbf{heapIs} \ \$ \mathbf{heap}_{funcstart\_724,1}, \ \$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p3}, \\
178).rem)
\rightarrow [simplify]
[43.11] ([false]: -(-asType < integer > (\$heap_{funcstart\_724,1}.p3) \% 178), [!(0)]
<-$heap<sub>funcstart_724,1.</sub>p3)]: asType<integer>($heap<sub>funcstart_724,1.</sub>p3) %
178) == asType < integer > (div(heapIs $heap_{funcstart\_724,1},
heap_{funcstart_{-724,1}.p3}, 178).rem
\rightarrow [from term 10.0, literala < -$heap<sub>funcstart_724,1</sub>.p3 is false whenever -2 <
(0 + literala)
    Proof of rule precondition:
    [43.11.0] - 2 < (0 + 0)
    \rightarrow [simplify]
    [43.11.2] true
\textit{[43.12]} \; ([\textbf{false}]: \; -(-\textbf{asType} < \textbf{integer} > (\$ \text{heap}_{funcstart\_724,1}.\text{p3}) \; \% \; 178),
[!false]: asType<integer>(sheap_{funcstart\_724,1.p3}) \% 178 ==
asType<integer>(div(heapIs $heap_{tuncstart\_724.1}, $heap_{tuncstart\_724.1}.p3,
178).rem)
```

```
\rightarrow [simplify]
[43.17] 0 == (-\text{div}(\mathbf{heapIs} \$ \text{heap}_{funcstart\_724,1}, \$ \text{heap}_{funcstart\_724,1}.\text{p3},
178).rem + (\text{$heap}_{funcstart\_724,1}.p3 \% 178))
[Take given term]
[52.0]!(0 == asType < integer > (div3.rem)) || !(0 ==
asType<integer>(div3.quot))
\rightarrow [from term 39.6, div3 is equal to div(heapIs $heap_{funcstart\_724,1},
heap_{funcstart_{-724,1}}.p3, 178
[52.1]!(0 == asType < integer) = (div(heapIs $heap_{tuncstart\_724,1}, 
\label{eq:funcstart_724,1.p3} $$ \operatorname{heap}_{funcstart_724,1.p3}, \ 178).rem)) \ || \ !(0 == \mathbf{asType} < \mathbf{integer} > (\operatorname{div}3.\operatorname{quot})) $$
\rightarrow [simplify]
[52.2] ! (0 == \operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.p3,
178).rem) ||!(0 == asType < integer > (div3.quot))|
\rightarrow [from term 39.6, div3 is equal to div(heapIs $heap_{funcstart\_724,1},
heap_{funcstart_{-724,1}}.p3, 178
\label{eq:constart_724,1} \text{[52.3] !} (0 == \operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.\operatorname{p3},
178).rem) || !(0 == asType < integer) > (div(heapIs $heap_{funcstart_{724,1}}, 
heap_{funcstart_{-724,1}}.p3, 178).quot)
\rightarrow [simplify]
[52.5]!(0 == \text{div}(\mathbf{heapIs} \$ \text{heap}_{funcstart\_724,1}, \$ \text{heap}_{funcstart\_724,1}.p3,
178).quot) \vee !(0 == \text{div}(\mathbf{heapIs} \$ heap_{funcstart\_724,1}, \$ heap_{funcstart\_724,1}.p3,
178).rem)
[Take given term]
[53.0] heap_{724,1;740,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow asType<short
int>((asType<int>(asType<short int>(div1.rem)) *
asType < int > (\$heap_{funcstart\_724,1}.r1)) - (asType < int > (asType < short)
int>(div1.quot)) * asType< int>($heap_{funcstart\_724,1}.b1))))
\rightarrow [from term 11.6, div1 is equal to div(heapIs $heap_{funcstart_{724,1}},
heap_{funcstart_{-724,1}}.p1, 177)
[53.1] \text{sheap}_{724,1;740,8} == \text{sheap}_{funcstart\_724,1}._replace(p1 \rightarrow asType<short
int>((asType<int>(asType<short int>(div(heapIs $heap_{tuncstart\_724.1},
\rho_{tuncstart_{-724.1},p1,177,rem} * asType<int>($\rho_{tuncstart_{-724.1},r1}\rho_{-724.1}.r1)) -
(asType<int>(asType<short int>(div1.quot)) *
asType < int > (\$heap_{funcstart\_724,1}.b1))))
\rightarrow [simplify]
[53.3] \theta == 
int>((div(heapIs \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1, 177).rem *
asType < int > (\$heap_{funcstart\_724,1}.r1)) - (asType < int > (asType < short)
```

```
int>(div1.quot)) * asType< int>($heap_{tuncstart\_724.1}.b1))))
\rightarrow [const static or extern object]
[53.4] heap_{724,1;740,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow asType<short
int>((div(heapIs \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1, 177).rem *
asType < int > (\$heap_{init}.r1)) - (asType < int > (asType < short)
int>(div1.quot)) * asType< int>($heap_{funcstart\_724,1}.b1))))
\rightarrow [expand definition of constant 'r1' at prang.c (15,20)]
[53.5] heap_{724,1;740,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow asType<short
int>((div(heapIs \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1, 177).rem *
asType < int > (asType < short int > ((int)171))) -
(asType < int > (asType < short int > (div1.quot)) *
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{b1}))))
\rightarrow [simplify]
[53.8] heap_{724,1;740,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow asType<short
int>((div(heapIs \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1, 177).rem * 171)
- (asType<int>(asType<short int>(div1.quot)) *
asType < int > (\$heap_{funcstart\_724,1}.b1))))
\rightarrow [from term 11.6, div1 is equal to div(heapIs $heap_{tuncstart\_724.1},
heap_{funcstart_{-724,1}}.p1, 177
[53.9] heap_{724,1;740,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow asType<short
int>((171 * div(heapIs \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1, 177).rem)
- (asType<int>(asType<short int>(div(heapIs $heap_{funcstart_724.1},
heap_{funcstart_{724,1}}, p1, 177).quot) *
asType < int > (\$heap_{funcstart\_724,1}.b1))))
\rightarrow [simplify]
[53.11] \theta == 
int>((171 * div(heapIs $heap_{funcstart\_724,1}, $heap_{funcstart\_724,1}.p1, 177).rem)
- (div(heapIs heap_{funcstart_{-724,1}}, heap_{funcstart_{-724,1}}, 177).quot *
asType < int > (\$heap_{funcstart\_724,1}.b1)))
\rightarrow [const static or extern object]
[53.12] \$ heap_{724,1;740,8} == \$ heap_{funcstart\_724,1}.\_\mathbf{replace} (p1 \to \mathbf{asType} < \mathbf{short})
int > ((171 * div(heapIs \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1, 177).rem)
- (div(heapIs heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p1, 177).quot *
asType < int > (\$heap_{init}.b1)))
\rightarrow [expand definition of constant 'b1' at prang.c (17,20)]
[53.13] heap_{724,1;740,8} == heap_{funcstart\_724,1}. replace(p1 \rightarrow asType<short
\mathbf{int} > ((171 * \operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724,1}, \$ \operatorname{heap}_{funcstart\_724,1}.\operatorname{p1}, 177).\operatorname{rem})
- (\text{div}(\mathbf{heapIs} \$ \text{heap}_{funcstart\_724,1}, \$ \text{heap}_{funcstart\_724,1}.\text{p1}, 177).\text{quot} *
asType<int>(asType<short int>((int)2))))
```

```
\rightarrow [simplify]
[53.19] $\text{heap}_{724,1:740.8} == $\text{heap}_{funcstart\_724,1}._\text{replace}(p1 \to ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).quot) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \text{$heap}_{funcstart\_724,1}, \ \text{$heap}_{funcstart\_724,1}.p1, \ 177).rem)))
[Take given term]
[57.0] heap_{724,1;742,8} == heap_{724,1;740,8}._replace(p2 \rightarrow asType<short
int>((asType<int>(asType<short int>(div2.rem)) *
asType < int > (\$heap_{724,1:740.8}.r2)) - (asType < int > (asType < short)
int>(div2.quot)) * asType<int>($heap<sub>724,1:740,8</sub>.b2))))
\rightarrow [from term 53.19, $heap<sub>724.1:740.8</sub> is equal to
heap_{funcstart\_724.1}._replace(p1 \rightarrow (-2 * div(heapIs heap_{funcstart\_724.1}),
\text{Sheap}_{funcstart_{-724,1},p1, 177}.\text{quot}) + (171 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart_{-724,1}}),
heap_{funcstart_{724,1}.p1, 177).rem}
[57.1] heap_{724,1;742,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 *
\operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724.1}, \$ \operatorname{heap}_{funcstart\_724.1}.p1,
177).rem)))._replace(p2 \rightarrow asType<short
int>((asType<int>(asType<short int>(div2.rem)) *
\mathbf{asType}{<}\mathbf{int}{>}(\$\text{heap}_{724,1;740,8}.\text{r2})) - (\mathbf{asType}{<}\mathbf{int}{>}(\mathbf{asType}{<}\mathbf{short}
int>(div2.quot)) * asType< int>($heap_{724.1:740.8}.b2))))
\rightarrow [from term 25.6, div2 is equal to div(heapIs $heap_{tuncstart} 724.1,
heap_{funcstart_{-724,1},p2,176}
[57.2] heap_{724,1;742,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 \ *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow asType<short
int>((asType<int>(asType<short int>(div(heapIs $heap_{funcstart\_724,1},
\text{sheap}_{funcstart=724.1}.\text{p2}, 176).\text{rem}) * asType < int > (\text{sheap}_{724.1:740.8}.\text{r2})) -
(asType<int>(asType<short int>(div2.quot)) *
asType < int > (\$heap_{724,1;740,8}.b2))))
[57.4] heap_{724,1;742,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).quot) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1,
(177).rem))._replace(p2 \rightarrow asType<short int>((div(heapIs)))._replace(p2 \rightarrow asType
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.\text{p2}, 176).\text{rem} *
\mathbf{asType} < \mathbf{int} > (\$ \mathrm{heap}_{724,1;740,8}.\mathrm{r2})) - (\mathbf{asType} < \mathbf{int} > (\mathbf{asType} < \mathbf{short}))
int>(div2.quot)) * asType<int>($heap<sub>724.1:740.8</sub>.b2))))
\rightarrow [from term 53.19, $heap_{724,1;740,8}$ is equal to
heap_{funcstart\_724,1}._replace(p1 \rightarrow (-2 * div(heapIs heap_{funcstart\_724,1}),
heap_{funcstart\_724,1}.p1, 177).quot + (171 * div(heapIs $heap_{funcstart\_724,1}, 177).quot) + (171 * div(heapIs $heap_{funcstart\_724,1}, 17
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heap_{funcstart_{-724,1}}.p1, 177).rem)
[57.5] heap_{724,1;742,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).quot) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow asType<short int>((div(heapIs
heap_{funcstart_{-724,1}}, heap_{funcstart_{-724,1}}.p2, 176).rem *
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathbf{\_replace}(\mathrm{p1} \rightarrow ((\text{-}2 * \mathrm{div}(\mathbf{heapIs}
\theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}
\text{Sheap}_{funcstart_{724,1}}, \text{Sheap}_{funcstart_{724,1}}, \text{p1}, 177).\text{rem})).\text{r2})) -
(asType<int>(asType<short int>(div2.quot)) *
asType < int > (\$heap_{724,1;740,8}.b2))))
\rightarrow [const member of object with modified fields]
[57.6] $heap<sub>724,1;742,8</sub> == $heap<sub>funcstart_724,1</sub>._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 \ *
\operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724.1}, \$ \operatorname{heap}_{funcstart\_724.1}.p1,
177).rem)))._{\mathbf{replace}}(p2 \rightarrow \mathbf{asType} < \mathbf{short\ int} > ((\operatorname{div}(\mathbf{heapIs}))))
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.p2, 176).rem *
asType < int > (\$heap_{funcstart\_724,1}.r2)) - (asType < int > (asType < short)
int>(div2.quot)) * asType< int>($heap_{724.1:740.8}.b2))))
\rightarrow [const static or extern object]
[57.7] heap_{724,1;742,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 \ *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1,
177).rem)))._{\mathbf{replace}}(p2 \rightarrow \mathbf{asType} < \mathbf{short\ int} > ((\operatorname{div}(\mathbf{heapIs}))))
\rho_{funcstart\_724,1}, \rho_{funcstart\_724,1.p2, 176}.rem *
asType < int > (\$heap_{init}.r2)) - (asType < int > (asType < short)
int>(div2.quot)) * asType<int>($heap<sub>724.1:740.8</sub>.b2))))
\rightarrow [expand definition of constant 'r2' at prang.c (20,20)]
[57.8] heap_{724,1;742,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}. p1, \ 177). \operatorname{quot}) + (171 *
\label{eq:div_heap} \text{div}(\textbf{heapIs} \ \$ \text{heap}_{funcstart\_724,1}, \ \$ \text{heap}_{funcstart\_724,1}.\text{p1},
(177).rem))._replace(p2 \rightarrow asType<short int>((div(heapIs)
\text{Sheap}_{funcstart_{-724,1}}, \text{Sheap}_{funcstart_{-724,1}}.p2, 176).rem *
asType < int > (asType < short int > ((int)172)))
(asType<int>(asType<short int>(div2.quot)) *
asType < int > (\$heap_{724,1;740,8}.b2))))
\rightarrow [simplify]
[57.11] $\text{heap}_{724,1:742.8} == $\text{heap}_{funcstart\_724,1}._\text{replace}(p1 \to ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}. p1, \ 177). \operatorname{quot}) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.p1,
177).rem)))._{\mathbf{replace}}(p2 \rightarrow \mathbf{asType} < \mathbf{short\ int} > ((\operatorname{div}(\mathbf{heapIs}))))
\text{Sheap}_{funcstart_{724,1}}, \text{Sheap}_{funcstart_{724,1}}.\text{p2}, 176).\text{rem} * 172) -
```

```
(asType<int>(asType<short int>(div2.quot)) *
asType < int > (\$heap_{724,1;740,8}.b2))))
\rightarrow [from term 25.6, div2 is equal to div(heapIs $heap_{funcstart\_724,1},
heap_{funcstart_{724,1}}.p2, 176
[57.12] $\text{heap}_{724,1;742,8} == $\text{heap}_{funcstart_724,1}._\text{replace}(p1 \to ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).quot) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow asType<short int>((172 * div(heapIs
heap_{funcstart_{724,1}}, heap_{funcstart_{724,1}}, 2, 176).rem –
(asType<int>(asType<short int>(div(heapIs $heap_{tuncstart\_724.1},
\text{sheap}_{funcstart\_724,1.p2}, 176).\text{quot}) * asType < int > (\text{sheap}_{724,1;740,8}.b2))))
\rightarrow [simplify]
[57.14] \rho_{724,1;742,8} == \rho_{14,1;742,8} == \rho_{14,1;742,8} = \rho_{14,1;742,8} == \rho_{14,1;742,8} = \rho_{14,1;7
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 \ *
\operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724,1}, \$ \operatorname{heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow asType<short int>((172 * div(heapIs
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.\text{p2}, 176).\text{rem}) - (\text{div}(\text{heapIs})
heap_{funcstart_{724,1}}, heap_{funcstart_{724,1}}, 2, 176).quot *
asType<int>($heap<sub>724.1:740.8</sub>.b2))))
\rightarrow [from term 53.19, $heap<sub>724.1:740.8</sub> is equal to
heap_{funcstart\_724,1}._replace(p1 \rightarrow (-2 * div(heapIs $heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1}.\text{p1}, 177).\text{quot} + (171 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
heap_{funcstart_{-724,1}.p1, 177).rem}
[57.15] $\text{heap}_{724,1:742,8} == \text{$heap}_{funcstart\_724,1}._\text{$replace}(p1 \to ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 *
\operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724,1}, \$ \operatorname{heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow asType<short int>((172 * div(heapIs
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.\text{p2}, 176).\text{rem}) - (\text{div}(\text{heapIs}))
\theta_{funcstart_{724,1}}, \theta_{funcstart_{724,1},p2,176}.quot *
asType < int > (\$heap_{funcstart\_724,1}.\_replace(p1 \rightarrow ((-2 * div(heapIs)))))))
\theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}
\text{Sheap}_{funcstart_{724,1}}, \text{Sheap}_{funcstart_{724,1},p1, 177}.\text{rem})).b2))))
\rightarrow [const member of object with modified fields]
[57.16] $\text{heap}_{724.1:742.8} == \text{$heap}_{funcstart\_724.1}._\text{replace}(p1 \to ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}. p1, \ 177). \operatorname{quot}) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow asType<short int>((172 * div(heapIs
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.\text{p2}, 176).\text{rem}) - (\text{div}(\text{heapIs})
heap_{funcstart_{724,1}}, heap_{funcstart_{724,1}}.p2, 176).quot *
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{b2}))))
\rightarrow [const static or extern object]
```

```
[57.17] $\text{heap}_{724,1;742,8} == \text{$heap}_{funcstart_724,1}._{\text{replace}}(p1 \to ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 \ *
\label{eq:div_heap} \text{div}(\textbf{heapIs} \ \$ \text{heap}_{funcstart\_724,1}, \ \$ \text{heap}_{funcstart\_724,1}.\text{p1},
177).rem)))._replace(p2 \rightarrow asType<short int>((172 * div(heapIs
\theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.p2, 176).quot *
asType < int > (\$heap_{init}.b2))))
\rightarrow [expand definition of constant 'b2' at prang.c (22,20)]
[57.18] $\text{heap}_{724,1:742,8} == \text{$heap}_{funcstart\_724,1}._\text{$replace}(p1 \to ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow asType<short int>((172 * div(heapIs
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.\text{p2}, 176).\text{rem}) - (\text{div}(\text{heapIs})
heap_{funcstart_{724,1}}, heap_{funcstart_{724,1}}, 2, 176, quot
asType<int>(asType<short int>((int)35)))))
\rightarrow [simplify]
[57.24] $heap<sub>724,1;742,8</sub> == $heap<sub>funcstart_724,1</sub>._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 \ *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart} \ 724.1, \ \$ \operatorname{heap}_{funcstart} \ 724.1, \ p1,
177).rem)))._replace(p2 \rightarrow ((-35 * div(heapIs $heap_{funcstart\_724,1},
\rho_{tuncstart_{-724,1},p2,176}, quot) + (172 * div(heapIs \rho_{tuncstart_{-724,1},p2}
heap_{funcstart_{-724,1}}.p2, 176).rem)
[Take goal term]
[1.0] ((asType<int>(asType<short int>(div3.rem)) *
asType < int > (\$heap_{724,1:742.8}.r3)) - (asType < int > (asType < short)
\mathbf{int}{>}(\mathrm{div3.quot})) \ * \ \mathbf{asType}{<} \mathbf{int}{>} (\$\mathrm{heap}_{724,1;742,8}.\mathrm{b3}))) \leq \mathbf{maxof}(\mathbf{short} \ \mathbf{int})
\rightarrow [from term 39.6, div3 is equal to div(heapIs $heap_{funcstart\_724,1},
heap_{funcstart_{-724,1}}.p3, 178
[1.1] ((asType<int>(asType<short int>(div(heapIs $heap_{funcstart\_724,1},
\text{sheap}_{funcstart\_724,1.p3}, 178).rem) * asType < int > (\text{sheap}_{724,1:742.8.r3})) -
(asType<int>(asType<short int>(div3.quot)) *
asType < int > (\$heap_{724,1:742.8}.b3))) \le maxof(short int)
\rightarrow [simplify]
[1.3] ((div(heapIs heap_{funcstart\_724,1}, heap_{funcstart\_724,1.p3}, 178).rem *
asType < int > (\$heap_{724,1:742,8}.r3)) - (asType < int > (asType < short)
int>(div3.quot)) * asType< int>($heap_{724,1;742,8}.b3))) \le maxof(short int)
\rightarrow [from term 57.24, $heap<sub>724,1;742,8</sub> is equal to
heap_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 * div(heapIs $heap_{funcstart\_724,1},
heap_{funcstart_{724,1},p1, 177}, quot) + (171 * div(heapIs p_{funcstart_{724,1},p1, 177}), quot)
\rho_{uncstart=724.1.p1, 177).rem})._replace(\rho_{uucstart=724.1.p1, 177).rem}))._replace(\rho_{uucstart=724.1.p1, 177).rem})
heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p2, 176).quot) + (172 * div(heapIs)
```

```
heap_{funcstart_{-724,1}}, heap_{funcstart_{-724,1}}, 2, 176).rem
[1.4] ((div(heapIs heap_{funcstart_{-724,1}}, heap_{funcstart_{-724,1}}, 178).rem *
asType < int > (\$heap_{funcstart\_724,1}.\_replace(p1 \rightarrow ((-2 * div(heapIs))))))
\$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1, 177).quot) + (171 * div(\mathbf{heapIs})
\rho_{tuncstart_{724,1}}, \rho_{tuncstart_{724,1}}, \rho_{tuncstart_{724,1}}, \rho_{tuncstart_{724,1}}, \rho_{tuncstart_{724,1}}, \rho_{tuncstart_{724,1}}
* div(\mathbf{heapIs} \ \$ heap_{funcstart\_724,1}, \ \$ heap_{funcstart\_724,1}.p2, \ 176).quot) + (172 \ *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p2, \ 176).rem))).r3)) -
(asType<int>(asType<short int>(div3.quot)) *
asType < int > (\$heap_{724.1:742.8}.b3))) \le maxof(short int)
\rightarrow [const member of object with modified fields]
[1.6] ((div(heapIs $heap_{funcstart\_724,1}, $heap_{funcstart\_724,1}.p3, 178).rem *
asType < int > (\$heap_{funcstart\_724,1}.r3)) - (asType < int > (asType < short)
int>(div3.quot)) * asType<int>($heap_{724.1:742.8}.b3))) \le maxof(short int)
\rightarrow [const static or extern object]
[1.7] ((div(heapIs \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}).rem *
asType < int > (\$heap_{init}.r3)) - (asType < int > (asType < short)
int>(div3.quot)) * asType< int>($heap_{724,1:742,8}.b3))) \le maxof(short int)
\rightarrow [expand definition of constant 'r3' at prang.c (25,20)]
[1.8] ((div(heapIs \theta_{funcstart\_724,1}, \theta_{funcst
asType < int > (asType < short int > ((int)170))) -
(asType<int>(asType<short int>(div3.quot)) *
asType < int > (\$heap_{724.1:742.8}.b3))) \le maxof(short int)
\rightarrow [simplify]
[1.11] ((div(heapIs $heap_{funcstart\_724,1}, $heap_{funcstart\_724,1}.p3, 178).rem *
170) - (asType<int>(asType<short int>(div3.quot))
asType < int > (\$heap_{724,1;742,8}.b3))) \le maxof(short int)
\rightarrow [from term 39.6, div3 is equal to div(heapIs $heap_{funcstart\_724,1},
heap_{funcstart_{-724,1}}.p3, 178
[1.12] ((170 * div(heapIs \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}),
178).rem) - (asType<int>(asType<short int>(div(heapIs
heap_{funcstart_{-724,1}}, heap_{funcstart_{-724,1}}, 178).quot)
asType < int > (\$heap_{724,1;742,8}.b3))) \le maxof(short int)
\rightarrow [simplify]
[1.14] ((170 * div(heapIs heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p3,
178).rem) - (div(heapIs heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p3,
178).quot * asType < int > (\$heap_{724,1;742,8}.b3))) \le maxof(short int)
\rightarrow [from term 57.24, $heap<sub>724,1;742,8</sub> is equal to
heap_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 * div(heapIs $heap_{funcstart\_724,1},
heap_{funcstart_{-724,1},p1, 177}, quot) + (171 * div(heapIs heap_{funcstart_{-724,1},p1, 177})
heap_{funcstart\_724,1}.p1, 177).rem)._replace(p2 \rightarrow (-35 * div(heapIs)))._replace
```

```
heap_{funcstart_{-724,1}}, heap_{funcstart_{-724,1}}, p_{funcstart_{-724,1}}, p_{funcstart_{-724,1}}, p_{funcstart_{-724,1}}, p_{funcstart_{-724,1}}
heap_{funcstart_{724,1}}, heap_{funcstart_{724,1}}, 2, 176).rem
[1.15] ((170 * div(heapIs $heap_{funcstart\_724,1}, $heap_{funcstart\_724,1}.p3,
178).rem) – (div(heapIs \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}.p3,
178).quot * asType<int>($heap_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 \ *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow ((-35 * div(heapIs $heap_{funcstart\_724,1},
\theta_{funcstart\_724,1}.p2, 176.quot) + (172 * div(heapIs \theta_{funcstart\_724,1},
\{\text{heap}_{funcstart\_724,1}.\text{p2}, 176\}.\text{rem}\}
\rightarrow [const member of object with modified fields]
[1.17] ((170 * div(heapIs $heap_{funcstart\_724,1}, $heap_{funcstart\_724,1}.p3,
178).rem) - (\text{div}(\mathbf{heapIs} \$ \text{heap}_{funcstart\_724,1}, \$ \text{heap}_{funcstart\_724,1}.p3,
178).quot * asType<int>($heap<sub>funcstart_724,1</sub>.b3))) \leq maxof(short int)
\rightarrow [const static or extern object]
[1.18] ((170 * div(heapIs \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}),
178).rem) – (\text{div}(\mathbf{heapIs} \$ \text{heap}_{funcstart\_724,1}, \$ \text{heap}_{funcstart\_724,1}.\text{p3},
178).quot * asType < int > (\$heap_{init}.b3))) \le maxof(short int)
\rightarrow [expand definition of constant 'b3' at prang.c (27,20)]
\label{eq:loss_loss} \mbox{[1.19]} \mbox{ ((170 * div(\mathbf{heapIs} \ \$heap_{funcstart\_724,1}, \ \$heap_{funcstart\_724,1}.p3, \ })
178).rem) – (\text{div}(\mathbf{heapIs} \$ \text{heap}_{funcstart\_724,1}, \$ \text{heap}_{funcstart\_724,1}.\text{p3},
178).quot * asType<int>(asType<short int>((int)63)))) \le maxof(short
int)
\rightarrow [simplify]
[1.38] -32768 < ((-170 * div(heapIs $heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1}.\text{p3}, 178).\text{rem} + (63 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
heap_{funcstart_{-724,1}}.p3, 178).quot)
\rightarrow [negate goal and search for contradiction]
[1.39]!(-32768 < ((-170 * div(heapIs $heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1}.\text{p3}, 178).\text{rem} + (63 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
heap_{funcstart_{-724,1}}.p3, 178).quot))
\rightarrow [simplify]
 \label{eq:continuous} \mbox{[1.44] $32767 < ((170 * div(\mathbf{heapIs} \$ heap_{funcstart\_724,1}, \$ heap_{funcstart\_724,1}.p3, } } 
178).rem) + (-63 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_724,1}, \text{\$heap}_{funcstart\_724,1}.p3,
178).quot))
[Branch on disjunction or conditional in term 52.5]
\textit{[63.0] !} (0 == \operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.\operatorname{p3},
178).quot) \vee!(0 == div(heapIs $heap_{funcstart\_724,1}, $heap_{funcstart\_724,1}.p3,
178).rem) \vee (0 == div(heapIs $heap_{funcstart\_724,1}, $heap_{funcstart\_724,1}.p3,
```

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178).quot)
[Copy term 1.44]
[66.0] \ 32767 < ((-63 * \operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724,1}, \$ \operatorname{heap}_{funcstart\_724,1}.p3,
178).quot) + (170 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_724,1}, \text{\$heap}_{funcstart\_724,1}.p3,
178).rem))
\rightarrow [from term 43.17, div(heapIs $heap_{funcstart\_724,1}, $heap_{funcstart\_724,1}.p3,
178).rem is equal to heap_{funcstart\_724,1}.p3 \% 178
[66.1] \ 32767 < ((-63 \ * \ \mathrm{div}(\mathbf{heapIs} \ \$ \mathrm{heap}_{funcstart\_724,1}, \ \$ \mathrm{heap}_{funcstart\_724,1}.\mathrm{p3},
178).quot) + (170 * (\$heap_{funcstart\_724,1}.p3 \% 178)))
[Copy term 63.0]
[96.0] ! (0 == \operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724,1}, \$ \operatorname{heap}_{funcstart\_724,1}.\operatorname{p3},
178).quot) \vee !(0 == \text{div}(\mathbf{heapIs} \$ heap_{funcstart\_724,1}, \$ heap_{funcstart\_724,1}.p3,
178).rem) \vee (0 == div(heapIs $heap_{funcstart\_724,1}, $heap_{funcstart\_724,1}.p3,
178).quot)
\rightarrow [from\ term\ 42.17,\ div(\textbf{heapIs}\ \$heap_{funcstart\_724,1},\ \$heap_{funcstart\_724,1}.p3,
178).quot is equal to heap_{funcstart\_724,1}.p3 / 178
[96.1]!(0 == (\text{$heap}_{funcstart\_724,1}.p3 / 178)) \lor ...
[Create new term from term 42.17 using rule: condition for equality of division]
[97.0] ((178 * (0 + -(-div(heapIs $heap_{funcstart\_724,1},
\text{Sheap}_{funcstart_{724,1}.p3}, 178).\text{quot}))) < (1 + \text{Sheap}_{funcstart_{724,1}.p3})) \land
($heap<sub>funcstart_724,1</sub>.p3 < (178 * (0 + 1 + -(-\text{div}(\textbf{heapIs})))
heap_{funcstart_{724,1}}, heap_{funcstart_{724,1}}, 178).quot))))
\rightarrow [simplify]
[97.15] \; (\text{-}1 < ((\text{-}178 \; * \; \mathrm{div}(\mathbf{heapIs} \; \$ \mathrm{heap}_{funcstart\_724,1}, \; \$ \mathrm{heap}_{funcstart\_724,1}.\mathrm{p3}, \;
178).quot) + heap_{funcstart_{724,1}.p3}) \land (-178 < (-heap_{funcstart_{724,1}.p3} + -heap_{funcstart_{724,1}.p3})
(178 * div(\mathbf{heapIs} \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p3, 178).quot)))
\rightarrow [separate conjunction and work on first sub-term]
[97.16] -178 < (-\$heap_{funcstart\_724,1}.p3 + (178 * div(heapIs))]
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.p3, 178).quot)
[Create new term from term 96.1 using rule: condition for inequality of
division]
[99.0] (!((0 * 178) < (1 + \text{$heap_{funcstart\_724,1.p3}$})) \lor !(\text{$heap_{funcstart\_724,1.p3}$})
< (178 * (0 + 1))) \lor !(0 == div(heapIs $heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1}.\text{p3}, 178).\text{rem} \lor (0 == \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
heap_{funcstart_{-724,1}}.p3, 178.quot
\rightarrow [simplify]
[99.3] (!(-1 < $heap_{tuncstart_724,1}.p3) \vee !($heap_{tuncstart_724,1}.p3 < (178 * (0 +
1))))) \vee ...
```

```
\rightarrow [from term 10.0, literala < $heap_{funcstart_724.1}.p3 is true whenever (-1 +
literala) < 0
    Proof of rule precondition:
    [99.3.0](-1+-1)<0
    \rightarrow [simplify]
    [99.3.2] true
[99.4] (!true \vee !($heap_{funcstart_724,1}.p3 < (178 * (0 + 1)))) \vee ...
\rightarrow [simplify]
[99.14] (177 < \rho_{funcstart\_724,1.p3}) \ \lor \ \dots
[Create new term from terms 99.14, 97.16 using rule: transitivity 3]
[100.0] ((-178 + 1 + 177) < (178 * div(heapIs $heap_{tuncstart\_724.1},
\text{Sheap}_{funcstart\_724,1}.\text{p3}, 178).\text{quot})) \lor !(0 == \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1}.\text{p3}, 178).\text{rem}) \lor (0 == \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
heap_{funcstart_{-724,1}.p3, 178}, quot
\rightarrow [simplify]
[100.1] (0 < (178 * div(heapIs heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p3,
178).quot)) ∨ ...
\rightarrow [product is positive]
[100.2] (((0 < 178) \land (0 < div(heapIs $heap<sub>funcstart_724.1</sub>,
\text{Sheap}_{funcstart_{-724,1},p3, 178}, quot)) \vee ((178 < 0) \wedge (div(heapIs
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.p3, 178).quot < 0))) \lor ...
\rightarrow [simplify]
[100.7] (0 < div(heapIs heap_{funcstart-724,1}, heap_{funcstart-724,1}.p3,
178).quot) ∨ ...
[Create new term from terms 100.7, 66.1 using rule: transitivity 11]
[103.0] ((1 + 32767 + (0 * 63)) < (170 * ($heap_{funcstart\_724,1}.p3 % 178))) \lor
!(0 == \operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724,1}, \$ \operatorname{heap}_{funcstart\_724,1}.\operatorname{p3}, 178).\operatorname{rem}) \vee (0
== \operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.p3, \ 178).\operatorname{quot})
\rightarrow [simplify]
[103.2] (32768 < (170 * (\$heap_{funcstart\_724,1}.p3 \% 178))) \lor ...
\rightarrow [literal comparison of product]
[103.3] ([170 < 0]: (32768 / -170) < -($heap_{funcstart\_724,1}.p3 % 178), [0 < -0.5]
170]: (32768 / 170) < (\text{$heap}_{funcstart\_724,1}.p3 \% 178), [0 == 170]: 32768 < 0)
V ...
→ [explicitly assert falsehood of skipped guards in subsequent guards]
```

[103.4] ([170 < 0]:  $(32768 / -170) < -(\text{$heap}_{funcstart\_724,1}.\text{p3 }\% 178)$ , [(0 < 0)]

```
170) \land !(170 < 0)]: (32768 / 170) < (\$heap_{funcstart\_724,1}.p3 \% 178), [(0 ==
170) \land !(0 < 170) \land !(170 < 0)]: 32768 < 0) \lor ...
\rightarrow [simplify]
[103.13] false \vee ...
[Remove 'false' term 103.13 and fetch new term from containing clause]
[106.0] 0 == \text{div}(\text{heapIs } \text{$heap}_{funcstart\_724,1}, \text{$heap}_{funcstart\_724,1}.\text{p3}, 178).\text{quot}
[Copy term 1.44]
\label{eq:final_loss} \textit{[66.1] } 32767 < ((-63 * div(\textbf{heapIs} \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p3,
178).quot) + (170 * (\text{$heap}_{funcstart\_724,1}.\text{p3} \% 178)))
\rightarrow [from term 106.0, div(heapIs $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}.p3,
178).quot is equal to 0
[66.2] 32767 < ((-63 * 0) + (170 * ($heap_{funcstart\_724,1}.p3 % 178)))
\rightarrow [simplify]
[66.4] 32767 < (170 * (\text{$heap}_{funcstart\_724,1}.\text{p3} \% 178))
\rightarrow [literal comparison of product]
[66.5] \; ([170<0] \colon (32767 \; / \; -170) < -(\$ \mathrm{heap}_{funcstart\_724,1}.\mathrm{p3} \; \% \; 178), \, [0<170] \colon
(32767 / 170) < (\text{$heap_{funcstart\_724,1}.p3 \% 178}), [0 == 170]: 32767 < 0)
\rightarrow [explicitly assert falsehood of skipped guards in subsequent guards]
\it [66.6]\ ([170<0]:\ (32767\ /\ -170)<-(\$heap_{funcstart\_724,1}.p3\ \%\ 178),\ [(0<
170) \land !(170 < 0): (32767 / 170) < (\$heap_{tuncstart\_724.1}.p3 \% 178), [(0 ==
170) \land !(0 < 170) \land !(170 < 0)]: 32767 < 0)
\rightarrow [simplify]
[66.15] false
Proof of verification condition: Assertion valid
Condition generated at: C:\Escher\Customers\prang\prang.c (61,31)
To prove: asType<integer>($heap<sub>724,1:744,8</sub>.p3) <
asType<integer>($heap<sub>724,1:744,8</sub>.M3)
Given:
heap_{init}.LIMIT == (int)80
heap_{init}.M1 == asType < short int > ((int)30269)
\theta_{init}.r1 == asType < short int > ((int)171)
heap_{init}.a1 == asType < short int > ((int)177)
\theta
heap_{init}.M2 == asType < short int > ((int)30307)
```

```
\rho_{init}.r2 == asType < short int > ((int)172)
heap_{init}.a2 == asType < short int > ((int)176)
heap_{init}.b2 == asType<short int>((int)35)
heap_{init}.M3 == asType < short int > ((int)30323)
\theta_{init}.r3 == asType<short int>((int)170)
heap_{init}.a3 == asType < short int > ((int)178)
\theta = asType < short int > ((int)63)
\theta = asType < short int > ((int)1)
\theta
\theta = asType < short int > ((int)3)
invariant
1<br/>({\bf heapIs}\ \$heap_{funcstart\_724,1})
div1 == div(\mathbf{heapIs} \$ heap_{funcstart\_724,1},
asType < int > (\$heap_{funcstart\_724,1}.p1),
asType < int > (\$heap_{funcstart\_724,1}.a1))
(asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.p1)) /
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a1))) = =
asType<integer>(div1.quot)
(asType<int>(asType<int>($heap_{funcstart\_724.1}.p1)) %
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a1))) = =
asType<integer>(div1.rem)
!(0 == asType < integer > (div1.rem)) || !(0 ==
asType<integer>(div1.quot))
div2 == div(\mathbf{heapIs} \$ heap_{funcstart\_724,1},
asType < int > (\$heap_{funcstart\_724,1}.p2),
asType < int > (\$heap_{funcstart\_724.1}.a2))
(asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.p2)) /
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a2))) = =
asType<integer>(div2.quot)
(asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.p2)) \%
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a2))) = =
asType<integer>(div2.rem)
!(0 == asType < integer > (div2.rem)) || !(0 ==
asType<integer>(div2.quot))
\label{eq:div3} \text{div3} == \text{div}(\mathbf{heapIs} \ \$ \text{heap}_{funcstart\_724,1},
asType < int > (\$heap_{funcstart\_724,1}.p3),
asType < int > (\$heap_{funcstart\_724,1}.a3))
(asType<integer>(asType<int>($heap_{funcstart\_724.1}.p3)) /
```

```
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a3))) = =
asType<integer>(div3.quot)
(\mathbf{asType}{<}\mathbf{int}{>}(\mathbf{asType}{<}\mathbf{int}{>}(\$\mathbf{heap}_{funcstart\_724,1}.\mathbf{p3}))~\%
\mathbf{asType}{<}\mathbf{integer}{>}(\mathbf{asType}{<}\mathbf{int}{>}(\$\mathbf{heap}_{funcstart\_724,1}.\mathbf{a3}))) = =
asType<integer>(div3.rem)
!(0 == asType < integer > (div3.rem)) || !(0 ==
asType<integer>(div3.quot))
\text{Sheap}_{724,1;740,8} == \text{Sheap}_{funcstart\_724,1}.\_\mathbf{replace}(\text{p1} \to \mathbf{asType} < \mathbf{short})
int>((asType<int>(asType<short int>(div1.rem)) *
asType < int > (\$heap_{funcstart\_724,1}.r1)) - (asType < int > (asType < short)
int>(div1.quot)) * asType< int>($heap_{funcstart\_724,1}.b1))))
-asType < integer const > (\$heap_{724.1:740.8}.M1) < 
asType<integer>($heap<sub>724.1:740.8</sub>.p1)
!(0 == asType < integer > (\$heap_{724,1:740.8}, p1))
asType < integer > ($heap_{724,1;740,8}.p1) < 
asType < integer > (\$heap_{724,1;740,8}.M1)
heap_{724,1;742,8} == heap_{724,1;740,8}. replace(p2 \to asType<short
int>((asType<int>(asType<short int>(div2.rem)) *
asType < int > (\$heap_{724,1:740,8}.r2)) - (asType < int > (asType < short)
int>(div2.quot)) * asType<int>($heap<sub>724,1:740,8</sub>.b2))))
-asType<integer const>($heap<sub>724.1:742.8</sub>.M2) <
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathrm{heap}_{724,1;742,8}.\mathrm{p2})
!(0 == asType < integer > (\$heap_{724,1:742.8} \cdot p2))
asType<integer>($heap<sub>724.1:742.8</sub>.p2) <
asType<integer>($heap<sub>724.1:742.8</sub>.M2)
heap_{724,1:744,8} == heap_{724,1:742,8}._replace(p3 \rightarrow asType<short
int>((asType<int>(asType<short int>(div3.rem)) *
asType < int > (\$heap_{724,1:742,8}.r3)) - (asType < int > (asType < short)
int>(div3.quot)) * asType< int>($heap_{724.1:742.8}.b3))))
-asType < integer const > (\$heap_{724,1:744.8}.M3) < (\$heap_{724,1:744.8}.M3)
asType<integer>($heap<sub>724,1;744,8</sub>.p3)
!(0 == asType < integer > (\$heap_{724,1:744,8}.p3))
Proof:
[Take given term]
[5.0] invariant1(heapIs heap_{funcstart\_724,1})
\rightarrow [expand definition of function 'invariant1' at prang.c (34,1)]
 \texttt{[5.1]} \; (((((0 < \mathbf{asType} < \mathbf{integer} > (\$ heap_{funcstart\_724,1}.p1)) \; \&\& \\
(\mathbf{asType} < \mathbf{integer} > (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p1}) <
```

```
asType<integer>(heap_{funcstart\_724,1}.M1))) && (0 <
asType < integer > (\$heap_{funcstart\_724,1}.p2))) \&\&
(\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{p2}) <
asType < integer > (\$heap_{funcstart\_724,1}.M2))) \&\& (0 <
\mathbf{asType} {<} \mathbf{integer} {>} (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p3}))) \ \&\& \\
(asType<integer>($heap_{tuncstart\_724,1}.p3) <
asType < integer > (\$heap_{funcstart\_724,1}.M3))
\rightarrow [simplify]
[5.3] (((((0 < \theta_{funcstart\_724,1.p1) && (\theta_{funcstart\_724,1.p1)
asType < integer > (\$heap_{funcstart\_724,1}.M1))) \&\& (0 <
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{p2})))\ \&\&
(\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p2}) <
asType<integer>(heap_{funcstart\_724,1}.M2))) && (0 <
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{p3})))\ \&\&
(asType < integer > (\$heap_{funcstart\_724,1}.p3) < 
asType < integer > (\$heap_{funcstart\_724,1}.M3))
\rightarrow [const static or extern object]
[5.4] (((((0 < \text{heap}_{funcstart\_724,1}.p1) && (\text{heap}_{funcstart\_724,1}.p1 <
asType<integer>($heap<sub>init</sub>.M1))) && (0 <
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p2})))\ \&\&
(\mathbf{asType} < \mathbf{integer} > (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p2}) <
asType < integer > (\$heap_{funcstart\_724,1}.M2))) \&\& (0 <
asType < integer > (\$heap_{funcstart_{-724,1}}.p3))) \&\&
(asType<integer>($heap_{tuncstart_724.1}.p3) <
asType < integer > (\$heap_{funcstart\_724,1}.M3))
\rightarrow [expand definition of constant 'M1' at prang.c (14,20)]
[5.5] (((((0 < $heap_{funcstart_{724,1}}.p1) && ($heap_{funcstart_{724,1}}.p1 <
asType < integer > (asType < short int > ((int)30269)))) && (0 < integer) && (0 < integer
asType < integer > (\$heap_{funcstart\_724,1}.p2))) \&\&
(\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{p2}) <
as
Type<integer>(\rho_{funcstart\_724,1}.M2))) & (0 <
asType < integer > (\$heap_{funcstart_{-724,1}}.p3))) \&\&
(\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{p3}) <
asType < integer > (\$heap_{funcstart_{-724.1}}.M3))
\rightarrow [simplify]
[5.16] \; ((((-30269 < -\$heap_{funcstart\_724,1}.p1) \; \land \; (0 < \$heap_{funcstart\_724,1}.p1) \; \land 
(0 < \text{\$heap}_{funcstart\_724,1}.p2)) \&\& (\text{\$heap}_{funcstart\_724,1}.p2 <
asType < integer > (\$heap_{funcstart\_724,1}.M2))) \&\& (0 < 1)
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p3})))\ \&\&
(asType < integer > (\$heap_{funcstart\_724,1}.p3) < 
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{M3}))
\rightarrow [const static or extern object]
```

```
[5.17] ((((-30269 < -\$heap_{funcstart\_724,1}.p1) \land (0 < \$heap_{funcstart\_724,1}.p1) 
(0 < \text{\$heap}_{funcstart\_724,1}.p2)) \&\& (\text{\$heap}_{funcstart\_724,1}.p2 <
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathrm{heap}_{init}.\mathrm{M2})))~\&\&~(0<
asType < integer > (\$heap_{funcstart\_724,1}.p3))) \&\&
(\mathbf{asType} < \mathbf{integer} > (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p3}) <
asType<integer>($heap_funcstart_724,1.M3))
\rightarrow [expand definition of constant 'M2' at prang.c (19,20)]
[5.18] ((((-30269 < -\$heap_{funcstart\_724,1}.p1) \land (0 < \$heap_{funcstart\_724,1}.p1) 
(0 < \text{$heap}_{funcstart\_724,1}.p2)) \&\& (\text{$heap}_{funcstart\_724,1}.p2 < 
asType<integer>(asType<short int>((int)30307)))) && (0 <
asType < integer > (\$heap_{funcstart\_724,1}.p3))) \&\&
(\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{p3}) <
asType < integer > (\$heap_{funcstart\_724,1}.M3))
\rightarrow [simplify]
[5.30] ((-30307 < -$heap_{tuncstart_724,1}.p2) \land (-30269 <
-\$heap_{funcstart\_724,1}.p1) \land (0 < \$heap_{funcstart\_724,1}.p1) \land (0 < \$heap_{funcstart\_724,1}.p1)
\text{Sheap}_{funcstart\_724,1.p2}) \land (0 < \text{Sheap}_{funcstart\_724,1.p3})) \&\&
(\text{\$heap}_{funcstart\_724,1}.\text{p3} < \text{asType} < \text{integer} > (\text{\$heap}_{funcstart\_724,1}.\text{M3}))
\rightarrow [const static or extern object]
[5.31] ((-30307 < -$heap<sub>funcstart_724,1.</sub>p2) \wedge (-30269 <
-\$heap_{funcstart\_724,1}.p1) \land (0 < \$heap_{funcstart\_724,1}.p1) \land (0 < \$heap_{funcstart\_724,1}.p1)
\text{Sheap}_{funcstart_{-724,1}.p2} \land (0 < \text{Sheap}_{funcstart_{-724,1}.p3})) \&\&
(\$heap_{funcstart\_724,1}.p3 < \mathbf{asType} < \mathbf{integer} > (\$heap_{init}.M3))
\rightarrow [expand definition of constant 'M3' at prang.c (24,20)]
[5.32] ((-30307 < -$heap_{funcstart\_724,1}.p2) \land (-30269 <
-\$heap_{funcstart\_724,1}.p1) \land (0 < \$heap_{funcstart\_724,1}.p1) \land (0 < \$heap_{funcstart\_724,1}.p1)
\text{Sheap}_{funcstart_{724,1}.p2} \land (0 < \text{Sheap}_{funcstart_{724,1}.p3})) \&\&
(\text{sheap}_{funcstart\_724,1}.p3 < asType < integer > (asType < short)
int > ((int)30323))
\rightarrow [simplify]
[5.40] (-30323 < -\$heap_{funcstart\_724,1}.p3) \land (-30307 < -30307)
-\$heap_{funcstart\_724,1}.p2) \wedge (-30269 < -\$heap_{funcstart\_724,1}.p1) \wedge (0 <
\text{Sheap}_{funcstart\_724,1}.\text{p1}) \land (0 < \text{Sheap}_{funcstart\_724,1}.\text{p2}) \land (0 <
heap_{funcstart_{-724,1}.p3}
[Work on sub-term 6 of conjunction in term 5.40]
\textit{[10.0]}~0 < \$ heap_{funcstart\_724,1}.p3
[Take given term]
[11.0] \operatorname{div1} == \operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724,1},
asType < int > (\$heap_{funcstart\_724,1}.p1),
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{a1}))
```

```
\rightarrow [simplify]
[11.1] \operatorname{div1} == \operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724,1}, \$ \operatorname{heap}_{funcstart\_724,1}.p1,
asType < int > (\$heap_{funcstart\_724,1}.a1))
\rightarrow [const static or extern object]
[11.2] \operatorname{div1} == \operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1,
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{init}.\mathtt{a1}))
\rightarrow [expand definition of constant 'a1' at prang.c (16,20)]
[11.3] \operatorname{div1} == \operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724,1}, \$ \operatorname{heap}_{funcstart\_724,1}.p1,
asType<int>(asType<short int>((int)177)))
\rightarrow [simplify]
[11.6] div1 == div(heapIs \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}.p1, 177)
[Take given term]
[25.0] div2 == div(heapIs heap_{funcstart_724,1},
asType < int > (\$heap_{funcstart\_724,1}.p2),
asType < int > (\$heap_{funcstart\_724,1}.a2))
\rightarrow [simplify]
[25.1] \operatorname{div2} == \operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p2,
asType < int > (\$heap_{funcstart\_724,1}.a2))
\rightarrow [const static or extern object]
[25.2] \operatorname{div2} == \operatorname{div}(\mathbf{heapIs} \operatorname{\$heap}_{funcstart\_724,1}, \operatorname{\$heap}_{funcstart\_724,1}.p2,
asType < int > (\$heap_{init}.a2))
\rightarrow [expand definition of constant 'a2' at prang.c (21,20)]
[25.3] div2 == div(heapIs \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}.p2,
asType<int>(asType<short int>((int)176)))
\rightarrow [simplify]
[25.6] div2 == div(heapIs $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}.p2, 176)
[Take given term]
[39.0] \operatorname{div3} == \operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724,1},
\mathbf{asType} < \mathbf{int} > (\$ \mathrm{heap}_{funcstart\_724,1}.\mathrm{p3}),
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{a3}))
\rightarrow [simplify]
[39.1] div3 == div(heapIs \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}.p3,
asType < int > (\$heap_{funcstart\_724,1}.a3))
\rightarrow [const static or extern object]
[39.2] \ \mathrm{div3} == \mathrm{div}(\mathbf{heapIs} \ \$ \mathrm{heap}_{funcstart\_724,1}, \ \$ \mathrm{heap}_{funcstart\_724,1}.\mathrm{p3},
asType < int > (\$heap_{init}.a3))
```

```
\rightarrow [expand definition of constant 'a3' at prang.c (26,20)]
[39.3] div3 == div(heapIs \theta_{funcstart_{-724,1}}, \theta_{funcstart_{-724,1}}.p3,
asType<int>(asType<short int>((int)178)))
\rightarrow [simplify]
[39.6]~{\rm div3} == {\rm div}(\mathbf{heapIs}~\$ \mathrm{heap}_{funcstart\_724,1},\,\$ \mathrm{heap}_{funcstart\_724,1}.\mathrm{p3},\,178)
[Assume known post-assertion, class invariant or type constraint for term 39.6]
\textit{[42.0]} \ (\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p3}) \ / \\
asType<integer>(178)) == asType<integer>(div(heapIs
heap_{funcstart_{-724,1}}, heap_{funcstart_{-724,1}}, 178).quot
\rightarrow [simplify]
[42.2] ($heap<sub>funcstart_724,1.</sub>p3 / 178) == asType<integer>(div(heapIs)
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.p3, 178).quot)
→ [expand definition of operator './' in class 'int' at built in declaration]
[42.3] ([asType<integer>(sheap_{funcstart\_724,1}.p3) < 0]:
-(-asType < integer > (\$heap_{funcstart\_724,1}.p3) / 178), []:
asType < integer > (\$heap_{funcstart-724.1}.p3) / 178) = =
\mathbf{asType} \small{<} \mathbf{integer} \small{>} ( \mathrm{div}(\mathbf{heapIs} \ \$ \mathrm{heap}_{funcstart\_724,1}, \ \$ \mathrm{heap}_{funcstart\_724,1}.\mathrm{p3}, \\
178).quot)
\rightarrow [explicitly assert falsehood of skipped guards in subsequent guards]
[42.4] \; ([\mathbf{asType} < \mathbf{integer} > (\$ heap_{funcstart\_724,1}.p3) < 0]:
-(-asType < integer > (\$heap_{funcstart\_724.1}.p3) / 178),
[!(asType < integer > (\$heap_{funcstart\_724,1}.p3) < 0)]:
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p3})~/~178) ==
\mathbf{asType} {<} \mathbf{integer} {>} ( \mathrm{div}(\mathbf{heapIs} \ \$ \mathrm{heap}_{funcstart\_724,1}, \ \$ \mathrm{heap}_{funcstart\_724,1}.\mathrm{p3}, \\
178).quot)
\rightarrow [simplify]
[42.7] ([0 < -$heap<sub>funcstart_724,1</sub>.p3]:
-(-asType < integer > (\$heap_{funcstart\_724,1}.p3) / 178),
[!(\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{p3}) < 0)]:
asType < integer > (\$heap_{funcstart\_724,1}.p3) / 178) = =
asType<integer>(div(heapIs $heap_funcstart_724,1, $heap_funcstart_724,1.p3,
178).quot)
\rightarrow [from term 10.0, literala < -$heap<sub>funcstart_724,1</sub>.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] \; ([\mathbf{false}]: \; -(-\mathbf{asType} < \mathbf{integer} > (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p3}) \; / \; 178),
[!(\mathbf{asType} < \mathbf{integer} > (\$ heap_{funcstart\_724,1}.p3) < 0)]:
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p3})~/~178) ==
asType<integer>(div(heapIs $heap_{funcstart\_724,1}, $heap_{funcstart\_724,1}.p3,
178).quot)
\rightarrow [simplify]
[42.11] ([false]: -(-asType < integer > (\$heap_{funcstart\_724,1}.p3) / 178), [!(0 <
-\$heap_{funcstart\_724,1}.p3): asType<integer>(\$heap_{funcstart\_724,1}.p3) / 178)
== asType < integer > (div(heapIs $heap_{funcstart\_724,1},
heap_{funcstart_{-724,1}}.p3, 178).quot
\rightarrow [from term 10.0, literala < -$heap<sub>funcstart_724.1</sub>.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 > (\$heap_{funcstart\_724,1}.p3) / 178),
[!false]: asType<integer>(\theta_{funcstart\_724,1.p3}) / 178) ==
\mathbf{asType} < \mathbf{integer} > (\mathbf{div}(\mathbf{heapIs} \ \$ \mathbf{heap}_{funcstart\_724,1}, \ \$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p3}, \\
178).quot)
\rightarrow [simplify]
[42.17] \ 0 == (-\text{div}(\mathbf{heapIs} \ \$ \text{heap}_{funcstart\_724,1}, \ \$ \text{heap}_{funcstart\_724,1}.\text{p3},
178).quot + (\text{$heap}_{funcstart\_724,1.p3} / 178))
[Assume known post-assertion, class invariant or type constraint for term 39.6]
[43.0] (as
Type<integer>($heap_{funcstart\_724,1}.p3) \%
asType<integer>(178)) == asType<integer>(div(heapIs
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.\text{p3}, 178).\text{rem}
\rightarrow [simplify]
[43.2] ($heap_{funcstart\_724,1}.p3 % 178) == asType<integer>(div(heapIs
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.\text{p3}, 178).\text{rem}
→ [expand definition of operator '.%' in class 'int' at built in declaration]
\textit{[43.3]} \; ([\mathbf{asType} < \mathbf{integer} > (\$ heap_{funcstart\_724,1}.p3) < 0]:
-(-asType < integer > (\$heap_{funcstart\_724,1}.p3) \% 178), []:
asType < integer > (\$heap_{funcstart\_724,1}.p3) \% 178) ==
asType<integer>(div(heapIs $heap_{tuncstart\_724.1}, $heap_{tuncstart\_724.1}.p3,
178).rem)
→ [explicitly assert falsehood of skipped guards in subsequent guards]
[43.4] ([asType<integer>(sheap_{funcstart\_724.1}.p3) < 0]:
```

```
-(-asType < integer > (\$heap_{funcstart\_724,1}.p3) \% 178),
[!(\mathbf{asType} < \mathbf{integer} > (\$ heap_{funcstart\_724,1}.p3) < 0)]:
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p3})~\%~178) ==
asType<integer>(div(heapIs heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p3,
178).rem)
\rightarrow [simplify]
[43.7] ([0 < -$heap<sub>funcstart_724,1</sub>.p3]:
-(-asType < integer > (\$heap_{funcstart\_724.1}.p3) \% 178),
[!(asType < integer > (\$heap_{funcstart\_724,1}.p3) < 0)]:
asType < integer > (\$heap_{funcstart\_724,1}.p3) \% 178) = =
\mathbf{asType} < \mathbf{integer} > (\mathbf{div}(\mathbf{heapIs} \$ \mathbf{heap}_{funcstart\_724,1}, \$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p3},
178).rem)
\rightarrow [from term 10.0, literala < -$heap<sub>funcstart_724.1</sub>.p3 is false whenever -2 <
(0 + literala)
    Proof of rule precondition:
    [43.7.0] - 2 < (0 + 0)
    \rightarrow [simplify]
    [43.7.2] true
[43.8] ([false]: -(-asType < integer > (\$heap_{funcstart\_724,1}.p3) \% 178),
[!(asType < integer > (\$heap_{funcstart\_724,1}.p3) < 0)]:
asType < integer > (\$heap_{funcstart\_724,1}.p3) \% 178) ==
\mathbf{asType} < \mathbf{integer} > (\mathbf{div}(\mathbf{heapIs} \ \$ \mathbf{heap}_{funcstart\_724,1}, \ \$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p3}, \\
178).rem)
\rightarrow [simplify]
[43.11] ([false]: -(-asType < integer > (\$heap_{funcstart\_724,1}.p3) \% 178), [!(0)]
<-$heap<sub>funcstart_724,1.</sub>p3)]: asType<integer>($heap<sub>funcstart_724,1.</sub>p3) %
178) == asType < integer > (div(heapIs $heap_{funcstart\_724,1},
heap_{funcstart_{-724,1}.p3}, 178).rem
\rightarrow [from term 10.0, literala < -$heap<sub>funcstart_724,1</sub>.p3 is false whenever -2 <
(0 + literala)
    Proof of rule precondition:
    [43.11.0] - 2 < (0 + 0)
    \rightarrow [simplify]
    [43.11.2] true
\textit{[43.12]} \; ([\textbf{false}]: \; -(-\textbf{asType} < \textbf{integer} > (\$ \text{heap}_{funcstart\_724,1}.\text{p3}) \; \% \; 178),
[!false]: asType<integer>(sheap_{funcstart\_724,1.p3}) % 178) ==
\mathbf{asType} < \mathbf{integer} > (\mathbf{div}(\mathbf{heapIs} \ \$ \mathbf{heap}_{funcstart\_724,1}, \ \$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p3}, \\
178).rem)
```

```
\rightarrow [simplify]
[43.17] 0 == (-\text{div}(\mathbf{heapIs} \$ \text{heap}_{funcstart\_724,1}, \$ \text{heap}_{funcstart\_724,1}.\text{p3},
178).rem + (\text{$heap}_{funcstart\_724,1}.p3 \% 178))
[Take given term]
[52.0]!(0 == asType < integer > (div3.rem)) || !(0 ==
asType<integer>(div3.quot))
\rightarrow [from term 39.6, div3 is equal to div(heapIs $heap_{funcstart\_724,1},
heap_{funcstart_{-724,1}}.p3, 178
[52.1]!(0 == asType < integer) = (div(heapIs $heap_{tuncstart\_724,1}, 
\label{eq:funcstart_724,1.p3} $$ \operatorname{heap}_{funcstart_724,1.p3}, \ 178).rem)) \ || \ !(0 == \mathbf{asType} < \mathbf{integer} > (\operatorname{div}3.\operatorname{quot})) $$
\rightarrow [simplify]
[52.2] ! (0 == \operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.p3,
178).rem) ||!(0 == asType < integer > (div3.quot))|
\rightarrow [from term 39.6, div3 is equal to div(heapIs $heap_{funcstart\_724,1},
heap_{funcstart_{-724,1}}.p3, 178
\label{eq:constart_724,1} \text{[52.3] !} (0 == \operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.\operatorname{p3},
178).rem) || !(0 == asType < integer) > (div(heapIs $heap_{funcstart_{724,1}}, 
heap_{funcstart_{724,1}}.p3, 178).quot)
\rightarrow [simplify]
[52.5]!(0 == \text{div}(\mathbf{heapIs} \$ \text{heap}_{funcstart\_724,1}, \$ \text{heap}_{funcstart\_724,1}.p3,
178).quot) \vee !(0 == \text{div}(\mathbf{heapIs} \$ heap_{funcstart\_724,1}, \$ heap_{funcstart\_724,1}.p3,
178).rem)
[Take given term]
[53.0] heap_{724,1;740,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow asType<short
int>((asType<int>(asType<short int>(div1.rem)) *
asType < int > (\$heap_{funcstart\_724,1}.r1)) - (asType < int > (asType < short)
int>(div1.quot)) * asType< int>($heap_{funcstart\_724,1}.b1))))
\rightarrow [from term 11.6, div1 is equal to div(heapIs $heap_{funcstart_{724,1}},
heap_{funcstart_{-724,1}}.p1, 177)
[53.1] \text{sheap}_{724,1;740,8} == \text{sheap}_{funcstart\_724,1}._replace(p1 \rightarrow asType<short
int>((asType<int>(asType<short int>(div(heapIs $heap_{tuncstart\_724.1},
\rho_{tuncstart_{-724.1},p1,177,rem} * asType<int>($\rho_{tuncstart_{-724.1},r1}\rho_{-724.1}.r1)) -
(asType<int>(asType<short int>(div1.quot)) *
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{b1}))))
\rightarrow [simplify]
[53.3] \theta == 
int>((div(heapIs \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1, 177).rem *
asType < int > (\$heap_{funcstart\_724,1}.r1)) - (asType < int > (asType < short)
```

```
int>(div1.quot)) * asType< int>($heap_{tuncstart\_724.1}.b1))))
\rightarrow [const static or extern object]
[53.4] heap_{724,1;740,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow asType<short
int>((div(heapIs \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1, 177).rem *
asType < int > (\$heap_{init}.r1)) - (asType < int > (asType < short)
int>(div1.quot)) * asType< int>($heap_{funcstart\_724,1}.b1))))
\rightarrow [expand definition of constant 'r1' at prang.c (15,20)]
[53.5] \theta == 
int>((div(heapIs \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1, 177).rem *
asType < int > (asType < short int > ((int)171))) -
(asType < int > (asType < short int > (div1.quot)) *
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{b1}))))
\rightarrow [simplify]
[53.8] heap_{724,1;740,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow asType<short
int>((div(heapIs \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1, 177).rem * 171)
- (asType<int>(asType<short int>(div1.quot)) *
asType < int > (\$heap_{funcstart\_724,1}.b1))))
\rightarrow [from term 11.6, div1 is equal to div(heapIs $heap_{tuncstart\_724.1},
heap_{funcstart_{-724,1}}.p1, 177
[53.9] heap_{724,1;740,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow asType<short
int>((171 * div(heapIs \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1, 177).rem)
- (asType<int>(asType<short int>(div(heapIs $heap_{funcstart_724.1},
heap_{funcstart_{724,1}}, p1, 177).quot)
asType < int > (\$heap_{funcstart\_724,1}.b1))))
\rightarrow [simplify]
[53.11] \theta == 
int>((171 * div(heapIs $heap_{funcstart\_724,1}, $heap_{funcstart\_724,1}.p1, 177).rem)
- (div(heapIs heap_{funcstart_{-724,1}}, heap_{funcstart_{-724,1}}, 177).quot *
asType < int > (\$heap_{funcstart\_724,1}.b1)))
\rightarrow [const static or extern object]
[53.12] \$ heap_{724,1;740,8} == \$ heap_{funcstart\_724,1}.\_\mathbf{replace} (p1 \to \mathbf{asType} < \mathbf{short})
int > ((171 * div(heapIs \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1, 177).rem)
- (div(heapIs heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p1, 177).quot *
asType < int > (\$heap_{init}.b1)))
\rightarrow [expand definition of constant 'b1' at prang.c (17,20)]
[53.13] heap_{724,1;740,8} == heap_{funcstart\_724,1}.replace(p1 \rightarrow asType<short
\mathbf{int} > ((171 * \operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724,1}, \$ \operatorname{heap}_{funcstart\_724,1}.\operatorname{p1}, 177).\operatorname{rem})
- (\text{div}(\mathbf{heapIs} \$ \text{heap}_{funcstart\_724,1}, \$ \text{heap}_{funcstart\_724,1}.\text{p1}, 177).\text{quot} *
asType<int>(asType<short int>((int)2))))
```

```
\rightarrow [simplify]
[53.19] $\text{heap}_{724,1:740.8} == $\text{heap}_{funcstart\_724,1}._\text{replace}(p1 \to ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).quot) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.\operatorname{p1}, \ 177).\operatorname{rem})))
[Take given term]
[57.0] \$ heap_{724,1;742,8} == \$ heap_{724,1;740,8}.\_\mathbf{replace}(p2 \to \mathbf{asType} < \mathbf{short})
int>((asType<int>(asType<short int>(div2.rem)) *
asType < int > (\$heap_{724,1:740.8}.r2)) - (asType < int > (asType < short)
int>(div2.quot)) * asType<int>($heap<sub>724,1:740,8</sub>.b2))))
\rightarrow [from term 53.19, $heap<sub>724.1:740.8</sub> is equal to
heap_{funcstart\_724.1}._replace(p1 \rightarrow (-2 * div(heapIs heap_{funcstart\_724.1}),
\text{Sheap}_{funcstart_{-724,1},p1, 177}.\text{quot}) + (171 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart_{-724,1}}),
heap_{funcstart_{724,1}.p1, 177).rem}
[57.1] heap_{724,1;742,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 *
\operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724.1}, \$ \operatorname{heap}_{funcstart\_724.1}.p1,
177).rem)))._replace(p2 \rightarrow asType<short
int>((asType<int>(asType<short int>(div2.rem)) *
\mathbf{asType}{<}\mathbf{int}{>}(\$\text{heap}_{724,1;740,8}.\text{r2})) - (\mathbf{asType}{<}\mathbf{int}{>}(\mathbf{asType}{<}\mathbf{short}
int>(div2.quot)) * asType< int>($heap_{724.1:740.8}.b2))))
\rightarrow [from term 25.6, div2 is equal to div(heapIs $heap_{tuncstart} 724.1,
heap_{funcstart_{-724,1},p2,176}
[57.2] heap_{724,1;742,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 \ *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow asType<short
int>((asType<int>(asType<short int>(div(heapIs $heap_{funcstart\_724,1},
\text{sheap}_{funcstart=724.1}.\text{p2}, 176).\text{rem}) * asType < int > (\text{sheap}_{724.1:740.8}.\text{r2})) -
(asType<int>(asType<short int>(div2.quot)) *
asType < int > (\$heap_{724,1;740,8}.b2))))
[57.4] heap_{724,1;742,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).quot) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.p1,
(177).rem))._replace(p2 \rightarrow asType<short int>((div(heapIs)))._replace(p2 \rightarrow asType
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.\text{p2}, 176).\text{rem} *
\mathbf{asType} < \mathbf{int} > (\$ \mathrm{heap}_{724,1;740,8}.\mathrm{r2})) - (\mathbf{asType} < \mathbf{int} > (\mathbf{asType} < \mathbf{short}))
int>(div2.quot)) * asType<int>($heap<sub>724.1:740.8</sub>.b2))))
\rightarrow [from term 53.19, $heap_{724,1;740,8}$ is equal to
heap_{funcstart\_724,1}._replace(p1 \rightarrow (-2 * div(heapIs heap_{funcstart\_724,1}),
heap_{funcstart\_724,1}.p1, 177).quot + (171 * div(heapIs $heap_{funcstart\_724,1}, 177).quot) + (171 * div(heapIs $heap_{funcstart\_724,1}, 17
```

```
heap_{funcstart_{-724,1}}.p1, 177).rem)
[57.5] heap_{724,1;742,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).quot) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow asType<short int>((div(heapIs
heap_{funcstart_{-724,1}}, heap_{funcstart_{-724,1}}.p2, 176).rem *
asType < int > (\$heap_{funcstart\_724,1}.\_replace(p1 \rightarrow ((-2 * div(heapIs)))))))
\theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}
\text{Sheap}_{funcstart_{724.1}}, \text{Sheap}_{funcstart_{724.1}}, \text{p1}, 177).\text{rem})).\text{r2})) -
(asType<int>(asType<short int>(div2.quot)) *
asType < int > (\$heap_{724,1;740,8}.b2))))
\rightarrow [const member of object with modified fields]
[57.6] $heap<sub>724,1;742,8</sub> == $heap<sub>funcstart_724,1</sub>._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 \ *
\operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724.1}, \$ \operatorname{heap}_{funcstart\_724.1}.p1,
177).rem)))._{\mathbf{replace}}(p2 \rightarrow \mathbf{asType} < \mathbf{short\ int} > ((\operatorname{div}(\mathbf{heapIs}))))
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.p2, 176).rem *
asType < int > (\$heap_{funcstart\_724,1}.r2)) - (asType < int > (asType < short)
int>(div2.quot)) * asType< int>($heap_{724.1:740.8}.b2))))
\rightarrow [const static or extern object]
[57.7] heap_{724,1;742,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 \ *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1,
177).rem)))._{\mathbf{replace}}(p2 \rightarrow \mathbf{asType} < \mathbf{short\ int} > ((\operatorname{div}(\mathbf{heapIs}))))
\rho_{funcstart\_724,1}, \rho_{funcstart\_724,1.p2, 176}.rem *
asType < int > (\$heap_{init}.r2)) - (asType < int > (asType < short)
int>(div2.quot)) * asType<int>($heap<sub>724.1:740.8</sub>.b2))))
\rightarrow [expand definition of constant 'r2' at prang.c (20,20)]
[57.8] heap_{724,1;742,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}. p1, \ 177). \operatorname{quot}) + (171 *
\label{eq:div_heap} \text{div}(\textbf{heapIs} \ \$ \text{heap}_{funcstart\_724,1}, \ \$ \text{heap}_{funcstart\_724,1}.\text{p1},
(177).rem))._replace(p2 \rightarrow asType<short int>((div(heapIs)
\text{Sheap}_{funcstart_{-724,1}}, \text{Sheap}_{funcstart_{-724,1}}.p2, 176).rem *
asType < int > (asType < short int > ((int)172)))
(asType<int>(asType<short int>(div2.quot)) *
asType < int > (\$heap_{724,1;740,8}.b2))))
\rightarrow [simplify]
[57.11] $\text{heap}_{724,1:742.8} == $\text{heap}_{funcstart\_724,1}._\text{replace}(p1 \to ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}. p1, \ 177). \operatorname{quot}) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.p1,
177).rem)))._{\mathbf{replace}}(p2 \rightarrow \mathbf{asType} < \mathbf{short\ int} > ((\operatorname{div}(\mathbf{heapIs}))))
\text{Sheap}_{funcstart_{724,1}}, \text{Sheap}_{funcstart_{724,1}}.p2, 176).rem * 172) -
```

```
(asType<int>(asType<short int>(div2.quot)) *
asType < int > (\$heap_{724,1;740,8}.b2))))
\rightarrow [from term 25.6, div2 is equal to div(heapIs $heap_{funcstart_{724,1}},
heap_{funcstart_{724,1}}.p2, 176
[57.12] $\text{heap}_{724,1;742,8} == $\text{heap}_{funcstart_724,1}._\text{replace}(p1 \to ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).quot) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow asType<short int>((172 * div(heapIs
heap_{funcstart_{724,1}}, heap_{funcstart_{724,1}}, 2, 176).rem –
(asType<int>(asType<short int>(div(heapIs $heap_{tuncstart\_724.1},
\text{sheap}_{funcstart\_724,1.p2}, 176).\text{quot}) * asType < int > (\text{sheap}_{724,1;740,8}.b2))))
\rightarrow [simplify]
[57.14] heap_{724,1;742,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 \ *
\operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724,1}, \$ \operatorname{heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow asType<short int>((172 * div(heapIs
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.\text{p2}, 176).\text{rem}) - (\text{div}(\text{heapIs})
heap_{funcstart_{724,1}}, heap_{funcstart_{724,1}}, 2, 176).quot *
asType<int>($heap<sub>724.1:740.8</sub>.b2))))
\rightarrow [from term 53.19, $heap<sub>724.1:740.8</sub> is equal to
heap_{funcstart\_724,1}._replace(p1 \rightarrow (-2 * div(heapIs $heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1}.\text{p1}, 177).\text{quot} + (171 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
heap_{funcstart_{-724,1}}.p1, 177).rem)
[57.15] $\text{heap}_{724,1:742,8} == \text{$heap}_{funcstart\_724,1}._\text{$replace}(p1 \to ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}. p1, \ 177). \operatorname{quot}) + (171 *
\operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724,1}, \$ \operatorname{heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow asType<short int>((172 * div(heapIs
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.\text{p2}, 176).\text{rem}) - (\text{div}(\text{heapIs}))
\theta_{funcstart_{724,1}}, \theta_{funcstart_{724,1},p2,176}.quot *
asType < int > (\$heap_{funcstart\_724,1}.\_replace(p1 \rightarrow ((-2 * div(heapIs)))))))
\theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}
\text{Sheap}_{funcstart_{724,1}}, \text{Sheap}_{funcstart_{724,1},p1, 177}.\text{rem})).b2))))
\rightarrow [const member of object with modified fields]
[57.16] $\text{heap}_{724.1:742.8} == \text{$heap}_{funcstart\_724.1}._\text{replace}(p1 \to ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}. p1, \ 177). \operatorname{quot}) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow asType<short int>((172 * div(heapIs
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.\text{p2}, 176).\text{rem}) - (\text{div}(\text{heapIs})
heap_{funcstart_{724,1}}, heap_{funcstart_{724,1}}.p2, 176).quot *
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{b2}))))
\rightarrow [const static or extern object]
```

```
[57.17] $\text{heap}_{724,1;742,8} == \text{$heap}_{funcstart_724,1}._{\text{replace}}(p1 \to ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 \ *
\label{eq:div_heap} \text{div}(\textbf{heapIs} \ \$ \text{heap}_{funcstart\_724,1}, \ \$ \text{heap}_{funcstart\_724,1}.\text{p1},
177).rem)))._replace(p2 \rightarrow asType<short int>((172 * div(heapIs
\theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}.p2, 176).rem) - (div(heapIs
heap_{funcstart_{724,1}}, heap_{funcstart_{724,1}}, 176).quot *
asType < int > (\$heap_{init}.b2))))
\rightarrow [expand definition of constant 'b2' at prang.c (22,20)]
[57.18] $\text{heap}_{724,1:742,8} == \text{$heap}_{funcstart\_724,1}._\text{$replace}(p1 \to ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 *
\label{eq:div_heap} \text{div}(\textbf{heapIs} \ \$ \text{heap}_{funcstart\_724,1}, \ \$ \text{heap}_{funcstart\_724,1}.\text{p1},
177).rem)))._replace(p2 \rightarrow asType<short int>((172 * div(heapIs
\theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}.p2, 176).rem) - (div(heapIs
heap_{funcstart_{724,1}}, heap_{funcstart_{724,1}}, 2, 176, quot
asType<int>(asType<short int>((int)35)))))
\rightarrow [simplify]
[57.24] $heap<sub>724,1;742,8</sub> == $heap<sub>funcstart_724,1</sub>._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 \ *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart} \ 724.1, \ \$ \operatorname{heap}_{funcstart} \ 724.1, \ p1,
177).rem)))._replace(p2 \rightarrow ((-35 * div(heapIs $heap_{funcstart\_724,1},
\rho_{tuncstart_{-724,1},p2,176}, quot) + (172 * div(heapIs \rho_{tuncstart_{-724,1},p2}
heap_{funcstart_{-724,1}}.p2, 176).rem))
[Take given term]
[61.0] $\text{heap}_{724,1:744,8} == $\text{heap}_{724,1:742,8}._\text{replace}(p3 \to \text{asType} < \text{short}
int>((asType<int>(asType<short int>(div3.rem)) *
asType < int > (\$heap_{724,1:742.8}.r3)) - (asType < int > (asType < short)
int>(div3.quot)) * asType<int>($heap<sub>724,1;742,8</sub>.b3))))
\rightarrow [from term 57.24, $\$heap_{724,1;742,8}$ is equal to
heap_{funcstart_{724,1}}._replace(p1 \rightarrow ((-2 * div(heapIs $heap_{funcstart_{724,1}}), + div(heapIs $heap_{funcstart_{724,1}}))
\text{Sheap}_{funcstart\_724,1}.p1, 177).quot) + (171 * div(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
heap_{funcstart\_724,1}.p1, 177).rem)._replace(p2 \rightarrow (-35 * div(heapIs)))._replace
heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p2, 176).quot) + (172 * div(heapIs)
heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p2, 176).rem)
[61.1] heap_{724,1;744,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 \ *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow ((-35 * div(heapIs $heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1}.\text{p2}, 176).\text{quot} + (172 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
\theta_{uncstart_724.1.p2, 176}.rem)._replace(p3 \rightarrow asType<short
int>((asType<int>(asType<short int>(div3.rem)) *
\mathbf{asType} < \mathbf{int} > (\$ \mathrm{heap}_{724,1;742,8}.\mathrm{r3})) - (\mathbf{asType} < \mathbf{int} > (\mathbf{asType} < \mathbf{short}))
int>(div3.quot)) * asType<int>($heap<sub>724,1:742,8</sub>.b3))))
```

```
\rightarrow [from term 39.6, div3 is equal to div(heapIs $heap_{funcstart\_724,1},
heap_{funcstart_{724,1}}.p3, 178
[61.2] $heap<sub>724,1:744,8</sub> == $heap<sub>funcstart_724,1</sub>._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.\operatorname{p1}, \ 177).\operatorname{quot}) + (171 \ *
\operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724.1}, \$ \operatorname{heap}_{funcstart\_724.1}.p1,
177).rem)))._replace(p2 \rightarrow ((-35 * div(heapIs $heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1}.\text{p2}, 176).\text{quot} + (172 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
\theta_{uncstart_724.1.p2, 176}.rem)._replace(p3 \rightarrow asType<short
int>((asType<int>(asType<short int>(div(heapIs $heap_{funcstart\_724,1},))
\text{sheap}_{funcstart\_724,1.p3}, 178).rem) * asType < int > (\text{sheap}_{724,1;742,8}.r3)) -
(asType<int>(asType<short int>(div3.quot)) *
asType < int > (\$heap_{724,1:742.8}.b3))))
\rightarrow [simplify]
[61.4] $heap<sub>724.1:744.8</sub> == $heap<sub>funcstart_724.1</sub>._replace(p1 \rightarrow ((-2 *
div(\mathbf{heapIs} \ \$heap_{funcstart\_724.1}, \ \$heap_{funcstart\_724.1}.p1, \ 177).quot) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow ((-35 * div(heapIs $heap_{funcstart\_724,1},
\theta_{funcstart_{-724,1},p2,176}.quot) + (172 * div(heapIs \theta_{funcstart_{-724,1},p2,176}).
\theta_{funcstart_{724,1},p2,176,rem})._replace(p3 \rightarrow asType<short
int>((div(heapIs \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p3, 178).rem *
asType < int > (\$heap_{724,1:742.8}.r3)) - (asType < int > (asType < short)
int>(div3.quot)) * asType< int>($heap_{724,1;742,8}.b3))))
\rightarrow [from term 57.24, $\$heap_{724,1;742,8}$ is equal to
heap_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 * div(heapIs *heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1}.\text{p1}, 177).\text{quot} + (171 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
heap_{funcstart\_724,1}.p1, 177).rem))._replace(p2 \rightarrow (-35 * div(heapIs)))._
heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p2, 176).quot) + (172 * div(heapIs)
heap_{funcstart_{724,1}}, heap_{funcstart_{724,1}}, p2, 176).rem)
[61.5] \rho_{1.5} = \rho_{1.5}
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 *
\operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724,1}, \$ \operatorname{heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow ((-35 * div(heapIs $heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1}.\text{p2}, 176).\text{quot} + (172 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
\rho_{funcstart\_724,1.p2, 176}.rem))._replace(p3 \rightarrow asType<short
int>((div(heapIs \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p3, 178).rem *
asType < int > (\$heap_{tuncstart\_724,1}.\_replace(p1 \rightarrow ((-2 * div(heapIs))))))
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.\text{p1}, 177).\text{quot}) + (171 * \text{div}(\text{heapIs})
* div(heapIs heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p2, 176).quot) + (172 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p2, \ 176).rem))).r3)) -
(asType<int>(asType<short int>(div3.quot)) *
asType < int > (\$heap_{724.1:742.8}.b3)))
\rightarrow [const member of object with modified fields]
```

```
[61.7] heap_{724,1;744,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow ((-35 * div(heapIs $heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1}.\text{p2}, 176).\text{quot} + (172 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
\theta_{funcstart\_724,1}.p2, 176).rem))).replace(p3 \rightarrow asType < short)
int>((div(heapIs $heap_{funcstart\_724,1}, $heap_{funcstart\_724,1}.p3, 178).rem *
asType < int > (\$heap_{tuncstart\_724.1}.r3)) - (asType < int > (asType < short)
int>(div3.quot)) * asType<int>($heap<sub>724.1:742.8</sub>.b3))))
\rightarrow [const static or extern object]
[61.8] heap_{724,1;744,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow ((-35 * div(heapIs $heap_{funcstart_724,1},
\text{Sheap}_{funcstart\_724,1}.\text{p2}, 176).\text{quot} + (172 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
\$ heap_{funcstart\_724,1}.p2,\,176).rem))).\_\textbf{replace}(p3 \rightarrow \textbf{asType} < \textbf{short}
int>((div(heapIs \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p3, 178).rem *
asType < int > (\$heap_{init}.r3)) - (asType < int > (asType < short)
int>(div3.quot)) * asType<int>($heap<sub>724.1:742.8</sub>.b3))))
\rightarrow [expand definition of constant 'r3' at prang.c (25,20)]
[61.9] heap_{724,1;744,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 *
\operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724.1}, \$ \operatorname{heap}_{funcstart\_724.1}.p1,
177).rem)))._replace(p2 \rightarrow ((-35 * div(heapIs $heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1}.\text{p2}, 176).\text{quot} + (172 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
\rho_{uncstart\_724,1.p2, 176).rem}).replace(p3 \rightarrow asType<short
int>((div(heapIs \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p3, 178).rem *
asType<int>(asType<short int>((int)170))) -
(asType<int>(asType<short int>(div3.quot)) *
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{724,1;742,8}.\mathrm{b3}))))
\rightarrow [simplify]
[61.12] $\text{heap}_{724.1:744.8} == $\text{heap}_{funcstart_724.1}. \text{replace}(p1 \to ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 \ *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow ((-35 * div(heapIs $heap_{funcstart\_724,1},
\text{Sheap}_{funcstart_{-724,1},p2}, 176).\text{quot}) + (172 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart_{-724,1}},
\theta_{funcstart_{724,1},p2,176,rem})._replace(p3 \rightarrow asType<short
int>((div(heapIs \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p3, 178).rem * 170)
- (asType < int > (asType < short int > (div3.quot))*
asType < int > (\$heap_{724,1;742,8}.b3))))
\rightarrow [from term 39.6, div3 is equal to div(heapIs $heap_{funcstart\_724,1},
heap_{funcstart_{724,1}}.p3, 178
```

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[61.13] $heap<sub>724,1;744,8</sub> == $heap<sub>funcstart_724,1</sub>._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 \ *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow ((-35 * div(heapIs $heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1}.\text{p2}, 176).\text{quot} + (172 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
\rho_{uncstart\_724,1}.p2, 176).rem))._replace(p3 \rightarrow asType<short int>((170
* \operatorname{div}(\mathbf{heapIs} \ \operatorname{\$heap}_{funcstart\_724,1}, \ \operatorname{\$heap}_{funcstart\_724,1}.p3, \ 178).rem) -
(asType<int>(asType<short int>(div(heapIs $heap_{tuncstart\_724.1},
\text{Sheap}_{funcstart\_724,1}.\text{p3}, 178).\text{quot}) * asType<int>(\text{Sheap}_{724,1;742,8}.\text{b3}))))
[61.15] $heap<sub>724,1;744,8</sub> == $heap<sub>funcstart_724,1</sub>._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 \ *
\operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724,1}, \$ \operatorname{heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow ((-35 * div(heapIs $heap_{funcstart_724,1},
\text{Sheap}_{funcstart\_724,1}.\text{p2}, 176).\text{quot} + (172 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
\rho_{uncstart_{-724,1},p2, 176,rem})._replace(p3 \rightarrow asType<short int>((170
* div(heapIs heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p3, 178).rem) –
(\text{div}(\mathbf{heapIs} \$ \text{heap}_{funcstart\_724.1}, \$ \text{heap}_{funcstart\_724.1}. \text{p3}, 178).\text{quot} *
asType<int>($heap<sub>724.1:742.8</sub>.b3))))
\rightarrow [from term 57.24, heap_{724,1;742,8} is equal to
heap_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 * div(heapIs heap_{funcstart\_724,1}),
\text{Sheap}_{funcstart\_724,1}.p1, 177).quot) + (171 * div(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
\rho_{uncstart\_724,1}.p1, 177).rem))._replace\rho_{uncstart\_724,1}.p1, 177).rem))._replace
heap_{funcstart\_724,1}, p_{funcstart\_724,1}, p_{funcstart\_724,1}, p_{funcstart\_724,1}, p_{funcstart\_724,1}
heap_{funcstart_{724,1}}, heap_{funcstart_{724,1}}, p2, 176).rem)
[61.16] heap_{724,1;744,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow ((-35 * div(heapIs $heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724.1.p2}, 176).\text{quot} + (172 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724.1},
\theta_{170} = \theta_{1
* div(heapIs heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p3, 178).rem) –
(\text{div}(\mathbf{heapIs} \$ \text{heap}_{funcstart\_724,1}, \$ \text{heap}_{funcstart\_724,1}.\text{p3}, 178).\text{quot} *
asType < int > (\$heap_{funcstart\_724,1}.\_replace(p1 \rightarrow ((-2 * div(heapIs))))))
heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p1, 177).quot) + (171 * div(heapIs)
\theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}
* div(\mathbf{heapIs} \ \$ heap_{funcstart\_724,1}, \ \$ heap_{funcstart\_724,1}.p2, \ 176).quot) + (172 \ *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.\operatorname{p2}, \ 176).\operatorname{rem}))).\operatorname{b3}))))
→ [const member of object with modified fields]
[61.18] $heap<sub>724,1;744,8</sub> == $heap<sub>funcstart_724,1</sub>._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).quot) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow ((-35 * div(heapIs $heap_{funcstart\_724,1},
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\text{Sheap}_{funcstart\_724,1}.\text{p2}, 176).\text{quot} + (172 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
\rho_{funcstart\_724,1}, p2, 176).rem)._replace(p3 \rightarrow asType<short int>((170
* \operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p3, \ 178).rem) -
(\text{div}(\mathbf{heapIs} \$ \text{heap}_{funcstart\_724,1}, \$ \text{heap}_{funcstart\_724,1}.\text{p3}, 178).\text{quot} *
asType < int > (\$heap_{funcstart\_724,1}.b3))))
\rightarrow [const static or extern object]
[61.19] $heap<sub>724,1;744,8</sub> == $heap<sub>funcstart_724,1</sub>._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).quot) + (171 *
\operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724,1}, \$ \operatorname{heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow ((-35 * div(heapIs $heap_{funcstart_724,1},
\text{Sheap}_{funcstart\_724,1.p2}, 176).\text{quot} + (172 * \text{div}(\text{heapIs} \text{Sheap}_{funcstart\_724,1}),
\theta_{funcstart\_724,1.p2, 176}.rem)._replace(p3 \rightarrow asType<short int>((170
* \operatorname{div}(\mathbf{heapIs} \ \operatorname{\$heap}_{funcstart\_724,1}, \ \operatorname{\$heap}_{funcstart\_724,1}.p3, \ 178).rem) -
(\text{div}(\mathbf{heapIs} \$ \text{heap}_{funcstart\_724,1}, \$ \text{heap}_{funcstart\_724,1}.\text{p3}, 178).\text{quot} *
asType < int > (\$heap_{init}.b3))))
\rightarrow [expand definition of constant 'b3' at prang.c (27,20)]
[61.20] heap_{724,1;744,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 \ *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart} \ 724.1, \ \$ \operatorname{heap}_{funcstart} \ 724.1, \ p1,
177).rem)))._replace(p2 \rightarrow ((-35 * div(heapIs $heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1.p2}, 176).\text{quot} + (172 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
\rho_{tuncstart_724.1}.p2, 176).rem))._replace(p3 \rightarrow asType<short int>((170
* div(heapIs heap_{funcstart\_724.1}, heap_{funcstart\_724.1}, n_{funcstart\_724.1}, n_{funcstart\_724.1}
(\text{div}(\mathbf{heapIs} \$ \text{heap}_{funcstart\_724,1}, \$ \text{heap}_{funcstart\_724,1}.\text{p3}, 178).\text{quot} *
asType<int>(asType<short int>((int)63)))))
\rightarrow [simplify]
[61.26] heap_{724,1;744,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724.1}, \ \$ \operatorname{heap}_{funcstart\_724.1}.p1,
177).rem)))._replace(p2 \rightarrow ((-35 * div(heapIs $heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724.1.p2}, 176).\text{quot} + (172 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724.1},
\rho_{funcstart\_724,1}.p2, 176).rem))._replace(p3 \rightarrow ((-63 * div(heapIs
\theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}. \theta_{funcstart\_724,1}. \theta_{funcstart\_724,1}. \theta_{funcstart\_724,1}. \theta_{funcstart\_724,1}.
heap_{funcstart_{724,1}}, heap_{funcstart_{724,1}}, 178).rem)
[Take goal term]
[1.0] \ \mathbf{asType} < \mathbf{integer} > (\$ heap_{724,1;744,8}.p3) <
asType<integer>($heap<sub>724.1:744.8</sub>.M3)
\rightarrow [from term 61.26, $heap<sub>724,1;744,8</sub> is equal to
heap_{funcstart\ 724.1}._replace(p1 \rightarrow ((-2 * div(heapIs heap_{funcstart\ 724.1}),
heap_{funcstart\_724,1}.p1, 177).quot + (171 * div(heapIs $heap_{funcstart\_724,1}, 177).quot) + (171 * div(heapIs $heap_{funcstart\_724,1}, 17
\rho_{funcstart\_724,1.p1, 177}.rem))._replace\rho_{funcstart\_724,1.p1, 177}.rem))._replace
heap_{funcstart\_724,1}, p_{funcstart\_724,1}, p_{funcstart\_724,1}, p_{funcstart\_724,1}, p_{funcstart\_724,1}
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heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p2, 176).rem)))._replace(p3 \rightarrow (-63 *
div(\mathbf{heapIs} \ \$heap_{funcstart\_724,1}, \ \$heap_{funcstart\_724,1}.p3, \ 178).quot) + (170 \ *
div(\mathbf{heapIs} \ \$heap_{funcstart\_724,1}, \ \$heap_{funcstart\_724,1}.p3, \ 178).rem))]
[1.1] asType<integer>(heap_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow ((-35 * div(heapIs $heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1}.\text{p2}, 176).\text{quot} + (172 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
\rho_{tuncstart\_724.1.p2, 176}.rem)._replace(p3 \rightarrow ((-63 * div(heapIs
heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p3, 178).quot) + (170 * div(heapIs
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.p3, 178).rem))).p3) <
asType<integer>($heap<sub>724.1:744.8</sub>.M3)
\rightarrow [simplify]
[1.3] ((-63 * div(heapIs heap_{funcstart_{-724.1}}, heap_{funcstart_{-724.1}}, p_3)
178).quot) + (170 * div(heapIs heap_{funcstart_{724,1}}, heap_{funcstart_{724,1}}, g_3,
(178).rem) < asType < integer > (\$heap_{724,1:744.8}.M3)
\rightarrow [from term 61.26, $heap<sub>724,1;744,8</sub> is equal to
heap_{funcstart\_724,1}.replace(p1 \rightarrow ((-2 * div(heapIs $heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724.1}, p1, 177).quot) + (171 * div(\text{heapIs } \text{Sheap}_{funcstart\_724.1}),
heap_{funcstart\_724,1}.p1, 177).rem))).\_replace(p2 \rightarrow ((-35 * div(heapIs))).\_replace(p2 \rightarrow ((-35 * div(heapIs)))))._replace(p2 \rightarrow ((-35 * div(heapIs)))))
heap_{funcstart\_724,1}, p_{funcstart\_724,1}, p_{funcstart\_724,1}, p_{funcstart\_724,1}, p_{funcstart\_724,1}
heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p2, 176).rem)))._replace(p3 \rightarrow (-63 *
div(\mathbf{heapIs} \ \$heap_{funcstart\_724.1}, \ \$heap_{funcstart\_724.1}.p3, \ 178).quot) + (170 \ *
div(\mathbf{heapIs} \ \$heap_{funcstart\_724,1}, \ \$heap_{funcstart\_724,1}.p3, \ 178).rem))]
[1.4] \; ((-63 \; * \; \mathrm{div}(\mathbf{heapIs} \; \$ \mathrm{heap}_{funcstart\_724,1}, \; \$ \mathrm{heap}_{funcstart\_724,1}.\mathrm{p3}, \;
178).quot) + (170 * div(heapIs \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}.p3,
178).rem)) < asType<integer>(p1 \rightarrow ((-2 * place))
div(\mathbf{heapIs} \ \$heap_{funcstart\_724,1}, \ \$heap_{funcstart\_724,1}.p1, \ 177).quot) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow ((-35 * div(heapIs $heap_{funcstart_724,1},
\text{Sheap}_{funcstart\_724,1.p2}, 176).\text{quot} + (172 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1}.\text{p2}, 176).\text{rem}))._replace(p3 \rightarrow ((-63 * div(heapIs)
heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p3, 178).quot) + (170 * div(heapIs)
heap_{funcstart_{724,1}}, heap_{funcstart_{724,1}}, 3, 178).rem))).M3)
→ [const member of object with modified fields]
[1.7] ((-63 * div(heap
Is \rho_{funcstart\_724,1}, \rho_
178).quot) + (170 * div(heapIs \theta_{funcstart_{-724,1}}, \theta_{funcstart_{-724,1}}, \theta_{funcstart_{-724,1}}.p3,
178).\text{rem})) < \mathbf{asType} < \mathbf{integer} > (\$ \text{heap}_{funcstart\_724,1}.\text{M3})
\rightarrow [const static or extern object]
\label{eq:constart_724,1} \textbf{[1.8] ((-63*div(\textbf{heapIs}\ \$heap_{funcstart\_724,1},\ \$heap_{funcstart\_724,1}.p3,}
178).quot) + (170 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_724,1}, \text{\$heap}_{funcstart\_724,1}.p3,
(178).rem) < asType < integer > (\$heap_{init}.M3)
```

```
\rightarrow [expand definition of constant 'M3' at prang.c (24,20)]
[1.9] ((-63 * div(heapIs heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p3,
178).quot) + (170 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_724,1}, \text{\$heap}_{funcstart\_724,1}.p3,
178).rem)) < asType<integer>(asType<short int>((int)30323))
\rightarrow [simplify]
[1.19] -30323 < ((-170 * div(heap
Is $heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1}.\text{p3}, 178).\text{rem} + (63 * \text{div}(\text{heapIs} \text{Sheap}_{funcstart\_724,1},
heap_{funcstart_{-724,1}}.p3, 178).quot)
→ [negate goal and search for contradiction]
[1.20]!(-30323 < ((-170 * div(heapIs $heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1}.\text{p3}, 178).\text{rem} + (63 * \text{div}(\text{heapIs} \text{Sheap}_{funcstart\_724,1},
heap_{funcstart_{-724,1}.p3, 178, quot)}
\rightarrow [simplify]
[1.25] 30322 < ((170 * div(heapIs $heap_{funcstart\_724,1}, $heap_{funcstart\_724,1}.p3,
178).rem) + (-63 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_724,1}, \text{\$heap}_{funcstart\_724,1}.p3,
178).quot))
[Branch on disjunction or conditional in term 52.5]
\label{eq:continuous_formula} \textit{[66.0] !} (0 == \operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.\operatorname{p3},
178).quot) \vee!(0 == div(heapIs $heap_{funcstart\_724,1}, $heap_{funcstart\_724,1}.p3,
178).rem) \vee (0 == div(heapIs $heap<sub>funcstart_724,1</sub>, $heap<sub>funcstart_724,1</sub>.p3,
178).quot)
[Copy term 1.25]
\label{eq:condition} \textit{[69.0] } 30322 < ((-63 * div(\textbf{heapIs} \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p3,
178).quot) + (170 * div(heapIs heapIs = f_{uncstart_{724,1}}, heap_{funcstart_{724,1}}, g_{uncstart_{724,1}}
178).rem))
\rightarrow [from term 43.17, div(heapIs $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}.p3,
178).rem is equal to heap_{funcstart_{-724.1}}.p3 % 178
\textit{[69.1] } 30322 < ((-63 * \text{div}(\textbf{heapIs} \$ \text{heap}_{funcstart\_724,1}, \$ \text{heap}_{funcstart\_724,1}.\text{p3},
178).quot) + (170 * (\$heap_{funcstart\_724,1}.p3 \% 178)))
[Copy term 66.0]
 [99.0] \ !(0 == \operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.p3, 
178).quot) \vee!(0 == div(heapIs $heap_{funcstart\_724,1}, $heap_{funcstart\_724,1}.p3,
178).rem) \vee (0 == div(heapIs $heap_{funcstart\_724,1}, $heap_{funcstart\_724,1}.p3,
178).quot)
\rightarrow [from\ term\ 42.17,\ div(\textbf{heapIs}\ \$heap_{funcstart\_724,1},\ \$heap_{funcstart\_724,1}.p3,
178).quot is equal to heap_{funcstart\_724,1}.p3 / 178
[99.1]!(0 == (\text{$heap}_{funcstart\_724,1}.p3 / 178)) \lor ...
[Create new term from term 42.17 using rule: condition for equality of division]
```

```
[100.0] ((178 * (0 + -(-\text{div}(\mathbf{heapIs} \$heap_{funcstart\_724,1},
\text{Sheap}_{funcstart_{724,1}.p3}, 178).\text{quot}))) < (1 + \text{Sheap}_{funcstart_{724,1}.p3})) \land
(heap_{funcstart\_724,1}.p3 < (178 * (0 + 1 + -(-div(heapIs)))
heap_{funcstart_{724,1}}, heap_{funcstart_{724,1}}, 178).quot))))
\rightarrow [simplify]
\label{eq:continuous} \mbox{[100.15] (-1 < ((-178 * div(\mathbf{heapIs} \ \$heap_{funcstart\_724,1}, \ \$heap_{funcstart\_724,1}.p3, \ })}
178).quot) + \text{$heap}_{funcstart\_724,1.p3}) \land (-178 < (-\text{$heap}_{funcstart\_724,1.p3} +
(178 * div(\mathbf{heapIs} \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p3, 178).quot)))
\rightarrow [separate conjunction and work on first sub-term]
[100.16] -178 < (-\text{\$heap}_{funcstart\_724,1}.\text{p3} + (178 * \text{div}(\text{heapIs}))
heap_{funcstart_{-724,1}}, heap_{funcstart_{-724,1}}, 3, 178
[Create new term from term 99.1 using rule: condition for inequality of
division]
[102.0] (!((0 * 178) < (1 + $heap_{funcstart_724.1}.p3)) \vee !($heap_{funcstart_724.1}.p3)
< (178 * (0 + 1))) \lor !(0 == div(heapIs \$heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1}.\text{p3}, 178).\text{rem}) \lor (0 == \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
heap_{funcstart_{-724,1}}.p3, 178).quot
\rightarrow [simplify]
[102.3] (!(-1 < \text{heap}_{funcstart\_724,1}.p3) \vee !(\text{heap}_{funcstart\_724,1}.p3 < (178 * (0)
+ 1)))) \vee ...
\rightarrow [from term 10.0, literala < $heap<sub>funcstart_724,1</sub>.p3 is true whenever (-1 +
literala) < 0
    Proof of rule precondition:
    [102.3.0](-1+-1)<0
    \rightarrow [simplify]
    [102.3.2] true
[102.4] (!true \vee !($heap_funcstart_724,1.p3 < (178 * (0 + 1)))) \vee ...
\rightarrow [simplify]
[102.14] (177 < $\text{heap}_{funcstart_724,1.p3}) \lor \dots
[Create new term from terms 102.14, 100.16 using rule: transitivity 3]
[103.0] ((-178 + 1 + 177) < (178 * div(heapIs $heap_{funcstart_724.1},
\text{Sheap}_{funcstart\_724,1}.\text{p3}, 178).\text{quot})) \lor !(0 == \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1}.\text{p3}, 178).\text{rem} \lor (0 == \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
heap_{funcstart_{-724,1}}.p3, 178).quot
\rightarrow [simplify]
[103.1] (0 < (178 * div(heapIs p_{funcstart_{-724,1}}, p_{funcstart_{-724,1}}, p_{funcstart_{-724,1}})
178).quot)) ∨ ...
```

```
\rightarrow [product is positive]
[103.2] (((0 < 178) \wedge (0 < div(heapIs $heap<sub>funcstart_724,1</sub>,
\text{Sheap}_{funcstart\_724,1.p3}, 178).\text{quot})) \lor ((178 < 0) \land (\text{div}(\textbf{heapIs})))
\theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}. p3, 178).quot < 0))) \vee \dots
\rightarrow [simplify]
[103.7] (0 < div(heapIs $heap_{funcstart_{-724,1}}, $heap_{funcstart_{-724,1}}.p3,
178).quot) \vee \dots
[Create new term from terms 103.7, 69.1 using rule: transitivity 11]
 [106.0] \; ((1+30322+(0*63)) < (170*(\$heap_{funcstart\_724,1}.p3\%178))) \; \lor \; (170*(\$heap_{funcstart\_724,1}.p3\%178)) \; (170*(\$heap_{funcstart\_724,1}.p3\%178)) \; \lor \; (170*(\$heap_{funcstart\_724,1}.p3\%178)) \; (170*(\$heap_{funcstart\_724,1}.p3\%178)) \; (170*(\$heap_{funcstart\_724,1}.p3\%178)) \; (170*(\$heap_{funcstart\_724,1}.p3\%17
!(0 == \operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.\operatorname{p3}, \ 178).\operatorname{rem}) \lor (0
== \operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.\operatorname{p3}, \ 178).\operatorname{quot})
\rightarrow [simplify]
[106.2] (30323 < (170 * ($heap_{funcstart\_724,1}.p3 % 178))) \vee ...
\rightarrow [literal comparison of product]
[106.3] ([170 < 0]: (30323 / -170) < -($heap_{funcstart\_724,1}.p3 % 178), [0 <
170]: (30323 / 170) < (\text{\$heap}_{funcstart\_724,1}.\text{p3} \% 178), [0 == 170]: 30323 < 0)
→ [explicitly assert falsehood of skipped guards in subsequent guards]
[106.4] \; ([170<0] \colon (30323 \; / \; \text{-}170) < -(\$ \text{heap}_{funcstart\_724,1}.\text{p3} \; \% \; 178), \; [(0<0.0) \; / \; ]
170) \land!(170 < 0)]: (30323 / 170) < ($heap_{funcstart\_724,1}.p3 % 178), [(0 ==
170) \land !(0 < 170) \land !(170 < 0)]: 30323 < 0) \lor ...
\rightarrow [simplify]
[106.13] false \vee ...
[Remove 'false' term 106.13 and fetch new term from containing clause]
[109.0] 0 == \text{div}(\mathbf{heapIs} \text{ \$heap}_{funcstart\_724,1}, \text{ \$heap}_{funcstart\_724,1}.p3, 178).quot
[Copy term 1.25]
\label{eq:continuous} \textit{[69.1] } 30322 < ((-63 * div(\textbf{heapIs} \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p3,
178).quot) + (170 * ($heap_{funcstart\_724,1}.p3 % 178)))
\rightarrow [from\ term\ 109.0,\ div(\textbf{heapIs}\ \$heap_{funcstart\_724,1},\ \$heap_{funcstart\_724,1}.p3,
178).quot is equal to 0]
[69.2] 30322 < ((-63 * 0) + (170 * (\$heap_{funcstart\_724,1}.p3 \% 178)))
\rightarrow [simplify]
[69.4] 30322 < (170 * ($heap_{funcstart\_724,1}.p3 % 178))
\rightarrow [literal comparison of product]
[69.5] ([170 < 0]: (30322 / -170) < -($heap_funcstart_724.1.p3 % 178), [0 < 170]:
(30322 / 170) < (\text{$heap}_{funcstart\_724,1}.\text{p3} \% 178), [0 == 170]: 30322 < 0)
```

```
→ [explicitly assert falsehood of skipped guards in subsequent guards]
[69.6] \; ([170 < 0]: \; (30322 \; / \; \text{-}170) < - (\$ \text{heap}_{funcstart\_724,1}.\text{p3} \; \% \; 178), \; [(0 < 10.5 \; \text{m})] \; (1.5 \; \text{m}) 
170) \land!(170 < 0)]: (30322 / 170) < ($heap_{funcstart\_724,1}.p3 % 178), [(0 ==
170) \land !(0 < 170) \land !(170 < 0)]: 30322 < 0)
\rightarrow [simplify]
[69.15] false
Proof of verification condition: Assertion valid
Condition generated at: C:\Escher\Customers\prang\prang.c (61,12)
To prove: -asType<integer const>($heap<sub>724 1.744 8.</sub>M3) <
asType<integer>($heap<sub>724.1:744.8</sub>.p3)
Given:
heap_{init}.LIMIT == (int)80
\theta sheap<sub>init</sub>.M1 == asType<short int>((int)30269)
\theta_{init}.r1 == asType < short int > ((int)171)
\theta
\theta
heap_{init}.M2 == asType < short int > ((int)30307)
\theta_{init}.r2 == asType < short int > ((int)172)
heap_{init}.a2 == asType < short int > ((int)176)
\theta = asType < short int > ((int)35)
heap_{init}.M3 == asType < short int > ((int)30323)
heap_{init}.r3 == asType < short int > ((int)170)
heap_{init}.a3 == asType<short int>((int)178)
\theta = asType < short int > ((int)63)
\theta
\theta
\theta = asType < short int > ((int)3)
invariant1(heapIs $heap_{tuncstart_{724.1}})
\operatorname{div1} == \operatorname{div}(\mathbf{heapIs} \ \operatorname{\$heap}_{funcstart\_724,1},
asType < int > (\$heap_{funcstart\_724,1}.p1),
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{a1}))
(\mathbf{asType}{<}\mathbf{integer}{>}(\mathbf{asType}{<}\mathbf{int}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{p1})) \ / \\
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a1))) = =
asType<integer>(div1.quot)
```

```
(asType < int > (asType < int > (\$heap_{funcstart\_724,1}.p1)) \%
\mathbf{asType} < \mathbf{integer} > (\mathbf{asType} < \mathbf{int} > (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{a1}))) = =
asType<integer>(div1.rem)
!(0 == asType < integer > (div1.rem)) || !(0 ==
asType<integer>(div1.quot))
div2 == div(\mathbf{heapIs} \$ heap_{funcstart\_724,1},
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p2}),
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{a2}))
(\mathbf{asType} < \mathbf{integer} > (\mathbf{asType} < \mathbf{int} > (\$ \mathbf{heap}_{funcstart\_724,1} \cdot \mathbf{p2})) \ / \ 
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a2))) = =
asType<integer>(div2.quot)
(asType < integer > (asType < int > (\$heap_{funcstart\_724.1}.p2)) \%
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a2))) = =
asType<integer>(div2.rem)
!(0 == asType < integer > (div2.rem)) || !(0 ==
asType<integer>(div2.quot))
div3 == div(\mathbf{heapIs} \$ heap_{funcstart\_724,1},
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p3}),
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{a3}))
(\mathbf{asType}{<}\mathbf{integer}{>}(\mathbf{asType}{<}\mathbf{int}{>}(\$\mathbf{heap}_{funcstart\_724,1}.\mathbf{p3})) \ / \\
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a3))) = =
asType<integer>(div3.quot)
(asType<integer>(asType<int>($heap_{tuncstart}, 724.1.p3)) %
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a3))) = =
asType<integer>(div3.rem)
!(0 == asType < integer > (div3.rem)) || !(0 ==
asType<integer>(div3.quot))
heap_{724,1:740.8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow asType<short
int>((asType<int>(asType<short int>(div1.rem)) *
asType < int > (\$heap_{funcstart\_724,1}.r1)) - (asType < int > (asType < short)
int>(div1.quot)) * asType< int>($heap_{funcstart\_724,1}.b1))))
-asType<integer const>($heap<sub>724.1:740.8</sub>.M1) <
asType<integer>($heap<sub>724.1:740.8</sub>.p1)
!(0 == asType < integer > (\$heap_{724,1:740.8}, p1))
asType<integer>($heap<sub>724,1;740,8</sub>.p1) <
asType<integer>($heap<sub>724,1;740,8</sub>.M1)
\$ heap_{724,1;742,8} == \$ heap_{724,1;740,8}. \textbf{\_replace} (p2 \rightarrow \textbf{asType} < \textbf{short}
int>((asType<int>(asType<short int>(div2.rem)) *
asType < int > (\$heap_{724.1:740.8}.r2)) - (asType < int > (asType < short)
int>(div2.quot)) * asType< int>($heap_{724.1:740.8}.b2))))
```

```
-asType < integer const > (\$heap_{724.1:742.8}.M2) < 
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathrm{heap}_{724,1;742,8}.\mathrm{p2})
!(0 == asType < integer > (\$heap_{724,1;742,8}.p2))
asType<integer>($heap<sub>724,1;742,8</sub>.p2) <
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathrm{heap}_{724,1;742,8}.\mathrm{M2})
heap_{724,1:744,8} == heap_{724,1:742,8}.replace(p3 \rightarrow asType<short
int>((asType<int>(asType<short int>(div3.rem)) *
asType < int > (\$heap_{724,1:742,8}.r3)) - (asType < int > (asType < short)
int>(div3.quot)) * asType<int>($heap<sub>724,1:742,8</sub>.b3))))
Proof:
[Take given term]
[5.0] invariant1(heapIs $heap_{tuncstart_724.1})
\rightarrow [expand definition of function 'invariant1' at prang.c (34,1)]
 \texttt{[5.1]} \left( \left( \left( \left( \left( 0 < \mathbf{asType} < \mathbf{integer} > \left( \$ \mathsf{heap}_{funcstart\_724,1}.\mathsf{p1} \right) \right) \right. \&\& \right. \right. 
(asType < integer > (\$heap_{funcstart\_724,1}.p1) <
as
Type<integer>(\rho_{funcstart\_724,1}.M1))) & (0 <
asType < integer > (\$heap_{funcstart\_724,1}.p2))) \&\&
(\mathbf{asType} {<} \mathbf{integer} {>} (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p2}) <
asType < integer > (\$heap_{funcstart\_724,1}.M2))) \&\& (0 <
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p3})))\ \&\&
(\mathbf{asType} {<} \mathbf{integer} {>} (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p3}) <
asType < integer > (\$heap_{funcstart_{-724.1}}.M3))
\rightarrow [simplify]
[5.3] (((((0 < $heap_{funcstart_724,1}.p1) && ($heap_{funcstart_724,1}.p1 < footnote{in the content of the c
asType < integer > (\$heap_{funcstart\_724,1}.M1))) \&\& (0 <
asType < integer > (\$heap_{funcstart\_724,1}.p2))) \&\&
(\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{p2}) <
asType < integer > (\$heap_{funcstart\_724,1}.M2))) \&\& (0 <
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p3})))\ \&\&
(asType < integer > (\$heap_{funcstart\_724,1}.p3) < 
asType < integer > (\$heap_{funcstart\_724,1}.M3))
\rightarrow [const static or extern object]
[5.4] \ (((((0 < \text{\$heap}_{funcstart\_724,1}.\text{p1}) \&\& \ (\text{\$heap}_{funcstart\_724,1}.\text{p1} <
asType<integer>($heap<sub>init</sub>.M1))) && (0 <
asType < integer > ($heap_{funcstart\_724,1}.p2))) &&
(\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{p2}) <
asType<integer>(heap_{funcstart\_724,1}.M2))) && (0 <
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p3})))\ \&\&
(\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{p3}) <
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{M3}))
```

```
\rightarrow [expand definition of constant 'M1' at prang.c (14,20)]
[5.5] (((((0 < $heap_{funcstart_724,1}.p1) && ($heap_{funcstart_724,1}.p1 < 
asType<integer>(asType<short int>((int)30269)))) && (0 <
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p2})))\ \&\&
(asType < integer > (\$heap_{funcstart\_724,1}.p2) < 
asType<integer>($heap_{funcstart\_724,1}.M2))) && (0 <
asType < integer > (\$heap_{funcstart\_724,1}.p3))) \&\&
(\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{p3}) <
asType < integer > (\$heap_{funcstart\_724.1}.M3))
\rightarrow [simplify]
[5.16] \left( \left( \left( \left( -30269 < -\$ \text{heap}_{funcstart\_724,1}.\text{p1} \right) \right. \wedge \left. \left( 0 < \$ \text{heap}_{funcstart\_724,1}.\text{p1} \right) \right. \wedge \right. \right)
(0 < \text{\$heap}_{funcstart\_724,1}.p2)) \&\& (\text{\$heap}_{funcstart\_724,1}.p2 <
asType<integer>(heap_{funcstart\_724,1}.M2))) && (0 <
asType < integer > (\$heap_{funcstart\_724,1}.p3))) \&\&
(asType<integer>($heap_{tuncstart\_724.1}.p3) <
asType < integer > (\$heap_{funcstart\_724,1}.M3))
\rightarrow [const static or extern object]
[5.17] \left( \left( \left( \left( -30269 < -\$ \text{heap}_{funcstart\_724,1}.\text{p1} \right) \right. \wedge \left. \left( 0 < \$ \text{heap}_{funcstart\_724,1}.\text{p1} \right) \right. \wedge \right. \right)
(0 < \text{\$heap}_{funcstart\_724,1}.p2)) \&\& (\text{\$heap}_{funcstart\_724,1}.p2 <
asType < integer > (\$heap_{init}.M2))) \&\& (0 <
asType < integer > (\$heap_{funcstart\_724,1}.p3))) \&\&
(\mathbf{asType} < \mathbf{integer} > (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p3}) <
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{M3}))
\rightarrow [expand definition of constant 'M2' at prang.c (19,20)]
[5.18] ((((-30269 < -\$heap_{funcstart\_724,1}.p1) \land (0 < \$heap_{funcstart\_724,1}.p1) 
(0 < \mathrm{\$heap}_{funcstart\_724,1}.\mathrm{p2})) && (\mathrm{\$heap}_{funcstart\_724,1}.\mathrm{p2} <
asType<integer>(asType<short int>((int)30307)))) && (0 <
asType < integer > (\$heap_{funcstart\_724,1}.p3))) \&\&
(asType < integer > (\$heap_{funcstart\_724.1}.p3) < 
asType < integer > (\$heap_{funcstart\_724,1}.M3))
\rightarrow [simplify]
[5.30] ((-30307 < -$heap_{funcstart\_724,1}.p2) \land (-30269 <
-\$heap_{funcstart\_724,1}.p1) \land (0 < \$heap_{funcstart\_724,1}.p1) \land (0 < \$heap_{funcstart\_724,1}.p1)
\text{Sheap}_{funcstart_{-724,1}.p2} \land (0 < \text{Sheap}_{funcstart_{-724,1}.p3})) \&\&
(\text{\$heap}_{funcstart\_724,1}.p3 < asType < integer > (\text{\$heap}_{funcstart\_724,1}.M3))
\rightarrow [const static or extern object]
[5.31] ((-30307 < -$heap<sub>funcstart_724,1.</sub>p2) \land (-30269 <
-\$heap_{funcstart\_724,1}.p1) \land (0 < \$heap_{funcstart\_724,1}.p1) \land (0 < \$heap_{funcstart\_724,1}.p1)
\text{Sheap}_{funcstart\_724,1.p2}) \land (0 < \text{Sheap}_{funcstart\_724,1.p3})) \&\&
(\text{\$heap}_{funcstart\_724.1}.\text{p3} < \text{asType} < \text{integer} > (\text{\$heap}_{init}.\text{M3}))
\rightarrow [expand definition of constant 'M3' at prang.c (24,20)]
```

```
[5.32] ((-30307 < -$heap_funcstart_724,1.p2) \land (-30269 <
-\$heap_{funcstart\_724,1}.p1) \land (0 < \$heap_{funcstart\_724,1}.p1) \land (0 < \$heap_{funcstart\_724,1}.p1)
\text{Sheap}_{funcstart\_724,1}.p2) \land (0 < \text{Sheap}_{funcstart\_724,1}.p3)) \&\&
(\text{sheap}_{funcstart\_724,1}.p3 < asType < integer > (asType < short)
int > ((int)30323)))
\rightarrow [simplify]
[5.40] (-30323 < -$heap<sub>funcstart_724,1.</sub>p3) \land (-30307 <
-\$heap_{funcstart\_724,1}.p2) \wedge (-30269 < -\$heap_{funcstart\_724,1}.p1) \wedge (0 <
\text{Sheap}_{funcstart_{-724,1}.p1} \land (0 < \text{Sheap}_{funcstart_{-724,1}.p2}) \land (0 <
heap_{funcstart_{724,1}.p3}
\rightarrow [separate conjunction and work on first sub-term]
[5.41] -30323 < -\$heap_{funcstart\_724,1}.p3
[Work on sub-term 6 of conjunction in term 5.40]
[10.0] 0 < $\text{heap}_{funcstart_724,1}.p3
[Take given term]
[11.0] \operatorname{div1} == \operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724,1},
asType < int > (\$heap_{funcstart\_724,1}.p1),
asType < int > (\$heap_{funcstart\_724,1}.a1))
\rightarrow [simplify]
[11.1] \operatorname{div1} == \operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724,1}, \$ \operatorname{heap}_{funcstart\_724,1}.p1,
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{a1}))
\rightarrow [const static or extern object]
[11.2] \ \mathrm{div1} == \mathrm{div}(\mathbf{heapIs} \ \$ \mathrm{heap}_{funcstart\_724,1}, \ \$ \mathrm{heap}_{funcstart\_724,1}.\mathrm{p1},
asType < int > (\$heap_{init}.a1))
\rightarrow [expand definition of constant 'a1' at prang.c (16,20)]
[11.3] \ \mathrm{div1} == \mathrm{div}(\mathbf{heapIs} \ \$ \mathrm{heap}_{funcstart\_724,1}, \ \$ \mathrm{heap}_{funcstart\_724,1}.\mathrm{p1},
asType<int>(asType<short int>((int)177)))
\rightarrow [simplify]
[11.6] \text{ div1} == \text{div}(\mathbf{heapIs} \$ heap_{funcstart\_724,1}, \$ heap_{funcstart\_724,1}.p1, 177)
[Take given term]
[25.0] \operatorname{div2} == \operatorname{div}(\mathbf{heapIs} \ \operatorname{\$heap}_{funcstart\_724,1},
asType < int > (\$heap_{funcstart\_724,1}.p2),
asType < int > (\$heap_{funcstart\_724,1}.a2))
\rightarrow [simplify]
[25.1] div2 == div(heapIs \theta_{funcstart_{-724,1}}, \theta_{funcstart_{-724,1}}.p2,
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{a2}))
\rightarrow [const static or extern object]
```

```
[25.2] \ \mathrm{div2} == \ \mathrm{div}(\mathbf{heapIs} \ \$ \mathrm{heap}_{funcstart\_724,1}, \ \$ \mathrm{heap}_{funcstart\_724,1}.\mathrm{p2},
asType < int > (\$heap_{init}.a2))
\rightarrow [expand definition of constant 'a2' at prang.c (21,20)]
[25.3]~{\rm div2} == {\rm div}(\mathbf{heapIs}~\$ \mathrm{heap}_{funcstart\_724,1},\,\$ \mathrm{heap}_{funcstart\_724,1}.\mathrm{p2},
asType < int > (asType < short int > ((int)176)))
\rightarrow [simplify]
[25.6] div2 == div(heapIs $heap_{funcstart\_724,1}, $heap_{funcstart\_724,1}.p2, 176)
[Take given term]
[39.0] div3 == div(heapIs $heap_{funcstart\_724,1},
asType < int > (\$heap_{funcstart\_724.1}.p3),
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{a3}))
\rightarrow [simplify]
[39.1] div3 == div(heapIs \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}.p3,
asType < int > (\$heap_{funcstart\_724,1}.a3))
\rightarrow [const static or extern object]
[39.2] div3 == div(heapIs $heap_{funcstart\_724.1}, $heap_{funcstart\_724.1}.p3,
asType < int > (\$heap_{init}.a3))
\rightarrow [expand definition of constant 'a3' at prang.c (26,20)]
[39.3] div3 == div(heapIs \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}.p3,
asType<int>(asType<short int>((int)178)))
\rightarrow [simplify]
[39.6]~{\rm div3} == {\rm div}(\mathbf{heapIs}~\$ \mathrm{heap}_{funcstart\_724,1},~\$ \mathrm{heap}_{funcstart\_724,1}.\mathrm{p3},~178)
[Assume known post-assertion, class invariant or type constraint for term 39.6]
[42.0] (asType<integer>(heap_{funcstart\_724,1}.p3) /
asType<integer>(178)) == asType<integer>(div(heapIs
\$heap_{funcstart\_724,1},\,\$heap_{funcstart\_724,1}.p3,\,178).quot)
\rightarrow [simplify]
[42.2] (heap_{funcstart\_724,1}.p3 / 178) == asType<integer>(div(heapIs
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.p3, 178).quot
→ [expand definition of operator './' in class 'int' at built in declaration]
[42.3] ([asType<integer>(sheap_{funcstart\_724,1.p3}) < 0]:
-(-asType < integer > (\$heap_{funcstart\_724,1}.p3) / 178), []:
asType < integer > (\$heap_{funcstart\_724.1}.p3) / 178) = =
\mathbf{asType} {<} \mathbf{integer} {>} ( \mathrm{div}(\mathbf{heapIs} \ \$ \mathrm{heap}_{funcstart\_724,1}, \ \$ \mathrm{heap}_{funcstart\_724,1}.\mathrm{p3}, \\
178).quot)
→ [explicitly assert falsehood of skipped guards in subsequent guards]
```

```
[42.4] ([asType<integer>(sheap_{funcstart\_724,1}.p3) < 0]:
-(-asType < integer > (\$heap_{funcstart\_724,1}.p3) / 178),
[!(\mathbf{asType} < \mathbf{integer} > (\$ heap_{funcstart\_724,1}.p3) < 0)]:
asType < integer > (\$heap_{funcstart\_724,1}.p3) / 178) = =
asType<integer>(div(heapIs p_{funcstart\_724,1}, p_{funcstart\_724,1}, p_{funcstart\_724,1}),
178).quot)
\rightarrow [simplify]
[42.7] ([0 < -$heap<sub>funcstart_724,1.</sub>p3]:
-(-asType < integer > (\$heap_{funcstart\_724,1}.p3) / 178),
[!(asType < integer > (\$heap_{funcstart\_724,1}.p3) < 0)]:
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p3})~/~178) ==
asType<integer>(div(heapIs p_{funcstart\_724,1}, p_{funcstart\_724,1}, p_{funcstart\_724,1}),
178).quot)
\rightarrow [from term 10.0, literala < -$heap<sub>funcstart_724.1</sub>.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] \; ([\mathbf{false}]: \; -(-\mathbf{asType} < \mathbf{integer} > (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p3}) \; / \; 178),
[!(\mathbf{asType} < \mathbf{integer} > (\$ heap_{funcstart\_724,1}.p3) < 0)]:
asType < integer > (\$heap_{funcstart\_724.1}.p3) / 178) = =
asType<integer>(div(heapIs $heap_funcstart_724,1, $heap_funcstart_724,1.p3,
178).quot)
\rightarrow [simplify]
[42.11] ([false]: -(-asType < integer > (\$heap_{funcstart\_724,1}.p3) / 178), [!(0 < integer > (\$heap_{funcstart\_724,1}.p3) / 178)]
-\$heap_{funcstart\_724,1}.p3)]: asType<integer>(\$heap_{funcstart\_724,1}.p3) / 178)
== asType < integer > (div(heapIs $heap_{funcstart\_724,1},
heap_{funcstart_{-724,1}}.p3, 178).quot
\rightarrow [from term 10.0, literala < -$heap<sub>funcstart_724,1</sub>.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] \; ([{\bf false}]: \; -({\bf -asType} < {\bf integer} > (\$ {\bf heap}_{funcstart\_724,1}.{\bf p3}) \; / \; 178),
[!false]: asType<integer>($heap<sub>funcstart_724,1.</sub>p3) / 178) ==
\mathbf{asType} < \mathbf{integer} > (\mathbf{div}(\mathbf{heapIs} \ \$ \mathbf{heap}_{funcstart\_724,1}, \ \$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p3}, \\
178).quot)
```

```
\rightarrow [simplify]
[42.17] \ 0 == (-\text{div}(\mathbf{heapIs} \ \$ \text{heap}_{funcstart\_724,1}, \ \$ \text{heap}_{funcstart\_724,1}.\text{p3},
178).quot + (\text{$heap}_{funcstart\_724,1}.p3 / 178))
[Assume known post-assertion, class invariant or type constraint for term 39.6]
[43.0] (as
Type<integer>($heap_{funcstart\_724,1}.p3) \%
asType<integer>(178)) == asType<integer>(div(heapIs
\$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p3, 178).rem)
\rightarrow [simplify]
[43.2] ($heap<sub>funcstart_724,1.</sub>p3 % 178) == asType<integer>(div(heapIs)
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.\text{p3}, 178).\text{rem}
→ [expand definition of operator '.%' in class 'int' at built in declaration]
[43.3] ([asType<integer>(sheap_{funcstart\_724,1.p3}) < 0]:
-(-asType < integer > (\$heap_{funcstart\_724,1}.p3) \% 178), []:
asType < integer > (\$heap_{funcstart\_724,1}.p3) \% 178) ==
asType<integer>(div(heapIs $heap_{tuncstart\_724.1}, $heap_{tuncstart\_724.1}.p3,
178).rem)
→ [explicitly assert falsehood of skipped guards in subsequent guards]
[43.4] \; ([\mathbf{asType} < \mathbf{integer} > (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p3}) < 0] :
-(-asType < integer > (\$heap_{funcstart\_724,1}.p3) \% 178),
[!(asType < integer > (\$heap_{funcstart\_724,1}.p3) < 0)]:
asType < integer > (\$heap_{funcstart\_724,1}.p3) \% 178) ==
\mathbf{asType} {<} \mathbf{integer} {>} ( \mathrm{div}(\mathbf{heapIs} \ \$ \mathrm{heap}_{funcstart\_724,1}, \ \$ \mathrm{heap}_{funcstart\_724,1}.\mathrm{p3}, \\
178).rem)
\rightarrow [simplify]
[43.7] ([0 < -$heap<sub>funcstart_724,1</sub>.p3]:
-(-asType < integer > (\$heap_{funcstart\_724,1}.p3) \% 178),
[!(asType < integer > (\$heap_{funcstart\_724,1}.p3) < 0)]:
asType < integer > (\$heap_{funcstart\_724,1}.p3) \% 178) ==
asType<integer>(div(heapIs $heap_{tuncstart\_724.1}, $heap_{tuncstart\_724.1}.p3,
178).rem)
\rightarrow [from term 10.0, literala < -$heap<sub>funcstart_724,1.</sub>p3 is false whenever -2 <
(0 + literala)
   Proof of rule precondition:
   [43.7.0] - 2 < (0 + 0)
   \rightarrow [simplify]
   [43.7.2] true
[43.8] ([false]: -(-asType < integer > (\$heap_{funcstart\_724,1}.p3) \% 178),
[!(asType < integer > (\$heap_{funcstart\_724,1}.p3) < 0)]:
```

```
asType < integer > (\$heap_{funcstart-724,1}.p3) \% 178) ==
\mathbf{asType} < \mathbf{integer} > (\mathrm{div}(\mathbf{heapIs} \ \$ \mathrm{heap}_{funcstart\_724,1}, \ \$ \mathrm{heap}_{funcstart\_724,1}.\mathrm{p3},
178).rem)
\rightarrow [simplify]
[43.11] ([false]: -(-asType < integer > (\$heap_{funcstart\_724,1}.p3) \% 178), [!(0)]
<-$heap<sub>funcstart_724.1</sub>.p3)]: asType<integer>($heap<sub>funcstart_724,1</sub>.p3) %
178) == asType<integer>(div(heapIs heap_{funcstart\_724,1},
heap_{funcstart_{-724,1}.p3, 178}.rem
\rightarrow [from term 10.0, literala < -$heap<sub>funcstart_724,1</sub>.p3 is false whenever -2 <
(0 + literala)
               Proof of rule precondition:
               [43.11.0] - 2 < (0 + 0)
               \rightarrow [simplify]
               [43.11.2] true
 [43.12] ([false]: -(-asType < integer > (\$heap_{funcstart_724.1}.p3) \% 178),
[!false]: asType<integer>(sheap_{funcstart\_724,1.p3}) \% 178 ==
asType<integer>(div(heapIs heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p3,
178).rem)
\rightarrow [simplify]
[43.17] 0 == (-\operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724,1}, \$ \operatorname{heap}_{funcstart\_724,1}.\operatorname{p3},
178).rem + (\text{$heap}_{funcstart\_724,1}.p3 \% 178))
[Take given term]
[53.0] \rho_{1740,8} == \rho_{1740,8} == \rho_{1740,8} == \rho_{1740,8} - \rho_{1740,8} == \rho_{1740,8} == \rho_{1740,8} - \rho_{1740,8} == \rho_{1740,8} 
int>((asType<int>(asType<short int>(div1.rem)) *
\mathbf{asType} \small{<} \mathbf{int} \small{>} (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{r1})) \\ - (\mathbf{asType} \small{<} \mathbf{int} \small{>} (\mathbf{asType} \small{<} \mathbf{short}
int>(div1.quot)) * asType< int>($heap_{tuncstart\_724.1}.b1))))
\rightarrow [from term 11.6, div1 is equal to div(heapIs $heap_{funcstart\_724,1},
heap_{funcstart_{-724,1}}.p1, 177)
[53.1] heap_{724,1;740,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow asType<short
int>((asType<int>(asType<short int>(div(heapIs $heap_{funcstart\_724,1},))
\theta_{funcstart\_724,1.p1, 177}.rem) * asType < int > (\theta_{funcstart\_724,1.p1, 177}.rem) - (\theta_{funcstart\_
(asType<int>(asType<short int>(div1.quot)) *
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{b1}))))
\rightarrow [simplify]
[53.3] \rho_{13,1;740,8} == \rho_{13,1;740,8} == \rho_{13,1;740,8} =- \rho_{
int>((div(heapIs \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1, 177).rem *
asType < int > (\$heap_{tuncstart\_724.1}.r1)) - (asType < int > (asType < short)
int>(div1.quot)) * asType< int>($heap_{tuncstart\_724.1}.b1))))
```

```
\rightarrow [const static or extern object]
[53.4] heap_{724,1:740,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow asType<short
int>((div(heapIs \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1, 177).rem *
asType < int > (\$heap_{init}.r1)) - (asType < int > (asType < short)
\mathbf{int}{>}(\mathbf{div1.quot})) * \mathbf{asType}{<} \mathbf{int}{>} (\$\mathbf{heap}_{funcstart\_724,1}.\mathbf{b1}))))
\rightarrow [expand definition of constant 'r1' at prang.c (15,20)]
[53.5] heap_{724,1:740.8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow asType<short
int>((div(heapIs \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1, 177).rem *
asType < int > (asType < short int > ((int)171))) -
(asType < int > (asType < short int > (div1.quot)) *
asType < int > (\$heap_{funcstart_{-724.1}}.b1)))
\rightarrow [simplify]
[53.8] \rho_{724,1;740,8} == \rho_{funcstart\_724,1}.\_replace(p1 \rightarrow asType < short)
int>((div(heapIs \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1, 177).rem * 171)
- (asType<int>(asType<short int>(div1.quot)) *
asType < int > (\$heap_{funcstart\_724,1}.b1))))
\rightarrow [from term 11.6, div1 is equal to div(heapIs $heap_{funcstart\_724,1},
heap_{funcstart_{-724,1}}.p1, 177)
[53.9] heap_{724,1;740,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow asType<short
\mathbf{int} > ((171 * \operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724,1}, \$ \operatorname{heap}_{funcstart\_724,1}.\operatorname{p1}, 177).\operatorname{rem})
- (asType<int>(asType<short int>(div(heapIs $heap_{funcstart_724.1},
heap_{funcstart_{724,1},p1, 177}, quot)) *
asType < int > (\$heap_{funcstart\_724.1}.b1)))
\rightarrow [simplify]
[53.11] \theta_{13} = \theta_
int > ((171 * div(heapIs \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1, 177).rem)
- (\text{div}(\textbf{heapIs} \$ \text{heap}_{funcstart\_724.1}, \$ \text{heap}_{funcstart\_724.1}. \text{p1}, 177).\text{quot} *
asType < int > (\$heap_{funcstart\_724.1}.b1)))
\rightarrow [const static or extern object]
[53.12] \theta_{12} = \theta_{124,1;740,8} = \theta_{124,1;74
int>((171 * div(heapIs $heap_{funcstart\_724,1}, $heap_{funcstart\_724,1}.p1, 177).rem)
- (\text{div}(\mathbf{heapIs} \$ \text{heap}_{funcstart\_724,1}, \$ \text{heap}_{funcstart\_724,1}.\text{p1}, 177).\text{quot} *
asType < int > (\$heap_{init}.b1)))
\rightarrow [expand definition of constant 'b1' at prang.c (17,20)]
[53.13] heap_{724,1;740,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow asType<short
int>((171 * div(heapIs $heap_{funcstart\_724,1}, $heap_{funcstart\_724,1}.p1, 177).rem)
- (\text{div}(\mathbf{heapIs} \$ \text{heap}_{funcstart\_724,1}, \$ \text{heap}_{funcstart\_724,1}.\text{p1}, 177).\text{quot} *
asType<int>(asType<short int>((int)2))))
\rightarrow [simplify]
```

```
[53.19] $\text{heap}_{724,1;740,8} == \text{$heap}_{funcstart\_724,1}._\text{$replace}(p1 \to ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).rem)))
[Take given term]
[57.0] $\text{heap}_{724,1:742,8} == $\text{heap}_{724,1:740,8}._\text{replace}(p2 \rightarrow \text{asType} < \text{short}
int>((asType<int>(asType<short int>(div2.rem)) *
asType < int > (\$heap_{724,1:740,8}.r2)) - (asType < int > (asType < short)
int>(div2.quot)) * asType< int>($heap_{724,1:740.8}.b2))))
\rightarrow [from term 53.19, $heap<sub>724,1;740,8</sub> is equal to
heap_{funcstart\_724,1}._replace(p1 \rightarrow (-2 * div(heapIs $heap_{funcstart\_724,1},
heap_{funcstart\_724,1}.p1, 177).quot + (171 * div(heapIs $heap_{funcstart\_724,1},
heap_{funcstart_{-724,1}}.p1, 177).rem)
[57.1] heap_{724,1;742,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 *
\operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724,1}, \$ \operatorname{heap}_{funcstart\_724,1}.p1,
(177).rem))._replace(p2 \rightarrow asType < short)
int>((asType<int>(asType<short\ int>(div2.rem))*
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{724,1;740,8}.\mathrm{r2})) - (\mathbf{asType}{<}\mathbf{int}{>}(\mathbf{asType}{<}\mathbf{short}
int>(div2.quot)) * asType< int>($heap_{724.1:740.8}.b2))))
\rightarrow [from term 25.6, div2 is equal to div(heapIs $heap_{funcstart\_724,1},
heap_{funcstart_{-724,1}}.p2, 176
[57.2] heap_{724,1;742,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).quot) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.p1,
(177).rem))._replace(p2 \rightarrow asType<short
int>((asType<int>(asType<short int>(div(heapIs $heap_{funcstart\_724.1},
\text{sheap}_{funcstart\_724,1.p2, 176}.\text{rem}) * asType < int > (\text{sheap}_{724,1;740,8.r2})) -
(asType<int>(asType<short int>(div2.quot)) *
asType<int>($heap<sub>724.1:740.8</sub>.b2))))
\rightarrow [simplify]
[57.4] $heap<sub>724,1:742,8</sub> == $heap<sub>funcstart_724,1</sub>._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).quot) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow asType<short int>((div(heapIs
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.p2, 176).rem *
\mathbf{asType} \small{<} \mathbf{int} \small{>} (\$ \mathrm{heap}_{724,1;740,8}.\mathrm{r2})) \\ - (\mathbf{asType} \small{<} \mathbf{int} \small{>} (\mathbf{asType} \small{<} \mathbf{short}
int>(div2.quot)) * asType<int>($heap<sub>724.1:740.8</sub>.b2))))
\rightarrow [from term 53.19, $heap<sub>724,1:740,8</sub> is equal to
heap_{funcstart\ 724.1}._replace(p1 \rightarrow (-2 * div(heapIs \$heap_{funcstart\ 724.1},
\text{Sheap}_{funcstart\_724,1.p1}, 177).\text{quot} + (171 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
heap_{funcstart_{-724,1}.p1, 177).rem}
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[57.5] heap_{724,1;742,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 \ *
\label{eq:div_heap} \text{div}(\textbf{heapIs} \ \$ \text{heap}_{funcstart\_724,1}, \ \$ \text{heap}_{funcstart\_724,1}.\text{p1},
(177).rem))._replace(p2 \rightarrow asType<short int>((div(heapIs)))._replace(p2 \rightarrow asType
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.\text{p2}, 176).\text{rem} *
asType < int > (\$heap_{funcstart\_724,1}.\_replace(p1 \rightarrow ((-2 * div(heapIs))))))
\theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}
heap_{funcstart_{724,1}}, heap_{funcstart_{724,1},p1, 177}.rem)).r2)) -
(asType<int>(asType<short int>(div2.quot)) *
\mathbf{asType}{<}\mathbf{int}{>}(\${\rm heap}_{724,1;740,8}.{\rm b2}))))
→ [const member of object with modified fields]
[57.6] \rho_{7.6}=0 $heap_{724,1;742,8} == $heap_{funcstart_724,1}._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 *
\operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724,1}, \$ \operatorname{heap}_{funcstart\_724,1}.p1,
177).rem)))._{\mathbf{replace}}(p2 \rightarrow \mathbf{asType} < \mathbf{short\ int} > ((\operatorname{div}(\mathbf{heapIs}))))
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.p2, 176).rem *
asType < int > (\$heap_{funcstart\_724,1}.r2)) - (asType < int > (asType < short)
int>(div2.quot)) * asType< int>($heap_{724.1:740.8}.b2))))
\rightarrow [const static or extern object]
[57.7] heap_{724,1;742,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 \ *
\operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724,1}, \$ \operatorname{heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow asType<short int>((div(heapIs
heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p2, 176).rem *
asType < int > (\$heap_{init}.r2)) - (asType < int > (asType < short)
int>(div2.quot)) * asType<int>($heap<sub>724.1:740.8</sub>.b2))))
\rightarrow [expand definition of constant 'r2' at prang.c (20,20)]
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1,
177).rem)))._{\mathbf{replace}}(p2 \rightarrow \mathbf{asType} < \mathbf{short\ int} > ((\operatorname{div}(\mathbf{heapIs}))))
heap_{funcstart_{-724,1}}, heap_{funcstart_{-724,1}}, 176).rem *
asType<int>(asType<short int>((int)172))) -
(asType<int>(asType<short int>(div2.quot)) *
asType<int>($heap<sub>724.1:740.8</sub>.b2))))
\rightarrow [simplify]
[57.11] $\text{heap}_{724,1;742,8} == \text{$heap}_{funcstart\_724,1}._\text{$replace}(p1 \to ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1,
177).rem)))._{\mathbf{replace}}(p2 \rightarrow \mathbf{asType} < \mathbf{short\ int} > ((\operatorname{div}(\mathbf{heapIs}))))
heap_{funcstart_{-724,1}}, heap_{funcstart_{-724,1}}.p2, 176).rem * 172) -
(asType<int>(asType<short int>(div2.quot)) *
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asType<int>($heap<sub>724.1:740.8</sub>.b2))))
\rightarrow [from term 25.6, div2 is equal to div(heapIs $heap_{funcstart\_724,1},
heap_{funcstart_{-724,1},p2,176}
[57.12] heap_{724,1;742,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).quot) + (171 *
\operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724.1}, \$ \operatorname{heap}_{funcstart\_724.1}.p1,
177).rem)))._replace(p2 \rightarrow asType<short int>((172 * div(heapIs
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.p2, 176).rem) -
(asType < int > (asType < short int > (div(heapIs $heap_{funcstart\_724,1}, 
\text{Sheap}_{funcstart\ 724,1}.p2,\ 176).quot) * asType<int>(\text{Sheap}_{724,1:740.8}.b2))))
\rightarrow [simplify]
[57.14] $\text{heap}_{724,1;742,8} == \text{$heap}_{funcstart\_724,1}._\text{$replace}(p1 \to ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow asType<short int>((172 * div(heapIs
heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p2, 176).rem) - (div(heapIs
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.p2, 176).quot *
asType < int > (\$heap_{724,1;740,8}.b2))))
\rightarrow [from term 53.19, $heap<sub>724,1;740,8</sub> is equal to
heap_{funcstart\_724.1}._replace(p1 \rightarrow (-2 * div(heapIs heap_{funcstart\_724.1},
\text{Sheap}_{funcstart\_724,1}.\text{p1}, 177).\text{quot} + (171 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
heap_{funcstart_{-724,1}}.p1, 177).rem)
[57.15] $heap<sub>724,1;742,8</sub> == $heap<sub>funcstart_724,1</sub>._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).quot) + (171 *
\operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724,1}, \$ \operatorname{heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow asType<short int>((172 * div(heapIs
heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p2, 176).rem) - (div(heapIs)
\theta_{funcstart_{724,1}}, \theta_{funcstart_{724,1},p2, 176}.quot *
asType < int > (\$heap_{funcstart\_724,1}.\_replace(p1 \rightarrow ((-2 * div(heapIs)))))))
\theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}.pl, 177).quot) + (171 * div(heapIs
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.p1, 177).rem))).b2))))
\rightarrow [const member of object with modified fields]
[57.16] $heap<sub>724,1;742,8</sub> == $heap<sub>funcstart_724,1</sub>._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow asType<short int>((172 * div(heapIs
\theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}.p2, 176).rem) - (div(heapIs
\theta_{funcstart_{724,1}}, \theta_{funcstart_{724,1}}, \theta_{funcstart_{724,1}}, \theta_{funcstart_{724,1}}
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{b2}))))
\rightarrow [const static or extern object]
[57.17] $\text{heap}_{724,1;742,8} == \text{$heap}_{funcstart\_724,1}._\text{$replace}(p1 \to ((-2 *
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\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).quot) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow asType<short int>((172 * div(heapIs
heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p2, 176).rem) - (div(heapIs
\theta_{funcstart_{724,1}}, \theta_{funcstart_{724,1},p2,176}, quot *
asType < int > (\$heap_{init}.b2))))
\rightarrow [expand definition of constant 'b2' at prang.c (22,20)]
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).quot) + (171 *
\operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724,1}, \$ \operatorname{heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow asType<short int>((172 * div(heapIs
\theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}
heap_{funcstart_{724,1}}, heap_{funcstart_{724,1}}, 2, 176).quot *
asType<int>(asType<short int>((int)35)))))
\rightarrow [simplify]
[57.24] $heap<sub>724,1;742,8</sub> == $heap<sub>funcstart_724,1</sub>._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow ((-35 * div(heapIs $heap_{tuncstart_724.1},
\text{Sheap}_{funcstart\_724,1.p2}, 176).\text{quot} + (172 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
heap_{funcstart_{-724,1}}.p2, 176).rem)
[Take given term]
[61.0] $\text{heap}_{724,1:744,8} == $\text{heap}_{724,1:742,8}._\text{replace}(p3 \to \text{asType} < \text{short}
int>((asType<int>(asType<short int>(div3.rem)) *
asType < int > (\$heap_{724.1:742.8}.r3)) - (asType < int > (asType < short)
int>(div3.quot)) * asType<int>($heap<sub>724,1:742,8</sub>.b3))))
\rightarrow [from term 57.24, $heap<sub>724,1;742,8</sub> is equal to
heap_{funcstart\_724.1}._replace(p1 \rightarrow ((-2 * div(heapIs heap_{funcstart\_724.1}),
\text{Sheap}_{funcstart_{-724,1},p1, 177}.\text{quot}) + (171 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart_{-724,1}})
\rho_{funcstart\_724,1}.p1, 177).rem))._replace(p2 \rightarrow (-35 * div(heapIs))
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.p2, 176).quot) + (172 * div(\textbf{heapIs})
heap_{funcstart_{-724,1}}, heap_{funcstart_{-724,1}}, p2, 176).rem)
[61.1] heap_{724,1:744,8} == heap_{funcstart\_724,1}.\_replace(p1 \to ((-2 * 
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow ((-35 * div(heapIs $heap_{funcstart\_724,1},
\theta_{funcstart\_724,1}.p2, 176.quot) + (172 * div(heapIs \theta_{funcstart\_724,1},
\theta_{tuncstart\_724,1}, p2, 176).rem)))._replace(p3 \rightarrow asType<short
int>((asType<int>(asType<short int>(div3.rem)) *
asType < int > (\$heap_{724,1;742,8}.r3)) - (asType < int > (asType < short)
int > (div3.quot)) * asType < int > (\$heap_{724,1;742,8}.b3))))
\rightarrow [from term 39.6, div3 is equal to div(heapIs $heap_{funcstart_{724,1}},
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heap_{funcstart_{-724,1}}.p3, 178)
[61.2] heap_{724,1;744,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).quot) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow ((-35 * div(heapIs $heap_{tuncstart_724.1},
\text{Sheap}_{funcstart\_724.1.p2}, 176).\text{quot} + (172 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724.1},
\theta_{funcstart\_724,1}.p2, 176).rem))._replace(p3 \rightarrow asType<short
int>((asType<int>(asType<short int>(div(heapIs $heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1.p3}, 178).\text{rem}) * \mathbf{asType} < \mathbf{int} > (\text{Sheap}_{724,1:742.8}.\text{r3})) -
(asType<int>(asType<short int>(div3.quot)) *
asType < int > (\$heap_{724,1;742,8}.b3))))
\rightarrow [simplify]
[61.4] heap_{724,1;744,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 *
div(\mathbf{heapIs} \ \$heap_{funcstart\_724.1}, \ \$heap_{funcstart\_724.1}.p1, \ 177).quot) + (171 *
\operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724.1}, \$ \operatorname{heap}_{funcstart\_724.1}.p1,
177).rem)))._replace(p2 \rightarrow ((-35 * div(heapIs $heap_{funcstart\_724,1},
\text{Sheap}_{funcstart_{724,1},p2, 176}.quot) + (172 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart_{724,1}},
\theta_{uncstart_724.1.p2, 176}.rem)._replace(p3 \rightarrow asType<short
int>((div(heapIs \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p3, 178).rem *
asType < int > (\$heap_{724,1:742,8}.r3)) - (asType < int > (asType < short)
int>(div3.quot)) * asType<int>($heap<sub>724,1:742,8</sub>.b3))))
\rightarrow [from term 57.24, $heap<sub>724,1;742,8</sub> is equal to
\text{Sheap}_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 * div(heapIs $heap_{funcstart\_724,1}), the sheap funcstart\_724,1).
\text{Sheap}_{funcstart\_724,1}.\text{p1}, 177).\text{quot} + (171 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
\rho_{funcstart\_724,1}.p1, 177).rem))._replace\rho_{funcstart\_724,1}.p1, 177).rem))._replace
heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p2, 176).quot) + (172 * div(heapIs)
heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p2, 176).rem)
[61.5] heap_{724,1;744,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow ((-35 * div(heapIs $heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1}.\text{p2}, 176).\text{quot} + (172 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
\theta_{funcstart\_724,1}.p2, 176).rem))._replace(p3 \rightarrow asType<short
int>((div(heapIs \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p3, 178).rem *
\mathbf{asType}{<}\mathbf{int}{>}(\$\text{heap}_{funcstart\_724,1}.\_\mathbf{replace}(\text{p1} \rightarrow ((\text{-2} * \text{div}(\mathbf{heapIs}
\text{Sheap}_{funcstart_{724,1}}, \text{Sheap}_{funcstart_{724,1}}, \text{p1}, 177).\text{quot}) + (171 * \text{div}(\text{heapIs}))
\$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1, 177).rem))).\_\mathbf{replace}(p2 \rightarrow ((-35), -20)))
* div(heapIs heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p2, 176).quot) + (172 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724.1}, \ \text{\$heap}_{funcstart\_724.1}.p2, 176).rem))).r3)) -
(asType<int>(asType<short int>(div3.quot))
asType<int>($heap<sub>724,1;742,8</sub>.b3))))
\rightarrow [const member of object with modified fields]
[61.7] $heap<sub>724,1;744,8</sub> == $heap<sub>funcstart_724,1</sub>._replace(p1 \rightarrow ((-2 *
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\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).quot) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow ((-35 * div(heapIs $heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1.p2}, 176).\text{quot}) + (172 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
\rho_{funcstart\_724,1.p2, 176}.rem))._replace(p3 \rightarrow asType<short
int>((div(heapIs \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p3, 178).rem *
asType < int > (\$heap_{funcstart\_724,1}.r3)) - (asType < int > (asType < short)
int>(div3.quot)) * asType<int>($heap<sub>724.1:742.8</sub>.b3))))
\rightarrow [const static or extern object]
[61.8] heap_{724,1;744,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 *
\label{eq:div_heap} \text{div}(\textbf{heapIs} \ \$ \text{heap}_{funcstart\_724,1}, \ \$ \text{heap}_{funcstart\_724,1}.\text{p1},
177).rem)))._replace(p2 \rightarrow ((-35 * div(heapIs $heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1}.\text{p2}, 176).\text{quot} + (172 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
\rho_{uncstart\_724,1.p2, 176).rem}))._replace(p3 \rightarrow asType<short
int>((div(heapIs \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p3, 178).rem *
\mathbf{asType} < \mathbf{int} > (\$ \mathbf{heap}_{init}.\mathbf{r3})) - (\mathbf{asType} < \mathbf{int} > (\mathbf{asType} < \mathbf{short})
int>(div3.quot)) * asType<int>($heap<sub>724.1:742.8</sub>.b3))))
\rightarrow [expand definition of constant 'r3' at prang.c (25,20)]
[61.9] heap_{724,1;744,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).quot) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow ((-35 * div(heapIs $heap_{tuncstart_724.1},
\text{Sheap}_{funcstart\_724,1}.\text{p2}, 176).\text{quot} + (172 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
\theta_{1} = \theta_{1} - \theta_{2} - \theta_{3} - \theta_{4} - \theta_{5} - \theta_{6} - \theta_{6
int>((div(heapIs \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p3, 178).rem *
asType<int>(asType<short int>((int)170))) -
(asType<int>(asType<short int>(div3.quot)) *
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{724,1;742,8}.\mathrm{b3}))))
\rightarrow [simplify]
[61.12] heap_{724,1;744,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow ((-35 * div(heapIs \rho_{tart\_724,1},
\text{Sheap}_{funcstart\_724.1.p2}, 176).\text{quot}) + (172 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724.1},
\theta_{uncstart_{724.1},p2,176}.rem)._replace(p3 \rightarrow asType<short
int>((div(heapIs \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p3, 178).rem * 170)
- (asType < int > (asType < short int > (div3.quot))
asType < int > (\$heap_{724,1;742,8}.b3))))
\rightarrow [from term 39.6, div3 is equal to div(heapIs $heap_{funcstart\_724,1},
heap_{funcstart_{-724,1}}.p3, 178
[61.13] heap_{724,1;744,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 *
```

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\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).quot) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow ((-35 * div(heapIs $heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1}.\text{p2}, 176).\text{quot} + (172 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
\rho_{tuncstart\_724,1.p2, 176, rem})._replace(p3 \rightarrow asType<short int>((170
* div(heapIs heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p3, 178).rem) –
(asType<int>(asType<short int>(div(heapIs $heap_{funcstart\_724.1},
\text{Sheap}_{funcstart_{724,1},p3, 178}, \text{quot}) * \mathbf{asType} < \mathbf{int} > (\text{Sheap}_{724,1;742,8}, \text{b3}))))
\rightarrow [simplify]
[61.15] $\text{heap}_{724,1:744,8} == \text{$heap}_{funcstart\_724,1}._\text{$replace}(p1 \to ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow ((-35 * div(heapIs $heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1}.\text{p2}, 176).\text{quot} + (172 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
\rho_{uncstart_{-724,1},p2, 176, rem)}._replace(p3 \rightarrow asType<short int>((170
* div(heapIs heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p3, 178).rem) –
(\text{div}(\mathbf{heapIs} \$ \text{heap}_{funcstart\_724,1}, \$ \text{heap}_{funcstart\_724,1}.\text{p3}, 178).\text{quot} *
asType<int>($heap<sub>724.1:742.8</sub>.b3))))
\rightarrow [from term 57.24, $heap<sub>724,1:742,8</sub> is equal to
\text{Sheap}_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 * div(\textbf{heapIs } \$heap_{funcstart\_724,1},
heap_{funcstart\_724,1}.p1, 177).quot + (171 * div(heapIs $heap_{funcstart\_724,1}, 177).quot) + (171 * div(heapIs $heap_{funcstart\_724,1}, 17
heap_{funcstart\_724,1}.p1, 177).rem)._replace(p2 \rightarrow (-35 * div(heapIs)))._
heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p2, 176).quot) + (172 * div(heapIs)
heap_{funcstart_{724,1}}, heap_{funcstart_{724,1}}, p2, 176).rem)
[61.16] $\text{heap}_{724,1;744,8} == \text{$heap}_{funcstart\_724,1}._\text{$replace}(p1 \to ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 \ *
\operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724,1}, \$ \operatorname{heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow ((-35 * div(heapIs $heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1}.\text{p2}, 176).\text{quot} + (172 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
\rho_{tuncstart=724.1}.p2, 176).rem))._replace(p3 \rightarrow asType<short int>((170
* div(heapIs heap_{funcstart\_724,1}, heap_{funcstart\_724,1}, n_{funcstart\_724,1}, n_{funcstart\_724,1}, n_{funcstart\_724,1}
(div(heapIs heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p3, 178).quot *
asType < int > (\$heap_{funcstart\_724,1}.\_replace(p1 \rightarrow ((-2 * div(heapIs)))))))
\theta_{funcstart_{724,1}}, \theta_{funcstart_{724,1},p1, 177}.quot) + (171 * div(heapIs)
\rho_{funcstart\_724,1}, \rho_{func
* div(\mathbf{heapIs} \ \$ heap_{funcstart\_724,1}, \ \$ heap_{funcstart\_724,1}.p2, \ 176).quot) + (172 \ *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p2, \ 176).rem))).b3))))
→ [const member of object with modified fields]
[61.18] $\text{heap}_{724,1;744,8} == \text{$heap}_{funcstart\_724,1}._\text{$replace}(p1 \to ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 *
\operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724,1}, \$ \operatorname{heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow ((-35 * div(heapIs $heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1.p2}, 176).\text{quot} + (172 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
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\rho_{tuncstart=724.1.p2, 176}.rem)._replace(p3 \rightarrow asType<short int>((170
* div(heapIs heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p3, 178).rem) –
(\text{div}(\mathbf{heapIs} \$ \text{heap}_{funcstart\_724,1}, \$ \text{heap}_{funcstart\_724,1}.\text{p3}, 178).\text{quot} *
asType < int > (\$heap_{funcstart\_724,1}.b3))))
\rightarrow [const static or extern object]
[61.19] $heap<sub>724,1;744,8</sub> == $heap<sub>funcstart_724,1</sub>._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).quot) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow ((-35 * div(heapIs $heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\ 724.1.p2}, 176).\text{quot} + (172 * \text{div}(\text{heapIs} \text{Sheap}_{funcstart\ 724.1},
\rho_{tuncstart\_724,1.p2, 176}.rem)._replace(p3 \rightarrow asType<short int>((170
* div(heapIs heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p3, 178).rem) –
(\text{div}(\mathbf{heapIs} \$ \text{heap}_{funcstart\_724,1}, \$ \text{heap}_{funcstart\_724,1}.\text{p3}, 178).\text{quot} *
asType < int > (\$heap_{init}.b3))))
\rightarrow [expand definition of constant 'b3' at prang.c (27,20)]
[61.20] heap_{724,1;744,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).quot) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow ((-35 * div(heapIs $heap_{tuncstart_724.1},
\text{Sheap}_{funcstart\_724,1.p2}, 176).\text{quot} + (172 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
\rho_{tuncstart\_724,1.p2, 176}.rem)._replace(p3 \rightarrow asType<short int>((170
* div(heapIs heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p3, 178).rem) –
(\text{div}(\mathbf{heapIs} \$ \text{heap}_{funcstart\_724.1}, \$ \text{heap}_{funcstart\_724.1}. \text{p3}, 178).\text{quot} *
asType<int>(asType<short int>((int)63)))))
\rightarrow [simplify]
[61.26] $heap<sub>724,1;744,8</sub> == $heap<sub>funcstart_724,1</sub>._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{$heap}_{funcstart\_724,1}, \ \text{$heap}_{funcstart\_724,1}.p1, \ 177).quot) + (171 *
\operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724,1}, \$ \operatorname{heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow ((-35 * div(heapIs $heap_{funcstart_724.1},
\text{Sheap}_{funcstart\_724,1}.\text{p2}, 176).\text{quot} + (172 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
\rho_{funcstart\_724,1}.p2, 176).rem))._replace(p3 \rightarrow ((-63 * div(heapIs
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.\text{p3}, 178).\text{quot}) + (170 * \text{div}(\text{heapIs}))
heap_{funcstart_{724,1}}, heap_{funcstart_{724,1}}, 178).rem)
[Take goal term]
[1.0] -asType<integer const>($heap_{724.1:744.8}.M3) <
asType<integer>($heap<sub>724.1:744.8</sub>.p3)
\rightarrow [from term 61.26, $heap<sub>724,1;744,8</sub> is equal to
heap_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 * div(heapIs $heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1}.p1, 177).quot) + (171 * div(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
\rho_{1.5}(p_2) = \rho_{1.5}(p_2) - \rho_{1
$heap_{funcstart\_724,1}, $heap_{funcstart\_724,1}.p2, 176).quot) + (172 * div(heapIs)
\theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}
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div(\mathbf{heapIs} \ \$heap_{funcstart\_724,1}, \ \$heap_{funcstart\_724,1}.p3, \ 178).quot) + (170 *
div(\mathbf{heapIs} \ \$heap_{funcstart\_724,1}, \ \$heap_{funcstart\_724,1}.p3, \ 178).rem))]
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 \ *
\operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724.1}, \$ \operatorname{heap}_{funcstart\_724.1}.p1,
177).rem)))._replace(p2 \rightarrow ((-35 * div(heapIs $heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1}.\text{p2}, 176).\text{quot} + (172 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
\rho_{funcstart\_724,1.p2, 176}.rem))._replace(p3 \rightarrow ((-63 * div(heapIs
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.p3, 178).quot) + (170 * div(heapIs)
\text{Sheap}_{funcstart_{724,1}}, \text{Sheap}_{funcstart_{724,1}}.p3, 178).rem))).M3) <
asType < integer > (\$heap_{724,1;744,8}.p3)
\rightarrow [const member of object with modified fields]
[1.4] -asType<integer const>($heap_{tuncstart\_724.1}.M3) <
asType<integer>($heap<sub>724.1:744.8</sub>.p3)
\rightarrow [const static or extern object]
[1.5] -asType<integer const>($heap_{init}.M3) <
asType<integer>($heap<sub>724.1:744.8</sub>.p3)
\rightarrow [expand definition of constant 'M3' at prang.c (24,20)]
[1.6] -asType<integer const>(asType<short int>((int)30323)) <
asType<integer>($heap<sub>724,1:744,8</sub>.p3)
\rightarrow [simplify]
[1.10] -30323 < asType<integer>($heap<sub>724,1:744,8</sub>.p3)
\rightarrow [from term 61.26, $heap_{724,1;744,8} is equal to
\text{Sheap}_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 * div(heapIs $heap_{funcstart\_724,1}), the sheap funcstart\_724,1).
\text{Sheap}_{funcstart_{724,1},p1, 177}.\text{quot}) + (171 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart_{724,1}})
\rho_{funcstart\_724,1}.p1, 177).rem))).\_replace(p2 \rightarrow ((-35 * div(heapIs))).\_replace(p2 \rightarrow ((-35 * div(heapIs)))).\_replace(p2 \rightarrow ((-35 * div(heapIs)))).\_replace(p2 \rightarrow ((-35 * div(heapIs)))))
heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p2, 176).quot) + (172 * div(heapIs)
heap_{funcstart\_724.1}, heap_{funcstart\_724.1}, p2, p2, p3, p4, p3, p4, p3, p4, 
div(\mathbf{heapIs} \ \$heap_{funcstart\_724,1}, \ \$heap_{funcstart\_724,1}.p3, \ 178).quot) + (170 \ *
div(\mathbf{heapIs} \ \$heap_{funcstart\_724,1}, \ \$heap_{funcstart\_724,1}.p3, \ 178).rem))]
[1.11] -30323 < asType<integer>($heap<sub>funcstart_724,1</sub>._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}. p1, \ 177). \operatorname{quot}) + (171 *
\operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724.1}, \$ \operatorname{heap}_{funcstart\_724.1}.p1,
177).rem)))._replace(p2 \rightarrow ((-35 * div(heapIs $heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1}.\text{p2}, 176).\text{quot} + (172 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
\rho_{funcstart\_724,1.p2, 176}.rem)._replace(p3 \rightarrow ((-63 * div(heapIs
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.\text{p3}, 178).\text{quot}) + (170 * \text{div}(\text{heapIs}))
heap_{funcstart_{724,1}}, heap_{funcstart_{724,1},p3, 178).rem))).p3)
\rightarrow [simplify]
 \label{eq:continuous} \mbox{[1.13] -30323} < ((-63 * \mbox{div}(\mathbf{heapIs} \ \$ \mbox{heap}_{funcstart\_724,1}, \ \$ \mbox{heap}_{funcstart\_724,1}.\mbox{p3},
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178).quot) + (170 * div(heapIs \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}.p3,
178).rem))
\rightarrow [negate goal and search for contradiction]
[1.14]!(-30323 < ((-63 * div(heapIs $heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1}.\text{p3}, 178).\text{quot}) + (170 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
heap_{funcstart_{-724,1}.p3, 178.rem})
\rightarrow [simplify]
[1.19] 30322 < ((63 * div(heapIs $heap_{funcstart\_724,1}, $heap_{funcstart\_724,1}.p3,
178).quot) + (-170 * \text{div}(\mathbf{heapIs} \$ \text{heap}_{funcstart\_724,1}, \$ \text{heap}_{funcstart\_724,1}.\text{p3},
178).rem))
[Copy term 1.19]
[67.0] 30322 < ((-170 * div(heapIs $heap_{funcstart\_724,1},
\text{Sheap}_{funcstart_{724,1},p3, 178}.rem) + (63 * div(heapIs \text{Sheap}_{funcstart_{724,1},p3})
heap_{funcstart_{-724,1}.p3}, 178).quot)
\rightarrow [from\ term\ 43.17,\ div(\textbf{heapIs}\ \$heap_{funcstart\_724,1},\ \$heap_{funcstart\_724,1}.p3,
178).rem is equal to heap_{funcstart_{-724,1}}.p3 % 178]
[67.1] 30322 < ((-170 * (\$heap_{funcstart\_724,1}.p3 \% 178)) + (63 * div(heapIs))
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.p3, 178).quot)
[Create new term from term 42.17 using rule: condition for equality of division]
[98.0] ((178 * (0 + -(-div(heapIs $heap_{funcstart\_724,1},
\text{Sheap}_{funcstart_{724,1}.p3}, 178).\text{quot}))) < (1 + \text{Sheap}_{funcstart_{724,1}.p3})) \land
(\text{\$heap}_{funcstart\_724.1}.p3 < (178 * (0 + 1 + -(-div(\textbf{heapIs}))))
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.p3, 178).quot))))
\rightarrow [simplify]
\label{eq:eq:fine_start_724,1} \text{ $$} \text{ $$} \{\text{-1} < ((\text{-178 * div}(\textbf{heapIs } \$\text{heap}_{funcstart\_724,1}, \$\text{heap}_{funcstart\_724,1}.p3,
178).quot) + \text{$heap}_{funcstart\_724.1}.p3)) \land (-178 < (-\text{$heap}_{funcstart\_724.1}.p3 +
(178*\operatorname{div}(\mathbf{heapIs}\ \$\operatorname{heap}_{funcstart\_724,1},\ \$\operatorname{heap}_{funcstart\_724,1}.\operatorname{p3},\ 178).\operatorname{quot})))
[Work on sub-term 2 of conjunction in term 98.15]
\label{eq:continuous} \textit{[99.0] -1} < ((-178 * div(\textbf{heapIs} \$ heap_{funcstart\_724,1}, \$ heap_{funcstart\_724,1}.p3,
178).\mathrm{quot}) + \$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p3})
[Create new term from terms 99.0, 5.41 using rule: transitivity 2]
[110.0] (-30323 + -1 + 1) < (-178 * div(heapIs $heap_{tuncstart\_724,1},
heap_{funcstart_{-724,1}}.p3, 178).quot
\rightarrow [simplify]
[110.1] -30323 < (-178 * div(heapIs $heap<sub>funcstart_724,1</sub>,
heap_{funcstart\_724,1}.p3, 178).quot
\rightarrow [literal comparison of product]
```

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[110.2] ([-178 < 0]: (-30323 / 178) < -\text{div}(\mathbf{heapIs} \$ \text{heap}_{funcstart\_724,1},
\theta_{funcstart\_724,1}.p3, 178, quot, [0 < -178]: (-30323 / -178) < \text{div}(\hat{heapIs})
→ [explicitly assert falsehood of skipped guards in subsequent guards]
[110.3] ([-178 < 0]: (-30323 / 178) < -\text{div}(\mathbf{heapIs} \$ \text{heap}_{funcstart\_724,1},
\theta_{uncstart_{724,1}.p3, 178}.quot, [(0 < -178) \land !(-178 < 0)]: (-30323 / -178)
< \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_724,1}, \text{\$heap}_{funcstart\_724,1}.\text{p3}, 178).\text{quot}, [(-178)]
==0) \wedge !(-178 < 0) \wedge !(0 < -178)]: -30323 < 0)
\rightarrow [simplify]
[110.7] -171 < -\text{div}(\text{heapIs }\text{\$heap}_{funcstart\_724,1}, \text{\$heap}_{funcstart\_724,1}.\text{p3},
[Create new term from terms 110.7, 67.1 using rule: transitivity 5]
[112.0] 30322 < ((-170 * ($heap_{funcstart_724.1}.p3 % 178)) + (63 * -(-171 + 1)))
\rightarrow [simplify]
[112.5] 19612 < (-170 * ($heap_{funcstart\_724,1}.p3 % 178))
\rightarrow [literal comparison of product]
[112.6] ([-170 < 0]: (19612 / 170) < –($heap _funcstart_724,1.p3 \% 178), [0 <
-170]: (19612 / -170) < (\text{$heap}_{funcstart\_724,1}.\text{p3} \% 178), [-170 == 0]: 19612 <
0)
→ [explicitly assert falsehood of skipped guards in subsequent guards]
[112.7] ([-170 < 0]: (19612 / 170) < -($heap_{funcstart\_724,1}.p3 % 178), [(0 < 19612 / 170)]
-170) \wedge !(-170 < 0)]: (19612 / -170) < ($heap_{funcstart_724,1}.p3 % 178), [(-170)]
==0) \land !(-170 < 0) \land !(0 < -170)]: 19612 < 0)
\rightarrow [simplify]
[112.12] false
Proof of verification condition: Type constraint satisfied in implicit
conversion from 'short int const' to 'int'
Condition generated at: C:\Escher\Customers\prang\prang.c (63,27)
Condition defined at:
To prove: minof(int) \le \$heap_{724,1;744,8}.M1
Given:
heap_{init}.LIMIT == (int)80
heap_{init}.M1 == asType < short int > ((int)30269)
\theta_{init}.r1 == asType < short int > ((int)171)
```

```
heap_{init}.a1 == asType < short int > ((int)177)
\theta = asType < short int > ((int)2)
\theta sheap<sub>init</sub>.M2 == asType<short int>((int)30307)
\theta_{init}.r2 == asType < short int > ((int)172)
\theta_{init}.a2 == asType<short int>((int)176)
heap_{init}.b2 == asType<short int>((int)35)
\theta = asType < short int > ((int)30323)
heap_{init}.r3 == asType < short int > ((int)170)
heap_{init}.a3 == asType < short int > ((int)178)
\theta = asType < short int > ((int)63)
\theta
\theta
\theta = asType < short int > ((int)3)
invariant
1(heap<br/>Is \rho_{funcstart\_724,1}
\operatorname{div1} == \operatorname{div}(\mathbf{heapIs} \ \operatorname{\$heap}_{funcstart\_724,1},
asType < int > (\$heap_{funcstart\_724,1}.p1),
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{a1}))
(asType<integer>(asType<int>($heap_{funcstart\_724,1}.p1)) /
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a1))) = =
asType<integer>(div1.quot)
(\mathbf{asType} < \mathbf{integer} > (\mathbf{asType} < \mathbf{int} > (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p1})) \%
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a1))) = =
asType<integer>(div1.rem)
!(0 == asType < integer > (div1.rem)) || !(0 ==
asType<integer>(div1.quot))
div2 == div(\mathbf{heapIs} \$ heap_{funcstart\_724.1},
asType < int > (\$heap_{funcstart\_724.1}.p2),
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{a2}))
(asType<integer>(asType<int>($heap_{funcstart\_724,1}.p2)) /
\mathbf{asType}{<}\mathbf{integer}{>}(\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{a2}))) ==
asType<integer>(div2.quot)
(\mathbf{asType}{<}\mathbf{integer}{>}(\mathbf{asType}{<}\mathbf{int}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{p2}))\ \%
asType < integer > (asType < int > (\$heap_{funcstart\_724.1}.a2))) = =
asType<integer>(div2.rem)
!(0 == asTvpe < integer > (div2.rem)) || !(0 ==
asType<integer>(div2.quot))
```

```
div3 == div(\mathbf{heapIs} \$heap_{funcstart\_724,1},
asType < int > (\$heap_{funcstart\_724,1}.p3),
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{a3}))
(asType<int>(asType<int>($heap_{tuncstart\_724.1}.p3)) /
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a3))) = =
asType<integer>(div3.quot)
(\mathbf{asType} {<} \mathbf{integer} {>} (\mathbf{asType} {<} \mathbf{int} {>} (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p3})) \ \%
\mathbf{asType}{<}\mathbf{integer}{>}(\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{a3}))) ==
asType<integer>(div3.rem)
!(0 == asType < integer > (div3.rem)) || !(0 ==
asType<integer>(div3.quot))
$heap_{724,1;740,8} == $heap_{funcstart\_724,1}.\_replace(p1 \rightarrow asType < short)
int>((asType<int>(asType<short int>(div1.rem)) *
asType < int > (\$heap_{funcstart\_724,1}.r1)) - (asType < int > (asType < short)
int>(div1.quot)) * asType< int>($heap_{funcstart\_724,1}.b1))))
-asType < integer\ const > (\$heap_{724,1;740,8}.M1) < 
asType<integer>($heap<sub>724.1:740.8</sub>.p1)
!(0 == asType < integer > (\$heap_{724,1;740,8}.p1))
asType<integer>($heap<sub>724,1:740,8</sub>.p1) <
asType<integer>($heap<sub>724,1:740,8</sub>.M1)
\rho_{724,1:742.8} == \rho_{724,1:740.8}._replace(p2 \rightarrow asType<short
int>((asType<int>(asType<short int>(div2.rem)) *
asType < int > (\$heap_{724.1:740.8}.r2)) - (asType < int > (asType < short)
int>(div2.quot)) * asType<int>($heap<sub>724.1:740.8</sub>.b2))))
-asType<integer const>($heap<sub>724,1:742,8</sub>.M2) <
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathrm{heap}_{724,1;742,8}.\mathrm{p2})
!(0 == asType < integer > (\$heap_{724,1:742.8}.p2))
asType<integer>($heap<sub>724.1:742.8</sub>.p2) <
asType<integer>($heap<sub>724.1:742.8</sub>.M2)
\text{sheap}_{724,1:744.8} == \text{sheap}_{724,1:742.8}._replace(p3 \rightarrow asType<short
int>((asType<int>(asType<short int>(div3.rem))
\mathbf{asType} < \mathbf{int} > (\$ \mathrm{heap}_{724,1;742,8}.\mathrm{r3})) - (\mathbf{asType} < \mathbf{int} > (\mathbf{asType} < \mathbf{short}))
int>(div3.quot)) * asType<int>($heap<sub>724.1:742.8</sub>.b3))))
-asType<integer const>($heap<sub>724,1:744,8</sub>.M3) <
asType<integer>($heap<sub>724.1:744.8</sub>.p3)
!(0 == asType < integer > (\$heap_{724.1:744.8}.p3))
asType<integer>($heap<sub>724,1:744,8</sub>.p3) <
asType<integer>($heap<sub>724,1:744,8</sub>.M3)
Proof:
```

```
[Take given term]
[11.0] \operatorname{div1} == \operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724,1},
asType < int > (\$heap_{funcstart\_724,1}.p1),
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{a1}))
\rightarrow [simplify]
[11.1] \operatorname{div1} == \operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724,1}, \$ \operatorname{heap}_{funcstart\_724,1}.p1,
asType < int > (\$heap_{funcstart\_724,1}.a1))
\rightarrow [const static or extern object]
[11.2] \ \mathrm{div1} == \mathrm{div}(\mathbf{heapIs} \ \$ \mathrm{heap}_{funcstart\_724,1}, \ \$ \mathrm{heap}_{funcstart\_724,1}.\mathrm{p1},
\mathbf{asType}{<}\mathbf{int}{>}(\$\text{heap}_{init}.\text{a1}))
\rightarrow [expand definition of constant 'a1' at prang.c (16,20)]
[11.3] \ \mathrm{div1} == \mathrm{div}(\mathbf{heapIs} \ \$ \mathrm{heap}_{funcstart\_724,1}, \ \$ \mathrm{heap}_{funcstart\_724,1}.\mathrm{p1},
asType<int>(asType<short int>((int)177)))
\rightarrow [simplify]
[11.6] \text{ div1} == \text{div}(\text{heapIs } \text{$heap}_{funcstart\_724,1}, \text{$heap}_{funcstart\_724,1}.\text{p1}, 177)
[Take given term]
[25.0] div2 == div(heapIs $heap_{funcstart\_724,1},
asType < int > (\$heap_{funcstart\_724,1}.p2),
asType < int > (\$heap_{funcstart\_724,1}.a2))
\rightarrow [simplify]
[25.1] div2 == div(heapIs \theta_{funcstart_{724,1}}, \theta_{funcstart_{724,1}}, \theta_{funcstart_{724,1}}
asType < int > (\$heap_{funcstart\_724,1}.a2))
\rightarrow [const static or extern object]
[25.2] \operatorname{div2} == \operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.p2,
asType < int > (\$heap_{init}.a2))
\rightarrow [expand definition of constant 'a2' at prang.c (21,20)]
[25.3] div2 == div(heapIs \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}.p2,
asType<int>(asType<short int>((int)176)))
\rightarrow [simplify]
[25.6] div2 == div(heapIs \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}.p2, 176)
[Take given term]
[39.0] \operatorname{div3} == \operatorname{div}(\mathbf{heapIs} \, \hat{\mathbf{s}}_{funcstart\_724,1}, 
asType < int > (\$heap_{funcstart\_724,1}.p3),
asType < int > (\$heap_{funcstart\_724,1}.a3))
\rightarrow [simplify]
[39.1] div3 == div(heapIs \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}.p3,
```

```
asType < int > (\$heap_{funcstart\_724.1}.a3))
\rightarrow [const static or extern object]
[39.2] \operatorname{div3} == \operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724,1}, \$ \operatorname{heap}_{funcstart\_724,1}.p3,
asType < int > (\$heap_{init}.a3))
\rightarrow [expand definition of constant 'a3' at prang.c (26,20)]
[39.3] \ \mathrm{div3} == \ \mathrm{div}(\mathbf{heapIs} \ \$ \mathrm{heap}_{funcstart\_724,1}, \ \$ \mathrm{heap}_{funcstart\_724,1}.\mathrm{p3},
asType<int>(asType<short int>((int)178)))
\rightarrow [simplify]
[39.6] \text{ div3} == \text{div}(\text{heapIs } \text{$heap}_{funcstart\_724,1}, \text{$heap}_{funcstart\_724,1}.\text{p3}, 178)
[Take given term]
[53.0] heap_{724,1:740,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow asType<short
int>((asType<int>(asType<short int>(div1.rem)) *
asType < int > (\$heap_{funcstart-724,1}.r1)) - (asType < int > (asType < short)
\mathbf{int}{>}(\mathbf{div1.quot})) * \mathbf{asType}{<} \mathbf{int}{>}(\$\mathbf{heap}_{funcstart\_724,1}.\mathbf{b1}))))
\rightarrow [from term 11.6, div1 is equal to div(heapIs $heap_{funcstart\_724,1},
heap_{funcstart_{-724,1},p1,177}
[53.1] \; \$ heap_{724,1;740,8} == \$ heap_{funcstart\_724,1}.\_\mathbf{replace} (p1 \rightarrow \mathbf{asType} < \mathbf{short}
int>((asType<int>(asType<short int>(div(heapIs $heap_{funcstart\_724,1},
\theta_{funcstart\_724,1.p1, 177}.rem) * asType < int > (\theta_{funcstart\_724,1.r1}) - (\theta_{funcstart\_724,1.r1}
(asType<int>(asType<short int>(div1.quot)) *
asType < int > (\$heap_{funcstart\_724,1}.b1))))
\rightarrow [simplify]
[53.3] \rho_{13,1;740,8} == \rho_{13,1;740,8} == \rho_{13,1;740,8} =- \rho_{
int>((div(heapIs \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1, 177).rem *
\mathbf{asType} \hspace{-0.1em}<\hspace{-0.1em} \mathbf{int} \hspace{-0.1em}> \hspace{-0.1em} (\$ \mathrm{heap}_{funcstart\_724,1}.\mathrm{r1})) - (\mathbf{asType} \hspace{-0.1em}<\hspace{-0.1em} \mathbf{int} \hspace{-0.1em}> \hspace{-0.1em} (\mathbf{asType} \hspace{-0.1em}<\hspace{-0.1em} \mathbf{short})
int>(div1.quot)) * asType< int>($heap_{tuncstart\_724.1}.b1))))
\rightarrow [const static or extern object]
[53.4] heap_{724,1;740,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow asType<short
int>((div(heapIs \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1, 177).rem *
asType < int > (\$heap_{init}.r1)) - (asType < int > (asType < short)
int>(div1.quot)) * asType<int>($heap_{funcstart\_724,1}.b1)))
\rightarrow [expand definition of constant 'r1' at prang.c (15,20)]
[53.5] heap_{724,1;740,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow asType<short
int>((div(heapIs \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1, 177).rem *
asType<int>(asType<short int>((int)171))) -
(asType<int>(asType<short int>(div1.quot)) *
asType < int > (\$heap_{funcstart\_724.1}.b1)))
\rightarrow [simplify]
```

```
[53.8] heap_{724,1;740,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow asType<short
int>((div(heapIs \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1, 177).rem * 171)
 - (asType < int > (asType < short int > (div1.quot)) *
asType < int > (\$heap_{funcstart\_724,1}.b1))))
\rightarrow [from term 11.6, div1 is equal to div(heapIs $heap_{funcstart_724.1},
heap_{funcstart_{724,1}}.p1, 177
[53.9] heap_{724,1:740,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow asType<short
int>((171 * div(heapIs $heap_{funcstart\_724,1}, $heap_{funcstart\_724,1}.p1, 177).rem)
- (asType < int > (asType < short int > (div(heapIs $heap_{funcstart\_724,1},
heap_{funcstart\ 724,1}.p1, 177).quot)
asType < int > (\$heap_{funcstart\_724,1}.b1))))
\rightarrow [simplify]
[53.11] \theta == 
\mathbf{int} > ((171 * \operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724,1}, \$ \operatorname{heap}_{funcstart\_724,1}.\operatorname{p1}, 177).\operatorname{rem})
- (\text{div}(\textbf{heapIs} \$ \text{heap}_{funcstart\_724,1}, \$ \text{heap}_{funcstart\_724,1}.\text{p1}, 177).\text{quot} *
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{b1}))))
\rightarrow [const static or extern object]
[53.12] heap_{724,1;740,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow asType<short
int>((171 * div(heapIs $heap_{funcstart\_724,1}, $heap_{funcstart\_724,1}.p1, 177).rem)
- (\text{div}(\mathbf{heapIs} \$ \text{heap}_{funcstart\_724,1}, \$ \text{heap}_{funcstart\_724,1}.\text{p1}, 177).\text{quot} *
asType < int > (\$heap_{init}.b1)))
\rightarrow [expand definition of constant 'b1' at prang.c (17,20)]
[53.13] \text{sheap}_{724,1:740.8} == \text{sheap}_{funcstart\_724,1}._replace(p1 \rightarrow asType<short
int>((171 * div(heapIs $heap_{funcstart\_724,1}, $heap_{funcstart\_724,1}.p1, 177).rem)
- (\text{div}(\mathbf{heapIs} \$ \text{heap}_{funcstart\_724,1}, \$ \text{heap}_{funcstart\_724,1}.\text{p1}, 177).\text{quot} *
\mathbf{asType}{<}\mathbf{int}{>}(\mathbf{asType}{<}\mathbf{short}\ \mathbf{int}{>}((\mathbf{int})2))))
\rightarrow [simplify]
[53.19] $\text{heap}_{724,1;740,8} == \text{$heap}_{funcstart\_724,1}._\text{$replace}(p1 \to ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.\operatorname{p1}, \ 177).\operatorname{rem})))
[Take given term]
[57.0] \$ heap_{724,1;742,8} == \$ heap_{724,1;740,8}.\_\mathbf{replace}(p2 \to \mathbf{asType} < \mathbf{short})
int>((asType<int>(asType<short int>(div2.rem)) *
asType < int > (\$heap_{724.1:740.8}.r2)) - (asType < int > (asType < short)
\mathbf{int}{>}(\text{div2.quot})) \ * \ \mathbf{asType}{<} \mathbf{int}{>} (\$\text{heap}_{724,1;740,8}.\text{b2}))))
\rightarrow [from term 53.19, $heap<sub>724,1;740,8</sub> is equal to
heap_{funcstart\_724,1}._replace(p1 \rightarrow (-2 * div(heapIs heap_{funcstart\_724,1}),
heap_{funcstart\_724,1}.p1, 177).quot + (171 * div(heapIs p_{funcstart\_724,1}),
heap_{funcstart_{-724,1}}.p1, 177).rem)
[57.1] $\text{heap}_{724,1;742,8} == \text{$heap}_{funcstart\_724,1}._\text{$\bf replace}(p1 \to ((-2 *
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\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).quot) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow asType<short
int>((asType<int>(asType<short int>(div2.rem)) *
asType < int > (\$heap_{724,1:740,8}.r2)) - (asType < int > (asType < short)
int>(div2.quot)) * asType< int>($heap_{724,1;740,8}.b2))))
\rightarrow [from term 25.6, div2 is equal to div(heapIs $heap_{tuncstart_{724.1}},
heap_{funcstart_{-724,1}}.p2, 176
[57.2] $heap<sub>724,1:742,8</sub> == $heap<sub>funcstart_724,1</sub>._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}. p1, \ 177). \operatorname{quot}) + (171 *
\label{eq:div_heap} \text{div}(\textbf{heapIs} \ \$ \text{heap}_{funcstart\_724,1}, \ \$ \text{heap}_{funcstart\_724,1}.\text{p1},
177).rem))).\_replace(p2 \rightarrow asType < short
int>((asType<int>(asType<short int>(div(heapIs $heap_{funcstart\_724,1},
\text{sheap}_{funcstart\_724,1.p2, 176}.\text{rem}) * \mathbf{asType} < \mathbf{int} > (\text{sheap}_{724,1:740.8}.\text{r2})) -
(asType<int>(asType<short int>(div2.quot)) *
\mathbf{asType}{<}\mathbf{int}{>}(\${\rm heap}_{724,1;740,8}.{\rm b2}))))
\rightarrow [simplify]
[57.4] heap_{724,1;742,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}. p1, \ 177). \operatorname{quot}) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.p1,
177).rem)))._{\mathbf{replace}}(p2 \rightarrow \mathbf{asType} < \mathbf{short\ int} > ((\operatorname{div}(\mathbf{heapIs}))))
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.p2, 176).rem *
asType < int > (\$heap_{724.1:740.8}.r2)) - (asType < int > (asType < short)
int>(div2.quot)) * asType< int>($heap_{724,1;740,8}.b2))))
\rightarrow [from term 53.19, $heap<sub>724,1:740,8</sub> is equal to
heap_{funcstart\_724,1}._replace(p1 \rightarrow (-2 * div(heapIs $heap_{funcstart\_724,1},
heap_{funcstart_{724,1},p1, 177}, quot) + (171 * div(heapIs p_{funcstart_{724,1},p1, 177}).
heap_{funcstart} 724.1.p1, 177).rem))]
[57.5] $heap<sub>724,1;742,8</sub> == $heap<sub>funcstart_724,1</sub>._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.p1,
177).rem)))._{\mathbf{replace}}(p2 \rightarrow \mathbf{asType} < \mathbf{short\ int} > ((\operatorname{div}(\mathbf{heapIs}))))
\theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}.p2, 176).rem
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathbf{\_replace}(\mathrm{p1} \rightarrow ((-2 * \mathrm{div}(\mathbf{heapIs}
\$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1, 177).quot) + (171 * div(\mathbf{heapIs})
\text{Sheap}_{funcstart_{724,1}}, \text{Sheap}_{funcstart_{724,1}}, 177).rem))).r2)) -
(asType<int>(asType<short int>(div2.quot)) *
asType < int > (\$heap_{724,1;740,8}.b2))))
\rightarrow [const member of object with modified fields]
[57.6] heap_{724,1;742,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 *
\operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724,1}, \$ \operatorname{heap}_{funcstart\_724,1}.p1,
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(177).rem)._replace(p2 \rightarrow asType<short int>((div(heapIs))
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.p2, 176).rem *
asType < int > (\$heap_{funcstart\_724,1}.r2)) - (asType < int > (asType < short)
int>(div2.quot)) * asType< int>($heap_{724,1:740,8}.b2))))
\rightarrow [const static or extern object]
[57.7] heap_{724,1;742,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).quot) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow asType<short int>((div(heapIs
\text{Sheap}_{funcstart_{-724,1}}, \text{Sheap}_{funcstart_{-724,1}}.p2, 176).rem *
asType < int > (\$heap_{init}.r2)) - (asType < int > (asType < short)
int>(div2.quot)) * asType< int>($heap_{724,1:740.8}.b2))))
\rightarrow [expand definition of constant 'r2' at prang.c (20,20)]
[57.8] heap_{724,1;742,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}. \operatorname{p1}, \ 177).\operatorname{quot}) + (171 \ *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.p1,
177).rem)))._{\mathbf{replace}}(p2 \rightarrow \mathbf{asType} < \mathbf{short\ int} > ((\operatorname{div}(\mathbf{heapIs}))))
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.\text{p2}, 176).\text{rem} *
asType<int>(asType<short int>((int)172))) -
(asType<int>(asType<short int>(div2.quot)) *
\mathbf{asType}{<}\mathbf{int}{>}(\${\rm heap}_{724,1;740,8}.{\rm b2}))))
\rightarrow [simplify]
[57.11] $\text{heap}_{724,1;742,8} == \text{$heap}_{funcstart\_724,1}._\text{$replace}(p1 \to ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 \ *
\operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724,1}, \$ \operatorname{heap}_{funcstart\_724,1}.p1,
177).rem)))._{\mathbf{replace}}(p2 \rightarrow \mathbf{asType} < \mathbf{short\ int} > ((\operatorname{div}(\mathbf{heapIs}))))
\theta_{172} = \theta_{1724,1}, \theta_{1724,1}, \theta_{1724,1} = \theta_{1724,1} = \theta_{1724,1}
(asType<int>(asType<short int>(div2.quot)) *
asType<int>($heap<sub>724.1:740.8</sub>.b2))))
\rightarrow [from term 25.6, div2 is equal to div(heapIs $heap_{funcstart_{724,1}},
heap_{funcstart_{-724,1},p2,176}
[57.12] heap_{724,1;742,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724.1}, \ \$ \operatorname{heap}_{funcstart\_724.1}.p1,
177).rem)))._replace(p2 \rightarrow asType<short int>((172 * div(heapIs
heap_{funcstart_{-724,1}}, heap_{funcstart_{-724,1}}, p_{176}.rem) -
(asType<int>(asType<short int>(div(heapIs $heap_{funcstart_724.1},
\text{sheap}_{funcstart_724,1}.\text{p2}, 176).\text{quot}) * asType<int>(\text{sheap}_{724,1:740.8}.\text{b2}))))
\rightarrow [simplify]
[57.14] $\text{heap}_{724,1;742,8} == \text{$heap}_{funcstart\_724,1}._\text{replace}(p1 \to ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 *
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```
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow asType<short int>((172 * div(heapIs
heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p2, 176).rem) - (div(heapIs
heap_{funcstart_{724,1}}, heap_{funcstart_{724,1}}, 2, 176).quot *
asType < int > (\$heap_{724,1;740,8}.b2))))
\rightarrow [from term 53.19, $heap<sub>724,1;740,8</sub> is equal to
heap_{funcstart\_724,1}._replace(p1 \rightarrow (-2 * div(heapIs $heap_{funcstart\_724,1},
heap_{funcstart\_724,1}.p1, 177).quot + (171 * div(heapIs $heap_{funcstart\_724,1},
heap_{funcstart_{724,1},p1,177,rem}
[57.15] $\text{heap}_{724,1:742,8} == \text{$heap}_{funcstart\_724,1}.$\text{$_-\text{replace}(p1$}\to ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 *
\label{eq:div_heap} \text{div}(\textbf{heapIs} \ \$ \text{heap}_{funcstart\_724,1}, \ \$ \text{heap}_{funcstart\_724,1}.\text{p1},
177).rem)))._replace(p2 \rightarrow asType<short int>((172 * div(heapIs
heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p2, 176).rem) - (div(heapIs
heap_{funcstart_{-724,1}}, heap_{funcstart_{-724,1}}.p2, 176).quot *
\mathbf{asType}{<}\mathbf{int}{>}(\$\text{heap}_{funcstart\_724,1}.\_\mathbf{replace}(\text{p1} \rightarrow ((\text{-2} * \text{div}(\mathbf{heapIs}
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.\text{p1}, 177).\text{quot}) + (171 * \text{div}(\text{heapIs}))
\text{Sheap}_{funcstart_{-724,1}}, \text{Sheap}_{funcstart_{-724,1}}.p1, 177).rem))).b2))))
\rightarrow [const member of object with modified fields]
[57.16] $heap<sub>724,1;742,8</sub> == $heap<sub>funcstart_724,1</sub>._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 \ *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow asType<short int>((172 * div(heapIs
\theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.\text{p2}, 176).\text{quot} *
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{b2}))))
\rightarrow [const static or extern object]
[57.17] heap_{724,1;742,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow asType<short int>((172 * div(heapIs
\theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}.p2, 176).rem) - (div(heapIs
heap_{funcstart\_724.1}, heap_{funcstart\_724.1}.p2, 176).quot *
asType < int > (\$heap_{init}.b2))))
\rightarrow [expand definition of constant 'b2' at prang.c (22,20)]
[57.18] heap_{724,1;742,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 *
\operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724.1}, \$ \operatorname{heap}_{funcstart\_724.1}.p1,
177).rem)))._replace(p2 \rightarrow asType<short int>((172 * div(heapIs
\theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}.p2, 176).rem) - (div(heapIs
heap_{funcstart_{724,1}}, heap_{funcstart_{724,1}}.p2, 176).quot *
asType<int>(asType<short int>((int)35)))))
```

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\rightarrow [simplify]
[57.24] $\text{heap}_{724,1:742,8} == $\text{heap}_{funcstart\_724,1}._\text{replace}(p1 \to ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).quot) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow ((-35 * div(heapIs $heap_{tuncstart_724.1},
\theta_{funcstart\_724,1}.p2, 176.quot) + (172 * div(heapIs \theta_{funcstart\_724,1},
heap_{funcstart_{-724,1}}.p2, 176).rem)
[Take given term]
[61.0] $\text{heap}_{724,1;744,8} == $\text{heap}_{724,1;742,8}._\text{replace}(p3 \to \text{asType} < \text{short}
int>((asType<int>(asType<short int>(div3.rem)) *
asType < int > (\$heap_{724.1:742.8}.r3)) - (asType < int > (asType < short)
int>(div3.quot)) * asType< int>($heap_{724,1;742,8}.b3))))
\rightarrow [from term 57.24, $heap<sub>724,1;742,8</sub> is equal to
heap_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 * div(heapIs $heap_{funcstart\_724,1},
heap_{funcstart\_724,1}.p1, 177).quot + (171 * div(heapIs $heap_{funcstart\_724,1}, 177).quot) + (171 * div(heapIs $heap_{funcstart\_724,1}, 17
heap_{funcstart\_724,1}.p1, 177).rem)._replace(p2 \rightarrow (-35 * div(heapIs)))._
heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p2, 176).quot) + (172 * div(heapIs)
heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p2, 176).rem))]
[61.1] \rho_{1.1} = \rho_{1.11,144,8} = \rho_{1
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).quot) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow ((-35 * div(heapIs $heap_{funcstart_724,1},
\text{Sheap}_{funcstart\_724,1}.\text{p2}, 176).\text{quot} + (172 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
\theta_{uncstart_{724.1},p2,176,rem})._replace(p3 \rightarrow asType<short
int>((asType<int>(asType<short int>(div3.rem)) *
asType < int > (\$heap_{724,1:742,8}.r3)) - (asType < int > (asType < short)
int > (div3.quot)) * asType < int > ($heap_{724,1;742,8}.b3))))
\rightarrow [from term 39.6, div3 is equal to div(heapIs $heap_{funcstart\_724,1},
heap_{funcstart_{-724,1}}.p3, 178
[61.2] heap_{724,1;744,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).quot) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow ((-35 * div(heapIs $heap_{funcstart_724,1},
\text{Sheap}_{funcstart\_724,1}.\text{p2}, 176).\text{quot} + (172 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
\theta_{funcstart\_724,1}.p2, 176).rem))).replace(p3 \rightarrow asType < short)
int>((asType<int>(asType<short int>(div(heapIs $heap_{funcstart\_724.1},
\text{sheap}_{funcstart_724,1.p3}, 178).rem) * asType<int>(\text{sheap}_{724,1:742.8.r3})) -
(asType<int>(asType<short int>(div3.quot)) *
asType<int>($heap<sub>724,1;742,8</sub>.b3))))
\rightarrow [simplify]
[61.4] \rho_{14,1;744,8} == \rho_{14,1;744,8} == \rho_{14,1;744,8} = \rho_{14,1;744,
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 *
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\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow ((-35 * div(heapIs $heap_{funcstart\_724,1},
\rho_{funcstart\_724,1.p2}, 176).quot) + (172 * div(heapIs \rho_{funcstart\_724,1},
\theta_{funcstart\_724,1}.p2, 176).rem))._replace(p3 \rightarrow asType<short
int>((div(heapIs \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p3, 178).rem *
\mathbf{asType} \small{<} \mathbf{int} \small{>} (\$ \mathrm{heap}_{724,1;742,8}.\mathrm{r3})) \\ - (\mathbf{asType} \small{<} \mathbf{int} \small{>} (\mathbf{asType} \small{<} \mathbf{short}
int>(div3.quot)) * asType<int>($heap<sub>724.1:742.8</sub>.b3))))
\rightarrow [from term 57.24, $\$heap_{724,1;742,8}$ is equal to
\text{Sheap}_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 * div(\textbf{heapIs } \text{Sheap}_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1}.\text{p1}, 177).\text{quot} + (171 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
heap_{funcstart\_724,1}.p1, 177).rem))._replace(p2 \rightarrow (-35 * div(heapIs))
heap_{funcstart_{-724,1}}, heap_{funcstart_{-724,1}}, p_{funcstart_{-724,1}}, p_{funcstart_{-724,1}}, p_{funcstart_{-724,1}}, p_{funcstart_{-724,1}}
heap_{funcstart_{724.1}}, heap_{funcstart_{724.1}}, 2, 176).rem
[61.5] heap_{724,1;744,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 \ ^*
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow ((-35 * div(heapIs $heap_{funcstart\_724,1},
\text{Sheap}_{funcstart_724,1}.\text{p2}, 176).\text{quot} + (172 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart_724,1},
\rho_{funcstart_724,1},p2, 176).rem))._replace(p3 \rightarrow asType<short
int>((div(heapIs \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p3, 178).rem *
asType<int>($heap<sub>funcstart_724.1</sub>._replace(p1 \rightarrow ((-2 * div(heapIs
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.\text{p1}, 177).\text{quot}) + (171 * \text{div}(\text{heapIs}))
\theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}
* div(heapIs heap_{funcstart_{-724,1}}, heap_{funcstart_{-724,1}}, p2, 176).quot) + (172 *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724.1}, \ \$ \operatorname{heap}_{funcstart\_724.1}. \operatorname{p2}, \ 176).\operatorname{rem}))).r3)) -
(asType<int>(asType<short int>(div3.quot)) *
asType<int>($heap<sub>724,1;742,8</sub>.b3))))
\rightarrow [const member of object with modified fields]
[61.7] heap_{724,1:744,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 \ *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow ((-35 * div(heapIs $heap_{funcstart_724,1},
\text{Sheap}_{funcstart\_724,1.p2}, 176).\text{quot}) + (172 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
\theta_{funcstart\_724,1}.p2, 176).rem))._replace(p3 \rightarrow asType<short
int>((div(heapIs \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p3, 178).rem *
asType < int > (\$heap_{funcstart\_724,1}.r3)) - (asType < int > (asType < short)
int>(div3.quot)) * asType<int>($heap<sub>724,1:742,8</sub>.b3))))
\rightarrow [const static or extern object]
[61.8] $heap<sub>724,1;744,8</sub> == $heap<sub>funcstart_724,1</sub>._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 *
\operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724,1}, \$ \operatorname{heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow ((-35 * div(heapIs $heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1.p2}, 176).\text{quot} + (172 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
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\rho_{funcstart=724.1.p2, 176}.rem)._replace(p3 \rightarrow asType<short
int>((div(heapIs \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p3, 178).rem *
asType < int > (\$heap_{init}.r3)) - (asType < int > (asType < short)
int>(div3.quot)) * asType< int>($heap_{724,1:742,8}.b3))))
\rightarrow [expand definition of constant 'r3' at prang.c (25,20)]
[61.9] heap_{724,1;744,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).quot) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow ((-35 * div(heapIs $heap_{funcstart\_724,1},
\rho_{tuncstart_{-724.1},p2, 176} + (172 * div(heapIs $heap_{tuncstart_{-724.1},p2})
\rho_{uncstart\_724,1.p2, 176).rem}))._replace(p3 \rightarrow asType<short
\mathbf{int}{>}((\mathrm{div}(\mathbf{heapIs}\ \$\mathrm{heap}_{funcstart\_724,1},\ \$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p3},\ 178).\mathrm{rem}\ *
asType<int>(asType<short int>((int)170))) -
(asType<int>(asType<short int>(div3.quot)) *
asType < int > (\$heap_{724,1;742,8}.b3))))
\rightarrow [simplify]
[61.12] $heap<sub>724,1;744,8</sub> == $heap<sub>funcstart_724,1</sub>._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart} \ 724.1, \ \$ \operatorname{heap}_{funcstart} \ 724.1, \ p1,
177).rem)))._replace(p2 \rightarrow ((-35 * div(heapIs $heap_{funcstart_724,1},
\text{Sheap}_{funcstart\_724,1.p2}, 176).\text{quot} + (172 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
\theta_{uncstart_724.1.p2, 176}.rem)._replace(p3 \rightarrow asType<short
int > ((div(heapIs \$heap_{funcstart\_724.1}, \$heap_{funcstart\_724.1}.p3, 178).rem * 170)
- (asType<int>(asType<short int>(div3.quot))
asType<int>($heap<sub>724.1:742.8</sub>.b3))))
\rightarrow [from term 39.6, div3 is equal to div(heapIs $heap_{funcstart\_724,1},
heap_{funcstart_{-724,1}}.p3, 178
[61.13] $\text{heap}_{724,1;744,8} == \text{$heap}_{funcstart\_724,1}._\text{$_{-}}replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).quot) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow ((-35 * div(heapIs $heap_{funcstart\_724.1},
\theta_{tuncstart} $\text{Neap} \text{funcstart} + (172 * \div(\text{heap} \text{Is} \text{$heap} \text{funcstart} + (172 * \div(\text{heap} \text{Is}))
\rho_{tuncstart=724.1}.p2, 176).rem))._replace(p3 \rightarrow asType<short int>((170
* div(heapIs heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p3, 178).rem) –
(asType<int>(asType<short int>(div(heapIs $heap_{tuncstart_724.1},
\text{sheap}_{funcstart=724,1.p3}, 178, \text{quot}) * asType < int > (\text{sheap}_{724,1:742.8.b3})))
\rightarrow [simplify]
[61.15] $heap<sub>724,1;744,8</sub> == $heap<sub>funcstart_724,1</sub>._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow ((-35 * div(heapIs $heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1}.\text{p2}, 176).\text{quot}) + (172 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
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\rho_{tuncstart=724.1.p2, 176}.rem)._replace(p3 \rightarrow asType<short int>((170
* div(heapIs heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p3, 178).rem) –
(div(heapIs \rho_{funcstart\_724,1}, \rho_{funcstart\_724,1}, 3, 178).quot *
asType < int > (\$heap_{724,1;742,8}.b3))))
\rightarrow [from term 57.24, $heap<sub>724.1:742.8</sub> is equal to
heap_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 * div(heapIs *heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1}.\text{p1}, 177).\text{quot} + (171 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
\rho_{funcstart\_724,1.p1, 177).rem})._replace\rho_{funcstart\_724,1.p1, 177).rem})._replace
heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p2, 176).quot) + (172 * div(heapIs)
heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p2, 176).rem))]
[61.16] $heap<sub>724,1;744,8</sub> == $heap<sub>funcstart_724,1</sub>._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 *
\operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724,1}, \$ \operatorname{heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow ((-35 * div(heapIs $heap_{funcstart_724,1},
\text{Sheap}_{funcstart\_724,1}.\text{p2}, 176).\text{quot} + (172 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
\theta_{uncstart_{-724,1},p2, 176,rem}))._replace(p3 \rightarrow asType<short int>((170
* div(heapIs heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p3, 178).rem) –
(\text{div}(\mathbf{heapIs} \$ \text{heap}_{funcstart\_724.1}, \$ \text{heap}_{funcstart\_724.1}. \text{p3}, 178).\text{quot} *
asType < int > (\$heap_{funcstart\_724,1}.\_replace(p1 \rightarrow ((-2 * div(heapIs))))))
\theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}.p1, 177).quot) + (171 * div(heapIs
\rho_{uncstart_{724,1}}, \rho_{uncstart_{724,1},p1, 177}.rem))._replace(p2 \rightarrow ((-35)
* div(heapIs heap_{funcstart_{-724,1}}, heap_{funcstart_{-724,1}}, 176).quot) + (172 *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.p2, \ 176).rem))).b3))))
\rightarrow [const member of object with modified fields]
[61.18] $heap<sub>724,1;744,8</sub> == $heap<sub>funcstart_724,1</sub>._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 *
\operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724,1}, \$ \operatorname{heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow ((-35 * div(heapIs $heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1}.\text{p2}, 176).\text{quot} + (172 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
\rho_{tuncstart=724.1}.p2, 176).rem))._replace(p3 \rightarrow asType<short int>((170
* div(heapIs heap_{funcstart\_724,1}, heap_{funcstart\_724,1}, n_{funcstart\_724,1}, n_{funcstart\_724,1}, n_{funcstart\_724,1}
(\text{div}(\mathbf{heapIs} \$ \text{heap}_{funcstart\_724,1}, \$ \text{heap}_{funcstart\_724,1}.\text{p3}, 178).\text{quot} *
asType < int > (\$heap_{funcstart\_724,1}.b3))))
\rightarrow [const static or extern object]
[61.19] $\text{heap}_{724,1;744,8} == \text{$heap}_{funcstart\_724,1}._\text{$replace}(p1 \to ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \operatorname{heap}_{funcstart\_724,1}, \ \operatorname{heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 *
\operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724,1}, \$ \operatorname{heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow ((-35 * div(heapIs $heap_{funcstart\_724,1},
\theta_{funcstart\_724,1.p2}, 176).quot) + (172 * div(heapIs \theta_{funcstart\_724,1},
\theta_{funcstart\_724,1.p2, 176}.rem)._replace(p3 \rightarrow asType<short int>((170
* div(heapIs heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p3, 178).rem) –
(\text{div}(\mathbf{heapIs} \$ \text{heap}_{funcstart\_724,1}, \$ \text{heap}_{funcstart\_724,1}.\text{p3}, 178).\text{quot} *
asType < int > (\$heap_{init}.b3))))
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\rightarrow [expand definition of constant 'b3' at prang.c (27,20)]
[61.20] $\text{heap}_{724,1:744,8} == $\text{heap}_{funcstart\_724,1}._\text{replace}(p1 \to ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).quot) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow ((-35 * div(heapIs $heap_{tuncstart_724.1},
\text{Sheap}_{funcstart\_724,1}.\text{p2}, 176).\text{quot} + (172 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
\rho_{tuncstart\_724,1.p2, 176}.rem)._replace(p3 \rightarrow asType<short int>((170
* \operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p3, \ 178).rem) -
(\text{div}(\mathbf{heapIs} \$ \text{heap}_{funcstart\_724.1}, \$ \text{heap}_{funcstart\_724.1}.\text{p3}, 178).\text{quot} *
asType<int>(asType<short int>((int)63)))))
\rightarrow [simplify]
[61.26] heap_{724,1;744,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 *
\operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724.1}, \$ \operatorname{heap}_{funcstart\_724.1}.p1,
177).rem)))._replace(p2 \rightarrow ((-35 * div(heapIs $heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1}.\text{p2}, 176).\text{quot} + (172 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
\theta_{funcstart\_724,1.p2, 176}.rem))._replace(p3 \rightarrow ((-63 * div(heapIs
\text{Sheap}_{funcstart_{-724,1}}, \text{Sheap}_{funcstart_{-724,1},p3, 178}, \text{quot}) + (170 * \text{div}(\text{heapIs}))
heap_{funcstart_{724,1}}, heap_{funcstart_{724,1}}, 3, 178).rem)
[Take goal term]
[1.0] minof(int) \leq $heap<sub>724.1:744.8</sub>.M1
\rightarrow [simplify]
[1.1] -32768 \leq $heap<sub>724.1:744.8</sub>.M1
\rightarrow [from term 61.26, $heap<sub>724,1;744,8</sub> is equal to
heap_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 * div(heapIs $heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1}.p1, 177).quot) + (171 * div(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
heap_{funcstart\_724,1}.p1, 177).rem))._replace(p2 \rightarrow ((-35 * div(heapIs)))._
heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p2, 176).quot) + (172 * div(heapIs)
heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p2, 176).rem)))._replace(p3 \rightarrow (-63 *
div(\mathbf{heapIs}\ \$heap_{funcstart\_724,1},\ \$heap_{funcstart\_724,1}.p3,\ 178).quot) + (170\ *
div(\mathbf{heapIs} \ \$heap_{funcstart\_724,1}, \ \$heap_{funcstart\_724,1}.p3, \ 178).rem))]
[1.2] -32768 \leq $heap<sub>funcstart_724,1</sub>._replace(p1 \rightarrow ((-2 * div(heapIs
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.\text{p1}, 177).\text{quot}) + (171 * \text{div}(\text{heapIs}))
\theta_{funcstart_{-724,1}}, \theta_{funcstart_{-724,1},p1, 177}.rem))._replace(p2 \rightarrow ((-35)
* div(heapIs heap_{funcstart_{-724,1}}, heap_{funcstart_{-724,1}}, p2, 176).quot) + (172 *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.p2,
176).rem)))._replace(p3 \rightarrow ((-63 * div(heapIs $heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1.p3}, 178).\text{quot} + (170 * \text{div}(\text{heapIs} \text{Sheap}_{funcstart\_724,1},
heap_{funcstart_{-724,1}.p3, 178.rem})).M1
\rightarrow [const member of object with modified fields]
[1.5] -32768 \le \text{$heap}_{funcstart\_724,1}.M1
```

```
\rightarrow [const static or extern object]
[1.6] -32768 \leq $heap<sub>init</sub>.M1
\rightarrow [expand definition of constant 'M1' at prang.c (14,20)]
[1.7] - 32768 \le asType < short int > ((int) 30269)
\rightarrow [simplify]
[1.10] true
Proof of verification condition: Type constraint satisfied in implicit
conversion from 'short int const' to 'int'
Condition generated at: C:\Escher\Customers\prang\prang.c (63,27)
Condition defined at:
To prove: heap_{724,1;744,8}.M1 \le maxof(int)
Given:
heap_{init}.LIMIT == (int)80
\theta
\theta_{init}.r1 == asType < short int > ((int)171)
\theta
\theta
\theta sheap<sub>init</sub>.M2 == asType<short int>((int)30307)
heap_{init}.r2 == asType < short int > ((int)172)
heap_{init}.a2 == asType < short int > ((int)176)
\theta = asType < short int > ((int)35)
\theta = asType < short int > ((int)30323)
heap_{init}.r3 == asType < short int > ((int)170)
heap_{init}.a3 == asType < short int > ((int)178)
\theta = asType < short int > ((int)63)
\theta
\theta
\theta = asType < short int > ((int)3)
invariant1(heapIs heap_{funcstart_{724,1}})
div1 == div(\mathbf{heapIs} \$ heap_{funcstart\_724.1},
asType < int > (\$heap_{funcstart\_724.1}.p1),
asType < int > (\$heap_{funcstart\_724.1}.a1))
```

```
(\mathbf{asType}{<}\mathbf{int}{>}(\mathbf{asType}{<}\mathbf{int}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{p1})) \ / \\
\mathbf{asType} < \mathbf{integer} > (\mathbf{asType} < \mathbf{int} > (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{a1}))) = =
asType < integer > (div1.quot)
(asType<integer>(asType<int>($heap_{tuncstart\_724.1}.p1)) %
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a1))) = =
asType<integer>(div1.rem)
!(0 == asType < integer > (div1.rem)) || !(0 ==
asType<integer>(div1.quot))
div2 == div(\mathbf{heapIs} \$ heap_{funcstart\_724,1},
\mathbf{asType} < \mathbf{int} > (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p2}),
asType < int > (\$heap_{funcstart_{-724,1}}.a2))
(asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.p2)) /
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a2))) = =
asType<integer>(div2.quot)
(asType<int>(asType<int>($heap_{tuncstart\_724.1}.p2)) %
\mathbf{asType}{<}\mathbf{integer}{>}(\mathbf{asType}{<}\mathbf{int}{>}(\$\mathbf{heap}_{funcstart\_724,1}.\mathbf{a2}))) = =
asType<integer>(div2.rem)
!(0 == asType < integer > (div2.rem)) || !(0 ==
asType<integer>(div2.quot))
div3 == div(\mathbf{heapIs} \$ heap_{funcstart\_724,1},
asType < int > (\$heap_{funcstart\_724,1}.p3),
asType < int > (\$heap_{funcstart\_724.1}.a3))
(asType<int>(asType<int>($heap_{tuncstart}, 724.1.p3)) /
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a3))) = =
asType<integer>(div3.quot)
(asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.p3)) \%
\mathbf{asType}{<}\mathbf{integer}{>}(\mathbf{asType}{<}\mathbf{int}{>}(\$\mathbf{heap}_{funcstart\_724,1}.\mathbf{a3}))) = =
asType<integer>(div3.rem)
!(0 == asType < integer > (div3.rem)) || !(0 ==
asType<integer>(div3.quot))
$heap_{724,1;740,8} == $heap_{funcstart\_724,1}.\_replace(p1 \rightarrow asType < short)
int>((asType<int>(asType<short int>(div1.rem)) *
\mathbf{asType} \small{<} \mathbf{int} \small{>} (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{r1})) - (\mathbf{asType} \small{<} \mathbf{int} \small{>} (\mathbf{asType} \small{<} \mathbf{short}
int>(div1.quot)) * asType<int>($heap_{funcstart\_724,1}.b1)))
-asType < integer const > (\$heap_{724,1:740.8}.M1) < 
asType<integer>($heap<sub>724.1:740.8</sub>.p1)
!(0 == asType < integer > (\$heap_{724,1;740,8}.p1))
asType<integer>($heap<sub>724.1:740.8</sub>.p1) <
asType<integer>($heap<sub>724.1:740.8</sub>.M1)
```

```
heap_{724,1;742,8} == heap_{724,1;740,8}.replace(p2 \rightarrow asType<short
int>((asType<int>(asType<short int>(div2.rem)) *
\mathbf{asType} < \mathbf{int} > (\$ \mathrm{heap}_{724,1;740,8}.\mathrm{r2})) - (\mathbf{asType} < \mathbf{int} > (\mathbf{asType} < \mathbf{short}))
int>(div2.quot)) * asType< int>($heap_{724,1;740.8}.b2))))
-asType<integer const>($heap<sub>724.1:742.8</sub>.M2) <
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathrm{heap}_{724,1;742,8}.\mathrm{p2})
!(0 == asType < integer > (\$heap_{724,1;742,8}.p2))
asType<integer>($heap<sub>724,1:742,8</sub>.p2) <
asType<integer>($heap<sub>724,1;742,8</sub>.M2)
\$heap_{724,1;744,8} == \$heap_{724,1;742,8}. \textbf{\_replace}(p3 \rightarrow \textbf{asType} < \textbf{short}
int>((asType<int>(asType<short int>(div3.rem)) *
asType < int > (\$heap_{724.1:742.8}.r3)) - (asType < int > (asType < short)
int>(div3.quot)) * asType<int>($heap<sub>724,1:742,8</sub>.b3))))
-{\bf asType}{<} {\bf integer~const}{>} (\${\rm heap}_{724,1;744,8}.{\rm M3}) <
asType<integer>($heap<sub>724.1:744.8</sub>.p3)
!(0 == asType < integer > (\$heap_{724,1;744,8}.p3))
asType<integer>($heap<sub>724,1:744,8</sub>.p3) <
asType<integer>($heap<sub>724,1:744,8</sub>.M3)
Proof:
[Take given term]
[11.0] \operatorname{div1} == \operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724,1},
asType < int > (\$heap_{funcstart\_724,1}.p1),
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{a1}))
\rightarrow [simplify]
[11.1] \ \mathrm{div1} == \mathrm{div}(\mathbf{heapIs} \ \$ \mathrm{heap}_{funcstart\_724,1}, \ \$ \mathrm{heap}_{funcstart\_724,1}.\mathrm{p1},
asType < int > (\$heap_{funcstart\_724.1}.a1))
\rightarrow [const static or extern object]
[11.2] \ \mathrm{div1} == \mathrm{div}(\mathbf{heapIs} \ \$ \mathrm{heap}_{funcstart\_724,1}, \ \$ \mathrm{heap}_{funcstart\_724,1}.\mathrm{p1},
asType < int > (\$heap_{init}.a1))
\rightarrow [expand definition of constant 'a1' at prang.c (16,20)]
[11.3] \ \mathrm{div1} == \mathrm{div}(\mathbf{heapIs} \ \$ \mathrm{heap}_{funcstart\_724,1}, \ \$ \mathrm{heap}_{funcstart\_724,1}.\mathrm{p1},
asType<int>(asType<short int>((int)177)))
\rightarrow [simplify]
[11.6] div1 == div(heapIs heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p1, 177)
[Take given term]
[25.0] div2 == div(heapIs $heap_{funcstart\_724,1},
asType < int > (\$heap_{funcstart\_724,1}.p2),
```

```
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{a2}))
\rightarrow [simplify]
[25.1] \operatorname{div2} == \operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.p2,
asType < int > (\$heap_{funcstart\_724,1}.a2))
\rightarrow [const static or extern object]
[25.2] \operatorname{div2} == \operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.p2,
asType < int > (\$heap_{init}.a2))
\rightarrow [expand definition of constant 'a2' at prang.c (21,20)]
[25.3] \operatorname{div2} == \operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p2,
asType<int>(asType<short int>((int)176)))
\rightarrow [simplify]
[25.6] \text{ div2} == \text{div}(\text{heapIs } \text{$heap}_{funcstart\_724,1}, \text{$heap}_{funcstart\_724,1}.p2, 176)
[Take given term]
[39.0] \operatorname{div3} == \operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724,1},
asType < int > (\$heap_{funcstart\_724,1}.p3),
asType < int > (\$heap_{funcstart\_724,1}.a3))
\rightarrow [simplify]
[39.1] div3 == div(heapIs $heap_{funcstart\_724.1}, $heap_{funcstart\_724.1}.p3,
asType < int > (\$heap_{funcstart\_724,1}.a3))
\rightarrow [const static or extern object]
[39.2] \operatorname{div3} == \operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.p3,
asType < int > (\$heap_{init}.a3))
\rightarrow [expand definition of constant 'a3' at prang.c (26,20)]
\label{eq:constant_724,1} \textit{[39.3]} \ \text{div3} == \ \text{div}(\mathbf{heapIs} \ \$ \text{heap}_{funcstart\_724,1}, \ \$ \text{heap}_{funcstart\_724,1}.\text{p3},
asType<int>(asType<short int>((int)178)))
\rightarrow [simplify]
[39.6] div3 == div(heapIs heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p3, 178)
[Take given term]
[53.0] heap_{724,1:740.8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow asType<short
int>((asType<int>(asType<short int>(div1.rem)) *
asType < int > (\$heap_{funcstart\_724,1}.r1)) - (asType < int > (asType < short)
\mathbf{int}{>}(\mathbf{div1.quot})) \ * \ \mathbf{asType}{<} \mathbf{int}{>} (\$\mathbf{heap}_{funcstart\_724,1}.\mathbf{b1}))))
\rightarrow [from term 11.6, div1 is equal to div(heapIs $heap_{funcstart\_724,1},
heap_{funcstart_{-724,1}}.p1, 177
[53.1] \theta == 
int>((asType<int>(asType<short int>(div(heapIs $heap_{funcstart\_724,1},
```

```
\rho_{tuncstart=724.1.p1, 177).rem} * asType<int>(\rho_{tuncstart=724.1.r1}) -
(asType < int > (asType < short int > (div1.quot)) *
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{b1}))))
\rightarrow [simplify]
[53.3] \theta == 
int>((div(heapIs \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1, 177).rem *
asType < int > (\$heap_{funcstart\_724.1}.r1)) - (asType < int > (asType < short)
int>(div1.quot)) * asType< int>($heap_{funcstart\_724,1}.b1))))
\rightarrow [const static or extern object]
[53.4] heap_{724,1;740,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow asType<short
int>((div(heapIs \$heap_{funcstart\_724.1}, \$heap_{funcstart\_724.1}, p1, 177).rem *
asType < int > (\$heap_{init}.r1)) - (asType < int > (asType < short)
int>(div1.quot)) * asType<int>($heap_{tuncstart,724,1}.b1))))
\rightarrow [expand definition of constant 'r1' at prang.c (15,20)]
[53.5] heap_{724,1;740,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow asType<short
\mathbf{int} > ((\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.\operatorname{p1}, \ 177).\operatorname{rem} \ *
asType<int>(asType<short int>((int)171))) -
(asType<int>(asType<short int>(div1.quot)) *
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{b1}))))
\rightarrow [simplify]
[53.8] heap_{724,1;740,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow asType<short
int > ((div(heapIs \$heap_{funcstart\_724.1}, \$heap_{funcstart\_724.1}, p1, 177).rem * 171)
- (asType<int>(asType<short int>(div1.quot)) *
asType < int > (\$heap_{funcstart\_724,1}.b1))))
\rightarrow [from term 11.6, div1 is equal to div(heapIs $heap_{funcstart_724,1},
heap_{funcstart_{724,1}}.p1, 177
[53.9] heap_{724,1;740,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow asType<short
int > ((171 * div(heapIs \$heap_{funcstart\_724.1}, \$heap_{funcstart\_724.1}, p1, 177).rem)
- (asType<int>(asType<short int>(div(heapIs $heap_{funcstart_724,1},))
heap_{funcstart_{-724,1}.p1, 177}.quot) *
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{b1}))))
\rightarrow [simplify]
[53.11] \theta_{124.1:740.8} = \theta_
int>((171 * div(heapIs \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1, 177).rem)
- (div(heapIs \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, 177).quot *
asType < int > (\$heap_{funcstart\_724,1}.b1))))
\rightarrow [const static or extern object]
[53.12] heap_{724,1;740,8} == heap_{funcstart\_724,1}.replace(p1 \rightarrow asType<short
int>((171 * div(heapIs \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1, 177).rem)
- (\text{div}(\textbf{heapIs} \$ \text{heap}_{funcstart\_724,1}, \$ \text{heap}_{funcstart\_724,1}.\text{p1}, 177).\text{quot} *
```

```
asType < int > (\$heap_{init}.b1)))
\rightarrow [expand definition of constant 'b1' at prang.c (17,20)]
[53.13] heap_{724,1;740,8} == heap_{funcstart\_724,1}. replace(p1 \rightarrow asType<short
int>((171 * div(heapIs \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1, 177).rem)
- (\text{div}(\mathbf{heapIs} \$ \text{heap}_{funcstart\_724,1}, \$ \text{heap}_{funcstart\_724,1}.\text{p1}, 177).\text{quot} *
asType<int>(asType<short int>((int)2))))
\rightarrow [simplify]
[53.19] $\text{heap}_{724.1:740.8} == $\text{heap}_{funcstart_724.1}._\text{replace}(p1 \to ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 \ *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{rem})))
[Take given term]
[57.0] $\text{heap}_{724,1:742.8} == $\text{heap}_{724,1:740.8}._\text{replace}(p2 \to \text{asType} < \text{short}
int>((asType<int>(asType<short int>(div2.rem)) *
asType < int > (\$heap_{724.1:740.8}.r2)) - (asType < int > (asType < short)
int>(div2.quot)) * asType< int>($heap_{724,1;740,8}.b2))))
\rightarrow [from term 53.19, $heap<sub>724,1:740,8</sub> is equal to
heap_{funcstart\_724,1}._replace(p1 \rightarrow (-2 * div(heapIs $heap_{funcstart\_724,1},
\text{Sheap}_{funcstart_{-724,1},p1,\ 177}.\text{quot}) + (171 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart_{-724,1}})
heap_{funcstart_{-724,1}}.p1, 177).rem)
[57.1] \theta_{17.42,8} = \theta_{17.42,8} = \theta_{17.42,8} = \theta_{17.42,8} = \theta_{17.42,8}. \theta_{17.42,8} = \theta_{17.42,8} = \theta_{17.42,8}
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 *
\operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724.1}, \$ \operatorname{heap}_{funcstart\_724.1}.p1,
(177).rem))._replace(p2 \rightarrow asType<short
int>((asType<int>(asType<short int>(div2.rem)) *
asType < int > (\$heap_{724,1:740,8}.r2)) - (asType < int > (asType < short)
int>(div2.quot)) * asType< int>($heap_{724,1;740.8}.b2))))
\rightarrow [from term 25.6, div2 is equal to div(heapIs $heap_{funcstart\_724,1},
heap_{funcstart_{724,1}}.p2, 176
[57.2] $\text{heap}_{724,1;742,8} == $\text{heap}_{funcstart\_724,1}._\text{replace}(\text{p1} \to ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1,
177).rem))).\_replace(p2 \rightarrow asType < short
\mathbf{int}{>}((\mathbf{asType}{<}\mathbf{int}{>}(\mathbf{asType}{<}\mathbf{short}\ \mathbf{int}{>}(\mathbf{div}(\mathbf{heapIs}\ \$\mathbf{heap}_{funcstart\_724,1},
\text{sheap}_{funcstart\_724,1.p2, 176}.\text{rem}) * asType < int > (\text{sheap}_{724,1:740.8.r2})) -
(asType<int>(asType<short int>(div2.quot)) *
asType < int > (\$heap_{724,1;740,8}.b2))))
\rightarrow [simplify]
[57.4] $heap<sub>724,1;742,8</sub> == $heap<sub>funcstart_724,1</sub>._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 \ *
\operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724,1}, \$ \operatorname{heap}_{funcstart\_724,1}.p1,
(177).rem))._replace(p2 \rightarrow asType<short int>((div(heapIs)
```

```
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.p2, 176).rem *
asType < int > (\$heap_{724,1:740,8}.r2)) - (asType < int > (asType < short)
int>(div2.quot)) * asType<int>($heap<sub>724,1:740,8</sub>.b2))))
\rightarrow [from term 53.19, $heap<sub>724,1;740,8</sub> is equal to
heap_{funcstart\_724.1}._replace(p1 \rightarrow (-2 * div(heapIs heap_{funcstart\_724.1}),
heap_{funcstart\_724,1}.p1, 177).quot + (171 * div(heapIs $heap_{funcstart\_724,1}, 177).quot) + (171 * div(heapIs $heap_{funcstart\_724,1}, 17
heap_{funcstart\_724,1}.p1, 177).rem))
[57.5] heap_{724,1;742,8} == heap_{funcstart\_724,1}.\_replace(p1 \to ((-2 * 
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 \ *
\operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724,1}, \$ \operatorname{heap}_{funcstart\_724,1}.p1,
177).rem)))._{\mathbf{replace}}(p2 \rightarrow \mathbf{asType} < \mathbf{short\ int} > ((\operatorname{div}(\mathbf{heapIs}))))
heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p2, 176).rem *
asType < int > (\$heap_{funcstart\_724,1}.\_replace(p1 \rightarrow ((-2 * div(heapIs))))))
\theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}
\text{Sheap}_{funcstart_{-724,1}}, \text{Sheap}_{funcstart_{-724,1}}.p1, 177).rem))).r2)) -
(asType<int>(asType<short int>(div2.quot)) *
asType < int > (\$heap_{724,1;740,8}.b2))))
→ [const member of object with modified fields]
[57.6] heap_{724,1;742,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).quot) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow asType<short int>((div(heapIs
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.p2, 176).rem *
asType < int > (\$heap_{tuncstart\_724.1}.r2)) - (asType < int > (asType < short)
int>(div2.quot)) * asType<int>($heap<sub>724.1:740.8</sub>.b2))))
\rightarrow [const static or extern object]
[57.7] heap_{724,1;742,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 *
\operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724.1}, \$ \operatorname{heap}_{funcstart\_724.1}.p1,
177).rem)))._replace(p2 \rightarrow asType<short int>((div(heapIs
e_{funcstart\_724,1}, e_{funcstart\_724,1.p2, 176}.rem *
asType < int > (\$heap_{init}.r2)) - (asType < int > (asType < short)
int>(div2.quot)) * asType< int>($heap_{724,1;740,8}.b2))))
\rightarrow [expand definition of constant 'r2' at prang.c (20,20)]
[57.8] heap_{724,1;742,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 \ *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.p1,
177).rem)))._{\mathbf{replace}}(p2 \rightarrow \mathbf{asType} < \mathbf{short\ int} > ((\operatorname{div}(\mathbf{heapIs}))))
heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p2, 176).rem *
asType<int>(asType<short int>((int)172))) -
(asType<int>(asType<short int>(div2.quot)) *
asType < int > (\$heap_{724,1;740,8}.b2))))
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\rightarrow [simplify]
[57.11] $\text{heap}_{724,1:742,8} == \text{$heap}_{funcstart\_724,1}._\text{$replace}(p1 \to ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).quot) + (171 *
\operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724,1}, \$ \operatorname{heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow asType<short int>((div(heapIs
\theta_{funcstart_{724,1}}, \theta_{funcstart_{724,1}}, 176).rem * 172) –
(asType<int>(asType<short int>(div2.quot)) *
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{724,1;740,8}.\mathrm{b2}))))
\rightarrow [from term 25.6, div2 is equal to div(heapIs $heap_{tuncstart\_724.1},
$heap_{tuncstart_{724,1}}.p2, 176)]
[57.12] $heap<sub>724,1;742,8</sub> == $heap<sub>funcstart_724,1</sub>._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724.1}, \ \$ \operatorname{heap}_{funcstart\_724.1}.p1,
177).rem)))._{\mathbf{replace}}(p2 \rightarrow \mathbf{asType} < \mathbf{short\ int} > ((172 * div(\mathbf{heapIs}))))
\theta_{funcstart_{724,1}}, \theta_{funcstart_{724,1}}, \theta_{funcstart_{724,1}}.p2, 176).rem) –
(asType<int>(asType<short int>(div(heapIs $heap_{funcstart\_724,1},))
\text{sheap}_{funcstart\_724,1}.\text{p2}, 176).\text{quot})) * asType < int > (\text{sheap}_{724,1;740.8}.\text{b2}))))
\rightarrow [simplify]
[57.14] $\text{heap}_{724,1;742,8} == \text{$heap}_{funcstart\_724,1}._\text{replace}(p1 \to ((-2 *
div(\mathbf{heapIs} \ \$heap_{funcstart\_724.1}, \ \$heap_{funcstart\_724.1}.p1, \ 177).quot) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow asType<short int>((172 * div(heapIs
\theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}.p2, 176).rem) - (div(heapIs
\theta_{funcstart_{724,1}}, \theta_{funcstart_{724,1}}, \theta_{funcstart_{724,1}}.p2, 176).quot
asType < int > (\$heap_{724,1:740,8}.b2))))
\rightarrow [from term 53.19, $heap<sub>724,1;740,8</sub> is equal to
heap_{funcstart\_724,1}._replace(p1 \rightarrow (-2 * div(heapIs heap_{funcstart\_724,1}),
\text{Sheap}_{funcstart\_724,1}.\text{p1}, 177).\text{quot} + (171 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
heap_{funcstart_{-724,1}}.p1, 177).rem)
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 \ *
\label{eq:div_heap} \text{div}(\textbf{heapIs} \ \$ \text{heap}_{funcstart\_724,1}, \ \$ \text{heap}_{funcstart\_724,1}.\text{p1},
177).rem))).\_\mathbf{replace}(p2 \rightarrow \mathbf{asType} < \mathbf{short\ int} > ((172\ ^*\ \mathrm{div}(\mathbf{heapIs}
heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p2, 176).rem) - (div(heapIs)
heap_{funcstart_{724,1}}, heap_{funcstart_{724,1}}, 2, 176).quot *
\mathbf{asType}{<}\mathbf{int}{>}(\$\text{heap}_{funcstart\_724,1}.\mathbf{\_replace}(\text{p1} \rightarrow ((\text{-2} * \text{div}(\mathbf{heapIs}
\text{Sheap}_{funcstart_{-724,1}}, \text{Sheap}_{funcstart_{-724,1}}, \text{p1}, 177).\text{quot}) + (171 * \text{div}(\text{heapIs}))
\text{Sheap}_{funcstart_{-724,1}}, \text{Sheap}_{funcstart_{-724,1}}.p1, 177).rem))).b2))))
\rightarrow [const member of object with modified fields]
[57.16] $heap<sub>724,1;742,8</sub> == $heap<sub>funcstart_724,1</sub>._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.p1,
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177).rem)))._replace(p2 \rightarrow asType<short int>((172 * div(heapIs
\$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p2, 176).rem) - (div(\textbf{heapIs}
heap_{funcstart_{724,1}}, heap_{funcstart_{724,1}}, 2, 176).quot *
asType < int > (\$heap_{funcstart\_724,1}.b2)))
\rightarrow [const static or extern object]
[57.17] $heap<sub>724,1;742,8</sub> == $heap<sub>funcstart_724,1</sub>._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).quot) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}. \operatorname{pl},
177).rem)))._replace(p2 \rightarrow asType<short int>((172 * div(heapIs
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.\text{p2}, 176).\text{rem}) - (\text{div}(\text{heapIs})
\theta_{funcstart_{724,1}}, \theta_{funcstart_{724,1},p2,176}, quot *
asType < int > (\$heap_{init}.b2))))
\rightarrow [expand definition of constant 'b2' at prang.c (22,20)]
[57.18] $heap<sub>724,1;742,8</sub> == $heap<sub>funcstart_724,1</sub>._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 \ *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow asType<short int>((172 * div(heapIs
\theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}
\text{Sheap}_{funcstart_{-724,1}}, \text{Sheap}_{funcstart_{-724,1}}.p2, 176).quot *
asType<int>(asType<short int>((int)35)))))
\rightarrow [simplify]
[57.24] $heap<sub>724,1;742,8</sub> == $heap<sub>funcstart_724,1</sub>._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 *
\operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724,1}, \$ \operatorname{heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow ((-35 * div(heapIs $heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1}.\text{p2}, 176).\text{quot} + (172 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
heap_{funcstart_{-724,1}.p2, 176).rem}
[Take given term]
[61.0] $\text{heap}_{724,1;744,8} == $\text{heap}_{724,1;742,8}._\text{replace}(p3 \to \text{asType} < \text{short}
int>((asType<int>(asType<short int>(div3.rem)) *
asType < int > (\$heap_{724,1:742,8}.r3)) - (asType < int > (asType < short)
\mathbf{int}{>}(\text{div3.quot})) \ * \ \mathbf{asType}{<} \mathbf{int}{>} (\$\text{heap}_{724,1;742,8}.\text{b3}))))
\rightarrow [from term 57.24, $\$heap_{724,1;742,8}$ is equal to
heap_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 * div(heapIs *heap_{funcstart\_724,1},
\text{Sheap}_{funcstart_{-724,1},p1, 177}.\text{quot}) + (171 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart_{-724,1}})
\rho_{uncstart_{-724,1}.p1, 177).rem})._replace\rho_{uncstart_{-724,1}.p1, 177).rem}._replace\rho_{uncstart_{-724,1}.p1, 177).rem}
heap_{funcstart\_724,1}, p_{funcstart\_724,1}, p_{funcstart\_724,1}, p_{funcstart\_724,1}, p_{funcstart\_724,1}
\$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p2, 176).rem))]
[61.1] $\text{heap}_{724,1;744,8} == $\text{heap}_{funcstart\_724,1}._\text{replace}(p1 \to ((-2 *
div(\mathbf{heapIs} \ \$heap_{funcstart\_724,1}, \ \$heap_{funcstart\_724,1}.p1, \ 177).quot) + (171 *
\operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724,1}, \$ \operatorname{heap}_{funcstart\_724,1}.p1,
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177).rem)))._replace(p2 \rightarrow ((-35 * div(heapIs $heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1.p2}, 176).\text{quot} + (172 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
\theta_{funcstart\_724,1}.p2, 176).rem))._replace(p3 \rightarrow asType<short
int>((asType<int>(asType<short int>(div3.rem)) *
asType < int > (\$heap_{724,1:742,8}.r3)) - (asType < int > (asType < short)
int > (div3.quot)) * asType < int > ($heap_{724,1:742.8}.b3))))
\rightarrow [from term 39.6, div3 is equal to div(heapIs $heap_{tuncstart_{724.1}},
heap_{funcstart_{-724,1}}.p3, 178
[61.2] $heap<sub>724,1:744,8</sub> == $heap<sub>funcstart_724,1</sub>._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 *
\label{eq:div_heap} \text{div}(\textbf{heapIs} \ \$ \text{heap}_{funcstart\_724,1}, \ \$ \text{heap}_{funcstart\_724,1}.\text{p1},
177).rem)))._replace(p2 \rightarrow ((-35 * div(heapIs $heap_{funcstart_724,1},
\text{Sheap}_{funcstart\_724,1.p2}, 176).\text{quot} + (172 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
\theta_{funcstart\_724,1}.p2, 176).rem))._replace(p3 \rightarrow asType<short
int>((asType<int>(asType<short int>(div(heapIs $heap_{funcstart\_724,1},
\text{sheap}_{funcstart-724,1.p3}, 178).rem) * asType<int>(\text{sheap}_{724,1.742,8.r3})) -
(asType<int>(asType<short int>(div3.quot)) *
asType<int>($heap<sub>724.1:742.8</sub>.b3))))
\rightarrow [simplify]
[61.4] $heap<sub>724,1;744,8</sub> == $heap<sub>funcstart_724,1</sub>._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).quot) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow ((-35 * div(heapIs $heap_{tuncstart_724.1},
\text{Sheap}_{funcstart\_724,1}.\text{p2}, 176).\text{quot} + (172 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
\rho_{funcstart\_724,1.p2, 176).rem})).\_replace(p3 \rightarrow asType < hort)
int>((div(heapIs \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p3, 178).rem *
asType < int > (\$heap_{724.1:742.8}.r3)) - (asType < int > (asType < short)
int>(div3.quot)) * asType< int>($heap_{724.1:742.8}.b3))))
\rightarrow [from term 57.24, $heap<sub>724,1;742,8</sub> is equal to
heap_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 * div(heapIs $heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1}.p1, 177).quot) + (171 * div(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
heap_{funcstart\_724,1}.p1, 177).rem))._replace(p2 \rightarrow (-35 * div(heapIs)))._
heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p2, 176).quot) + (172 * div(heapIs)
heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p2, 176).rem))]
[61.5] $heap<sub>724,1;744,8</sub> == $heap<sub>funcstart_724,1</sub>._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 *
\operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724,1}, \$ \operatorname{heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow ((-35 * div(heapIs \rho_{tart\_724,1},
\rho_{funcstart\_724,1.p2}, 176).quot) + (172 * div(heapIs \rho_{funcstart\_724,1},
\rho_{funcstart\_724,1.p2, 176}.rem))._replace(p3 \rightarrow asType<short
int>((\text{div}(\mathbf{heapIs} \$ \text{heap}_{funcstart\_724,1}, \$ \text{heap}_{funcstart\_724,1}.p3, 178).\text{rem} *
asType < int > (\$heap_{funcstart\_724,1}.\_replace(p1 \rightarrow ((-2 * div(heapIs)))))))
\$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1, 177).quot) + (171 * div(\textbf{heapIs})
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\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.p1, 177).rem))).\_replace(p2 \rightarrow ((-35))
* div(\mathbf{heapIs} \ \$heap_{funcstart\_724,1}, \ \$heap_{funcstart\_724,1}.p2, \ 176).quot) + (172 \ *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.\operatorname{p2}, \ 176).\operatorname{rem}))).\operatorname{r3})) \ -
(asType<int>(asType<short int>(div3.quot)) '
asType < int > (\$heap_{724,1;742,8}.b3))))
→ [const member of object with modified fields]
[61.7] heap_{724,1;744,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).quot) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow ((-35 * div(heapIs $heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1}.\text{p2}, 176).\text{quot} + (172 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
\theta_{funcstart\_724,1}.p2, 176).rem))._replace(p3 \rightarrow asType<short
int>((div(heapIs \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p3, 178).rem *
asType < int > (\$heap_{funcstart\_724,1}.r3)) - (asType < int > (asType < short)
int>(div3.quot)) * asType< int>($heap_{724,1;742,8}.b3))))
\rightarrow [const static or extern object]
[61.8] heap_{724,1;744,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart} \ 724.1, \ \$ \operatorname{heap}_{funcstart} \ 724.1, \ p1,
177).rem)))._replace(p2 \rightarrow ((-35 * div(heapIs $heap_{funcstart_724,1},
\text{Sheap}_{funcstart\_724,1.p2}, 176).\text{quot} + (172 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
\theta_{uncstart_724.1.p2, 176}.rem)._replace(p3 \rightarrow asType<short
int>((div(heapIs \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p3, 178).rem *
asType < int > (\$heap_{init}.r3)) - (asType < int > (asType < short)
int>(div3.quot)) * asType< int>($heap_{724.1:742.8}.b3))))
\rightarrow [expand definition of constant 'r3' at prang.c (25,20)]
[61.9] \rho_{1.9} = \rho_{1.9}
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 *
\operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724.1}, \$ \operatorname{heap}_{funcstart\_724.1}.p1,
177).rem)))._replace(p2 \rightarrow ((-35 * div(heapIs $heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724.1.p2}, 176).\text{quot} + (172 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724.1},
\rho_{tuncstart\_724.1.p2, 176}.rem))._replace(p3 \rightarrow asType<short
int>((div(heapIs \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p3, 178).rem *
asType<int>(asType<short int>((int)170))) -
(asType<int>(asType<short int>(div3.quot)) *
asType < int > (\$heap_{724.1:742.8}.b3)))
\rightarrow [simplify]
[61.12] $\text{heap}_{724,1;744,8} == $\text{heap}_{funcstart\_724,1}._\text{replace}(p1 \to ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 \ *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow ((-35 * div(heapIs $heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1}.\text{p2}, 176).\text{quot}) + (172 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
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\rho_{funcstart=724.1.p2, 176}.rem)._replace(p3 \rightarrow asType<short
int>((div(heapIs \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p3, 178).rem * 170)
- (asType < int > (asType < short int > (div3.quot))*
asType < int > (\$heap_{724,1;742,8}.b3))))
\rightarrow [from term 39.6, div3 is equal to div(heapIs $heap_{funcstart_724.1},
heap_{funcstart_{724,1}}.p3, 178
[61.13] $heap<sub>724,1;744,8</sub> == $heap<sub>funcstart_724,1</sub>._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).quot) + (171 *
\operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724,1}, \$ \operatorname{heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow ((-35 * div(heapIs $heap_{tuncstart}, 724.1,
\text{Sheap}_{funcstart\_724,1.p2}, 176).\text{quot} + (172 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
\rho_{tuncstart\_724,1.p2, 176}.rem)._replace(p3 \rightarrow asType<short int>((170
* div(heapIs heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p3, 178).rem) -
(asType<int>(asType<short int>(div(heapIs $heap_{funcstart\_724,1},))
\text{sheap}_{funcstart\_724,1}.\text{p3}, 178).\text{quot}) * asType<int>(\text{sheap}_{724,1;742,8}.\text{b3}))))
\rightarrow [simplify]
[61.15] $heap<sub>724,1;744,8</sub> == $heap<sub>funcstart_724,1</sub>._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart} \ 724.1, \ \$ \operatorname{heap}_{funcstart} \ 724.1, \ p1,
177).rem)))._replace(p2 \rightarrow ((-35 * div(heapIs $heap_{funcstart_724,1},
\text{Sheap}_{funcstart\_724,1.p2}, 176).\text{quot} + (172 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
\rho_{tuncstart_724.1}.p2, 176).rem))._replace(p3 \rightarrow asType<short int>((170
* div(heapIs heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p3, 178).rem) –
(\text{div}(\mathbf{heapIs} \$ \text{heap}_{funcstart\_724,1}, \$ \text{heap}_{funcstart\_724,1}.\text{p3}, 178).\text{quot} *
asType<int>($heap<sub>724.1:742.8</sub>.b3))))
\rightarrow [from term 57.24, $heap<sub>724,1;742,8</sub> is equal to
heap_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 * div(heapIs $heap_{funcstart\_724,1},
heap_{funcstart\_724,1}.p1, 177).quot + (171 * div(heapIs $heap_{funcstart\_724,1},
\rho_{uncstart\_724,1}.p1, 177).rem))._replace\rho_{uncstart\_724,1}.p1, 177).rem))._replace
heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p2, 176).quot) + (172 * div(heapIs)
heap_{funcstart_{724,1}}, heap_{funcstart_{724,1}}, 2, 176).rem
[61.16] $\text{heap}_{724.1:744.8} == $\text{heap}_{funcstart_724.1}.$\text{-replace}(p1 \to ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 \ *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow ((-35 * div(heapIs $heap_{funcstart\_724,1},
\text{Sheap}_{funcstart_{-724,1},p2, 176}.quot) + (172 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart_{-724,1}},
\rho_{funcstart\_724,1}.p2, 176).rem))._replace(p3 \rightarrow asType<short int>((170)
* \operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p3, \ 178).rem) -
(\text{div}(\mathbf{heapIs} \$ \text{heap}_{funcstart\_724,1}, \$ \text{heap}_{funcstart\_724,1}.\text{p3}, 178).\text{quot} *
asType < int > (\$heap_{funcstart\_724,1}.\_replace(p1 \rightarrow ((-2 * div(heapIs)))))))
\theta_{funcstart_{724,1}}, \theta_{funcstart_{724,1},p1, 177}.quot) + (171 * div(heapIs)
\rho_{tuncstart\_724,1}, \rho_{tuncstart\_724,1}, \rho_{tuncstart\_724,1}, \rho_{tuncstart\_724,1}, \rho_{tuncstart\_724,1}, \rho_{tuncstart\_724,1}, \rho_{tuncstart\_724,1}
* div(heapIs heap_{funcstart_{724,1}}, heap_{funcstart_{724,1}}, 176).quot) + (172 *
```

```
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.\operatorname{p2}, \ 176).\operatorname{rem}))).\operatorname{b3}))))
\rightarrow [const member of object with modified fields]
[61.18] $heap<sub>724,1;744,8</sub> == $heap<sub>funcstart_724,1</sub>._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).quot) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow ((-35 * div(heapIs $heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1}.\text{p2}, 176).\text{quot} + (172 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
\rho_{tuncstart\_724,1.p2, 176}.rem)._replace(p3 \rightarrow asType<short int>((170
* div(heapIs heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p3, 178).rem) –
(\text{div}(\mathbf{heapIs} \$ \text{heap}_{funcstart\_724,1}, \$ \text{heap}_{funcstart\_724,1}.\text{p3}, 178).\text{quot} *
asType < int > (\$heap_{funcstart\_724,1}.b3))))
\rightarrow [const static or extern object]
[61.19] $heap<sub>724,1;744,8</sub> == $heap<sub>funcstart_724,1</sub>._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 *
\operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724,1}, \$ \operatorname{heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow ((-35 * div(heapIs $heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1}.\text{p2}, 176).\text{quot} + (172 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
\rho_{uncstart\_724,1.p2, 176).rem}))._replace(p3 \rightarrow asType<short int>((170
* div(heapIs heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p3, 178).rem) -
(\text{div}(\mathbf{heapIs} \$ \text{heap}_{funcstart\_724,1}, \$ \text{heap}_{funcstart\_724,1}.\text{p3}, 178).\text{quot} *
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{init}.\mathrm{b3}))))
\rightarrow [expand definition of constant 'b3' at prang.c (27,20)]
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).quot) + (171 *
\operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724,1}, \$ \operatorname{heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow ((-35 * div(heapIs $heap_{funcstart\_724,1},
\theta_{funcstart\_724,1.p2}, 176).quot) + (172 * div(heapIs \theta_{funcstart\_724,1},
\theta_{funcstart\_724,1}.p2, 176).rem))._replace(p3 \rightarrow asType<short int>((170
* div(heapIs heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p3, 178).rem) –
(div(heapIs heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p3, 178).quot *
asType<int>(asType<short int>((int)63)))))
\rightarrow [simplify]
[61.26] $heap<sub>724,1;744,8</sub> == $heap<sub>funcstart_724,1</sub>._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow ((-35 * div(heapIs $heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1}.\text{p2}, 176).\text{quot} + (172 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724.1.p2}, 176).rem))._replace(p3 \rightarrow ((-63 * div(heapIs)
heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p3, 178).quot) + (170 * div(heapIs
\$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p3, 178).rem)))
[Take goal term]
```

```
[1.0] $heap<sub>724,1:744.8</sub>.M1 \leq maxof(int)
\rightarrow [from term 61.26, $heap<sub>724.1:744.8</sub> is equal to
heap_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 * div(heapIs $heap_{funcstart\_724,1},
heap_{funcstart\_724,1}.p1, 177).quot + (171 * div(heapIs $heap_{funcstart\_724,1}, 177).quot) + (171 * div(heapIs $heap_{funcstart\_724,1}, 17
\rho_{funcstart\_724.1.p1, 177).rem}))._replace\rho_{funcstart\_724.1.p1, 177).rem})
heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p2, 176).quot) + (172 * div(heapIs)
heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p2, 176).rem)))._replace(p3 \rightarrow (-63 *
div(\mathbf{heapIs} \ \$heap_{funcstart\_724,1}, \ \$heap_{funcstart\_724,1}.p3, \ 178).quot) + (170 *
div(\mathbf{heapIs} \ \$heap_{funcstart\_724,1}, \ \$heap_{funcstart\_724,1}.p3, \ 178).rem))]
[1.1] heap_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 * div(heapIs
\theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}.p1, 177).quot) + (171 * div(heapIs
* div(\mathbf{heapIs} \ \$ heap_{funcstart\_724,1}, \ \$ heap_{funcstart\_724,1}.p2, \ 176).quot) + (172 \ *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p2,
176).rem)))._replace(p3 \rightarrow ((-63 * div(heapIs $heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1}.\text{p3}, 178).\text{quot} + (170 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1}.\text{p3}, 178).\text{rem})).\text{M1} \leq \text{maxof(int)}
\rightarrow [const member of object with modified fields]
[1.4] $\text{heap}_{funcstart_724.1}.\text{M1} \leq \text{maxof(int)}
\rightarrow [const static or extern object]
[1.5] $heap<sub>init</sub>.M1 \leq maxof(int)
\rightarrow [expand definition of constant 'M1' at prang.c (14,20)]
[1.6] asType<short int>((int)30269) < maxof(int)
\rightarrow [simplify]
[1.10] true
Proof of verification condition: Type constraint satisfied in implicit
conversion from 'short int' to 'int'
Condition generated at: C:\Escher\Customers\prang\prang.c (63,17)
Condition defined at:
To prove: minof(int) \le \$heap_{724,1:744,8}.p1
Given:
heap_{init}.LIMIT == (int)80
\theta
\theta_{init}.r1 == asType < short int > ((int)171)
\theta
\theta = asType < short int > ((int)2)
```

```
heap_{init}.M2 == asType < short int > ((int)30307)
\theta_{init}.r2 == asType < short int > ((int)172)
\theta_{init}.a2 == asType<short int>((int)176)
heap_{init}.b2 == asType<short int>((int)35)
heap_{init}.M3 == asType < short int > ((int)30323)
heap_{init}.r3 == asType < short int > ((int)170)
heap_{init}.a3 == asType < short int > ((int)178)
\theta = asType < short int > ((int)63)
\theta = asType < short int > ((int)1)
\theta
\rho = asType < short int > ((int)3)
invariant1(heapIs heap_{funcstart_{-724,1}})
div1 == div(\mathbf{heapIs} \$ heap_{funcstart\_724.1},
asType < int > (\$heap_{funcstart\_724.1}.p1),
asType < int > (\$heap_{funcstart\_724,1}.a1))
(asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.p1)) /
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a1))) ==
asType<integer>(div1.quot)
(asType < int > (asType < int > (\$heap_{funcstart\_724,1}.p1)) \%
asType < integer > (asType < int > (\$heap_{funcstart_{-724.1}}.a1))) = =
asType<integer>(div1.rem)
!(0 == asType < integer > (div1.rem)) || !(0 ==
asType<integer>(div1.quot))
div2 == div(\mathbf{heapIs} \$heap_{funcstart\_724,1},
asType < int > (\$heap_{funcstart\_724.1}.p2),
asType < int > (\$heap_{funcstart\_724,1}.a2))
(asType<integer>(asType<int>($heap_{funcstart\_724.1}.p2)) /
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a2))) = =
asType<integer>(div2.quot)
(\mathbf{asType} < \mathbf{integer} > (\mathbf{asType} < \mathbf{int} > (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p2})) \ \%
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a2))) = =
asType<integer>(div2.rem)
!(0 == asTvpe < integer > (div2.rem)) || !(0 ==
asType<integer>(div2.quot))
div3 == div(\mathbf{heapIs} \$ heap_{funcstart\_724,1},
asType < int > (\$heap_{funcstart\_724,1}.p3),
asType < int > (\$heap_{funcstart\_724,1}.a3))
```

```
(\mathbf{asType} {<} \mathbf{integer} {>} (\mathbf{asType} {<} \mathbf{int} {>} (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p3})) \ / \\
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a3))) = =
asType<integer>(div3.quot)
(asType<int>(asType<int>($heap_{tuncstart\_724,1}.p3)) %
\mathbf{asType}{<}\mathbf{integer}{>}(\mathbf{asType}{<}\mathbf{int}{>}(\$\mathbf{heap}_{funcstart\_724,1}.\mathbf{a3}))) = =
asType<integer>(div3.rem)
!(0 == asType < integer > (div3.rem)) || !(0 ==
asType<integer>(div3.quot))
\$heap_{724,1;740,8} == \$heap_{funcstart\_724,1}.\_\textbf{replace}(p1 \rightarrow \textbf{asType} < \textbf{short}
int>((asType<int>(asType<short int>(div1.rem)) *
asType < int > (\$heap_{funcstart\_724,1}.r1)) - (asType < int > (asType < short)
int>(div1.quot)) * asType<int>($heap_{funcstart\_724,1}.b1)))
-asType<integer const>($heap<sub>724,1:740,8</sub>.M1) <
asType<integer>($heap<sub>724,1:740,8</sub>.p1)
!(0 == asType < integer > (\$heap_{724,1;740,8}.p1))
asType<integer>($heap<sub>724,1;740,8</sub>.p1) <
asType<integer>($heap<sub>724.1:740.8</sub>.M1)
\text{heap}_{724.1:742.8} == \text{heap}_{724.1:740.8}._replace(p2 \rightarrow asType<short)
int>((asType<int>(asType<short int>(div2.rem))
asType < int > (\$heap_{724,1:740,8}.r2)) - (asType < int > (asType < short)
int>(div2.quot)) * asType<int>($heap<sub>724.1:740.8</sub>.b2))))
-asType < integer\ const > (\$heap_{724,1;742,8}.M2) < 
asType<integer>($heap<sub>724.1:742.8</sub>.p2)
!(0 == asType < integer > (\$heap_{724,1:742.8}.p2))
asType<integer>($heap<sub>724.1:742.8</sub>.p2) <
asType<integer>($heap<sub>724.1:742.8</sub>.M2)
heap_{724,1:744,8} == heap_{724,1:742,8}.replace(p3 \rightarrow asType<short
int>((asType<int>(asType<short int>(div3.rem)) *
asType < int > (\$heap_{724,1:742.8}.r3)) - (asType < int > (asType < short)
int > (div3.quot)) * asType < int > ($heap_{724,1;742,8}.b3))))
-asType < integer const > (\$heap_{724,1;744,8}.M3) < 
asType<integer>($heap<sub>724.1:744.8</sub>.p3)
!(0 == asType < integer > (\$heap_{724,1:744.8}.p3))
asType < integer > (\$heap_{724,1;744,8}.p3) < 
\mathbf{asType} < \mathbf{integer} > (\$ \mathrm{heap}_{724,1;744,8}.\mathrm{M3})
Proof:
[Take given term]
[11.0] \operatorname{div1} == \operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724,1},
```

```
\mathbf{asType} < \mathbf{int} > (\$ \mathrm{heap}_{funcstart\_724,1}.\mathrm{p1}),
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{a1}))
\rightarrow [simplify]
[11.1]~{\rm div1} == {\rm div}(\mathbf{heapIs}~\$ \mathrm{heap}_{funcstart\_724,1},\,\$ \mathrm{heap}_{funcstart\_724,1}.\mathrm{p1},
\mathbf{asType} < \mathbf{int} > (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{a1}))
\rightarrow [const static or extern object]
[11.2] div1 == div(heapIs \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}.p1,
asType < int > (\$heap_{init}.a1))
\rightarrow [expand definition of constant 'a1' at prang.c (16,20)]
\textit{[11.3]} \ \text{div1} == \text{div}(\mathbf{heapIs} \ \$ \text{heap}_{funcstart\_724,1}, \ \$ \text{heap}_{funcstart\_724,1}.\text{p1},
asType<int>(asType<short int>((int)177)))
\rightarrow [simplify]
[11.6] \text{ div1} == \text{div}(\mathbf{heapIs} \$ heap_{funcstart\_724,1}, \$ heap_{funcstart\_724,1}.p1, 177)
[Take given term]
[25.0] \operatorname{div2} == \operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724,1},
asType < int > (\$heap_{funcstart\_724,1}.p2),
asType < int > (\$heap_{funcstart\_724,1}.a2))
\rightarrow [simplify]
[25.1] \ \mathrm{div2} == \mathrm{div}(\mathbf{heapIs} \ \$ \mathrm{heap}_{funcstart\_724,1}, \ \$ \mathrm{heap}_{funcstart\_724,1}.\mathrm{p2},
asType < int > (\$heap_{funcstart\_724,1}.a2))
\rightarrow [const static or extern object]
[25.2] \operatorname{div2} == \operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p2,
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{init}.\mathrm{a2}))
\rightarrow [expand definition of constant 'a2' at prang.c (21,20)]
[25.3] div2 == div(heapIs $heap_{tuncstart\_724.1}, $heap_{tuncstart\_724.1}.p2,
asType<int>(asType<short int>((int)176)))
\rightarrow [simplify]
[25.6] div2 == div(heapIs heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p2, 176)
[Take given term]
[39.0] div3 == div(heapIs $heap_{funcstart\_724,1},
asType < int > (\$heap_{funcstart\_724,1}.p3),
asType < int > (\$heap_{funcstart\_724,1}.a3))
\rightarrow [simplify]
[39.1] div3 == div(heapIs heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p3,
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{a3}))
\rightarrow [const static or extern object]
```

```
[39.2] div3 == div(heapIs heap_{funcstart_{-724,1}}, heap_{funcstart_{-724,1}}.p3,
asType < int > (\$heap_{init}.a3))
\rightarrow [expand definition of constant 'a3' at prang.c (26,20)]
[39.3] \operatorname{div3} == \operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724,1}, \$ \operatorname{heap}_{funcstart\_724,1}.p3,
asType<int>(asType<short int>((int)178)))
\rightarrow [simplify]
[39.6] div3 == div(heapIs heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p3, 178)
[Take given term]
[53.0] \theta == 
int>((asType<int>(asType<short int>(div1.rem)) *
asType < int > (\$heap_{funcstart\_724,1}.r1)) - (asType < int > (asType < short)
int>(div1.quot)) * asType<int>($heap_{funcstart\_724,1}.b1)))
\rightarrow [from term 11.6, div1 is equal to div(heapIs $heap_{funcstart\_724,1},
heap_{funcstart_{-724,1}}.p1, 177)
[53.1] heap_{724,1:740.8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow asType<short
int>((asType<int>(asType<short int>(div(heapIs $heap_{funcstart_724.1},))
\text{Sheap}_{funcstart\_724,1.p1, 177}.\text{rem}) * \mathbf{asType} < \mathbf{int} > (\text{Sheap}_{funcstart\_724,1.r1})) - (\mathbf{sheap}_{funcstart\_724,1.r1}) - (\mathbf{sh
(asType<int>(asType<short int>(div1.quot)) *
asType < int > (\$heap_{funcstart\_724,1}.b1))))
\rightarrow [simplify]
[53.3] \text{sheap}_{724,1;740,8} == \text{sheap}_{funcstart\_724,1}._replace(p1 \rightarrow asType<short
int>((div(heapIs \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1, 177).rem *
asType < int > (\$heap_{funcstart\_724,1}.r1)) - (asType < int > (asType < short)
int>(div1.quot)) * asType< int>($heap_{tuncstart\_724.1}.b1))))
\rightarrow [const static or extern object]
[53.4] heap_{724,1;740,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow asType<short
int>((div(heapIs \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1, 177).rem *
asType < int > (\$heap_{init}.r1)) - (asType < int > (asType < short)
\mathbf{int}{>}(\mathbf{div1.quot})) * \mathbf{asType}{<} \mathbf{int}{>} (\$\mathbf{heap}_{funcstart\_724,1}.\mathbf{b1}))))
\rightarrow [expand definition of constant 'r1' at prang.c (15,20)]
[53.5] heap_{724,1;740,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow asType<short
int>((div(heapIs \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1, 177).rem *
asType < int > (asType < short int > ((int)171))) -
(asType<int>(asType<short int>(div1.quot)) *
asType < int > (\$heap_{funcstart\_724.1}.b1)))
\rightarrow [simplify]
[53.8] heap_{724,1:740.8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow asType<short
int > ((div(heapIs \$heap_{funcstart\_724.1}, \$heap_{funcstart\_724.1}, p1, 177).rem * 171)
- (asType<int>(asType<short int>(div1.quot)) *
```

```
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{b1}))))
 \rightarrow [from term 11.6, div1 is equal to div(heapIs $heap_{tuncstart_724.1},
 heap_{funcstart_{-724,1}}.p1, 177
 [53.9] \rho_{13,1;740,8} == \rho_{13,1;740,8} == \rho_{13,1;740,8} =- \rho_{
int>((171 * div(heapIs \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1, 177).rem)
 - (asType<int>(asType<short int>(div(heapIs $heap_{funcstart_724.1},
 heap_{funcstart_{724,1}}.p1, 177).quot) *
asType < int > (\$heap_{funcstart\_724,1}.b1))))
 \rightarrow [simplify]
 [53.11] \theta == 
int>((171 * div(heapIs \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1, 177).rem)
 - (\text{div}(\mathbf{heapIs} \$ \text{heap}_{funcstart\_724,1}, \$ \text{heap}_{funcstart\_724,1}.\text{p1}, 177).\text{quot} *
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{b1}))))
 \rightarrow [const static or extern object]
 [53.12] heap_{724,1;740,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow asType<short
int>((171 * div(heapIs \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1, 177).rem)
 - (\text{div}(\mathbf{heapIs} \$ \text{heap}_{funcstart\_724,1}, \$ \text{heap}_{funcstart\_724,1}.\text{p1}, 177).\text{quot} *
asType < int > (\$heap_{init}.b1)))
 \rightarrow [expand definition of constant 'b1' at prang.c (17,20)]
 [53.13] \theta_{13} = \theta_
int > ((171 * div(heapIs \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1, 177).rem)
 - (\text{div}(\mathbf{heapIs} \$ \text{heap}_{funcstart\_724,1}, \$ \text{heap}_{funcstart\_724,1}.\text{p1}, 177).\text{quot} *
asType<int>(asType<short int>((int)2))))
 \rightarrow [simplify]
[53.19] $\text{heap}_{724,1;740,8} == \text{$heap}_{funcstart\_724,1}.$\text{$_{-}$replace}(p1 \to ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).quot) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.\operatorname{p1}, \ 177).\operatorname{rem})))
 [Take given term]
 [54.0] -asType<integer const>($heap_{724.1:740.8}.M1) <
asType<integer>($heap<sub>724.1:740.8</sub>.p1)
 \rightarrow [from term 53.19, $heap<sub>724,1;740,8</sub> is equal to
 heap_{funcstart\_724,1}._replace(p1 \rightarrow (-2 * div(heapIs heap_{funcstart\_724,1}),
 \text{Sheap}_{funcstart\_724,1}.p1, 177).quot) + (171 * div(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
 heap_{funcstart_{-724,1}.p1, 177).rem}
 [54.1] -asType<integer const>(\rho1 + \rho2 + \rho3 -asType<integer const>(\rho1 - \rho3 - \rho4 - \rho5 - \rho6 - \rho7 - \rho7 - \rho8 - \rho9 - \rho9
div(\mathbf{heapIs} \ \$heap_{funcstart\_724.1}, \ \$heap_{funcstart\_724.1}.p1, \ 177).quot) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).rem))).M1) <
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathrm{heap}_{724,1;740,8}.\mathrm{p1})
 \rightarrow [const member of object with modified fields]
```

```
[54.2] -asType<integer const>(heap_{funcstart\_724.1}.M1) <
asType<integer>($heap<sub>724,1;740,8</sub>.p1)
\rightarrow [const static or extern object]
[54.3] -asType<integer const>(heap_{init}.M1) <
asType < integer > (\$heap_{724,1;740,8}.p1)
\rightarrow [expand definition of constant 'M1' at prang.c (14,20)]
[54.4] -asType<integer const>(asType<short int>((int)30269)) <
asType < integer > (\$heap_{724,1;740,8}.p1)
\rightarrow [simplify]
[54.8] - 30269 < asType < integer > ($heap_{724,1.740,8.p1})
\rightarrow [from term 53.19, $heap<sub>724,1:740.8</sub> is equal to
heap_{funcstart\_724,1}._replace(p1 \rightarrow (-2 * div(heapIs heap_{funcstart\_724,1}),
\text{Sheap}_{funcstart\_724,1}.\text{p1}, 177).\text{quot} + (171 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
heap_{funcstart_{-724,1}}.p1, 177).rem
[54.9] -30269 < asType<integer>($heap_{funcstart\_724.1}._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.p1, \ 177).rem))).p1)
\rightarrow [simplify]
 \label{eq:continuous} \mbox{[54.11] -30269} < ((-2 * \mbox{div}(\mathbf{heapIs} \ \$ \mbox{heap}_{funcstart\_724,1}, \ \$ \mbox{heap}_{funcstart\_724,1}.p1, \\
177).quot) + (171 * div(heapIs heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p1,
177).rem))
[Take given term]
[57.0] $\text{heap}_{724,1:742,8} == $\text{heap}_{724,1:740.8}.$\text{-replace}(p2 \to asType < short)
int>((asType<int>(asType<short int>(div2.rem)) *
asType < int > (\$heap_{724.1:740.8}.r2)) - (asType < int > (asType < short)
int>(div2.quot)) * asType< int>($heap_{724.1:740.8}.b2))))
\rightarrow [from term 53.19, $heap<sub>724.1:740.8</sub> is equal to
heap_{funcstart\_724,1}._replace(p1 \rightarrow (-2 * div(heapIs $heap_{funcstart\_724,1},
heap_{funcstart\_724,1}.p1, 177).quot + (171 * div(heapIs p_{funcstart\_724,1})
heap_{funcstart_{-724,1}.p1, 177).rem}
[57.1] $\text{heap}_{724,1;742,8} == \text{$heap}_{funcstart\_724,1}._\text{$replace}(p1 \to ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1,
177).rem))).\_replace(p2 \rightarrow asType < short
\mathbf{int}{>}((\mathbf{asType}{<}\mathbf{int}{>}(\mathbf{asType}{<}\mathbf{short}\ \mathbf{int}{>}(\mathbf{div2.rem}))\ ^*
asType < int > (\$heap_{724,1.740,8}.r2)) - (asType < int > (asType < short)
int>(div2.quot)) * asType<int>($heap<sub>724.1:740.8</sub>.b2))))
\rightarrow [from term 25.6, div2 is equal to div(heapIs $heap_{funcstart\_724,1},
heap_{funcstart_{-724,1}}.p2, 176)
```

```
[57.2] heap_{724,1;742,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 *
\label{eq:div_heap} \text{div}(\textbf{heapIs} \ \$ \text{heap}_{funcstart\_724,1}, \ \$ \text{heap}_{funcstart\_724,1}.\text{p1},
177).rem))).\_replace(p2 \rightarrow asType < short
\mathbf{int}{>}((\mathbf{asType}{<}\mathbf{int}{>}(\mathbf{asType}{<}\mathbf{short}\ \mathbf{int}{>}(\mathbf{div}(\mathbf{heapIs}\ \$\mathbf{heap}_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1.p2}, 176).\text{rem}) * asType < int > (\text{Sheap}_{724,1:740.8}.\text{r2})) -
(asType<int>(asType<short int>(div2.quot)) *
asType<int>($heap<sub>724.1:740.8</sub>.b2))))
\rightarrow [simplify]
[57.4] $heap<sub>724,1:742,8</sub> == $heap<sub>funcstart_724,1</sub>._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1,
177).rem)))._{\mathbf{replace}}(p2 \rightarrow \mathbf{asType} < \mathbf{short\ int} > ((\operatorname{div}(\mathbf{heapIs}))))
heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p2, 176).rem *
\mathbf{asType} < \mathbf{int} > (\$ \mathrm{heap}_{724,1;740,8}.\mathrm{r2})) - (\mathbf{asType} < \mathbf{int} > (\mathbf{asType} < \mathbf{short}))
int>(div2.quot)) * asType<int>($heap<sub>724,1:740,8</sub>.b2))))
\rightarrow [from term 53.19, $heap<sub>724.1:740.8</sub> is equal to
heap_{funcstart\_724.1}._replace(p1 \rightarrow (-2 * div(heapIs heap_{funcstart\_724.1}),
\text{Sheap}_{funcstart\_724,1}.p1, 177).quot) + (171 * div(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
heap_{funcstart_{-724,1}}.p1, 177).rem)
[57.5] heap_{724,1;742,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 \ *
\operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724.1}, \$ \operatorname{heap}_{funcstart\_724.1}.p1,
177).rem)))._{\mathbf{replace}}(p2 \rightarrow \mathbf{asType} < \mathbf{short\ int} > ((\operatorname{div}(\mathbf{heapIs}))))
heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p2, 176).rem *
asType < int > (\$heap_{funcstart\_724,1}.\_replace(p1 \rightarrow ((-2 * div(heapIs)))))))
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.\text{p1}, 177).\text{quot}) + (171 * \text{div}(\textbf{heapIs})
heap_{funcstart_{-724,1}}, heap_{funcstart_{-724,1}}, 177).rem))).r2)) -
(asType<int>(asType<short int>(div2.quot)) *
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{724,1;740,8}.\mathrm{b2}))))
\rightarrow [const member of object with modified fields]
[57.6] $heap<sub>724.1:742.8</sub> == $heap<sub>funcstart_724.1</sub>._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.p1,
177).rem)))._{\mathbf{replace}}(p2 \rightarrow \mathbf{asType} < \mathbf{short\ int} > ((\operatorname{div}(\mathbf{heapIs}))))
heap_{funcstart_{-724,1}}, heap_{funcstart_{-724,1}}, p_{176}.rem *
\mathbf{asType} \hspace{-0.1em}<\hspace{-0.1em} \mathbf{int} \hspace{-0.1em}> \hspace{-0.1em} (\$ heap_{funcstart\_724,1}.r2)) - (\mathbf{asType} \hspace{-0.1em}<\hspace{-0.1em} \mathbf{int} \hspace{-0.1em}> \hspace{-0.1em} (\mathbf{asType} \hspace{-0.1em}<\hspace{-0.1em} \mathbf{short})
int > (div2.quot)) * asType < int > (\$heap_{724,1;740,8}.b2))))
\rightarrow [const static or extern object]
[57.7] heap_{724,1;742,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 *
\operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724,1}, \$ \operatorname{heap}_{funcstart\_724,1}.p1,
```

```
177).rem)))._{replace(p2 \rightarrow asType < short int > ((div(heapIs))))}
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.p2, 176).rem *
asType < int > (\$heap_{init}.r2)) - (asType < int > (asType < short)
int>(div2.quot)) * asType< int>($heap_{724,1:740,8}.b2))))
\rightarrow [expand definition of constant 'r2' at prang.c (20,20)]
[57.8] heap_{724,1;742,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).quot) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow asType<short int>((div(heapIs
\text{Sheap}_{funcstart_{-724,1}}, \text{Sheap}_{funcstart_{-724,1}}.p2, 176).rem *
asType<int>(asType<short int>((int)172))) -
(asType<int>(asType<short int>(div2.quot)) *
asType < int > (\$heap_{724,1;740,8}.b2))))
\rightarrow [simplify]
[57.11] $\text{heap}_{724,1;742,8} == \text{$heap}_{funcstart\_724,1}._\text{$replace}(p1 \to ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.p1,
177).rem))).replace(p2 \rightarrow asType < short int > ((div(heapIs)))
\text{Sheap}_{funcstart_{724,1}}, \text{Sheap}_{funcstart_{724,1}}.\text{p2}, 176).\text{rem} * 172) -
(asType<int>(asType<short int>(div2.quot)) *
\mathbf{asType}{<}\mathbf{int}{>}(\${\rm heap}_{724,1;740,8}.{\rm b2}))))
\rightarrow [from term 25.6, div2 is equal to div(heapIs $heap_{funcstart_724,1},
heap_{funcstart_{-724,1}}.p2, 176
[57.12] $\text{heap}_{724,1:742.8} == $\text{heap}_{funcstart\_724,1}._\text{replace}(p1 \to ((-2 *
div(\mathbf{heapIs} \ \$heap_{funcstart\_724,1}, \ \$heap_{funcstart\_724,1}.p1, \ 177).quot) + (171 *
\operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724,1}, \$ \operatorname{heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow asType<short int>((172 * div(heapIs
heap_{funcstart_{-724,1}}, heap_{funcstart_{-724,1}}.p2, 176).rem –
(asType<int>(asType<short int>(div(heapIs $heap_{funcstart\_724,1},
\text{sheap}_{funcstart\_724,1.p2, 176}.\text{quot}) * asType < int > (\text{sheap}_{724,1;740,8}.\text{b2}))))
\rightarrow [simplify]
[57.14] $heap<sub>724,1;742,8</sub> == $heap<sub>funcstart_724,1</sub>._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.\operatorname{p1}, \ 177).\operatorname{quot}) + (171 \ *
\operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724.1}, \$ \operatorname{heap}_{funcstart\_724.1}.p1,
177).rem)))._replace(p2 \rightarrow asType<short int>((172 * div(heapIs
\theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}.p2, 176).rem) - (div(heapIs
heap_{funcstart_{724,1}}, heap_{funcstart_{724,1}}.p2, 176).quot *
asType<int>($heap<sub>724.1:740.8</sub>.b2))))
\rightarrow [from term 53.19, $heap<sub>724.1:740.8</sub> is equal to
heap_{funcstart\_724,1}._replace(p1 \rightarrow (-2 * div(heapIs heap_{funcstart\_724,1}),
\text{Sheap}_{funcstart\_724,1}.p1, 177).quot) + (171 * div(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
heap_{funcstart_{-724,1}}.p1, 177).rem)
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[57.15] $heap<sub>724,1;742,8</sub> == $heap<sub>funcstart_724,1</sub>._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 \ *
\label{eq:div_heap} \text{div}(\textbf{heapIs} \ \$ \text{heap}_{funcstart\_724,1}, \ \$ \text{heap}_{funcstart\_724,1}.\text{p1},
177).rem)))._replace(p2 \rightarrow asType<short int>((172 * div(heapIs
\theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}
\theta_{funcstart_{724,1}}, \theta_{funcstart_{724,1},p2,176}, quot *
asType<int>($heap<sub>funcstart_724,1</sub>._replace(p1 \rightarrow ((-2 * div(heapIs
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.\text{p1}, 177).\text{quot}) + (171 * \text{div}(\text{heapIs}))
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.p1, 177).rem))).b2))))
\rightarrow [const member of object with modified fields]
[57.16] $heap<sub>724,1;742,8</sub> == $heap<sub>funcstart_724,1</sub>._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 *
\operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724,1}, \$ \operatorname{heap}_{funcstart\_724,1}.p1,
177).rem))).\_replace(p2 \rightarrow asType<short int>((172 * div(heapIs
heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p2, 176).rem) - (div(heapIs
heap_{funcstart_{-724,1}}, heap_{funcstart_{-724,1}}, 2, 176).quot *
asType < int > (\$heap_{funcstart\_724,1}.b2))))
\rightarrow [const static or extern object]
[57.17] $\text{heap}_{724,1:742,8} == \text{$heap}_{funcstart\_724,1}._\text{$replace}(p1 \to ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).quot) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow asType<short int>((172 * div(heapIs
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.\text{p2}, 176).\text{rem}) - (\text{div}(\text{heapIs})
\theta_{funcstart_{724,1}}, \theta_{funcstart_{724,1}}, \theta_{funcstart_{724,1}}.p2, 176).quot
asType < int > (\$heap_{init}.b2))))
\rightarrow [expand definition of constant 'b2' at prang.c (22,20)]
[57.18] heap_{724,1;742,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 *
\operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724.1}, \$ \operatorname{heap}_{funcstart\_724.1}.p1,
177).rem)))._{\mathbf{replace}}(p2 \rightarrow \mathbf{asType} < \mathbf{short\ int} > ((172 * div(\mathbf{heapIs}))))
\theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}.p2, 176).rem) - (div(heapIs
\text{Sheap}_{funcstart_{724,1}}, \text{Sheap}_{funcstart_{724,1}}, p2, 176).quot *
asType<int>(asType<short int>((int)35)))))
\rightarrow [simplify]
[57.24] $heap<sub>724,1;742,8</sub> == $heap<sub>funcstart_724,1</sub>._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).quot) + (171 *
\operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724,1}, \$ \operatorname{heap}_{funcstart\_724,1}.p1,
(-35 * div(\mathbf{heapIs} \$heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1.p2}, 176).\text{quot} + (172 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
heap_{funcstart_{-724,1}}.p2, 176).rem)
[Take given term]
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[61.0] $heap<sub>724.1:744.8</sub> == $heap<sub>724.1:742.8</sub>._replace(p3 \rightarrow asType<short
int>((asType<int>(asType<short int>(div3.rem)) *
asType < int > (\$heap_{724,1:742,8}.r3)) - (asType < int > (asType < short)
int>(div3.quot)) * asType< int>($heap_{724,1;742,8}.b3))))
\rightarrow [from term 57.24, $heap<sub>724.1:742.8</sub> is equal to
heap_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 * div(heapIs *heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1}.\text{p1}, 177).\text{quot} + (171 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
heap_{funcstart\_724,1}.p1, 177).rem)).\_replace(p2 \rightarrow (-35 * div(heapIs))).
heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p2, 176).quot) + (172 * div(heapIs)
heap_{funcstart_{724,1}}, heap_{funcstart_{724,1}}, 176).rem)
[61.1] heap_{724,1;744,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 *
\operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724,1}, \$ \operatorname{heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow ((-35 * div(heapIs $heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1}.\text{p2}, 176).\text{quot} + (172 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
\rho_{funcstart\_724,1.p2, 176}.rem))._replace(p3 \rightarrow asType<short
int>((asType<int>(asType<short int>(div3.rem)) *
asType < int > (\$heap_{724.1:742.8}.r3)) - (asType < int > (asType < short)
int>(div3.quot)) * asType< int>($heap_{724.1:742.8}.b3))))
\rightarrow [from term 39.6, div3 is equal to div(heapIs $heap_{funcstart\_724,1},
heap_{funcstart_{724,1}}.p3, 178
[61.2] heap_{724,1;744,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 *
div(\mathbf{heapIs} \ \$heap_{funcstart\_724.1}, \ \$heap_{funcstart\_724.1}.p1, \ 177).quot) + (171 *
\operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724.1}, \$ \operatorname{heap}_{funcstart\_724.1}.p1,
177).rem)))._replace(p2 \rightarrow ((-35 * div(heapIs $heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1}.\text{p2}, 176).\text{quot} + (172 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
\theta_{tuncstart\_724,1}, p2, 176).rem)))._replace(p3 \rightarrow asType<short
int>((asType<int>(asType<short int>(div(heapIs $heap_{funcstart\_724,1},))
\text{sheap}_{funcstart\_724,1.p3}, 178).rem) * asType<int>(\text{sheap}_{724,1;742,8.r3})) -
(asType<int>(asType<short int>(div3.quot)) *
asType<int>($heap<sub>724,1:742,8</sub>.b3))))
\rightarrow [simplify]
[61.4] $heap<sub>724,1;744,8</sub> == $heap<sub>funcstart_724,1</sub>._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 \ *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow ((-35 * div(heapIs $heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1}.\text{p2}, 176).\text{quot} + (172 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
\theta_{funcstart_{724,1},p2,176,rem})._replace(p3 \rightarrow asType<short
int>((div(heapIs \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p3, 178).rem *
asType < int > (\$heap_{724,1:742,8}.r3)) - (asType < int > (asType < short)
int>(div3.quot)) * asType<int>($heap<sub>724,1:742,8</sub>.b3))))
\rightarrow [from term 57.24, $\$heap_{724,1;742,8}$ is equal to
heap_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 * div(heapIs *heap_{funcstart\_724,1},
```

```
\text{Sheap}_{funcstart_{-724,1},p1, 177}.\text{quot}) + (171 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart_{-724,1}})
\$heap_{funcstart\_724,1}.p1,\ 177).rem))).\_\textbf{replace}(p2 \rightarrow (-35\ *\ div(\textbf{heapIs}))).
heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p2, 176).quot) + (172 * div(heapIs)
heap_{funcstart_{724,1}}, heap_{funcstart_{724,1}}, 2, 176).rem
[61.5] heap_{724,1;744,8} == heap_{funcstart\_724,1}.\_replace(p1 \to ((-2 * 
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}. p1, \ 177). \operatorname{quot}) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow ((-35 * div(heapIs $heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1.p2}, 176).\text{quot} + (172 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
\frac{\text{sheap}_{funcstart\_724,1.p2, 176}.rem)}{\text{replace}(p3 \rightarrow asType < short)}
int>((div(heapIs \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p3, 178).rem *
asType < int > (\$heap_{funcstart\_724.1}.\_replace(p1 \rightarrow ((-2 * div(heapIs))))))
heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p1, 177).quot) + (171 * div(heapIs)
\rho_{funcstart\_724,1}, \rho_{funcstart\_724,1}
* div(\mathbf{heapIs} \ \$ heap_{funcstart\_724,1}, \ \$ heap_{funcstart\_724,1}.p2, \ 176).quot) + (172 \ *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p2, \ 176).rem))).r3)) -
(asType<int>(asType<short int>(div3.quot)) *
asType < int > (\$heap_{724,1;742,8}.b3))))
→ [const member of object with modified fields]
[61.7] heap_{724,1;744,8} == heap_{funcstart\_724,1}.\_replace(p1 \to ((-2 * 
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 \ *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow ((-35 * div(heapIs $heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1.p2}, 176).\text{quot}) + (172 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
\theta_{funcstart\_724,1}.p2, 176).rem))._replace(p3 \rightarrow asType<short
int>((div(heapIs \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p3, 178).rem *
\mathbf{asType} \hspace{-0.1em}<\hspace{-0.1em} \mathbf{int} \hspace{-0.1em}> \hspace{-0.1em} (\$ heap_{funcstart\_724,1}.r3)) - (\mathbf{asType} \hspace{-0.1em}<\hspace{-0.1em} \mathbf{int} \hspace{-0.1em}> \hspace{-0.1em} (\mathbf{asType} \hspace{-0.1em}<\hspace{-0.1em} \mathbf{short})
int>(div3.quot)) * asType<int>($heap<sub>724,1:742,8</sub>.b3))))
\rightarrow [const static or extern object]
[61.8] heap_{724,1;744,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 \ *
\operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724,1}, \$ \operatorname{heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow ((-35 * div(heapIs $heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1}.\text{p2}, 176).\text{quot} + (172 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
\theta_{funcstart\_724,1.p2, 176}.rem))._replace(p3 \rightarrow asType<short
int>((div(heapIs \$heap_{funcstart\_724.1}, \$heap_{funcstart\_724.1}.p3, 178).rem *
asType < int > (\$heap_{init}.r3)) - (asType < int > (asType < short)
int>(div3.quot)) * asType<int>($heap<sub>724.1:742.8</sub>.b3))))
\rightarrow [expand definition of constant 'r3' at prang.c (25,20)]
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 \ *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow ((-35 * div(heapIs $heap_{funcstart\_724,1},
```

```
\text{Sheap}_{funcstart_{-724,1},p2}, 176).\text{quot}) + (172 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart_{-724,1}},
\rho_{funcstart\_724.1.p2, 176}.rem). replace(p3 \rightarrow asType<short
int>((div(heapIs \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p3, 178).rem *
asType<int>(asType<short int>((int)170))) -
(asType<int>(asType<short int>(div3.quot)) *
asType<int>($heap<sub>724,1;742,8</sub>.b3))))
\rightarrow [simplify]
[61.12] $heap<sub>724,1;744,8</sub> == $heap<sub>funcstart_724,1</sub>._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).quot) + (171 *
\operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724,1}, \$ \operatorname{heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow ((-35 * div(heapIs $heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1.p2}, 176).\text{quot} + (172 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
\$ heap_{funcstart\_724,1}.p2,\,176).rem))).\_\textbf{replace}(p3 \rightarrow \textbf{asType} < \textbf{short}
int > ((div(heapIs \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p3, 178).rem * 170)
- (asType < int > (asType < short int > (div3.quot))
asType<int>($heap<sub>724,1;742,8</sub>.b3))))
\rightarrow [from term 39.6, div3 is equal to div(heapIs $heap_{tuncstart_724.1},
heap_{funcstart_{-724,1}}.p3, 178
[61.13] heap_{724,1;744,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).quot) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow ((-35 * div(heapIs $heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724.1.p2}, 176).\text{quot} + (172 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724.1},
\rho_{tuncstart_{724,1},p2,176,rem})._replace(p3 \rightarrow asType<short int>((170
* div(heapIs heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p3, 178).rem) –
(asType<int>(asType<short int>(div(heapIs $heap_{tuncstart\_724.1},
\text{Sheap}_{funcstart_{724,1},p3, 178}, \text{quot}) * \mathbf{asType} < \mathbf{int} > (\text{Sheap}_{724,1;742,8}, \text{b3}))))
\rightarrow [simplify]
[61.15] $heap<sub>724,1;744,8</sub> == $heap<sub>funcstart_724,1</sub>._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow ((-35 * div(heapIs $heap_{tuncstart_724.1},
\text{Sheap}_{funcstart\_724.1.p2}, 176).\text{quot} + (172 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724.1},
\rho_{uncstart\_724,1.p2, 176}.rem)...replace(p3 \rightarrow asType<short int>((170
* div(heapIs heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p3, 178).rem) –
(\text{div}(\mathbf{heapIs} \$ \text{heap}_{funcstart\_724.1}, \$ \text{heap}_{funcstart\_724.1}. \text{p3}, 178).\text{quot} *
asType < int > (\$heap_{724,1;742,8}.b3))))
\rightarrow [from term 57.24, $heap<sub>724.1:742.8</sub> is equal to
heap_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 * div(heapIs $heap_{funcstart\_724,1},
heap_{funcstart\_724,1}.p1, 177).quot) + (171 * div(heapIs $heap_{funcstart\_724,1}, 1
heap_{funcstart\_724.1}.p1, 177).rem)._replace(p2 \rightarrow (-35 * div(heapIs)))._
heap_{funcstart\_724,1}, heap_{funcstart\_724,1}. p2, p2, p2, p3, p2, p3, p4, p3, p4, 
\{\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.p2, 176\}.rem)\}
```

```
[61.16] $heap<sub>724,1;744,8</sub> == $heap<sub>funcstart_724,1</sub>._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow ((-35 * div(heapIs $heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1}.\text{p2}, 176).\text{quot} + (172 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
\frac{\text{sheap}_{funcstart\_724,1.p2, 176}.rem)}{\text{.replace}(p3 \rightarrow asType < short int} > ((170))
* div(heapIs heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p3, 178).rem) –
(\text{div}(\mathbf{heapIs} \$ \text{heap}_{funcstart\_724,1}, \$ \text{heap}_{funcstart\_724,1}.\text{p3}, 178).\text{quot} *
asType<int>($heap<sub>funcstart_724,1</sub>._replace(p1 \rightarrow ((-2 * div(heapIs
\theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}
\theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}
* div(\mathbf{heapIs} \ \$ heap_{funcstart\_724,1}, \ \$ heap_{funcstart\_724,1}.p2, \ 176).quot) + (172 \ *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p2, \ 176).rem))).b3))))
\rightarrow [const member of object with modified fields]
[61.18] $\text{heap}_{724,1;744,8} == \text{$heap}_{funcstart\_724,1}._\text{$-replace}(p1 \to ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 \ *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow ((-35 * div(heapIs $heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1}.\text{p2}, 176).\text{quot} + (172 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
\rho_{tuncstart\_724.1.p2, 176).rem})._replace(p3 \rightarrow asType<short int>((170
* div(heapIs heap_{funcstart\_724.1}, heap_{funcstart\_724.1}, n_{funcstart\_724.1}, n_{funcstart\_724.1}
(\text{div}(\mathbf{heapIs} \$ \text{heap}_{funcstart\_724,1}, \$ \text{heap}_{funcstart\_724,1}.\text{p3}, 178).\text{quot} *
asType < int > (\$heap_{funcstart\_724,1}.b3))))
\rightarrow [const static or extern object]
[61.19] $heap<sub>724,1;744,8</sub> == $heap<sub>funcstart_724,1</sub>._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 *
\operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724,1}, \$ \operatorname{heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow ((-35 * div(heapIs $heap_{funcstart_724,1},
\text{Sheap}_{funcstart\_724,1}.\text{p2}, 176).\text{quot} + (172 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
\rho_{tuncstart=724.1}.p2, 176).rem))._replace(p3 \rightarrow asType<short int>((170
* div(heapIs heap_{funcstart\_724,1}, heap_{funcstart\_724,1}, n_{funcstart\_724,1}, n_{funcstart\_724,1}, n_{funcstart\_724,1}
(\text{div}(\mathbf{heapIs} \$ \text{heap}_{funcstart\_724,1}, \$ \text{heap}_{funcstart\_724,1}.\text{p3}, 178).\text{quot} *
asType < int > (\$heap_{init}.b3)))
\rightarrow [expand definition of constant 'b3' at prang.c (27,20)]
[61.20] $\text{heap}_{724,1;744,8} == \text{$heap}_{funcstart\_724,1}._\text{$replace}(p1 \to ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \operatorname{heap}_{funcstart\_724,1}, \ \operatorname{heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 *
\operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724,1}, \$ \operatorname{heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow ((-35 * div(heapIs $heap_{funcstart\_724,1},
\theta_{funcstart\_724,1.p2}, 176).quot) + (172 * div(heapIs \theta_{funcstart\_724,1},
\theta_{funcstart\_724,1.p2, 176}.rem)._replace(p3 \rightarrow asType<short int>((170
* div(heapIs heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p3, 178).rem) –
(\text{div}(\mathbf{heapIs} \$ \text{heap}_{funcstart\_724,1}, \$ \text{heap}_{funcstart\_724,1}.\text{p3}, 178).\text{quot} *
asType<int>(asType<short int>((int)63)))))
```

```
\rightarrow [simplify]
[61.26] $\text{heap}_{724,1:744,8} == $\text{heap}_{funcstart\_724,1}._\text{replace}(p1 \to ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).quot) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow ((-35 * div(heapIs $heap_{funcstart_724.1},
\text{Sheap}_{funcstart\_724,1}.\text{p2}, 176).\text{quot} + (172 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
\rho_{funcstart\_724,1.p2, 176}.rem)._replace(p3 \rightarrow ((-63 * div(heapIs
\theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}.p3, 178).quot) + (170 * div(heapIs
heap_{funcstart_{-724,1}}, heap_{funcstart_{-724,1}}, 178).rem)
[Take goal term]
[1.0] minof(int) \leq $heap<sub>724.1:744.8</sub>.p1
\rightarrow [simplify]
[1.1] -32768 \leq $heap<sub>724.1:744.8</sub>.p1
\rightarrow [from term 61.26, $heap<sub>724.1:744.8</sub> is equal to
heap_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 * div(heapIs *heap_{funcstart\_724,1},
heap_{funcstart\_724,1}.p1, 177).quot + (171 * div(heapIs p_{funcstart\_724,1}),
heap_{funcstart\_724,1}.p1, 177).rem))).\_replace(p2 \rightarrow ((-35 * div(heapIs))).\_replace(p2 \rightarrow ((-35 * div(heapIs)))).\_replace(p2 \rightarrow ((-35 * div(heapIs)))))
heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p2, 176).quot) + (172 * div(heapIs)
heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p2, 176).rem)))._replace(p3 \rightarrow (-63 *
div(\mathbf{heapIs} \ \$heap_{funcstart\_724,1}, \ \$heap_{funcstart\_724,1}.p3, \ 178).quot) + (170 *
div(\mathbf{heapIs} \ \$heap_{funcstart\_724,1}, \ \$heap_{funcstart\_724,1}.p3, \ 178).rem))]
[1.2] -32768 \leq $heap<sub>funcstart_724.1</sub>._replace(p1 \rightarrow ((-2 * div(heapIs
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.\text{p1}, 177).\text{quot}) + (171 * \text{div}(\text{heapIs}))
\theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}
* div(heapIs heap_{funcstart_{-724,1}}, heap_{funcstart_{-724,1}}, p2, 176).quot) + (172 *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724.1}, \ \$ \operatorname{heap}_{funcstart\_724.1}.p2,
176).rem)))._replace(p3 \rightarrow ((-63 * div(heapIs $heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724.1.p3}, 178).\text{quot} + (170 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724.1},
heap_{funcstart_{-724,1}}.p3, 178).rem)).p1
\rightarrow [simplify]
[1.7] -32769 < ((-2 * div(heapIs $heap_{funcstart\_724,1}, $heap_{funcstart\_724,1}.p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{$heap}_{funcstart\_724,1}, \text{$heap}_{funcstart\_724,1}.\text{p1},
177).rem))
\rightarrow [from term 54.11, literala < ((-2 * div(heapIs $heap_{funcstart\_724,1},
heap_{funcstart_{724,1},p1, 177}, quot) + (171 * div(heapIs p_{funcstart_{724,1},p1, 177}).
heap_{funcstart\_724,1}.p1, 177).rem is true whenever (-1 + literala) < -30269
    Proof of rule precondition:
    [1.7.0](-32769 + -1) < -30269
    \rightarrow [simplify]
    [1.7.2] true
```

## [1.8] true

```
Proof of verification condition: Type constraint satisfied in implicit
conversion from 'short int' to 'int'
Condition generated at: C:\Escher\Customers\prang\prang.c (63,17)
Condition defined at:
To prove: heap_{724,1;744,8}.p1 \le maxof(int)
Given:
heap_{init}.LIMIT == (int)80
heap_{init}.M1 == asType < short int > ((int)30269)
heap_{init}.r1 == asType < short int > ((int)171)
heap_{init}.a1 == asType < short int > ((int)177)
\theta
heap_{init}.M2 == asType < short int > ((int)30307)
\rho_{init}.r2 == asType < short int > ((int)172)
heap_{init}.a2 == asType < short int > ((int)176)
\theta
\theta sheap<sub>init</sub>.M3 == asType<short int>((int)30323)
\theta
heap_{init}.a3 == asType < short int > ((int)178)
heap_{init}.b3 == asType < short int > ((int)63)
\theta = asType < short int > ((int)1)
\theta
\theta = asType < short int > ((int)3)
invariant1(heapIs heap_{funcstart_{724,1}})
\operatorname{div1} == \operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724,1},
\mathbf{asType} < \mathbf{int} > (\$ \mathrm{heap}_{funcstart\_724,1}.\mathrm{p1}),
asType < int > (\$heap_{funcstart_{-724,1}}.a1))
(asType<integer>(asType<int>($heap_{tuncstart}, 724,1.p1)) /
\mathbf{asType} < \mathbf{integer} > (\mathbf{asType} < \mathbf{int} > (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{a1}))) = =
asType<integer>(div1.quot)
(asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.p1)) \%
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a1))) = =
asType<integer>(div1.rem)
!(0 == asType < integer > (div1.rem)) || !(0 ==
```

```
asType<integer>(div1.quot))
div2 == div(\mathbf{heapIs} \$heap_{funcstart\_724,1},
asType < int > (\$heap_{funcstart\_724,1}.p2),
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{a2}))
(asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.p2)) /
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a2))) = =
asType<integer>(div2.quot)
(\mathbf{asType} {<} \mathbf{integer} {>} (\mathbf{asType} {<} \mathbf{int} {>} (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p2})) \ \%
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a2))) = =
asType<integer>(div2.rem)
!(0 == asType < integer > (div2.rem)) || !(0 ==
asType<integer>(div2.quot))
div3 == div(\mathbf{heapIs} \$ heap_{funcstart\_724,1},
asType < int > (\$heap_{funcstart\_724,1}.p3),
asType < int > (\$heap_{funcstart\_724,1}.a3))
(asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.p3)) /
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a3))) = =
asType<integer>(div3.quot)
(\mathbf{asType} < \mathbf{integer} > (\mathbf{asType} < \mathbf{int} > (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p3})) \ \%
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a3))) = =
asType<integer>(div3.rem)
!(0 == asType < integer > (div3.rem)) || !(0 ==
asType<integer>(div3.quot))
\text{Sheap}_{724,1;740,8} == \text{Sheap}_{funcstart\_724,1}.\_\mathbf{replace}(\text{p1} \to \mathbf{asType} < \mathbf{short})
int>((asType<int>(asType<short int>(div1.rem)) *
asType < int > (\$heap_{funcstart\_724,1}.r1)) - (asType < int > (asType < short)
int>(div1.quot)) * asType<int>($heap_{funcstart\_724,1}.b1)))
-asType < integer const > (\$heap_{724.1:740.8}.M1) < 
asType<integer>($heap<sub>724,1:740,8</sub>.p1)
!(0 == \mathbf{asType} {<} \mathbf{integer} {>} (\$ \mathrm{heap}_{724,1;740,8}.\mathrm{p1}))
{\bf asType}{<} {\bf integer}{>} (\${\rm heap}_{724,1;740,8}.{\rm p1}) <
\mathbf{asType} < \mathbf{integer} > (\$ \mathrm{heap}_{724,1;740,8}.\mathrm{M1})
heap_{724,1:742,8} == heap_{724,1:740,8}.replace(p2 \rightarrow asType<short
int>((asType<int>(asType<short int>(div2.rem)) *
asType < int > (\$heap_{724.1:740.8}.r2)) - (asType < int > (asType < short)
int > (div2.quot)) * asType < int > ($heap_{724,1:740.8}.b2))))
-asType<integer const>($heap<sub>724.1:742.8</sub>.M2) <
asType<integer>($heap<sub>724.1:742.8</sub>.p2)
!(0 == asType < integer > (\$heap_{724,1:742,8}.p2))
```

```
{\bf asType}{<} {\bf integer}{>} (\$ {\rm heap}_{724,1;742,8}.{\rm p2}) <
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathrm{heap}_{724,1;742,8}.\mathrm{M2})
heap_{724,1:744,8} == heap_{724,1:742,8}.replace(p3 \rightarrow asType<short
int>((asType<int>(asType<short int>(div3.rem)) *
asType < int > (\$heap_{724.1:742.8}.r3)) - (asType < int > (asType < short)
int>(div3.quot)) * asType< int>($heap_{724,1:742,8}.b3))))
-asType < integer const > (\$heap_{724,1:744,8}.M3) < 
asType<integer>($heap<sub>724,1:744,8</sub>.p3)
!(0 == \mathbf{asType} {<} \mathbf{integer} {>} (\$ \mathrm{heap}_{724,1;744,8}.\mathrm{p3}))
asType<integer>($heap<sub>724.1:744.8</sub>.p3) <
asType<integer>($heap<sub>724.1:744.8</sub>.M3)
Proof:
[Take given term]
[11.0] \operatorname{div1} == \operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724,1},
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p1}),
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{a1}))
\rightarrow [simplify]
[11.1]~{\rm div1} == {\rm div}(\mathbf{heapIs}~\$ \mathrm{heap}_{funcstart\_724,1},~\$ \mathrm{heap}_{funcstart\_724,1}.\mathrm{p1},
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{a1}))
\rightarrow [const static or extern object]
\textit{[11.2]} \ \text{div1} == \text{div}(\mathbf{heapIs} \ \$ \text{heap}_{funcstart\_724,1}, \ \$ \text{heap}_{funcstart\_724,1}.\text{p1},
asType < int > (\$heap_{init}.a1))
\rightarrow [expand definition of constant 'a1' at prang.c (16,20)]
[11.3] \ \mathrm{div1} == \mathrm{div}(\mathbf{heapIs} \ \$ \mathrm{heap}_{funcstart\_724,1}, \ \$ \mathrm{heap}_{funcstart\_724,1}.\mathrm{p1},
asType<int>(asType<short int>((int)177)))
\rightarrow [simplify]
[11.6] \operatorname{div1} == \operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724,1}, \$ \operatorname{heap}_{funcstart\_724,1}.\operatorname{p1}, 177)
[Take given term]
[25.0] div2 == div(heapIs $heap_{funcstart\_724,1},
asType < int > (\$heap_{funcstart\_724,1}.p2),
asType < int > (\$heap_{funcstart\_724,1}.a2))
\rightarrow [simplify]
[25.1] \operatorname{div2} == \operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p2,
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{a2}))
\rightarrow [const static or extern object]
[25.2] \operatorname{div2} == \operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p2,
asType < int > (\$heap_{init}.a2))
```

```
\rightarrow [expand definition of constant 'a2' at prang.c (21,20)]
[25.3] div2 == div(heapIs \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}.p2,
asType<int>(asType<short int>((int)176)))
\rightarrow [simplify]
[25.6] div2 == div(heapIs $heap_{funcstart\_724,1}, $heap_{funcstart\_724,1}.p2, 176)
[Take given term]
[39.0] div3 == div(heapIs $heap_{funcstart\_724,1},
asType < int > (\$heap_{funcstart\_724,1}.p3),
asType < int > (\$heap_{funcstart\_724,1}.a3))
\rightarrow [simplify]
[39.1] \operatorname{div3} == \operatorname{div}(\mathbf{heapIs} \ \operatorname{\$heap}_{funcstart\_724,1}, \ \operatorname{\$heap}_{funcstart\_724,1}.p3,
asType < int > (\$heap_{funcstart\_724,1}.a3))
\rightarrow [const static or extern object]
[39.2] \ \mathrm{div3} == \mathrm{div}(\mathbf{heapIs} \ \$ \mathrm{heap}_{funcstart\_724,1}, \ \$ \mathrm{heap}_{funcstart\_724,1}.\mathrm{p3},
asType < int > (\$heap_{init}.a3))
\rightarrow [expand definition of constant 'a3' at prang.c (26,20)]
[39.3] \ \mathrm{div3} == \mathrm{div}(\mathbf{heapIs} \ \$ \mathrm{heap}_{funcstart\_724,1}, \ \$ \mathrm{heap}_{funcstart\_724,1}.\mathrm{p3},
asType<int>(asType<short int>((int)178)))
\rightarrow [simplify]
[39.6] div3 == div(heapIs heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p3, 178)
[Take given term]
[53.0] \text{sheap}_{724,1;740,8} == \text{sheap}_{funcstart\_724,1}._replace(p1 \rightarrow asType<short
int>((asType<int>(asType<short int>(div1.rem)) *
asType < int > (\$heap_{funcstart\_724,1}.r1)) - (asType < int > (asType < short)
int>(div1.quot)) * asType< int>($heap_{funcstart\_724,1}.b1))))
\rightarrow [from term 11.6, div1 is equal to div(heapIs $heap_{funcstart\_724,1},
heap_{funcstart_{-724,1}}.p1, 177
[53.1] \text{heap}_{724,1;740,8} == \text{heap}_{funcstart\_724,1}._replace(p1 \rightarrow asType<short
int>((asType<int>(asType<short int>(div(heapIs $heap_{funcstart\_724,1},))
\text{Sheap}_{funcstart\_724,1}.\text{p1}, 177).\text{rem}) * asType<int>(\text{Sheap}_{funcstart\_724,1}.\text{r1})) -
(asType<int>(asType<short int>(div1.quot)) *
asType < int > (\$heap_{funcstart\_724.1}.b1))))
\rightarrow [simplify]
[53.3] \rho_{13,1;740,8} == \rho_{13,1;740,8} == \rho_{13,1;740,8} =- \rho_{
int>((div(heapIs \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1, 177).rem *
asType < int > (\$heap_{tuncstart\_724.1}.r1)) - (asType < int > (asType < short)
int>(div1.quot)) * asType< int>($heap_{tuncstart\_724.1}.b1))))
```

```
\rightarrow [const static or extern object]
[53.4] heap_{724,1:740,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow asType<short
int>((div(heapIs \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1, 177).rem *
asType < int > (\$heap_{init}.r1)) - (asType < int > (asType < short)
\mathbf{int}{>}(\mathbf{div1.quot})) * \mathbf{asType}{<} \mathbf{int}{>} (\$\mathbf{heap}_{funcstart\_724,1}.\mathbf{b1}))))
\rightarrow [expand definition of constant 'r1' at prang.c (15,20)]
[53.5] heap_{724,1:740.8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow asType<short
int>((div(heapIs \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1, 177).rem *
asType < int > (asType < short int > ((int)171))) -
(asType < int > (asType < short int > (div1.quot)) *
asType < int > (\$heap_{funcstart_{-724.1}}.b1)))
\rightarrow [simplify]
[53.8] \rho_{724,1;740,8} == \rho_{funcstart\_724,1}.\_replace(p1 \rightarrow asType < short)
int>((div(heapIs \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1, 177).rem * 171)
- (asType<int>(asType<short int>(div1.quot)) *
asType < int > (\$heap_{funcstart\_724,1}.b1))))
\rightarrow [from term 11.6, div1 is equal to div(heapIs $heap_{funcstart\_724,1},
heap_{funcstart_{-724,1}}.p1, 177)
[53.9] heap_{724,1;740,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow asType<short
\mathbf{int} > ((171 * \operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724,1}, \$ \operatorname{heap}_{funcstart\_724,1}.\operatorname{p1}, 177).\operatorname{rem})
- (asType<int>(asType<short int>(div(heapIs $heap_{funcstart_724.1},
heap_{funcstart_{724,1},p1, 177}, quot)) *
asType < int > (\$heap_{funcstart\_724.1}.b1)))
\rightarrow [simplify]
[53.11] \theta_{13} = \theta_
int > ((171 * div(heapIs \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1, 177).rem)
- (\text{div}(\textbf{heapIs} \$ \text{heap}_{funcstart\_724.1}, \$ \text{heap}_{funcstart\_724.1}. \text{p1}, 177).\text{quot} *
asType < int > (\$heap_{funcstart\_724.1}.b1)))
\rightarrow [const static or extern object]
[53.12] \theta_{12} = \theta_{124,1;740,8} = \theta_{124,1;74
int>((171 * div(heapIs $heap_{funcstart\_724,1}, $heap_{funcstart\_724,1}.p1, 177).rem)
- (\text{div}(\mathbf{heapIs} \$ \text{heap}_{funcstart\_724,1}, \$ \text{heap}_{funcstart\_724,1}.\text{p1}, 177).\text{quot} *
asType < int > (\$heap_{init}.b1)))
\rightarrow [expand definition of constant 'b1' at prang.c (17,20)]
[53.13] heap_{724,1;740,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow asType<short
int>((171 * div(heapIs $heap_{funcstart\_724,1}, $heap_{funcstart\_724,1}.p1, 177).rem)
- (\text{div}(\mathbf{heapIs} \$ \text{heap}_{funcstart\_724,1}, \$ \text{heap}_{funcstart\_724,1}.\text{p1}, 177).\text{quot} *
asType<int>(asType<short int>((int)2))))
\rightarrow [simplify]
```

```
[53.19] $heap<sub>724,1;740,8</sub> == $heap<sub>funcstart_724,1</sub>._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).rem)))
[Take given term]
[56.0] asType<integer>($heap_{724,1;740,8}.p1) <
asType<integer>($heap<sub>724.1:740.8</sub>.M1)
\rightarrow [from term 53.19, $heap<sub>724,1;740,8</sub> is equal to
heap_{funcstart\_724,1}._replace(p1 \rightarrow (-2 * div(heapIs heap_{funcstart\_724,1}),
heap_{funcstart_{-724,1},p1, 177}, quot) + (171 * div(heapIs p_{funcstart_{-724,1},p1, 177}).
heap_{funcstart_{724,1}}.p1, 177).rem)
[56.1] asType<integer>(p1 \rightarrow ((-2 * p1) + p1))
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).quot) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.\operatorname{p1}, \ 177).\operatorname{rem}))).\operatorname{p1}) <
asType<integer>($heap<sub>724,1:740,8</sub>.M1)
\rightarrow [simplify]
[56.3] ((-2 * div(heapIs heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p1,
177).quot) + (171 * div(heapIs heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p1,
(177).rem) < asType < integer > (\$heap_{724,1;740.8}.M1)
\rightarrow [from term 53.19, $heap<sub>724,1;740,8</sub> is equal to
heap_{funcstart\_724,1}._replace(p1 \rightarrow (-2 * div(heapIs heap_{funcstart\_724,1}),
heap_{funcstart\_724,1}.p1, 177).quot + (171 * div(heapIs p_{funcstart\_724,1}),
heap_{funcstart_{-724,1},p1, 177,rem}
[56.4] ((-2 * div(heapIs heap_{funcstart_{724,1}}, heap_{funcstart_{724,1},p1})
177).quot) + (171 * div(heapIs \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}.p1,
177).rem)) < asType<integer>($heap<sub>funcstart_724,1</sub>._replace(p1 \rightarrow ((-2 *
div(\mathbf{heapIs} \ \$heap_{funcstart\_724,1}, \ \$heap_{funcstart\_724,1}.p1, \ 177).quot) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.p1, \ 177).rem))).M1)
→ [const member of object with modified fields]
[56.5] ((-2 * div(heapIs heap_{funcstart_{-724,1}}, heap_{funcstart_{-724,1}}.p1,
177).quot) + (171 * \text{div}(\mathbf{heapIs} \$ \text{heap}_{funcstart\_724,1}, \$ \text{heap}_{funcstart\_724,1}.\text{p1},
(177).rem) < asType < integer > (\$heap_{funcstart\_724.1}.M1)
\rightarrow [const static or extern object]
[56.6] ((-2 * div(heapIs heap_{funcstart-724,1}, heap_{funcstart-724,1}.p1,
177).quot) + (171 * div(heapIs heap_{funcstart_{724,1}}, heap_{funcstart_{724,1},p1},
(177).rem) < asType < integer > (\$heap_{init}.M1)
\rightarrow [expand definition of constant 'M1' at prang.c (14,20)]
[56.7] ((-2 * div(heap
Is \rho_{funcstart\_724,1}, \rho_{funcstart\_724,1}.p1,
177).quot) + (171 * div(heapIs \theta_{funcstart_{-724,1}}, \theta_{funcstart_{-724,1}}, p1,
177).rem)) < \mathbf{asType} < \mathbf{integer} > (\mathbf{asType} < \mathbf{short\ int} > ((\mathbf{int})30269))
```

```
\rightarrow [simplify]
[56.17] -30269 < ((-171 * div(heapIs $heap_{funcstart\_724,1},)]
\text{Sheap}_{funcstart_{-724,1},p1, 177}.\text{rem}) + (2 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart_{-724,1}})
heap_{funcstart_{-724,1}.p1, 177}.quot)
[Take given term]
[57.0] $\text{heap}_{724,1;742,8} == $\text{heap}_{724,1;740,8}._\text{replace}(p2 \rightarrow \text{asType} < \text{short}
int>((asType<int>(asType<short int>(div2.rem)) *
asType < int > (\$heap_{724,1:740.8}.r2)) - (asType < int > (asType < short)
int>(div2.quot)) * asType<int>($heap<sub>724,1:740,8</sub>.b2))))
\rightarrow [from term 53.19, $heap<sub>724.1:740.8</sub> is equal to
heap_{funcstart\_724.1}._replace(p1 \rightarrow (-2 * div(heapIs heap_{funcstart\_724.1}),
\text{Sheap}_{funcstart_{-724,1},p1, 177}.\text{quot}) + (171 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart_{-724,1}}),
heap_{funcstart_{724,1}.p1, 177).rem}
[57.1] heap_{724,1;742,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 *
\operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724.1}, \$ \operatorname{heap}_{funcstart\_724.1}.p1,
(177).rem))._replace(p2 \rightarrow asType<short
int>((asType<int>(asType<short int>(div2.rem)) *
\mathbf{asType}{<}\mathbf{int}{>}(\$\text{heap}_{724,1;740,8}.\text{r2})) - (\mathbf{asType}{<}\mathbf{int}{>}(\mathbf{asType}{<}\mathbf{short}
int>(div2.quot)) * asType< int>($heap_{724.1:740.8}.b2))))
\rightarrow [from term 25.6, div2 is equal to div(heapIs $heap_{tuncstart} 724.1,
heap_{funcstart_{-724,1}}.p2, 176
[57.2] heap_{724,1;742,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 \ *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow asType<short
\mathbf{int}{>}((\mathbf{asType}{<}\mathbf{int}{>}(\mathbf{asType}{<}\mathbf{short}\ \mathbf{int}{>}(\mathbf{div}(\mathbf{heapIs}\ \$\mathbf{heap}_{funcstart\_724,1},
\text{sheap}_{funcstart=724.1}.\text{p2}, 176).\text{rem}) * asType < int > (\text{sheap}_{724.1:740.8}.\text{r2})) -
(asType<int>(asType<short int>(div2.quot)) *
asType < int > (\$heap_{724,1;740,8}.b2))))
[57.4] heap_{724,1;742,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).quot) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.p1,
(177).rem))._replace(p2 \rightarrow asType<short int>((div(heapIs)
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.\text{p2}, 176).\text{rem} *
\mathbf{asType} < \mathbf{int} > (\$ \mathrm{heap}_{724,1;740,8}.\mathrm{r2})) - (\mathbf{asType} < \mathbf{int} > (\mathbf{asType} < \mathbf{short}
int>(div2.quot)) * asType<int>($heap<sub>724.1:740.8</sub>.b2))))
\rightarrow [from term 53.19, $heap_{724,1;740,8}$ is equal to
heap_{funcstart\_724,1}._replace(p1 \rightarrow (-2 * div(heapIs heap_{funcstart\_724,1}),
heap_{funcstart\_724,1}.p1, 177).quot + (171 * div(heapIs $heap_{funcstart\_724,1}, 177).quot) + (171 * div(heapIs $heap_{funcstart\_724,1}, 17
```

```
heap_{funcstart_{-724,1}}.p1, 177).rem)
[57.5] heap_{724,1;742,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).quot) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow asType<short int>((div(heapIs
heap_{funcstart_{-724,1}}, heap_{funcstart_{-724,1}}.p2, 176).rem *
asType < int > (\$heap_{funcstart\_724,1}.\_replace(p1 \rightarrow ((-2 * div(heapIs)))))))
\theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}
\text{Sheap}_{funcstart_{724,1}}, \text{Sheap}_{funcstart_{724,1},p1, 177}.\text{rem})).r2)) -
(asType<int>(asType<short int>(div2.quot)) *
asType < int > (\$heap_{724,1;740,8}.b2))))
\rightarrow [const member of object with modified fields]
[57.6] $heap<sub>724,1;742,8</sub> == $heap<sub>funcstart_724,1</sub>._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 *
\operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724.1}, \$ \operatorname{heap}_{funcstart\_724.1}.p1,
177).rem)))._{\mathbf{replace}}(p2 \rightarrow \mathbf{asType} < \mathbf{short\ int} > ((\operatorname{div}(\mathbf{heapIs}))))
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.p2, 176).rem *
asType < int > (\$heap_{funcstart-724,1}.r2)) - (asType < int > (asType < short)
int>(div2.quot)) * asType< int>($heap_{724.1:740.8}.b2))))
\rightarrow [const static or extern object]
[57.7] heap_{724,1;742,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 \ *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.p1,
177).rem)))._{\mathbf{replace}}(p2 \rightarrow \mathbf{asType} < \mathbf{short\ int} > ((\operatorname{div}(\mathbf{heapIs}))))
\rho_{funcstart\_724,1}, \rho_{funcstart\_724,1.p2, 176}.rem *
asType < int > (\$heap_{init}.r2)) - (asType < int > (asType < short)
int>(div2.quot)) * asType<int>($heap<sub>724.1:740.8</sub>.b2))))
\rightarrow [expand definition of constant 'r2' at prang.c (20,20)]
[57.8] heap_{724,1;742,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}. p1, \ 177). \operatorname{quot}) + (171 *
\label{eq:div_heap} \text{div}(\textbf{heapIs} \ \$ \text{heap}_{funcstart\_724,1}, \ \$ \text{heap}_{funcstart\_724,1}.\text{p1},
(177).rem))._replace(p2 \rightarrow asType<short int>((div(heapIs)
\text{Sheap}_{funcstart_{-724,1}}, \text{Sheap}_{funcstart_{-724,1}}.p2, 176).rem *
asType < int > (asType < short int > ((int)172)))
(asType<int>(asType<short int>(div2.quot)) *
asType < int > (\$heap_{724,1;740,8}.b2))))
\rightarrow [simplify]
[57.11] $\text{heap}_{724,1:742.8} == $\text{heap}_{funcstart\_724,1}._\text{replace}(p1 \to ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}. p1, \ 177). \operatorname{quot}) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.p1,
177).rem)))._{\mathbf{replace}}(p2 \rightarrow \mathbf{asType} < \mathbf{short\ int} > ((\operatorname{div}(\mathbf{heapIs}))))
\text{Sheap}_{funcstart_{724,1}}, \text{Sheap}_{funcstart_{724,1}}.\text{p2}, 176).\text{rem} * 172) -
```

```
(asType<int>(asType<short int>(div2.quot)) *
asType < int > (\$heap_{724,1;740,8}.b2))))
\rightarrow [from term 25.6, div2 is equal to div(heapIs $heap_{funcstart\_724,1},
heap_{funcstart_{724,1}}.p2, 176
[57.12] $\text{heap}_{724,1;742,8} == $\text{heap}_{funcstart_724,1}._\text{replace}(p1 \to ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).quot) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow asType<short int>((172 * div(heapIs
heap_{funcstart_{724,1}}, heap_{funcstart_{724,1}}, 2, 176).rem –
(asType<int>(asType<short int>(div(heapIs $heap_{tuncstart\_724.1},
\text{sheap}_{funcstart\_724,1.p2}, 176).\text{quot}) * asType<int>(\text{sheap}_{724,1;740,8}.\text{b2}))))
\rightarrow [simplify]
[57.14] \rho_{724,1;742,8} == \rho_{14,1;742,8} == \rho_{14,1;742,8} = \rho_{14,1;742,8} == \rho_{14,1;742,8} = \rho_{14,1;7
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 \ *
\operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724,1}, \$ \operatorname{heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow asType<short int>((172 * div(heapIs
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.\text{p2}, 176).\text{rem}) - (\text{div}(\text{heapIs})
heap_{funcstart_{724,1}}, heap_{funcstart_{724,1}}, 2, 176).quot *
asType<int>($heap<sub>724.1:740.8</sub>.b2))))
\rightarrow [from term 53.19, $heap<sub>724.1:740.8</sub> is equal to
heap_{funcstart\_724,1}._replace(p1 \rightarrow (-2 * div(heapIs $heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1}.\text{p1}, 177).\text{quot} + (171 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
heap_{funcstart_{-724,1}.p1, 177).rem}
[57.15] $\text{heap}_{724,1:742,8} == \text{$heap}_{funcstart\_724,1}._\text{$replace}(p1 \to ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 *
\operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724,1}, \$ \operatorname{heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow asType<short int>((172 * div(heapIs
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.\text{p2}, 176).\text{rem}) - (\text{div}(\text{heapIs}))
\theta_{funcstart_{724,1}}, \theta_{funcstart_{724,1},p2,176}.quot *
asType < int > (\$heap_{funcstart\_724,1}.\_replace(p1 \rightarrow ((-2 * div(heapIs)))))))
\theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}
\text{Sheap}_{funcstart_{724,1}}, \text{Sheap}_{funcstart_{724,1},p1, 177}.\text{rem})).b2))))
\rightarrow [const member of object with modified fields]
[57.16] $heap<sub>724.1:742.8</sub> == $heap<sub>funcstart_724.1</sub>._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}. p1, \ 177). \operatorname{quot}) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow asType<short int>((172 * div(heapIs
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.\text{p2}, 176).\text{rem}) - (\text{div}(\text{heapIs})
\theta_{funcstart_{724,1}}, \theta_{funcstart_{724,1},p2,176}.quot *
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{b2}))))
\rightarrow [const static or extern object]
```

```
[57.17] $\text{heap}_{724,1;742,8} == \text{$heap}_{funcstart_724,1}._{\text{replace}}(p1 \to ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 \ *
\label{eq:div_heap} \text{div}(\textbf{heapIs} \ \$ \text{heap}_{funcstart\_724,1}, \ \$ \text{heap}_{funcstart\_724,1}.\text{p1},
177).rem)))._replace(p2 \rightarrow asType<short int>((172 * div(heapIs
\theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}.p2, 176).rem) - (div(heapIs
heap_{funcstart_{724,1}}, heap_{funcstart_{724,1}}, 176).quot *
asType < int > (\$heap_{init}.b2))))
\rightarrow [expand definition of constant 'b2' at prang.c (22,20)]
[57.18] $\text{heap}_{724,1:742,8} == \text{$heap}_{funcstart\_724,1}._\text{$replace}(p1 \to ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow asType<short int>((172 * div(heapIs
\theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}.p2, 176).rem) - (div(heapIs
heap_{funcstart_{724,1}}, heap_{funcstart_{724,1}}, 2, 176, quot
asType<int>(asType<short int>((int)35)))))
\rightarrow [simplify]
[57.24] $heap<sub>724,1;742,8</sub> == $heap<sub>funcstart_724,1</sub>._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 \ *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart} \ 724.1, \ \$ \operatorname{heap}_{funcstart} \ 724.1, \ p1,
177).rem)))._replace(p2 \rightarrow ((-35 * div(heapIs $heap_{funcstart\_724,1},
\rho_{tuncstart_{-724,1},p2,176}, quot) + (172 * div(heapIs \rho_{tuncstart_{-724,1},p2}
heap_{funcstart_{-724,1}}.p2, 176).rem)
[Take given term]
[61.0] $\text{heap}_{724,1:744,8} == $\text{heap}_{724,1:742,8}._\text{replace}(p3 \to \text{asType} < \text{short}
int>((asType<int>(asType<short int>(div3.rem)) *
asType < int > (\$heap_{724,1:742.8}.r3)) - (asType < int > (asType < short)
int>(div3.quot)) * asType<int>($heap<sub>724,1;742,8</sub>.b3))))
\rightarrow [from term 57.24, $\$heap_{724,1;742,8}$ is equal to
heap_{funcstart_{724,1}}._replace(p1 \rightarrow ((-2 * div(heapIs $heap_{funcstart_{724,1}}), + div(heapIs $heap_{funcstart_{724,1}}))
\text{Sheap}_{funcstart\_724,1}.p1, 177).quot) + (171 * div(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
heap_{funcstart\_724,1}.p1, 177).rem)._replace(p2 \rightarrow (-35 * div(heapIs)))._
heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p2, 176).quot) + (172 * div(heapIs)
heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p2, 176).rem)
[61.1] heap_{724,1;744,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 \ *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow ((-35 * div(heapIs $heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1}.\text{p2}, 176).\text{quot} + (172 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
\theta_{uncstart_724.1.p2, 176}.rem)._replace(p3 \rightarrow asType<short
int>((asType<int>(asType<short int>(div3.rem)) *
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{724,1;742,8}.\mathrm{r3})) - (\mathbf{asType}{<}\mathbf{int}{>}(\mathbf{asType}{<}\mathbf{short}
int>(div3.quot)) * asType<int>($heap<sub>724,1:742,8</sub>.b3))))
```

```
\rightarrow [from term 39.6, div3 is equal to div(heapIs $heap_{funcstart\_724,1},
heap_{funcstart_{724,1}}.p3, 178
[61.2] $heap<sub>724,1:744,8</sub> == $heap<sub>funcstart_724,1</sub>._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.\operatorname{p1}, \ 177).\operatorname{quot}) + (171 \ *
\operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724.1}, \$ \operatorname{heap}_{funcstart\_724.1}.p1,
177).rem)))._replace(p2 \rightarrow ((-35 * div(heapIs $heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1}.\text{p2}, 176).\text{quot} + (172 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
\theta_{uncstart_{724.1},p2,176}.rem)._replace(p3 \rightarrow asType<short
int>((asType<int>(asType<short int>(div(heapIs $heap_{funcstart\_724,1},))
\text{sheap}_{funcstart\_724,1.p3}, 178).rem) * asType < int > (\text{sheap}_{724,1;742,8}.r3)) -
(asType<int>(asType<short int>(div3.quot)) *
asType < int > (\$heap_{724,1:742.8}.b3))))
\rightarrow [simplify]
[61.4] $heap<sub>724.1:744.8</sub> == $heap<sub>funcstart_724.1</sub>._replace(p1 \rightarrow ((-2 *
div(\mathbf{heapIs} \ \$heap_{funcstart\_724.1}, \ \$heap_{funcstart\_724.1}.p1, \ 177).quot) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow ((-35 * div(heapIs $heap_{funcstart\_724,1},
\theta_{funcstart_{-724,1},p2,176} + (172 * div(heapIs \theta_{funcstart_{-724,1},p2,176}) + (172 * div(heapIs \theta_{funcstart_{-724,1},p2,176})
\theta_{funcstart_{724,1},p2,176,rem})._replace(p3 \rightarrow asType<short
int>((div(heapIs \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p3, 178).rem *
asType < int > (\$heap_{724,1:742.8}.r3)) - (asType < int > (asType < short)
int>(div3.quot)) * asType< int>($heap_{724,1;742,8}.b3))))
\rightarrow [from term 57.24, $heap<sub>724.1:742.8</sub> is equal to
heap_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 * div(heapIs *heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1}.\text{p1}, 177).\text{quot} + (171 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
heap_{funcstart\_724,1}.p1, 177).rem))._replace(p2 \rightarrow (-35 * div(heapIs)))._
heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p2, 176).quot) + (172 * div(heapIs)
heap_{funcstart_{724,1}}, heap_{funcstart_{724,1}}, p2, 176).rem)
[61.5] \rho_{1.5} = \rho_{1.5}
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 *
\operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724,1}, \$ \operatorname{heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow ((-35 * div(heapIs $heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1}.\text{p2}, 176).\text{quot} + (172 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
\rho_{funcstart\_724,1.p2, 176}.rem))._replace(p3 \rightarrow asType<short
int>((div(heapIs \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p3, 178).rem *
asType < int > (\$heap_{tuncstart\_724,1}.\_replace(p1 \rightarrow ((-2 * div(heapIs))))))
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.\text{p1}, 177).\text{quot}) + (171 * \text{div}(\text{heapIs}))
* div(heapIs heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p2, 176).quot) + (172 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p2, \ 176).rem))).r3)) -
(asType<int>(asType<short int>(div3.quot)) *
asType < int > (\$heap_{724.1:742.8}.b3)))
\rightarrow [const member of object with modified fields]
```

```
[61.7] heap_{724,1;744,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).quot) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow ((-35 * div(heapIs $heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1}.\text{p2}, 176).\text{quot} + (172 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
\rho_{funcstart\_724,1.p2, 176}.rem))._replace(p3 \rightarrow asType<short
int>((div(heapIs $heap_{funcstart\_724,1}, $heap_{funcstart\_724,1}.p3, 178).rem *
asType < int > (\$heap_{tuncstart\_724.1}.r3)) - (asType < int > (asType < short)
int>(div3.quot)) * asType<int>($heap<sub>724.1:742.8</sub>.b3))))
\rightarrow [const static or extern object]
[61.8] heap_{724,1;744,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow ((-35 * div(heapIs $heap_{funcstart_724,1},
\text{Sheap}_{funcstart\_724,1}.\text{p2}, 176).\text{quot} + (172 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
\$ heap_{funcstart\_724,1}.p2,\,176).rem))).\_\textbf{replace}(p3 \rightarrow \textbf{asType} < \textbf{short}
int>((div(heapIs \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p3, 178).rem *
asType < int > (\$heap_{init}.r3)) - (asType < int > (asType < short)
int>(div3.quot)) * asType<int>($heap<sub>724.1:742.8</sub>.b3))))
\rightarrow [expand definition of constant 'r3' at prang.c (25,20)]
[61.9] heap_{724,1;744,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 \ *
\operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724.1}, \$ \operatorname{heap}_{funcstart\_724.1}.p1,
177).rem)))._replace(p2 \rightarrow ((-35 * div(heapIs $heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1}.\text{p2}, 176).\text{quot} + (172 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
\rho_{uncstart\_724,1.p2, 176).rem}).replace(p3 \rightarrow asType<short
int>((div(heapIs \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p3, 178).rem *
asType<int>(asType<short int>((int)170))) -
(asType<int>(asType<short int>(div3.quot)) *
asType < int > (\$heap_{724,1;742,8}.b3))))
\rightarrow [simplify]
[61.12] $\text{heap}_{724.1:744.8} == $\text{heap}_{funcstart\_724.1}. \text{replace}(p1 \to ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 \ *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow ((-35 * div(heapIs $heap_{funcstart\_724,1},
\text{Sheap}_{funcstart_{-724,1},p2}, 176).\text{quot}) + (172 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart_{-724,1}},
\theta_{funcstart_{724,1},p2,176,rem})._replace(p3 \rightarrow asType<short
int>((div(heapIs \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p3, 178).rem * 170)
- (asType < int > (asType < short int > (div3.quot))*
asType < int > (\$heap_{724,1;742,8}.b3))))
\rightarrow [from term 39.6, div3 is equal to div(heapIs $heap_{funcstart\_724,1},
heap_{funcstart_{724,1}}.p3, 178
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[61.13] $heap<sub>724,1;744,8</sub> == $heap<sub>funcstart_724,1</sub>._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 \ *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow ((-35 * div(heapIs $heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1}.\text{p2}, 176).\text{quot} + (172 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
\rho_{uncstart\_724,1}.p2, 176).rem))._replace(p3 \rightarrow asType<short int>((170
* \operatorname{div}(\mathbf{heapIs} \ \operatorname{\$heap}_{funcstart\_724,1}, \ \operatorname{\$heap}_{funcstart\_724,1}.p3, \ 178).rem) -
(asType<int>(asType<short int>(div(heapIs $heap_{tuncstart\_724.1},
\text{Sheap}_{funcstart\_724,1}.\text{p3}, 178).\text{quot}) * asType<int>(\text{Sheap}_{724,1;742,8}.\text{b3}))))
[61.15] $heap<sub>724,1;744,8</sub> == $heap<sub>funcstart_724,1</sub>._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 \ *
\operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724,1}, \$ \operatorname{heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow ((-35 * div(heapIs $heap_{funcstart_724,1},
\text{Sheap}_{funcstart\_724,1}.\text{p2}, 176).\text{quot} + (172 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
\rho_{uncstart_{-724,1},p2, 176,rem})._replace(p3 \rightarrow asType<short int>((170
* div(heapIs heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p3, 178).rem) –
(\text{div}(\mathbf{heapIs} \$ \text{heap}_{funcstart\_724.1}, \$ \text{heap}_{funcstart\_724.1}. \text{p3}, 178).\text{quot} *
asType<int>($heap<sub>724.1:742.8</sub>.b3))))
\rightarrow [from term 57.24, heap_{724,1;742,8} is equal to
heap_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 * div(heapIs heap_{funcstart\_724,1}),
\text{Sheap}_{funcstart\_724,1}.p1, 177).quot) + (171 * div(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
\rho_{uncstart\_724,1}.p1, 177).rem))._replace\rho_{uncstart\_724,1}.p1, 177).rem)
heap_{funcstart\_724,1}, p_{funcstart\_724,1}, p_{funcstart\_724,1}, p_{funcstart\_724,1}, p_{funcstart\_724,1}
heap_{funcstart_{724,1}}, heap_{funcstart_{724,1}}, p2, 176).rem)
[61.16] \rho_{724,1;744,8} == \rho_{funcstart\_724,1}.\_replace(p1 \rightarrow ((-2 * p1.24)))
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow ((-35 * div(heapIs $heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724.1.p2}, 176).\text{quot} + (172 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724.1},
\theta_{170} = \theta_{1
* div(heapIs heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p3, 178).rem) –
(\text{div}(\mathbf{heapIs} \$ \text{heap}_{funcstart\_724,1}, \$ \text{heap}_{funcstart\_724,1}.\text{p3}, 178).\text{quot} *
asType < int > (\$heap_{funcstart\_724,1}.\_replace(p1 \rightarrow ((-2 * div(heapIs))))))
heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p1, 177).quot) + (171 * div(heapIs)
\theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}
* div(\mathbf{heapIs} \ \$ heap_{funcstart\_724,1}, \ \$ heap_{funcstart\_724,1}.p2, \ 176).quot) + (172 \ *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.\operatorname{p2}, \ 176).\operatorname{rem}))).\operatorname{b3}))))
→ [const member of object with modified fields]
[61.18] heap_{724,1;744,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).quot) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow ((-35 * div(heapIs $heap_{funcstart\_724,1},
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\text{Sheap}_{funcstart\_724,1}.\text{p2}, 176).\text{quot} + (172 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
\rho_{funcstart\_724,1}, p2, 176).rem)._replace(p3 \rightarrow asType<short int>((170
* \operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p3, \ 178).rem) -
(\text{div}(\mathbf{heapIs} \$ \text{heap}_{funcstart\_724,1}, \$ \text{heap}_{funcstart\_724,1}.\text{p3}, 178).\text{quot} *
asType < int > (\$heap_{funcstart\_724,1}.b3))))
\rightarrow [const static or extern object]
[61.19] $heap<sub>724,1;744,8</sub> == $heap<sub>funcstart_724,1</sub>._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).quot) + (171 *
\operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724,1}, \$ \operatorname{heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow ((-35 * div(heapIs $heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1.p2}, 176).\text{quot} + (172 * \text{div}(\text{heapIs} \text{Sheap}_{funcstart\_724,1},
\rho_{tuncstart\_724,1.p2, 176}.rem)._replace(p3 \rightarrow asType<short int>((170
* \operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p3, \ 178).rem) -
(\text{div}(\mathbf{heapIs} \$ \text{heap}_{funcstart\_724,1}, \$ \text{heap}_{funcstart\_724,1}.\text{p3}, 178).\text{quot} *
asType < int > (\$heap_{init}.b3))))
\rightarrow [expand definition of constant 'b3' at prang.c (27,20)]
[61.20] heap_{724,1;744,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 \ *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart} \ 724.1, \ \$ \operatorname{heap}_{funcstart} \ 724.1, \ p1,
177).rem)))._replace(p2 \rightarrow ((-35 * div(heapIs $heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1.p2}, 176).\text{quot} + (172 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
\rho_{tuncstart_724.1}.p2, 176).rem))._replace(p3 \rightarrow asType<short int>((170
* div(heapIs heap_{funcstart\_724.1}, heap_{funcstart\_724.1}, n_{funcstart\_724.1}, n_{funcstart\_724.1}
(\text{div}(\mathbf{heapIs} \$ \text{heap}_{funcstart\_724,1}, \$ \text{heap}_{funcstart\_724,1}.\text{p3}, 178).\text{quot} *
asType<int>(asType<short int>((int)63)))))
\rightarrow [simplify]
[61.26] heap_{724,1;744,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 \ *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724.1}, \ \$ \operatorname{heap}_{funcstart\_724.1}.p1,
177).rem)))._replace(p2 \rightarrow ((-35 * div(heapIs $heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724.1.p2}, 176).\text{quot} + (172 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724.1},
\rho_{funcstart\_724,1}.p2, 176).rem))._replace(p3 \rightarrow ((-63 * div(heapIs
\theta_{funcstart_{-724,1}}, \theta_{funcstart_{-724,1}}, \theta_{funcstart_{-724,1}}, \theta_{funcstart_{-724,1}}, \theta_{funcstart_{-724,1}}
heap_{funcstart_{724,1}}, heap_{funcstart_{724,1}}, 178).rem)
[Take goal term]
[1.0] $heap<sub>724,1;744,8</sub>.p1 \leq maxof(int)
\rightarrow [from term 61.26, $heap<sub>724,1;744,8</sub> is equal to
heap_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 * div(heapIs $heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\ 724,1}, p1,\ 177).quot) + (171 * div(\textbf{heapIs}\ \text{Sheap}_{funcstart\ 724,1},
\rho_{1.5}(p_2) = \rho_{1.5}(p_2) - \rho_{1
heap_{funcstart\_724,1}, p_{funcstart\_724,1}, p_{funcstart\_724,1}, p_{funcstart\_724,1}, p_{funcstart\_724,1}
\theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}
```

```
div(\mathbf{heapIs} \ \$heap_{funcstart\_724,1}, \ \$heap_{funcstart\_724,1}.p3, \ 178).quot) + (170 *
div(\mathbf{heapIs} \ \$heap_{funcstart\_724,1}, \ \$heap_{funcstart\_724,1}.p3, \ 178).rem))]
[1.1] \text{sheap}_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 * div(heapIs
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.\text{p1}, 177).\text{quot}) + (171 * \text{div}(\text{heapIs}))
\theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}
* div(\mathbf{heapIs} \ \$ heap_{funcstart\_724,1}, \ \$ heap_{funcstart\_724,1}.p2, \ 176).quot) + (172 \ *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.p2,
176).rem)))._replace(p3 \rightarrow ((-63 * div(heapIs $heap_{funcstart\_724,1},
\text{heap}_{funcstart\_724,1}.\text{p3}, 178).\text{quot} + (170 * \text{div}(\text{heapIs} \text{heap}_{funcstart\_724,1},
\theta_{funcstart_{-724,1}.p3, 178, rem}).p1 \leq \max_{f(int)}
\rightarrow [simplify]
[1.18] -32768 < ((-171 * div(heapIs $heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1}.\text{p1}, 177).\text{rem} + (2 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
heap_{funcstart_{724,1}}.p1, 177).quot)
\rightarrow [from term 56.17, literala < ((-171 * div(heapIs $heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1}.\text{p1}, 177).\text{rem} + (2 * div(\textbf{heapIs} \$heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1}.p1, 177).quot) is true whenever (-1 + \text{literala}) < -30269
    Proof of rule precondition:
    [1.18.0](-32768 + -1) < -30269
    \rightarrow [simplify]
    [1.18.2] true
[1.19] true
Proof of verification condition: Type constraint satisfied in explicit
conversion from 'integer' to 'int'
Condition generated at: C:\Escher\Customers\prang\prang.c (63,11)
Condition defined at:
To prove: minof(int) \le
static\_cast < integer > (asType < int > (\$heap_{724,1:744,8}.p1) < (int)0)
Given:
heap_{init}.LIMIT == (int)80
\theta sheap<sub>init</sub>.M1 == asType<short int>((int)30269)
\theta_{init}.r1 == asType < short int > ((int)171)
heap_{init}.a1 == asType < short int > ((int)177)
\theta
heap_{init}.M2 == asType < short int > ((int)30307)
\theta_{init}.r2 == asType < short int > ((int)172)
```

```
\theta
\theta
heap_{init}.M3 == asType < short int > ((int)30323)
\theta_{init}.r3 == asType < short int > ((int)170)
heap_{init}.a3 == asType < short int > ((int)178)
heap_{init}.b3 == asType < short int > ((int)63)
\theta = asType < short int > ((int)1)
\theta
\theta = asType < short int > ((int)3)
invariant
1<br/>( \mathbf{heapIs}\ \$ \mathbf{heap}_{funcstart\_724,1})
\operatorname{div1} == \operatorname{div}(\mathbf{heapIs} \ \operatorname{\$heap}_{funcstart\_724,1},
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p1}),
asType < int > (\$heap_{funcstart\_724,1}.a1))
(asType<int>(asType<int>($heap_{tuncstart\_724.1}.p1)) /
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a1))) = =
asType<integer>(div1.quot)
(asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.p1)) \%
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a1))) = =
asType<integer>(div1.rem)
!(0 == asType < integer > (div1.rem)) || !(0 ==
asType<integer>(div1.quot))
\label{eq:div2} \text{div2} == \text{div}(\mathbf{heapIs} \ \$ \text{heap}_{funcstart\_724,1},
\mathbf{asType} < \mathbf{int} > (\$ \mathrm{heap}_{funcstart\_724,1}.\mathrm{p2}),
asType < int > (\$heap_{funcstart\_724,1}.a2))
(asType<integer>(asType<int>($heap_{tuncstart\_724.1}.p2)) /
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a2))) = =
asType<integer>(div2.quot)
(asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.p2)) \%
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a2))) = =
asType<integer>(div2.rem)
!(0 == asType < integer > (div2.rem)) || !(0 ==
asType<integer>(div2.quot))
\mathrm{div3} == \mathrm{div}(\mathbf{heapIs} \ \$ \mathrm{heap}_{funcstart\_724,1},
\mathbf{asType} < \mathbf{int} > (\$ \mathrm{heap}_{funcstart\_724,1}.\mathrm{p3}),
asType < int > (\$heap_{funcstart\_724,1}.a3))
(asType<int>(asType<int>($heap_{tuncstart\_724.1}.p3)) /
\mathbf{asType}{<}\mathbf{integer}{>}(\mathbf{asType}{<}\mathbf{int}{>}(\$\mathbf{heap}_{funcstart\_724,1}.\mathbf{a3}))) = =
asType<integer>(div3.quot)
```

```
(asType<integer>(asType<int>($heap_{tuncstart\_724.1}.p3)) %
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a3))) = =
asType<integer>(div3.rem)
!(0 == asType < integer > (div3.rem)) || !(0 ==
asType < integer > (div3.quot))
heap_{724,1;740,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow asType<short
int>((asType<int>(asType<short int>(div1.rem)) *
asType < int > (\$heap_{funcstart\_724,1}.r1)) - (asType < int > (asType < short)
int>(div1.quot)) * asType< int>($heap_{funcstart\_724,1}.b1))))
-asType<integer const>($heap<sub>724,1;740,8</sub>.M1) <
asType<integer>($heap<sub>724,1:740,8</sub>.p1)
!(0 == asType < integer > (\$heap_{724,1:740.8}.p1))
asType<integer>($heap<sub>724,1:740,8</sub>.p1) <
asType<integer>($heap<sub>724,1:740,8</sub>.M1)
heap_{724,1;742,8} == heap_{724,1;740,8}.replace(p2 \rightarrow asType<short
int>((asType<int>(asType<short int>(div2.rem)) *
asType < int > (\$heap_{724.1:740.8}.r2)) - (asType < int > (asType < short)
\mathbf{int}{>}(\text{div2.quot})) * \mathbf{asType}{<} \mathbf{int}{>} (\$\text{heap}_{724,1;740,8}.\text{b2}))))
-\mathbf{asType}{<}\mathbf{integer\ const}{>}(\$\mathrm{heap}_{724,1;742,8}.\mathrm{M2}) <
asType<integer>($heap<sub>724,1:742,8</sub>.p2)
!(0 == asType < integer > (\$heap_{724,1;742,8}.p2))
asType<integer>($heap<sub>724,1:742,8</sub>.p2) <
asType<integer>($heap<sub>724,1;742,8</sub>.M2)
\text{heap}_{724.1:744.8} == \text{heap}_{724.1:742.8}._replace(p3 \rightarrow asType<short)
int>((asType<int>(asType<short int>(div3.rem))
asType < int > (\$heap_{724,1;742,8}.r3)) - (asType < int > (asType < short)
int>(div3.quot)) * asType<int>($heap<sub>724.1:742.8</sub>.b3))))
-asType<integer const>($heap<sub>724.1:744.8</sub>.M3) <
asType<integer>($heap<sub>724.1:744.8</sub>.p3)
!(0 == \mathbf{asType} {<} \mathbf{integer} {>} (\$ heap_{724,1;744,8}.p3))
asType<integer>($heap<sub>724.1:744.8</sub>.p3) <
asType<integer>($heap<sub>724,1:744,8</sub>.M3)
Proof:
[Take given term]
[11.0] \operatorname{div1} == \operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724,1},
asType < int > (\$heap_{funcstart\_724,1}.p1),
asType < int > (\$heap_{funcstart\_724.1}.a1))
\rightarrow [simplify]
```

```
[11.1]~{\rm div1} == {\rm div}(\mathbf{heapIs}~\$ \mathrm{heap}_{funcstart\_724,1},\,\$ \mathrm{heap}_{funcstart\_724,1}.\mathrm{p1},
asType < int > (\$heap_{funcstart\_724,1}.a1))
\rightarrow [const static or extern object]
\textit{[11.2]} \ \text{div1} == \text{div}(\mathbf{heapIs} \ \$ \text{heap}_{funcstart\_724,1}, \ \$ \text{heap}_{funcstart\_724,1}.\text{p1},
asType < int > (\$heap_{init}.a1))
\rightarrow [expand definition of constant 'a1' at prang.c (16,20)]
[11.3] div1 == div(heapIs heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p1,
asType<int>(asType<short int>((int)177)))
\rightarrow [simplify]
[11.6] div1 == div(heapIs heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p1, 177)
[Take given term]
[25.0] \operatorname{div2} == \operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724,1},
asType < int > (\$heap_{funcstart\_724,1}.p2),
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{a2}))
\rightarrow [simplify]
[25.1] div2 == div(heapIs $heap_{funcstart\_724.1}, $heap_{funcstart\_724.1}.p2,
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{a2}))
\rightarrow [const static or extern object]
[25.2]~{\rm div2} == {\rm div}(\mathbf{heapIs}~\$ \mathrm{heap}_{funcstart\_724,1},\,\$ \mathrm{heap}_{funcstart\_724,1}.\mathrm{p2},
asType < int > (\$heap_{init}.a2))
\rightarrow [expand definition of constant 'a2' at prang.c (21,20)]
[25.3] \operatorname{div2} == \operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724,1}, \$ \operatorname{heap}_{funcstart\_724,1}.p2,
asType < int > (asType < short int > ((int)176)))
\rightarrow [simplify]
[25.6] div2 == div(heapIs $heap_{funcstart\_724,1}, $heap_{funcstart\_724,1}.p2, 176)
[Take given term]
[39.0] \operatorname{div3} == \operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724,1},
asType < int > (\$heap_{funcstart\_724,1}.p3),
asType < int > (\$heap_{funcstart\_724,1}.a3))
\rightarrow [simplify]
[39.1] \ \mathrm{div3} == \mathrm{div}(\mathbf{heapIs} \ \$ \mathrm{heap}_{funcstart\_724,1}, \ \$ \mathrm{heap}_{funcstart\_724,1}.\mathrm{p3},
asType < int > (\$heap_{funcstart\_724,1}.a3))
\rightarrow [const static or extern object]
[39.2] \operatorname{div3} == \operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.p3,
asType < int > (\$heap_{init}.a3))
\rightarrow [expand definition of constant 'a3' at prang.c (26,20)]
```

```
[39.3] div3 == div(heapIs heap_{funcstart_{-724,1}}, heap_{funcstart_{-724,1}}.p3,
asType<int>(asType<short int>((int)178)))
\rightarrow [simplify]
[39.6] \text{ div3} == \text{div}(\text{heapIs } \text{$heap}_{funcstart\_724,1}, \text{$heap}_{funcstart\_724,1}.\text{p3}, 178)
[Take given term]
[53.0] heap_{724,1;740,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow asType<short
int>((asType<int>(asType<short int>(div1.rem)) *
asType < int > (\$heap_{tuncstart\_724.1}.r1)) - (asType < int > (asType < short)
\mathbf{int}{>}(\mathbf{div1.quot})) \ * \ \mathbf{asType}{<} \mathbf{int}{>} (\$\mathbf{heap}_{funcstart\_724,1}.\mathbf{b1}))))
\rightarrow [from term 11.6, div1 is equal to div(heapIs $heap_{funcstart\_724,1},
heap_{funcstart_{-724,1}}.p1, 177)
[53.1] \theta == 
int>((asType<int>(asType<short int>(div(heapIs $heap_{funcstart_724.1},))
\text{sheap}_{funcstart\_724.1}.\text{p1}, 177).\text{rem} ** asType<int>(\text{sheap}_{funcstart\_724.1}.\text{r1})) -
(asType<int>(asType<short int>(div1.quot)) *
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{b1}))))
\rightarrow [simplify]
[53.3] \text{sheap}_{724,1;740,8} == \text{sheap}_{funcstart\_724,1}._replace(p1 \rightarrow asType<short
int>((div(heapIs \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1, 177).rem *
\mathbf{asType} < \mathbf{int} > (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{r1})) - (\mathbf{asType} < \mathbf{int} > (\mathbf{asType} < \mathbf{short}))
int>(div1.quot)) * asType<int>($heap_{funcstart\_724,1}.b1)))
\rightarrow [const static or extern object]
[53.4] heap_{724,1;740,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow asType<short
int>((div(heapIs \$heap_{funcstart\_724.1}, \$heap_{funcstart\_724.1}, p1, 177).rem *
asType < int > (\$heap_{init}.r1)) - (asType < int > (asType < short)
\mathbf{int}{>}(\mathbf{div1.quot})) \ * \ \mathbf{asType}{<} \mathbf{int}{>} (\$\mathbf{heap}_{funcstart\_724,1}.\mathbf{b1}))))
\rightarrow [expand definition of constant 'r1' at prang.c (15,20)]
[53.5] heap_{724,1;740,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow asType<short
int>((div(heapIs \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1, 177).rem *
asType<int>(asType<short int>((int)171))) -
(asType<int>(asType<short int>(div1.quot)) *
asType < int > (\$heap_{funcstart\_724,1}.b1))))
\rightarrow [simplify]
[53.8] \text{sheap}_{724,1;740,8} == \text{sheap}_{funcstart\_724,1}._replace(p1 \rightarrow asType<short
int>((div(heapIs $heap_{tuncstart_724.1}, $heap_{tuncstart_724.1}.p1, 177).rem * 171)
- (asType<int>(asType<short int>(div1.quot)) *
asType < int > (\$heap_{funcstart\_724,1}.b1))))
\rightarrow [from term 11.6, div1 is equal to div(heapIs $heap_{funcstart\_724,1},
heap_{funcstart_{-724,1}}.p1, 177
```

```
[53.9] heap_{724,1;740,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow asType<short
int>((171 * div(heapIs $heap_{funcstart\_724,1}, $heap_{funcstart\_724,1}.p1, 177).rem)
- (asType<int>(asType<short int>(div(heapIs $heap_{funcstart\_724,1},
heap_{funcstart_{-724,1}}.p1, 177).quot) *
asType < int > (\$heap_{funcstart\_724,1}.b1))))
\rightarrow [simplify]
[53.11] \theta == 
int>((171 * div(heapIs $heap_{funcstart\_724,1}, $heap_{funcstart\_724,1}.p1, 177).rem)
- (\text{div}(\mathbf{heapIs} \$ \text{heap}_{funcstart\_724,1}, \$ \text{heap}_{funcstart\_724,1}.\text{p1}, 177).\text{quot} *
asType < int > (\$heap_{funcstart\ 724,1}.b1)))
\rightarrow [const static or extern object]
[53.12] heap_{724,1;740,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow asType<short
int > ((171 * div(heapIs \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1, 177).rem)
- (\text{div}(\mathbf{heapIs} \$ \text{heap}_{funcstart\_724,1}, \$ \text{heap}_{funcstart\_724,1}.\text{p1}, 177).\text{quot} *
asType < int > (\$heap_{init}.b1))))
\rightarrow [expand definition of constant 'b1' at prang.c (17,20)]
[53.13] \text{heap}_{724,1;740,8} == \text{heap}_{funcstart\_724,1}._replace(p1 \rightarrow asType<short
int>((171 * div(heapIs $heap_{funcstart\_724,1}, $heap_{funcstart\_724,1}.p1, 177).rem)
- (\text{div}(\mathbf{heapIs} \$ \text{heap}_{funcstart\_724,1}, \$ \text{heap}_{funcstart\_724,1}.\text{p1}, 177).\text{quot} *
asType<int>(asType<short int>((int)2))))
\rightarrow [simplify]
[53.19] \text{$heap}_{724,1;740,8} == \text{$heap}_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.\operatorname{p1}, \ 177).\operatorname{rem})))
[Take given term]
[55.0]!(0 == asType < integer > (\$heap_{724.1:740.8}.p1))
\rightarrow [from term 53.19, $heap<sub>724,1:740,8</sub> is equal to
heap_{funcstart\_724,1}._replace(p1 \rightarrow (-2 * div(heapIs heap_{funcstart\_724,1}),
\text{Sheap}_{funcstart\_724,1}.p1, 177).quot) + (171 * div(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
heap_{funcstart_{-724,1}}.p1, 177).rem)
[55.1] !(0 == asType<integer>($heap_{funcstart\_724,1}.replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \text{$heap}_{funcstart\_724.1}, \ \text{$heap}_{funcstart\_724.1}.p1, \ 177).rem))).p1))
\rightarrow [simplify]
[55.3] !(0 == ((-2 * div(heapIs $heap_{funcstart\_724,1}, $heap_{funcstart\_724,1}.p1,
177).quot) + (171 * div(heapIs heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p1,
177).rem)))
[Take given term]
[57.0] $\text{heap}_{724,1;742,8} == $\text{heap}_{724,1;740,8}._\text{replace}(p2 \rightarrow \text{asType} < \text{short}
```

```
int>((asType<int>(asType<short int>(div2.rem)) *
asType < int > (\$heap_{724,1:740,8}.r2)) - (asType < int > (asType < short)
int>(div2.quot)) * asType<int>($heap<sub>724,1:740,8</sub>.b2))))
\rightarrow [from term 53.19, $heap<sub>724.1:740.8</sub> is equal to
heap_{funcstart\_724.1}._replace(p1 \rightarrow (-2 * div(heapIs heap_{funcstart\_724.1}),
\text{Sheap}_{funcstart\_724,1}.\text{p1}, 177).\text{quot} + (171 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
heap_{funcstart\_724,1}.p1, 177).rem))
[57.1] heap_{724,1;742,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).quot) + (171 *
\operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724,1}, \$ \operatorname{heap}_{funcstart\_724,1}.p1,
177).rem))).\_replace(p2 \rightarrow asType < short
int>((asType<int>(asType<short int>(div2.rem)) *
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{724,1;740,8}.\mathrm{r2})) - (\mathbf{asType}{<}\mathbf{int}{>}(\mathbf{asType}{<}\mathbf{short}
int > (div2.quot)) * asType < int > ($heap_{724,1:740.8}.b2))))
\rightarrow [from term 25.6, div2 is equal to div(heapIs $heap_{funcstart\_724,1},
heap_{funcstart_{-724,1}}.p2, 176)
[57.2] $\text{heap}_{724,1;742,8} == $\text{heap}_{funcstart\_724,1}._\text{replace}(p1 \to ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 \ *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart} \ 724.1, \ \$ \operatorname{heap}_{funcstart} \ 724.1, \ p1,
177).rem)))._replace(p2 \rightarrow asType<short
int>((asType<int>(asType<short int>(div(heapIs $heap_{funcstart\_724.1},
\text{sheap}_{funcstart\_724,1}.\text{p2}, 176).\text{rem}) * asType < int > (\text{sheap}_{724,1;740,8}.\text{r2})) -
(asType<int>(asType<short int>(div2.quot)) *
asType < int > (\$heap_{724,1:740.8}.b2))))
\rightarrow [simplify]
[57.4] heap_{724,1;742,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{$heap}_{funcstart\_724,1}, \ \text{$heap}_{funcstart\_724,1}.p1, \ 177).quot) + (171 *
\operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724,1}, \$ \operatorname{heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow asType<short int>((div(heapIs
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.p2, 176).rem *
asType < int > (\$heap_{724.1:740.8}.r2)) - (asType < int > (asType < short)
int>(div2.quot)) * asType<int>($heap<sub>724.1:740.8</sub>.b2))))
\rightarrow [from term 53.19, $heap<sub>724,1:740,8</sub> is equal to
heap_{funcstart\_724,1}._replace(p1 \rightarrow (-2 * div(heapIs $heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1}.\text{p1}, 177).\text{quot} + (171 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
$heap_{funcstart\_724,1}.p1, 177).rem))]
[57.5] $heap<sub>724,1;742,8</sub> == $heap<sub>funcstart_724,1</sub>._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow asType<short int>((div(heapIs
\theta_{funcstart_{724,1}}, \theta_{funcstart_{724,1},p2, 176}.rem *
asType<int>($heap<sub>funcstart_724,1</sub>._replace(p1 \rightarrow ((-2 * div(heapIs
```

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\theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}
\text{Sheap}_{funcstart_{724,1}}, \text{Sheap}_{funcstart_{724,1},p1, 177).rem})).r2)) -
(asType<int>(asType<short int>(div2.quot)) *
asType < int > (\$heap_{724,1;740,8}.b2))))
\rightarrow [const member of object with modified fields]
[57.6] heap_{724,1;742,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).quot) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow asType<short int>((div(heapIs
\text{Sheap}_{funcstart_{-724,1}}, \text{Sheap}_{funcstart_{-724,1}}.p2, 176).rem *
asType < int > (\$heap_{funcstart\_724,1}.r2)) - (asType < int > (asType < short)
int>(div2.quot)) * asType<int>($heap<sub>724,1:740,8</sub>.b2))))
\rightarrow [const static or extern object]
[57.7] \rho_{17,742,8} == \rho_{17,742,1}.\_replace(p1 \rightarrow ((-2 * p1 + p1)))
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 \ *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow asType<short int>((div(heapIs
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.\text{p2}, 176).\text{rem} *
asType < int > (\$heap_{init}.r2)) - (asType < int > (asType < short)
int>(div2.quot)) * asType< int>($heap_{724.1:740.8}.b2))))
\rightarrow [expand definition of constant 'r2' at prang.c (20,20)]
[57.8] heap_{724,1;742,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 *
\operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724,1}, \$ \operatorname{heap}_{funcstart\_724,1}.p1,
(177).rem)._replace(p2 \rightarrow asType<short int>((div(heapIs))
heap_{funcstart_{-724,1}}, heap_{funcstart_{-724,1}}, 176).rem *
asType<int>(asType<short int>((int)172))) -
(asType < int > (asType < short int > (div2.quot)) *
asType<int>($heap<sub>724.1:740.8</sub>.b2))))
\rightarrow [simplify]
[57.11] $\text{heap}_{724,1:742,8} == \text{$heap}_{funcstart\_724,1}._\text{$replace}(p1 \to ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).quot) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow asType<short int>((div(heapIs
heap_{funcstart_{724,1}}, heap_{funcstart_{724,1}}.p2, 176).rem * 172) -
(asType<int>(asType<short int>(div2.quot)) *
asType<int>($heap<sub>724.1:740.8</sub>.b2))))
\rightarrow [from term 25.6, div2 is equal to div(heapIs $heap_{tuncstart\_724.1},
$heap_{tuncstart_{724,1}}.p2, 176)]
[57.12] $\text{heap}_{724,1;742,8} == \text{$heap}_{funcstart\_724,1}._\text{replace}(p1 \to ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 *
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\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow asType<short int>((172 * div(heapIs
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.p2, 176).rem) -
(asType<int>(asType<short int>(div(heapIs $heap_{funcstart_724,1},))
\text{Sheap}_{funcstart\_724,1}.\text{p2}, 176).\text{quot}) * asType<int>(\text{Sheap}_{724,1:740.8}.\text{b2}))))
\rightarrow [simplify]
[57.14] $\text{heap}_{724,1:742,8} == \text{$heap}_{funcstart\_724,1}._\text{$replace}(p1 \to ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).quot) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow asType<short int>((172 * div(heapIs
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.\text{p2}, 176).\text{rem}) - (\text{div}(\text{heapIs})
heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p2, 176).quot *
asType < int > (\$heap_{724,1;740,8}.b2))))
\rightarrow [from term 53.19, $heap<sub>724.1:740.8</sub> is equal to
heap_{funcstart\_724.1}._replace(p1 \rightarrow (-2 * div(heapIs heap_{funcstart\_724.1}),
heap_{funcstart\_724,1}.p1, 177).quot + (171 * div(heapIs p_{funcstart\_724,1}),
heap_{funcstart_{724,1}}.p1, 177).rem)
[57.15] $heap<sub>724,1;742,8</sub> == $heap<sub>funcstart_724,1</sub>._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}. p1, \ 177). \operatorname{quot}) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow asType<short int>((172 * div(heapIs
\theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}.p2, 176).rem) - (div(heapIs
\text{Sheap}_{funcstart_{-724,1}}, \text{Sheap}_{funcstart_{-724,1}}.p2, 176).quot *
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathbf{\_replace}(\mathrm{p1} \rightarrow ((\text{-}2 * \mathrm{div}(\mathbf{heapIs}
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.\text{p1}, 177).\text{quot}) + (171 * \text{div}(\text{heapIs}))
heap_{funcstart_{-724,1}}, heap_{funcstart_{-724,1}}, 177).rem)).b2))))
\rightarrow [const member of object with modified fields]
[57.16] heap_{724,1;742,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 \ *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow asType<short int>((172 * div(heapIs
\theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}.p2, 176).rem) - (div(heapIs
\theta_{funcstart_{724,1}}, \theta_{funcstart_{724,1}}, \theta_{funcstart_{724,1}}.p2, 176).quot
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{b2}))))
\rightarrow [const static or extern object]
[57.17] $heap<sub>724,1;742,8</sub> == $heap<sub>funcstart_724,1</sub>._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 *
\operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724.1}, \$ \operatorname{heap}_{funcstart\_724.1}.p1,
177).rem)))._replace(p2 \rightarrow asType<short int>((172 * div(heapIs
\theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}.p2, 176).rem) - (div(heapIs
heap_{funcstart_{724,1}}, heap_{funcstart_{724,1}}.p2, 176).quot *
asType < int > (\$heap_{init}.b2))))
```

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\rightarrow [expand definition of constant 'b2' at prang.c (22,20)]
[57.18] $\text{heap}_{724,1:742,8} == \text{$heap}_{funcstart\_724,1}._\text{$replace}(p1 \to ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).quot) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow asType<short int>((172 * div(heapIs
\theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}.p2, 176).rem) - (div(heapIs
\theta_{funcstart_{724,1}}, \theta_{funcstart_{724,1},p2,176}.quot
asType<int>(asType<short int>((int)35)))))
\rightarrow [simplify]
[57.24] heap_{724,1;742,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 *
div(\mathbf{heapIs} \ \$heap_{funcstart\_724,1}, \ \$heap_{funcstart\_724,1}.p1, \ 177).quot) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow ((-35 * div(heapIs $heap_{funcstart\_724.1},
\text{Sheap}_{funcstart\_724.1.p2}, 176).\text{quot} + (172 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724.1},
heap_{funcstart_{724,1}}.p2, 176).rem)
[Take given term]
\textit{[61.0] $$heap$_{724,1;744,8} == $$heap$_{724,1;742,8}.$\_\textbf{replace}(p3 \to \textbf{asType} < \textbf{short}
int>((asType<int>(asType<short int>(div3.rem)) *
asType < int > (\$heap_{724,1;742,8}.r3)) - (asType < int > (asType < short)
int>(div3.quot)) * asType< int>($heap_{724.1:742.8}.b3))))
\rightarrow [from term 57.24, $heap<sub>724.1:742.8</sub> is equal to
heap_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 * div(heapIs $heap_{funcstart\_724,1},
heap_{funcstart\_724,1}.p1, 177).quot + (171 * div(heapIs p_{funcstart\_724,1})
\$heap_{funcstart\_724,1}.p1,\ 177).rem))).\_\textbf{replace}(p2 \rightarrow (-35\ *\ div(\textbf{heapIs}))).
heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p2, 176).quot) + (172 * div(heapIs)
heap_{funcstart_{-724,1}}, heap_{funcstart_{-724,1}}, p2, 176).rem)
[61.1] heap_{724,1;744,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 \ *
\operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724.1}, \$ \operatorname{heap}_{funcstart\_724.1}.p1,
177).rem)))._replace(p2 \rightarrow ((-35 * div(heapIs $heap_{funcstart\_724,1},
\theta_{funcstart\_724,1.p2}, 176).quot) + (172 * div(heapIs \theta_{funcstart\_724,1},
\theta_{funcstart_{724,1},p2,176,rem})._replace(p3 \rightarrow asType<short
int>((asType<int>(asType<short int>(div3.rem)) *
asType < int > (\$heap_{724,1:742.8}.r3)) - (asType < int > (asType < short)
int>(div3.quot)) * asType< int>($heap_{724,1;742,8}.b3))))
\rightarrow [from term 39.6, div3 is equal to div(heapIs $heap_{funcstart\_724,1},
heap_{funcstart_{-724,1}}.p3, 178
[61.2] $heap<sub>724,1:744,8</sub> == $heap<sub>funcstart_724,1</sub>._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 *
\operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724,1}, \$ \operatorname{heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow ((-35 * div(heapIs $heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1.p2}, 176).\text{quot}) + (172 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
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\rho_{uncstart_{724,1},p2,176,rem})._replace(p3 \rightarrow asType<short
int>((asType < int > (asType < short int > (div(heapIs $heap_{funcstart\_724,1}, 
\text{sheap}_{funcstart\_724,1}.\text{p3}, 178).\text{rem}) * asType<int>(\text{sheap}_{724,1;742,8}.\text{r3})) -
(asType<int>(asType<short int>(div3.quot)) *
asType < int > (\$heap_{724,1;742,8}.b3))))
\rightarrow [simplify]
[61.4] heap_{724,1;744,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).quot) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow ((-35 * div(heapIs $heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1}.\text{p2}, 176).\text{quot} + (172 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
\theta_{funcstart\_724,1}.p2, 176).rem))._replace(p3 \rightarrow asType<short
int>((div(heapIs \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p3, 178).rem *
asType < int > (\$heap_{724,1:742.8}.r3)) - (asType < int > (asType < short)
int>(div3.quot)) * asType<int>($heap<sub>724,1:742,8</sub>.b3))))
\rightarrow [from term 57.24, $\$heap_{724,1;742,8}$ is equal to
heap_{funcstart\_724.1}._replace(p1 \rightarrow ((-2 * div(heapIs $heap_{funcstart\_724.1},
\text{Sheap}_{funcstart_{-724,1},p1, 177}.\text{quot}) + (171 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart_{-724,1}})
\rho_{funcstart\_724.1.p1, 177).rem})._replace\rho_{funcstart\_724.1.p1, 177).rem})._replace
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.p2, 176).quot) + (172 * div(\textbf{heapIs})
heap_{funcstart_{-724,1}}, heap_{funcstart_{-724,1}}, p2, 176).rem)
[61.5] heap_{724,1;744,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 \ *
\operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724.1}, \$ \operatorname{heap}_{funcstart\_724.1}.p1,
177).rem)))._replace(p2 \rightarrow ((-35 * div(heapIs $heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1}.\text{p2}, 176).\text{quot} + (172 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
\theta_{uncstart_724.1.p2, 176}.rem)._replace(p3 \rightarrow asType<short
int>((div(heapIs \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p3, 178).rem *
\mathbf{asType}{<}\mathbf{int}{>}(\$\text{heap}_{funcstart\_724,1}.\mathbf{\_replace}(\text{p1} \rightarrow ((\text{-2} * \text{div}(\mathbf{heapIs}
heap_{funcstart_{-724,1}}, heap_{funcstart_{-724,1}}.p1, 177).quot) + (171 * div(heapIs)
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.p1, 177).rem))).\_replace(p2 \rightarrow ((-35))
* div(\mathbf{heapIs} \ \$ heap_{funcstart\_724,1}, \ \$ heap_{funcstart\_724,1}.p2, \ 176).quot) + (172 \ *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p2, \ 176).rem))).r3)) -
(asType<int>(asType<short int>(div3.quot))
asType < int > (\$heap_{724,1;742,8}.b3))))
→ [const member of object with modified fields]
[61.7] heap_{724,1;744,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).quot) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow ((-35 * div(heapIs $heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1}.\text{p2}, 176).\text{quot} + (172 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
\theta_{funcstart\_724,1.p2, 176).rem}))._replace(p3 \rightarrow asType<short
int>((div(heapIs \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p3, 178).rem *
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asType < int > (\$heap_{tuncstart\_724.1}.r3)) - (asType < int > (asType < short)
int > (div3.quot)) * asType < int > ($heap_{724,1;742,8}.b3))))
\rightarrow [const static or extern object]
[61.8] heap_{724,1;744,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).quot) + (171 *
\operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724.1}, \$ \operatorname{heap}_{funcstart\_724.1}.p1,
177).rem)))._replace(p2 \rightarrow ((-35 * div(heapIs $heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1.p2}, 176).\text{quot} + (172 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
\theta_{1} = \theta_{1} - \theta_{2} = \theta_{1} - \theta_{2} = \theta_{2} - \theta_{3} - \theta_{4} = \theta_{1} - \theta_{2} - \theta_{4} = \theta_{1} - \theta_{2} - \theta_{4} = \theta_{4} - \theta_{4} - \theta_{4} - \theta_{4} - \theta_{4} = \theta_{4} - \theta_{4
int>((div(heapIs $heap_{funcstart\_724,1}, $heap_{funcstart\_724,1}.p3, 178).rem *
asType < int > (\$heap_{init}.r3)) - (asType < int > (asType < short)
int>(div3.quot)) * asType<int>($heap<sub>724,1:742,8</sub>.b3))))
\rightarrow [expand definition of constant 'r3' at prang.c (25,20)]
[61.9] heap_{724,1;744,8} == heap_{funcstart\_724,1}.\_replace(p1 \to ((-2 * 
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 \ *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow ((-35 * div(heapIs \rho_{tart\_724,1},
\text{Sheap}_{funcstart\_724,1}.\text{p2}, 176).\text{quot}) + (172 * \text{div}(\text{heapIs} \text{Sheap}_{funcstart\_724,1},
\rho_{tuncstart_{1},724,1},p2,176,rem)._replace(p3 \rightarrow asType<short
int>((div(heapIs \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p3, 178).rem *
asType<int>(asType<short int>((int)170))) -
(asType<int>(asType<short int>(div3.quot)) *
asType < int > (\$heap_{724,1;742,8}.b3))))
\rightarrow [simplify]
[61.12] heap_{724,1;744,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 \ *
\operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724,1}, \$ \operatorname{heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow ((-35 * div(heapIs $heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1}.\text{p2}, 176).\text{quot} + (172 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
\theta_{1} = \theta_{1} - \theta_{2} - \theta_{3} - \theta_{4} - \theta_{5} - \theta_{6} - \theta_{6
int>((div(heapIs \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p3, 178).rem * 170)
- (asType<int>(asType<short int>(div3.quot)) *
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{724,1;742,8}.\mathrm{b3}))))
\rightarrow [from term 39.6, div3 is equal to div(heapIs $heap_{funcstart\_724,1},
heap_{funcstart_{-724,1}}.p3, 178
[61.13] $heap<sub>724,1;744,8</sub> == $heap<sub>funcstart_724,1</sub>._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 *
\operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724.1}, \$ \operatorname{heap}_{funcstart\_724.1}.p1,
177).rem)))._replace(p2 \rightarrow ((-35 * div(heapIs $heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1}.\text{p2}, 176).\text{quot} + (172 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
\theta_{uncstart_724,1.p2, 176).rem}))._replace(p3 \rightarrow asType<short int>((170
* div(heapIs heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p3, 178).rem) –
```

```
(asType<int>(asType<short int>(div(heapIs $heap_{tuncstart_{-724.1}},))
\text{sheap}_{funcstart\_724,1.p3}, 178).\text{quot}) * asType < int > (\text{sheap}_{724,1:742.8.b3})))
\rightarrow [simplify]
[61.15] $heap<sub>724,1;744,8</sub> == $heap<sub>funcstart_724,1</sub>._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).quot) + (171 *
\operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724.1}, \$ \operatorname{heap}_{funcstart\_724.1}.p1,
177).rem)))._replace(p2 \rightarrow ((-35 * div(heapIs $heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1.p2}, 176).\text{quot} + (172 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
\theta_{funcstart\_724,1.p2, 176}.rem)._replace(p3 \rightarrow asType<short int>((170
* div(heapIs heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p3, 178).rem) -
(\text{div}(\mathbf{heapIs} \$ \text{heap}_{funcstart\_724,1}, \$ \text{heap}_{funcstart\_724,1}.\text{p3}, 178).\text{quot} *
\mathbf{asType}{<}\mathbf{int}{>}(\${\rm heap}_{724,1;742,8}.{\rm b3}))))
\rightarrow [from term 57.24, $heap<sub>724,1;742,8</sub> is equal to
heap_{funcstart\_724.1}._replace(p1 \rightarrow ((-2 * div(heapIs $heap_{funcstart\_724.1},
\text{Sheap}_{funcstart\_724,1}.p1, 177).quot) + (171 * div(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
\theta_{funcstart\_724,1}.p1, 177).rem))._replace(p2 \rightarrow (-35 * div(\mathbf{heapIs})))
heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p2, 176).quot) + (172 * div(heapIs)
heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p2, 176).rem)
[61.16] $\text{heap}_{724,1:744,8} == $\text{heap}_{funcstart\_724,1}._\text{replace}(p1 \to ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).quot) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow ((-35 * div(heapIs $heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724.1.p2}, 176).\text{quot} + (172 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724.1},
\rho_{tuncstart_724.1}.p2, 176).rem))._replace(p3 \rightarrow asType<short int>((170
* div(heapIs heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p3, 178).rem) –
(div(heapIs heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p3, 178).quot *
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathbf{\_replace}(\mathrm{p1} \rightarrow ((-2\ *\ \mathrm{div}(\mathbf{heapIs}
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.\text{p1}, 177).\text{quot}) + (171 * \text{div}(\text{heapIs})
\theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}.p1, 177).rem))).\_replace(p2 \rightarrow ((-35))
* div(heapIs heap_{funcstart_{-724,1}}, heap_{funcstart_{-724,1}}, p2, 176).quot) + (172 *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.p2, \ 176).rem))).b3))))
\rightarrow [const member of object with modified fields]
[61.18] $\text{heap}_{724,1;744,8} == \text{$heap}_{funcstart\_724,1}._\text{$replace}(p1 \to ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 \ *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow ((-35 * div(heapIs $heap_{funcstart_724.1},
\text{Sheap}_{funcstart\_724,1}.\text{p2}, 176).\text{quot} + (172 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
\rho_{funcstart\_724.1.p2, 176}.rem)._replace(p3 \rightarrow asType<short int>((170
* div(heapIs heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p3, 178).rem) –
(\text{div}(\mathbf{heapIs} \$ \text{heap}_{funcstart\_724,1}, \$ \text{heap}_{funcstart\_724,1}.\text{p3}, 178).\text{quot} *
asType < int > (\$heap_{funcstart\_724,1}.b3))))
\rightarrow [const static or extern object]
```

```
[61.19] $heap<sub>724,1;744,8</sub> == $heap<sub>funcstart_724,1</sub>._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).quot) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow ((-35 * div(heapIs $heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1}.\text{p2}, 176).\text{quot} + (172 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
\rho_{tuncstart\_724,1.p2, 176, rem})._replace(p3 \rightarrow asType<short int>((170
* div(heapIs heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p3, 178).rem) –
(\text{div}(\mathbf{heapIs} \$ \text{heap}_{funcstart\_724.1}, \$ \text{heap}_{funcstart\_724.1}. \text{p3}, 178).\text{quot} *
asType < int > (\$heap_{init}.b3)))
\rightarrow [expand definition of constant 'b3' at prang.c (27,20)]
[61.20] $heap<sub>724,1;744,8</sub> == $heap<sub>funcstart_724,1</sub>._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 \ *
\operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724,1}, \$ \operatorname{heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow ((-35 * div(heapIs $heap_{funcstart_724,1},
\text{Sheap}_{funcstart\_724,1}.\text{p2}, 176).\text{quot} + (172 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
\theta_{uncstart_{-724,1},p2, 176,rem}))._replace(p3 \rightarrow asType<short int>((170
* div(heapIs heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p3, 178).rem) –
(\text{div}(\mathbf{heapIs} \$ \text{heap}_{funcstart\_724.1}, \$ \text{heap}_{funcstart\_724.1}. \text{p3}, 178).\text{quot} *
asType<int>(asType<short int>((int)63)))))
\rightarrow [simplify]
[61.26] $heap<sub>724,1;744,8</sub> == $heap<sub>funcstart_724,1</sub>._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 \ *
\operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724.1}, \$ \operatorname{heap}_{funcstart\_724.1}.p1,
177).rem)))._replace(p2 \rightarrow ((-35 * div(heapIs $heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1}.\text{p2}, 176).\text{quot} + (172 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
\theta_{uncstart\_724,1}.p2, 176).rem))).\_replace(p3 \rightarrow ((-63 * div(heapIs)))._replace(p3 \rightarrow ((-63 * div(heapIs))))._replace(p3 \rightarrow ((-63 * div(heapIs))))._replace(p3 \rightarrow ((-63 * div(heapIs))))._replace(p3 \rightarrow ((-63 * div(heapIs))))._replace(p3 \rightarrow ((-63 * div(heapIs)))))._replace(p3 \rightarrow ((-63 * div(heapIs))))._replace(p3 \rightarrow ((-63 * div(heapIs))))._replace(p3 \rightarrow ((-63 * div(heapIs)))))._replace(p3 \rightarrow ((-63 * div(heapIs)))))._replace(p3 \rightarrow ((-63 * div(heapIs)))))._replace(p3 \rightarrow ((-63 * div(heapIs)))))._replace(p3 \rightarrow ((-63 * div(heapIs))))))._replace(p3 \rightarrow ((-63 * div(heapIs)))))._replace(p3 \rightarrow ((-63 * div(heapIs)))))))))._replace(p3 \rightarrow ((-63 * div(heapIs)))))
\text{Sheap}_{funcstart_{724.1}}, \text{Sheap}_{funcstart_{724.1}}.\text{p3}, 178).\text{quot}) + (170 * \text{div}(\text{heapIs}))
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.p3, 178).rem)))
[Take goal term]
[1.0] minof(int) \leq static_cast<integer>(asType<int>($heap<sub>724.1:744.8</sub>.p1)
< (int)0)
\rightarrow [simplify]
[1.1] -32768 \leq static_cast<integer>(asType<int>($heap<sub>724.1:744.8</sub>.p1) <
(int)0)
\rightarrow [from term 61.26, $heap<sub>724.1:744.8</sub> is equal to
heap_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 * div(heapIs $heap_{funcstart\_724,1},
heap_{funcstart_{724,1},p1, 177}, quot) + (171 * div(heapIs heap_{funcstart_{724,1},p1, 177})
\$heap_{funcstart\_724,1}.p1,\ 177).rem))).\_\mathbf{replace}(p2 \rightarrow ((-35\ *\ div(\mathbf{heapIs}
heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p2, 176).quot) + (172 * div(heapIs)
\rho_{funcstart\_724,1}, \rho_{funcstart\_724,1}
div(\mathbf{heapIs} \$ heap_{funcstart\_724,1}, \$ heap_{funcstart\_724,1}.p3, 178).quot) + (170 *
\operatorname{div}(\mathbf{heapIs} \ \$ heap_{funcstart\_724,1}, \ \$ heap_{funcstart\_724,1}.p3, \ 178).rem))]
```

```
[1.2] -32768 <
\textbf{static\_cast} < \textbf{integer} > (\textbf{asType} < \textbf{int} > (\$ \text{heap}_{funcstart\_724,1}. \_\textbf{replace}(\text{p1} \rightarrow
((-2*\operatorname{div}(\mathbf{heapIs}\ \$ \operatorname{heap}_{funcstart\_724,1},\ \$ \operatorname{heap}_{funcstart\_724,1}.\operatorname{p1},\ 177).\operatorname{quot}) +\\
(171 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_724,1}, \text{\$heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow ((-35 * div(heapIs $heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1.p2}, 176).\text{quot} + (172 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
heap_{funcstart\_724,1.p2, 176).rem})).\_replace(p3 \rightarrow ((-63 * div(heapIs))).\_replace(p3 \rightarrow ((-63 * div(heapIs)))).\_replace(p3 \rightarrow ((-63 * div(heapIs)))))
\text{Sheap}_{funcstart_{724,1}}, \text{Sheap}_{funcstart_{724,1}}, p3, 178).quot) + (170 * div(heapIs)
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.p3, 178).rem))).p1) < (int)0)
\rightarrow [simplify]
[1.14] -32768 \leq ([0 < ((-171 * div(heapIs $heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1}.\text{p1}, 177).\text{rem} + (2 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
heap_{funcstart_{-724,1},p1, 177}, quot))]: 1, []: 0)
→ [explicitly assert falsehood of skipped guards in subsequent guards]
[1.15] -32768 \leq ([0 < ((-171 * div(heapIs $heap<sub>funcstart_724,1</sub>,
\text{Sheap}_{funcstart\_724,1}.\text{p1}, 177).\text{rem} + (2 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
heap_{funcstart\_724,1}.p1, 177).quot): 1, [!(0 < ((-171 * div(heapIs)))]: 1, [!(0 <
\theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}
heap_{funcstart_{-724,1}}, heap_{funcstart_{-724,1}}, 177).quot)))]: 0)
\rightarrow [simplify]
[1.20] -32768 \leq ([0 < ((-171 * div(heapIs $heap<sub>funcstart_724,1</sub>,
\text{Sheap}_{funcstart\_724,1}.\text{p1}, 177).\text{rem} + (2 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
\rho_{funcstart\_724,1.p1, 177}.quot): 1, [-1 < ((171 * div(heapIs))
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.\text{p1}, 177).\text{rem}) + (-2 * \text{div}(\text{heapIs}))
heap_{funcstart_{-724,1}}, heap_{funcstart_{-724,1}}, 177).quot): 0)
\rightarrow [from term 55.3, -1 < ((-2 * div(heapIs $heap_{funcstart\_724,1},
heap_{funcstart\_724,1}.p1, 177).quot) + (171 * div(heapIs $heap_{funcstart\_724,1}, 1
heap_{funcstart\_724.1.p1}, 177).rem) is true if and only if 0 < ((-2 * div(heapIs)))
heap_{funcstart\_724.1}, heap_{funcstart\_724.1}.p1, 177).quot) + (171 * div(heapIs
heap_{funcstart_{724,1}}, heap_{funcstart_{724,1}}, 177).rem
[1.21] -32768 \leq ([0 < ((-171 * div(heapIs $heap_{funcstart\_724,1}, 
\text{Sheap}_{funcstart\_724,1}.\text{p1}, 177).\text{rem} + (2 * \text{div}(\text{heapIs} \text{Sheap}_{funcstart\_724,1},
heap_{funcstart_{-724,1}}, p1, 177).quot): 1, [0 < ((-2 * div(heapIs))]:
\text{Sheap}_{funcstart_{-724,1}}, \text{Sheap}_{funcstart_{-724,1}}.\text{p1}, 177).\text{quot}) + (171 * \text{div}(\text{heapIs})
\{heap_{funcstart_{-724,1}}, \{heap_{funcstart_{-724,1}}, p1, 177\}.rem\}\}: 0)
\rightarrow [simplify]
[1.23] -32769 < ([0 < ((-171 * div(\mathbf{heapIs} \$heap_{funcstart\_724,1}, 
\text{Sheap}_{funcstart\_724,1}.\text{p1}, 177).\text{rem} + (2 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1.p1}, 177).\text{quot}): 1, [0 < ((-2 * \text{div}(\textbf{heapIs})))]: 1, [0 < ((-2 * \text{div}(\textbf{heapIs})))]:
\text{Sheap}_{funcstart_{-724,1}}, \text{Sheap}_{funcstart_{-724,1},p1, 177}, \text{quot}) + (171 * \text{div}(\text{heapIs}))
\{\text{heap}_{funcstart\_724,1}, \{\text{heap}_{funcstart\_724,1}.p1, 177\}.rem\}\}: 0
```

```
\label{eq:continuous} \textit{[1.24]} \; ([0 < ((-171 \; * \; \mathrm{div}(\mathbf{heapIs} \; \$ \mathrm{heap}_{funcstart\_724,1}, \; \$ \mathrm{heap}_{funcstart\_724,1}.\mathrm{p1}, \;
177).rem) + (2 * div(heapIs heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p1,
177).quot))]: -32769 < 1, [0 < ((-2 * div(\mathbf{heapIs} \$heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724.1.p1}, 177).\text{quot} + (171 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724.1},
\frac{\text{sheap}_{funcstart\_724,1.p1, 177}.rem)}{\text{rem}} : -32769 < 0)
\rightarrow [simplify]
\label{eq:continuous} \textit{[1.26]} \; ([0 < ((-171 \; * \; \mathrm{div}(\mathbf{heapIs} \; \$ \mathrm{heap}_{funcstart\_724,1}, \; \$ \mathrm{heap}_{funcstart\_724,1}.\mathrm{p1}, \;
177).rem) + (2 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_724,1}, \text{\$heap}_{funcstart\_724,1}.p1,
177).quot))]: true, [0 < ((-2 * div(\mathbf{heapIs} \$heap_{funcstart\_724,1}, 
\text{Sheap}_{funcstart\_724,1}.\text{p1}, 177).\text{quot} + (171 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
\frac{\text{sheap}_{funcstart\_724,1.p1, 177}.rem)}{\text{true}}
\rightarrow [all guards have equal guarded terms]
[1.27] true
Proof of verification condition: Type constraint satisfied in explicit
conversion from 'integer' to 'int'
Condition generated at: C:\Escher\Customers\prang\prang.c (63,11)
Condition defined at:
To prove: static_cast<integer>(asType<int>($heap<sub>724.1:744.8</sub>.p1) <
(int)0) \le maxof(int)
Given:
heap_{init}.LIMIT == (int)80
heap_{init}.M1 == asType < short int > ((int)30269)
\theta_{init}.r1 == asType < short int > ((int)171)
heap_{init}.a1 == asType < short int > ((int)177)
heap_{init}.M2 == asType < short int > ((int)30307)
\theta_{init}.r2 == asType<short int>((int)172)
heap_{init}.a2 == asType < short int > ((int)176)
\theta == asType<short int>((int)35)
heap_{init}.M3 == asType < short int > ((int)30323)
heap_{init}.r3 == asType < short int > ((int)170)
heap_{init}.a3 == asType < short int > ((int)178)
\theta = asType < short int > ((int)63)
\theta = asType < short int > ((int)1)
```

 $\rightarrow$  [move guard outside expression]

```
\rho_{init}.p2 == asType < short int > ((int)2)
\theta = asType < short int > ((int)3)
invariant1(heapIs heap_{funcstart\_724.1})
div1 == div(\mathbf{heapIs} \$heap_{funcstart\_724,1},
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p1}),
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{a1}))
(asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.p1)) /
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a1))) = =
asType<integer>(div1.quot)
(asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.p1)) \%
\mathbf{asType} < \mathbf{integer} > (\mathbf{asType} < \mathbf{int} > (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{a1}))) = =
asType<integer>(div1.rem)
!(0 == asType < integer > (div1.rem)) || !(0 ==
asType<integer>(div1.quot))
div2 == div(\mathbf{heapIs} \$heap_{funcstart\_724,1},
asType < int > (\$heap_{funcstart\_724,1}.p2),
asType < int > (\$heap_{funcstart\_724,1}.a2))
(asType < int > (sheap_{funcstart\_724,1}.p2)) /
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a2))) = =
asType<integer>(div2.quot)
(\mathbf{asType} {<} \mathbf{integer} {>} (\mathbf{asType} {<} \mathbf{int} {>} (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p2})) \ \%
\mathbf{asType}{<}\mathbf{integer}{>}(\mathbf{asType}{<}\mathbf{int}{>}(\$\mathbf{heap}_{funcstart\_724,1}.\mathbf{a2}))) = =
asType<integer>(div2.rem)
!(0 == asType < integer > (div2.rem)) || !(0 ==
asType<integer>(div2.quot))
div3 == div(\mathbf{heapIs} \$ heap_{funcstart\_724,1},
asType < int > (\$heap_{funcstart\_724,1}.p3),
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{a3}))
(asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.p3)) /
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a3))) = =
asType<integer>(div3.quot)
(\mathbf{asType} {<} \mathbf{integer} {>} (\mathbf{asType} {<} \mathbf{int} {>} (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p3})) \ \%
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a3))) = =
asType<integer>(div3.rem)
!(0 == asType < integer > (div3.rem)) || !(0 ==
asType<integer>(div3.quot))
\text{Sheap}_{724,1;740,8} == \text{Sheap}_{funcstart\_724,1}.\_\mathbf{replace}(\text{p1} \to \mathbf{asType} < \mathbf{short})
int>((asType<int>(asType<short int>(div1.rem)) *
asType < int > (\$heap_{funcstart\_724,1}.r1)) - (asType < int > (asType < short)
```

```
\mathbf{int}{>}(\mathbf{div1.quot})) \ * \ \mathbf{asType}{<} \mathbf{int}{>} (\$\mathbf{heap}_{funcstart\_724,1}.\mathbf{b1}))))
-asType < integer const > (\$heap_{724,1:740.8}.M1) < 1
asType<integer>($heap<sub>724.1:740.8</sub>.p1)
!(0 == asType < integer > (\$heap_{724,1;740,8}.p1))
asType<integer>($heap<sub>724,1:740,8</sub>.p1) <
asType<integer>($heap<sub>724,1:740,8</sub>.M1)
\$heap_{724,1;742,8} == \$heap_{724,1;740,8}. \textbf{\_replace}(p2 \rightarrow \textbf{asType} < \textbf{short}
int>((asType<int>(asType<short int>(div2.rem)) *
asType < int > (\$heap_{724.1:740.8}.r2)) - (asType < int > (asType < short)
int>(div2.quot)) * asType<int>($heap<sub>724.1:740.8</sub>.b2))))
-asType<integer const>($heap<sub>724,1:742,8</sub>.M2) <
asType<integer>($heap<sub>724,1;742,8</sub>.p2)
!(0 == \mathbf{asType} {<} \mathbf{integer} {>} (\$ heap_{724,1;742,8}.p2))
asType<integer>($heap<sub>724,1:742,8</sub>.p2) <
asType<integer>($heap<sub>724,1:742,8</sub>.M2)
\text{heap}_{724.1:744.8} == \text{heap}_{724.1:742.8}._replace(p3 \rightarrow asType<short)
int>((asType<int>(asType<short int>(div3.rem)) *
asType < int > (\$heap_{724,1;742,8}.r3)) - (asType < int > (asType < short)
int > (div3.quot)) * asType < int > ($heap_{724,1;742,8}.b3))))
-{\bf asType}{<}{\bf integer~const}{>}(\${\rm heap}_{724,1;744,8}.{\rm M3}) <
asType<integer>($heap<sub>724,1:744,8</sub>.p3)
!(0 == asType < integer > (\$heap_{724,1;744,8}.p3))
asType<integer>($heap<sub>724,1:744,8</sub>.p3) <
asType<integer>($heap<sub>724,1:744,8</sub>.M3)
Proof:
[Take given term]
[11.0] \operatorname{div1} == \operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724,1},
asType < int > (\$heap_{funcstart\_724,1}.p1),
asType < int > (\$heap_{funcstart\_724,1}.a1))
\rightarrow [simplify]
[11.1]~{\rm div1} == {\rm div}(\mathbf{heapIs}~\$ \mathrm{heap}_{funcstart\_724,1}, \$ \mathrm{heap}_{funcstart\_724,1}.\mathrm{p1},
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{a1}))
\rightarrow [const static or extern object]
[11.2] \operatorname{div1} == \operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724,1}, \$ \operatorname{heap}_{funcstart\_724,1}.p1,
asType < int > (\$heap_{init}.a1))
\rightarrow [expand definition of constant 'a1' at prang.c (16,20)]
[11.3] \operatorname{div1} == \operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724,1}, \$ \operatorname{heap}_{funcstart\_724,1}.p1,
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asType<int>(asType<short int>((int)177)))
\rightarrow [simplify]
[11.6] div1 == div(heapIs $heap_{funcstart\_724,1}, $heap_{funcstart\_724,1}.p1, 177)
[Take given term]
[25.0] div2 == div(heapIs heap_{funcstart\_724,1},
asType < int > (\$heap_{funcstart\_724,1}.p2),
asType < int > (\$heap_{funcstart\_724,1}.a2))
\rightarrow [simplify]
[25.1] \operatorname{div2} == \operatorname{div}(\mathbf{heapIs} \operatorname{\$heap}_{funcstart\_724,1}, \operatorname{\$heap}_{funcstart\_724,1}.p2,
asType < int > (\$heap_{funcstart\_724.1}.a2))
\rightarrow [const static or extern object]
[25.2] div2 == div(heapIs $heap_{funcstart\_724,1}, $heap_{funcstart\_724,1}.p2,
asType < int > (\$heap_{init}.a2))
\rightarrow [expand definition of constant 'a2' at prang.c (21,20)]
[25.3] div2 == div(heapIs \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}.p2,
\mathbf{asType}{<}\mathbf{int}{>}(\mathbf{asType}{<}\mathbf{short}\ \mathbf{int}{>}((\mathbf{int})176)))
\rightarrow [simplify]
[25.6] div2 == div(heapIs \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}.p2, 176)
[Take given term]
[39.0] \operatorname{div3} == \operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724,1},
asType < int > (\$heap_{funcstart\_724,1}.p3),
asType < int > (\$heap_{funcstart\_724,1}.a3))
\rightarrow [simplify]
\label{eq:constant_724,1} \text{div3} == \text{div}(\mathbf{heapIs} \ \$ \text{heap}_{funcstart\_724,1}, \ \$ \text{heap}_{funcstart\_724,1}.\text{p3},
asType < int > (\$heap_{funcstart\_724,1}.a3))
\rightarrow [const static or extern object]
[39.2] div3 == div(heapIs $heap_{funcstart\_724.1}, $heap_{funcstart\_724.1}.p3,
asType < int > (\$heap_{init}.a3))
\rightarrow [expand definition of constant 'a3' at prang.c (26,20)]
[39.3] div3 == div(heapIs heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p3,
asType<int>(asType<short int>((int)178)))
\rightarrow [simplify]
[39.6] div3 == div(heapIs heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p3, 178)
[Take given term]
[53.0] \; \$ heap_{724,1;740,8} == \$ heap_{funcstart\_724,1}.\_\mathbf{replace} (p1 \to \mathbf{asType} < \mathbf{short}
int>((asType<int>(asType<short int>(div1.rem)) *
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asType < int > (\$heap_{tuncstart\_724.1}.r1)) - (asType < int > (asType < short)
int>(div1.quot)) * asType< int>($heap_{funcstart\_724,1}.b1))))
\rightarrow [from term 11.6, div1 is equal to div(heapIs $heap_{funcstart_724,1},
heap_{funcstart_{-724,1}}.p1, 177
[53.1] \theta == 
int>((asType<int>(asType<short int>(div(heapIs $heap_{tuncstart_724.1},))
\text{sheap}_{funcstart\_724,1}.\text{p1}, 177).\text{rem}) * asType<int>(\text{sheap}_{funcstart\_724,1}.\text{r1})) -
(asType<int>(asType<short int>(div1.quot)) *
asType < int > (\$heap_{funcstart\_724,1}.b1))))
\rightarrow [simplify]
[53.3] heap_{724,1:740.8} == heap_{funcstart\_724,1}-replace(p1 \rightarrow asType<short
int>((div(heapIs \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1, 177).rem *
\mathbf{asType} \small{<} \mathbf{int} \small{>} (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{r1})) \\ - (\mathbf{asType} \small{<} \mathbf{int} \small{>} (\mathbf{asType} \small{<} \mathbf{short}
int>(div1.quot)) * asType< int>($heap_{funcstart\_724,1}.b1))))
\rightarrow [const static or extern object]
[53.4] heap_{724,1;740,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow asType<short
int>((div(heapIs \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1, 177).rem *
asType < int > (\$heap_{init}.r1)) - (asType < int > (asType < short)
\mathbf{int}{>}(\mathbf{div1.quot})) * \mathbf{asType}{<} \mathbf{int}{>} (\$\mathbf{heap}_{funcstart\_724,1}.\mathbf{b1}))))
\rightarrow [expand definition of constant 'r1' at prang.c (15,20)]
[53.5] heap_{724,1;740,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow asType<short
int>((div(heapIs \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1, 177).rem *
asType<int>(asType<short int>((int)171))) -
(asType<int>(asType<short int>(div1.quot)) *
asType < int > (\$heap_{funcstart\_724,1}.b1))))
\rightarrow [simplify]
[53.8] heap_{724,1;740,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow asType<short
int>((div(heapIs \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1, 177).rem * 171)
- (asType < int > (asType < short int > (div1.quot))
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{b1}))))
\rightarrow [from term 11.6, div1 is equal to div(heapIs $heap_{funcstart_{-724,1}},
heap_{funcstart_{724,1}}.p1, 177
[53.9] heap_{724,1:740.8} == heap_{funcstart\_724,1}-replace(p1 \rightarrow asType<short
int>((171 * div(heapIs $heap_tuncstart_724.1, $heap_tuncstart_724.1.p1, 177).rem)
- (asType<int>(asType<short int>(div(heapIs $heap_{funcstart 724.1},
heap_{funcstart_{724,1},p1,177}, quot)) *
asType < int > (\$heap_{funcstart\_724,1}.b1))))
\rightarrow [simplify]
[53.11] $heap<sub>724.1:740.8</sub> == $heap<sub>funcstart_724.1</sub>._replace(p1 \rightarrow asType<short
int>((171 * div(heapIs \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1, 177).rem)
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- (\text{div}(\mathbf{heapIs} \$ \text{heap}_{funcstart\_724,1}, \$ \text{heap}_{funcstart\_724,1}.\text{p1}, 177).\text{quot} *
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{b1}))))
\rightarrow [const static or extern object]
[53.12] heap_{724,1;740,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow asType<short
int>((171 * div(heapIs $heap_{funcstart\_724,1}, $heap_{funcstart\_724,1}.p1, 177).rem)
- (\text{div}(\mathbf{heapIs} \$ \text{heap}_{funcstart\_724.1}, \$ \text{heap}_{funcstart\_724.1}. p1, 177).\text{quot} *
asType < int > (\$heap_{init}.b1)))
\rightarrow [expand definition of constant 'b1' at prang.c (17,20)]
[53.13] \theta_{13} = \theta_
int > ((171 * div(heapIs \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1, 177).rem)
- (\text{div}(\mathbf{heapIs} \$ \text{heap}_{funcstart\_724.1}, \$ \text{heap}_{funcstart\_724.1}.\text{p1}, 177).\text{quot} *
asType<int>(asType<short int>((int)2))))
\rightarrow [simplify]
[53.19] $\text{heap}_{724,1;740,8} == \text{$heap}_{funcstart\_724,1}._\text{$replace}(p1 \to ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.\operatorname{p1}, \ 177).\operatorname{rem})))
[Take given term]
\textit{[55.0] } ! (0 == \mathbf{asType} < \mathbf{integer} > (\$ heap_{724,1;740,8}.p1))
\rightarrow [from term 53.19, $heap<sub>724,1:740,8</sub> is equal to
heap_{funcstart\_724,1}._replace(p1 \rightarrow (-2 * div(heapIs heap_{funcstart\_724,1}),
\text{Sheap}_{funcstart\_724,1}.p1, 177).quot) + (171 * div(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
$heap_{funcstart\_724,1}.p1, 177).rem))]
[55.1] !(0 == asType<integer>($heap_{funcstart\_724,1}.replace(p1 \rightarrow ((-2 *
div(\mathbf{heapIs} \ \$heap_{funcstart\_724.1}, \ \$heap_{funcstart\_724.1}.p1, \ 177).quot) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \text{$heap}_{funcstart\_724.1}, \ \text{$heap}_{funcstart\_724.1}.p1, \ 177).rem))).p1))
[55.3] !(0 == ((-2 * div(heapIs $heap_{funcstart_{-724,1}}, $heap_{funcstart_{-724,1}}.p1,
177).quot) + (171 * div(heapIs heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p1,
177).rem)))
[Take given term]
[57.0] $\text{heap}_{724,1:742,8} == $\text{heap}_{724,1:740,8}._\text{replace}(p2 \to \text{asType} < \text{short}
int>((asType<int>(asType<short int>(div2.rem)) *
asType < int > (\$heap_{724,1:740.8}.r2)) - (asType < int > (asType < short)
int>(div2.quot)) * asType< int>($heap_{724,1;740,8}.b2))))
\rightarrow [from term 53.19, $heap<sub>724,1;740,8</sub> is equal to
heap_{funcstart\_724,1}._replace(p1 \rightarrow (-2 * div(heapIs \$heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1}.p1, 177).quot) + (171 * div(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
heap_{funcstart_{-724,1}.p1, 177).rem}
[57.1] $\text{heap}_{724.1:742.8} == $\text{heap}_{funcstart_724.1}._\text{replace}(p1 \to ((-2 *
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\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).quot) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow asType<short
int>((asType<int>(asType<short int>(div2.rem)) *
asType < int > (\$heap_{724,1:740,8}.r2)) - (asType < int > (asType < short)
int>(div2.quot)) * asType< int>($heap_{724,1;740,8}.b2))))
\rightarrow [from term 25.6, div2 is equal to div(heapIs $heap_{tuncstart_{724.1}},
heap_{funcstart_{-724,1}}.p2, 176
[57.2] $heap<sub>724,1:742,8</sub> == $heap<sub>funcstart_724,1</sub>._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}. p1, \ 177). \operatorname{quot}) + (171 *
\label{eq:div_heap} \text{div}(\textbf{heapIs} \ \$ \text{heap}_{funcstart\_724,1}, \ \$ \text{heap}_{funcstart\_724,1}.\text{p1},
177).rem))).\_replace(p2 \rightarrow asType < short
int>((asType<int>(asType<short int>(div(heapIs $heap_{funcstart\_724,1},
\text{sheap}_{funcstart\_724,1.p2, 176}.\text{rem}) * \mathbf{asType} < \mathbf{int} > (\text{sheap}_{724,1:740.8}.\text{r2})) -
(asType<int>(asType<short int>(div2.quot)) *
asType < int > (\$heap_{724,1;740,8}.b2))))
\rightarrow [simplify]
[57.4] heap_{724,1;742,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}. p1, \ 177). \operatorname{quot}) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.p1,
177).rem)))._{\mathbf{replace}}(p2 \rightarrow \mathbf{asType} < \mathbf{short\ int} > ((\operatorname{div}(\mathbf{heapIs}))))
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.p2, 176).rem *
asType < int > (\$heap_{724.1:740.8}.r2)) - (asType < int > (asType < short)
int>(div2.quot)) * asType< int>($heap_{724,1;740,8}.b2))))
\rightarrow [from term 53.19, $heap<sub>724,1:740,8</sub> is equal to
heap_{funcstart\_724,1}._replace(p1 \rightarrow (-2 * div(heapIs $heap_{funcstart\_724,1},
heap_{funcstart\_724,1}.p1, 177).quot + (171 * div(heapIs $heap_{funcstart\_724,1}, 177).quot) + (171 * div(heapIs $heap_{funcstart\_724,1}, 17
heap_{funcstart} 724.1.p1, 177).rem))]
[57.5] $heap<sub>724,1;742,8</sub> == $heap<sub>funcstart_724,1</sub>._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.p1,
177).rem)))._{\mathbf{replace}}(p2 \rightarrow \mathbf{asType} < \mathbf{short\ int} > ((\operatorname{div}(\mathbf{heapIs}))))
\theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}.p2, 176).rem
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathbf{\_replace}(\mathrm{p1} \rightarrow ((-2\ *\ \mathrm{div}(\mathbf{heapIs}
\$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1, 177).quot) + (171 * div(\mathbf{heapIs})
\text{Sheap}_{funcstart_{724,1}}, \text{Sheap}_{funcstart_{724,1}}, 177).rem))).r2)) -
(asType<int>(asType<short int>(div2.quot)) *
asType < int > (\$heap_{724,1;740,8}.b2))))
\rightarrow [const member of object with modified fields]
[57.6] heap_{724,1;742,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 *
\operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724,1}, \$ \operatorname{heap}_{funcstart\_724,1}.p1,
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177).rem)))._{\mathbf{replace}}(p2 \rightarrow \mathbf{asType} < \mathbf{short\ int} > ((\operatorname{div}(\mathbf{heapIs}))))
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.p2, 176).rem *
asType < int > (\$heap_{funcstart\_724,1}.r2)) - (asType < int > (asType < short)
int>(div2.quot)) * asType< int>($heap_{724,1:740,8}.b2))))
\rightarrow [const static or extern object]
[57.7] heap_{724,1;742,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).quot) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow asType<short int>((div(heapIs
\text{Sheap}_{funcstart_{-724,1}}, \text{Sheap}_{funcstart_{-724,1}}.p2, 176).rem *
asType < int > (\$heap_{init}.r2)) - (asType < int > (asType < short)
int>(div2.quot)) * asType< int>($heap_{724,1:740.8}.b2))))
\rightarrow [expand definition of constant 'r2' at prang.c (20,20)]
[57.8] heap_{724,1;742,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}. \operatorname{p1}, \ 177).\operatorname{quot}) + (171 \ *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.p1,
177).rem)))._{\mathbf{replace}}(p2 \rightarrow \mathbf{asType} < \mathbf{short\ int} > ((\operatorname{div}(\mathbf{heapIs}))))
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.\text{p2}, 176).\text{rem} *
asType<int>(asType<short int>((int)172))) -
(asType<int>(asType<short int>(div2.quot)) *
\mathbf{asType}{<}\mathbf{int}{>}(\${\rm heap}_{724,1;740,8}.{\rm b2}))))
\rightarrow [simplify]
[57.11] $\text{heap}_{724,1;742,8} == \text{$heap}_{funcstart\_724,1}._\text{$replace}(p1 \to ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 \ *
\operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724,1}, \$ \operatorname{heap}_{funcstart\_724,1}.p1,
177).rem)))._{\mathbf{replace}}(p2 \rightarrow \mathbf{asType} < \mathbf{short\ int} > ((\operatorname{div}(\mathbf{heapIs}))))
\theta_{172} = \theta_{1724,1}, \theta_{172} = \theta_{1724,1}, \theta_{172} = \theta_{1724,1}.
(asType<int>(asType<short int>(div2.quot)) *
asType<int>($heap<sub>724.1:740.8</sub>.b2))))
\rightarrow [from term 25.6, div2 is equal to div(heapIs $heap_{funcstart_{724,1}},
heap_{funcstart_{724,1}}.p2, 176)
[57.12] heap_{724,1;742,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724.1}, \ \$ \operatorname{heap}_{funcstart\_724.1}.p1,
177).rem)))._replace(p2 \rightarrow asType<short int>((172 * div(heapIs
heap_{funcstart_{-724,1}}, heap_{funcstart_{-724,1}}, p_{176}.rem) -
(asType<int>(asType<short int>(div(heapIs $heap_{funcstart_724.1},
\text{sheap}_{funcstart_724,1}.\text{p2}, 176).\text{quot}) * asType<int>(\text{sheap}_{724,1:740.8}.\text{b2}))))
\rightarrow [simplify]
[57.14] $\text{heap}_{724,1;742,8} == \text{$heap}_{funcstart\_724,1}._\text{replace}(p1 \to ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \operatorname{\$heap}_{funcstart\_724,1}, \ \operatorname{\$heap}_{funcstart\_724,1}.\operatorname{p1}, \ 177).\operatorname{quot}) + (171 *
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\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow asType<short int>((172 * div(heapIs
heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p2, 176).rem) - (div(heapIs
heap_{funcstart_{724,1}}, heap_{funcstart_{724,1}}, 2, 176).quot *
asType < int > (\$heap_{724,1;740,8}.b2))))
\rightarrow [from term 53.19, $heap<sub>724,1;740,8</sub> is equal to
heap_{funcstart\_724,1}._replace(p1 \rightarrow (-2 * div(heapIs $heap_{funcstart\_724,1},
heap_{funcstart\_724,1}.p1, 177).quot + (171 * div(heapIs $heap_{funcstart\_724,1},
heap_{funcstart_{724,1},p1,177,rem})
[57.15] $\text{heap}_{724,1:742,8} == \text{$heap}_{funcstart\_724,1}.$\text{$_-\text{replace}(p1$}\to ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 *
\label{eq:div_heap} \text{div}(\textbf{heapIs} \ \$ \text{heap}_{funcstart\_724,1}, \ \$ \text{heap}_{funcstart\_724,1}.\text{p1},
177).rem)))._replace(p2 \rightarrow asType<short int>((172 * div(heapIs
heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p2, 176).rem) - (div(heapIs
heap_{funcstart_{-724,1}}, heap_{funcstart_{-724,1}}.p2, 176).quot *
\mathbf{asType}{<}\mathbf{int}{>}(\$\text{heap}_{funcstart\_724,1}.\_\mathbf{replace}(\text{p1} \rightarrow ((\text{-2} * \text{div}(\mathbf{heapIs}
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.\text{p1}, 177).\text{quot}) + (171 * \text{div}(\text{heapIs}))
\text{Sheap}_{funcstart_{-724,1}}, \text{Sheap}_{funcstart_{-724,1}}.p1, 177).rem))).b2))))
\rightarrow [const member of object with modified fields]
[57.16] $heap<sub>724,1;742,8</sub> == $heap<sub>funcstart_724,1</sub>._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 \ *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow asType<short int>((172 * div(heapIs
\theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.\text{p2}, 176).\text{quot} *
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{b2}))))
\rightarrow [const static or extern object]
[57.17] heap_{724,1;742,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow asType<short int>((172 * div(heapIs
\theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}.p2, 176).rem) - (div(heapIs
heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p2, 176).quot *
asType < int > (\$heap_{init}.b2))))
\rightarrow [expand definition of constant 'b2' at prang.c (22,20)]
[57.18] heap_{724,1;742,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 *
\operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724.1}, \$ \operatorname{heap}_{funcstart\_724.1}.p1,
177).rem)))._replace(p2 \rightarrow asType<short int>((172 * div(heapIs
\theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}.p2, 176).rem) - (div(heapIs
heap_{funcstart_{724,1}}, heap_{funcstart_{724,1}}.p2, 176).quot *
asType<int>(asType<short int>((int)35)))))
```

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\rightarrow [simplify]
[57.24] $\text{heap}_{724,1:742,8} == $\text{heap}_{funcstart\_724,1}._\text{replace}(p1 \to ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).quot) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow ((-35 * div(heapIs $heap_{tuncstart_724.1},
\theta_{funcstart\_724,1}.p2, 176.quot) + (172 * div(heapIs \theta_{funcstart\_724,1},
heap_{funcstart_{-724,1}}.p2, 176).rem))
[Take given term]
[61.0] $\text{heap}_{724,1;744,8} == $\text{heap}_{724,1;742,8}._\text{replace}(p3 \to \text{asType} < \text{short}
int>((asType<int>(asType<short int>(div3.rem)) *
asType < int > (\$heap_{724.1:742.8}.r3)) - (asType < int > (asType < short)
int>(div3.quot)) * asType< int>($heap_{724,1;742,8}.b3))))
\rightarrow [from term 57.24, $\$heap_{724,1:742,8}$ is equal to
heap_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 * div(heapIs $heap_{funcstart\_724,1},
heap_{funcstart\_724,1}.p1, 177).quot + (171 * div(heapIs $heap_{funcstart\_724,1}, 177).quot) + (171 * div(heapIs $heap_{funcstart\_724,1}, 17
heap_{funcstart\_724,1}.p1, 177).rem)._replace(p2 \rightarrow (-35 * div(heapIs)))._
heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p2, 176).quot) + (172 * div(heapIs)
heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p2, 176).rem))]
[61.1] \rho_{1.1} = \rho_{1.11,144,8} = \rho_{1
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).quot) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow ((-35 * div(heapIs $heap_{funcstart_724,1},
\text{Sheap}_{funcstart\_724,1}.\text{p2}, 176).\text{quot} + (172 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
\theta_{uncstart_{724.1},p2,176}.rem)._replace(p3 \rightarrow asType<short
int>((asType<int>(asType<short int>(div3.rem)) *
asType < int > (\$heap_{724,1:742,8}.r3)) - (asType < int > (asType < short)
int > (div3.quot)) * asType < int > ($heap_{724,1;742,8}.b3))))
\rightarrow [from term 39.6, div3 is equal to div(heapIs $heap_{funcstart\_724,1},
heap_{funcstart_{-724,1}}.p3, 178
[61.2] heap_{724,1;744,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow ((-35 * div(heapIs $heap_{funcstart_724,1},
\text{Sheap}_{funcstart\_724,1}.\text{p2}, 176).\text{quot} + (172 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
\theta_{funcstart\_724,1}.p2, 176).rem))._replace(p3 \rightarrow asType<short
int>((asType<int>(asType<short int>(div(heapIs $heap_{funcstart\_724.1},
\text{sheap}_{funcstart_724,1.p3}, 178).\text{rem}) * asType < int > (\text{sheap}_{724,1:742.8.r3})) -
(asType<int>(asType<short int>(div3.quot)) *
asType<int>($heap<sub>724,1;742,8</sub>.b3))))
\rightarrow [simplify]
[61.4] \rho_{14,1;744,8} == \rho_{14,1;744,8} == \rho_{14,1;744,8} = \rho_{14,1;744,
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 *
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\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow ((-35 * div(heapIs $heap_{funcstart\_724,1},
\rho_{funcstart\_724,1.p2}, 176).quot) + (172 * div(heapIs \rho_{funcstart\_724,1},
\theta_{funcstart\_724,1}.p2, 176).rem))._replace(p3 \rightarrow asType<short
int>((div(heapIs \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p3, 178).rem *
\mathbf{asType} \small{<} \mathbf{int} \small{>} (\$ \mathrm{heap}_{724,1;742,8}.\mathrm{r3})) \\ - (\mathbf{asType} \small{<} \mathbf{int} \small{>} (\mathbf{asType} \small{<} \mathbf{short}
int>(div3.quot)) * asType<int>($heap<sub>724.1:742.8</sub>.b3))))
\rightarrow [from term 57.24, $\$heap_{724,1;742,8}$ is equal to
\text{Sheap}_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 * div(\textbf{heapIs } \text{Sheap}_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1}.\text{p1}, 177).\text{quot} + (171 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
heap_{funcstart\_724,1}.p1, 177).rem))._replace(p2 \rightarrow (-35 * div(heapIs))
heap_{funcstart_{-724,1}}, heap_{funcstart_{-724,1}}, p_{funcstart_{-724,1}}, p_{funcstart_{-724,1}}, p_{funcstart_{-724,1}}, p_{funcstart_{-724,1}}
heap_{funcstart_{724.1}}, heap_{funcstart_{724.1}}, 2, 176).rem
[61.5] heap_{724,1;744,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 \ *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow ((-35 * div(heapIs $heap_{funcstart\_724,1},
\text{Sheap}_{funcstart_724,1}.\text{p2}, 176).\text{quot} + (172 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart_724,1},
\rho_{funcstart_{724,1},p2,176,rem})._replace(p3 \rightarrow asType<short
int>((div(heapIs \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p3, 178).rem *
asType<int>($heap<sub>funcstart_724.1</sub>._replace(p1 \rightarrow ((-2 * div(heapIs
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.\text{p1}, 177).\text{quot}) + (171 * \text{div}(\text{heapIs})
\theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}
* div(heapIs heap_{funcstart_{-724,1}}, heap_{funcstart_{-724,1}}, 176).quot) + (172 *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724.1}, \ \$ \operatorname{heap}_{funcstart\_724.1}. \operatorname{p2}, \ 176).\operatorname{rem}))).\operatorname{r3})) -
(asType<int>(asType<short int>(div3.quot)) *
asType<int>($heap<sub>724,1;742,8</sub>.b3))))
\rightarrow [const member of object with modified fields]
[61.7] heap_{724,1:744,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 \ *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow ((-35 * div(heapIs $heap_{funcstart_724,1},
\text{Sheap}_{funcstart\_724,1}.\text{p2}, 176).\text{quot}) + (172 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
\theta_{funcstart\_724,1}.p2, 176).rem))._replace(p3 \rightarrow asType<short
int>((div(heapIs \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p3, 178).rem *
asType < int > (\$heap_{funcstart\_724,1}.r3)) - (asType < int > (asType < short)
int>(div3.quot)) * asType<int>($heap<sub>724,1:742,8</sub>.b3))))
\rightarrow [const static or extern object]
[61.8] $heap<sub>724,1;744,8</sub> == $heap<sub>funcstart_724,1</sub>._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 *
\operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724,1}, \$ \operatorname{heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow ((-35 * div(heapIs $heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1.p2}, 176).\text{quot} + (172 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
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\rho_{funcstart=724.1.p2, 176}.rem)._replace(p3 \rightarrow asType<short
int>((div(heapIs \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p3, 178).rem *
asType < int > (\$heap_{init}.r3)) - (asType < int > (asType < short)
int>(div3.quot)) * asType< int>($heap_{724,1:742,8}.b3))))
\rightarrow [expand definition of constant 'r3' at prang.c (25,20)]
[61.9] heap_{724,1;744,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).quot) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow ((-35 * div(heapIs $heap_{funcstart\_724,1},
\rho_{tuncstart_{-724.1},p2, 176} + (172 * div(heapIs $heap_{tuncstart_{-724.1},p2})
\rho_{uncstart\_724,1.p2, 176).rem}))._replace(p3 \rightarrow asType<short
\mathbf{int}{>}((\mathrm{div}(\mathbf{heapIs}\ \$\mathrm{heap}_{funcstart\_724,1},\ \$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p3},\ 178).\mathrm{rem}\ *
asType<int>(asType<short int>((int)170))) -
(asType<int>(asType<short int>(div3.quot)) *
asType < int > (\$heap_{724,1;742,8}.b3))))
\rightarrow [simplify]
[61.12] $heap<sub>724,1;744,8</sub> == $heap<sub>funcstart_724,1</sub>._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart} \ 724.1, \ \$ \operatorname{heap}_{funcstart} \ 724.1, \ p1,
177).rem)))._replace(p2 \rightarrow ((-35 * div(heapIs $heap_{funcstart_724,1},
\text{Sheap}_{funcstart\_724,1.p2}, 176).\text{quot} + (172 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
\theta_{uncstart_724.1.p2, 176}.rem)._replace(p3 \rightarrow asType<short
int > ((div(heapIs \$heap_{funcstart\_724.1}, \$heap_{funcstart\_724.1}.p3, 178).rem * 170)
- (asType<int>(asType<short int>(div3.quot))
asType<int>($heap<sub>724.1:742.8</sub>.b3))))
\rightarrow [from term 39.6, div3 is equal to div(heapIs $heap_{funcstart\_724,1},
heap_{funcstart_{-724,1}}.p3, 178
[61.13] $\text{heap}_{724,1;744,8} == \text{$heap}_{funcstart\_724,1}._\text{$_{-}}replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).quot) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow ((-35 * div(heapIs $heap_{funcstart\_724.1},
\theta_{tuncstart} $\text{Neap} \text{funcstart} + (172 * \div(\text{heap} \text{Is} \text{$heap} \text{funcstart} + (172 * \div(\text{heap} \text{Is}))
\rho_{tuncstart=724.1}.p2, 176).rem))._replace(p3 \rightarrow asType<short int>((170
* div(heapIs heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p3, 178).rem) –
(asType<int>(asType<short int>(div(heapIs $heap_{tuncstart_724.1},
\text{sheap}_{funcstart=724,1.p3}, 178, \text{quot}) * asType < int > (\text{sheap}_{724,1:742.8.b3})))
\rightarrow [simplify]
[61.15] $heap<sub>724,1;744,8</sub> == $heap<sub>funcstart_724,1</sub>._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 \ *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow ((-35 * div(heapIs $heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1}.\text{p2}, 176).\text{quot}) + (172 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
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\rho_{tuncstart=724.1.p2, 176}.rem)._replace(p3 \rightarrow asType<short int>((170
* div(heapIs heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p3, 178).rem) –
(div(heapIs \rho_{funcstart\_724,1}, \rho_{funcstart\_724,1}, 178).quot *
asType < int > (\$heap_{724,1;742,8}.b3))))
\rightarrow [from term 57.24, $heap<sub>724.1:742.8</sub> is equal to
heap_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 * div(heapIs *heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1}.\text{p1}, 177).\text{quot} + (171 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
\rho_{funcstart\_724,1.p1, 177).rem})._replace\rho_{funcstart\_724,1.p1, 177).rem})._replace
heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p2, 176).quot) + (172 * div(heapIs)
heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p2, 176).rem))]
[61.16] $heap<sub>724,1;744,8</sub> == $heap<sub>funcstart_724,1</sub>._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 *
\operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724,1}, \$ \operatorname{heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow ((-35 * div(heapIs $heap_{funcstart_724,1},
\text{Sheap}_{funcstart\_724,1}.\text{p2}, 176).\text{quot} + (172 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
\theta_{uncstart_{-724,1},p2, 176,rem}))._replace(p3 \rightarrow asType<short int>((170
* div(heapIs heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p3, 178).rem) –
(\text{div}(\mathbf{heapIs} \$ \text{heap}_{funcstart\_724.1}, \$ \text{heap}_{funcstart\_724.1}. \text{p3}, 178).\text{quot} *
asType < int > (\$heap_{funcstart\_724,1}.\_replace(p1 \rightarrow ((-2 * div(heapIs))))))
\theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}.p1, 177).quot) + (171 * div(heapIs
\rho_{uncstart_{724,1}}, \rho_{uncstart_{724,1},p1, 177}.rem))._replace(p2 \rightarrow ((-35)
* div(heapIs heap_{funcstart_{-724,1}}, heap_{funcstart_{-724,1}}, p2, 176).quot) + (172 *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.p2, \ 176).rem))).b3))))
\rightarrow [const member of object with modified fields]
[61.18] $heap<sub>724,1;744,8</sub> == $heap<sub>funcstart_724,1</sub>._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 \ *
\operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724,1}, \$ \operatorname{heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow ((-35 * div(heapIs $heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1}.\text{p2}, 176).\text{quot} + (172 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
\rho_{tuncstart=724.1}.p2, 176).rem))._replace(p3 \rightarrow asType<short int>((170
* div(heapIs heap_{funcstart\_724,1}, heap_{funcstart\_724,1}, n_{funcstart\_724,1}, n_{funcstart\_724,1}, n_{funcstart\_724,1}
(\text{div}(\mathbf{heapIs} \$ \text{heap}_{funcstart\_724,1}, \$ \text{heap}_{funcstart\_724,1}.\text{p3}, 178).\text{quot} *
asType < int > (\$heap_{funcstart\_724,1}.b3))))
\rightarrow [const static or extern object]
[61.19] $\text{heap}_{724,1;744,8} == \text{$heap}_{funcstart\_724,1}._\text{$replace}(p1 \to ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \operatorname{heap}_{funcstart\_724,1}, \ \operatorname{heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 *
\operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724,1}, \$ \operatorname{heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow ((-35 * div(heapIs $heap_{funcstart\_724,1},
\theta_{funcstart\_724,1.p2}, 176).quot) + (172 * div(heapIs \theta_{funcstart\_724,1},
\theta_{funcstart\_724,1.p2, 176}.rem)._replace(p3 \rightarrow asType<short int>((170
* div(heapIs heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p3, 178).rem) –
(\text{div}(\mathbf{heapIs} \$ \text{heap}_{funcstart\_724,1}, \$ \text{heap}_{funcstart\_724,1}.\text{p3}, 178).\text{quot} *
asType < int > (\$heap_{init}.b3))))
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\rightarrow [expand definition of constant 'b3' at prang.c (27,20)]
[61.20] $\text{heap}_{724,1:744,8} == $\text{heap}_{funcstart\_724,1}._\text{replace}(p1 \to ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).quot) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow ((-35 * div(heapIs $heap_{tuncstart_724.1},
\text{Sheap}_{funcstart\_724,1}.\text{p2}, 176).\text{quot} + (172 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
\rho_{uncstart\_724,1.p2, 176).rem})).\_replace(p3 \rightarrow asType < short int > ((170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 -
* div(heapIs heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p3, 178).rem) –
(\text{div}(\mathbf{heapIs} \$ \text{heap}_{funcstart\_724.1}, \$ \text{heap}_{funcstart\_724.1}.\text{p3}, 178).\text{quot} *
asType<int>(asType<short int>((int)63)))))
\rightarrow [simplify]
[61.26] heap_{724,1;744,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 *
div(heapIs \$heap_{funcstart\_724.1}, \$heap_{funcstart\_724.1}.p1, 177).quot) + (171 *
\operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724.1}, \$ \operatorname{heap}_{funcstart\_724.1}.p1,
177).rem)))._replace(p2 \rightarrow ((-35 * div(heapIs $heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1}.\text{p2}, 176).\text{quot} + (172 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
\theta_{uncstart\_724,1}.p2, 176).rem))).\_replace(p3 \rightarrow ((-63 * div(heapIs)))._replace(p3 \rightarrow ((-63 * div(heapIs))))._replace(p3 \rightarrow ((-63 * div(heapIs))))._replace(p3 \rightarrow ((-63 * div(heapIs))))._replace(p3 \rightarrow ((-63 * div(heapIs))))._replace(p3 \rightarrow ((-63 * div(heapIs)))))._replace(p3 \rightarrow ((-63 * div(heapIs)))))._replace(p3 \rightarrow ((-63 * div(heapIs))))._replace(p3 \rightarrow ((-63 * div(heapIs)))))._replace(p3 \rightarrow ((-63 * div(heapIs)))))))))._replace(p3 \rightarrow ((-63 * div(heapIs)))))._replace(p3 \rightarrow ((-63 * div(heapIs)))))))))))
\text{Sheap}_{funcstart\_724.1}, \text{Sheap}_{funcstart\_724.1}.p3, 178).quot) + (170 * div(heapIs)
heap_{funcstart_{724,1}}, heap_{funcstart_{724,1}}, 178).rem)
[1.0] static_cast<integer>(asType<int>($heap<sub>724.1:744.8</sub>.p1) < (int)0) \leq
maxof(int)
\rightarrow [from term 61.26, $heap<sub>724,1;744,8</sub> is equal to
heap_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 * div(heapIs $heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1}.p1, 177).quot + (171 * div(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
heap_{funcstart\_724,1}.p1, 177).rem))).\_replace(p2 \rightarrow ((-35 * div(heapIs))).\_replace(p2 \rightarrow ((-35 * div(heapIs)))))._replace(p2 \rightarrow ((-35 * div(heapIs)))))
heap_{funcstart\_724,1}, p_{funcstart\_724,1}, p_{funcstart\_724,1}, p_{funcstart\_724,1}, p_{funcstart\_724,1}
\theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}
div(\mathbf{heapIs} \ \$heap_{funcstart\_724,1}, \ \$heap_{funcstart\_724,1}.p3, \ 178).quot) + (170 \ *
div(\mathbf{heapIs} \ \$heap_{funcstart\_724,1}, \ \$heap_{funcstart\_724,1}.p3, \ 178).rem))]
[1.1] \ \mathbf{static\_cast} < \mathbf{integer} > (\mathbf{asType} < \mathbf{int} > (\$ \mathrm{heap}_{funcstart\_724,1}. \_\mathbf{replace} (\mathrm{p1}
\rightarrow ((-2 * div(heapIs $heap_{funcstart\_724,1}, $heap_{funcstart\_724,1}.p1, 177).quot) +
(171 * \text{div}(\textbf{heapIs} \$ \text{heap}_{funcstart\_724,1}, \$ \text{heap}_{funcstart\_724,1}.\text{p1},
177).rem)))._replace(p2 \rightarrow ((-35 * div(heapIs $heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1}.\text{p2}, 176).\text{quot} + (172 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
heap_{funcstart\_724,1.p2, 176).rem})).\_replace(p3 \rightarrow ((-63 * div(heapIs))).\_replace(p3 \rightarrow ((-63 * div(heapIs)))).\_replace(p3 \rightarrow ((-63 * div(heapIs)))))
\text{Sheap}_{funcstart_{-724,1}}, \text{Sheap}_{funcstart_{-724,1}}.p3, 178).quot) + (170 * div(heapIs)
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.p3, 178).rem))).p1) < (int)0) \le
maxof(int)
\rightarrow [simplify]
[1.13] \; ([0 < ((-171 * \operatorname{div}(\mathbf{heapIs} \; \$ \operatorname{heap}_{funcstart\_724,1}, \, \$ \operatorname{heap}_{funcstart\_724,1}.\operatorname{p1}, \,
177).rem) + (2 * div(heapIs $heap_{funcstart\_724,1}, $heap_{funcstart\_724,1}.p1,
```

```
[177].quot): 1, []: 0) \leq maxof(int)
→ [explicitly assert falsehood of skipped guards in subsequent guards]
\label{eq:loss_loss} $[1.14]$ ([0 < ((-171 * div(\mathbf{heapIs} \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1,
177).rem) + (2 * \text{div}(\mathbf{heapIs} \$ \text{heap}_{funcstart\_724,1}, \$ \text{heap}_{funcstart\_724,1}.\text{p1},
177).quot))]: 1, [!(0 < ((-171 * div(heapIs $heap_{tuncstart\_724.1},
\theta_{funcstart\_724,1}.p1, 177).rem + (2 * div(heapIs $heap_{funcstart\_724,1}, + div(heapIs $heap_{funcstart\_
\frac{\text{sheap}_{funcstart\_724,1.p1, 177}.\text{quot}}{\text{pl}}: 0) \leq \max_{f(int)}
\rightarrow [simplify]
\label{eq:loss_loss} $[1.19]$ ([0 < ((-171 * div(\mathbf{heapIs} \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1,
177).rem) + (2 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_724,1}, \text{\$heap}_{funcstart\_724,1}.p1,
177).quot))]: 1, [-1 < ((171 * div(heapIs $heap_{funcstart\_724.1},
\text{Sheap}_{funcstart_{-724,1},p1, 177}.\text{rem}) + (-2 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart_{-724,1},p1, 177}).
\{\text{heap}_{funcstart\_724,1}.\text{p1}, 177\}.\text{quot}\}: 0 \le \text{maxof}(\text{int})
\rightarrow [from term 55.3, -1 < ((-2 * div(heapIs $heap_{funcstart\_724,1},
heap_{funcstart_{724,1},p1, 177}, quot) + (171 * div(heapIs p_{funcstart_{724,1},p1, 177}), quot)
heap_{funcstart_{724,1},p1, 177, rem} is true if and only if 0 < ((-2 * div(heapIs)))
heap_{funcstart\_724.1}, heap_{funcstart\_724.1}.p1, 177).quot) + (171 * div(heapIs)
heap_{funcstart_{724,1}}, heap_{funcstart_{724,1},p1,177}.rem)
[1.20] ([0 < ((-171 * div(heapIs heapIs = f_{uncstart_{-724,1}}, heap_{funcstart_{-724,1}}, p_1, f_{uncstart_{-724,1}}]
177).rem) + (2 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_724,1}, \text{\$heap}_{funcstart\_724,1}.p1,
177).quot))]: 1, [0 < ((-2 * div(\mathbf{heapIs} \$heap_{funcstart}, 724.1), 
\text{Sheap}_{funcstart\_724.1}.\text{p1}, 177).\text{quot} + (171 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724.1},
\text{Sheap}_{funcstart\_724,1}.\text{p1}, 177).\text{rem}): 0) \leq \text{maxof}(\text{int})
\rightarrow [simplify]
[1.22] (-1 + ([0 < ((-171 * div(heapIs $heap_{funcstart\_724.1},
\text{Sheap}_{funcstart\_724,1}.\text{p1}, 177).\text{rem} + (2 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1.p1}, 177).\text{quot}): 1, [0 < ((-2 * \text{div}(\textbf{heapIs})))]: 1, [0 < ((-2 * \text{div}(\textbf{heapIs})))]:
\theta_{funcstart_{724,1}}, \theta_{funcstart_{724,1},p1, 177}.quot + (171 * div(heapIs))
\label{eq:heap-funcstart_724,1} \$ heap_{funcstart\_724,1}.p1,\ 177).rem))]:\ 0)) < 32767
\rightarrow [move guard outside expression]
[1.23] ([0 < ((-171 * div(heapIs heapIs funcstart_{-724,1}, heap_{funcstart_{-724,1}}.p1,
177).rem) + (2 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_724,1}, \text{\$heap}_{funcstart\_724,1}.p1,
177).quot))]: -1 + 1, [0 < ((-2 * div(\mathbf{heapIs} \$heap_{funcstart\_724,1}, 
\rho_{tuncstart_{-724,1},p1, 177} = 177 + (171 * div(heapIs $heap_{tuncstart_{-724,1}})
\text{Sheap}_{funcstart\_724,1}.\text{p1}, 177).\text{rem}): -1 + 0) < 32767
\rightarrow [simplify]
[1.26] \ 0 < (32767 + -([0 < ((-171 * div(heapIs $heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1}.\text{p1}, 177).\text{rem} + (2 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
\rho_{uncstart_{724,1},p1,177,quot}): 0, \rho_{uncstart_{724,1},p1,177,quot}: 0, \rho_{uncstart_{724,1},p1,177,quot}:
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.\text{p1}, 177).\text{quot}) + (171 * \text{div}(\text{heapIs}))
\{\text{heap}_{funcstart\_724,1}, \{\text{heap}_{funcstart\_724,1}, \text{p1}, 177\}.\text{rem}\}\}: -1\}
```

```
\rightarrow [move guard outside expression]
[1.27] \ 0 < (32767 + ([0 < ((-171 * div(heapIs $heap_{tuncstart\_724,1},
\text{Sheap}_{funcstart\_724,1}.\text{p1}, 177).\text{rem} + (2 * \text{div}(\text{heapIs} \text{Sheap}_{funcstart\_724,1},
\frac{\text{sheap}_{funcstart\_724.1.p1, 177}.\text{quot}}{177}: -0, [0 < ((-2 * \text{div}(\text{heapIs})))]:
heap_{funcstart_{724,1}}, heap_{funcstart_{724,1}}, 177).quot + (171 * div(heapIs))
heap_{funcstart_{724,1}}, heap_{funcstart_{724,1}}, 177).rem): --1)
\rightarrow [simplify]
[1.29] \ 0 < (32767 + ([0 < ((-171 * div(heapIs $heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1}.\text{p1}, 177).\text{rem} + (2 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1}.\text{p1}, 177).\text{quot}): 0, [0 < ((-2 * \text{div}(\textbf{heapIs})))]: 0, [0 < ((-2 * \text{div}(\textbf{heapIs})))]:
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.\text{p1}, 177).\text{quot}) + (171 * \text{div}(\text{heapIs}))
heap_{funcstart_{724,1}}, heap_{funcstart_{724,1}}, 177).rem): 1)
\rightarrow [move guard outside expression]
[1.30] 0 < ([0 < ((-171 * div(heapIs $heap_{funcstart\_724,1},
\text{Sheap}_{funcstart_724,1}.\text{p1}, 177).\text{rem} + (2 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart_724,1},
\frac{\text{sheap}_{funcstart\_724.1.pl}, 177).\text{quot}}{177).\text{quot}} : 0 + 32767, [0 < ((-2 * div(\textbf{heapIs})))]
\text{Sheap}_{funcstart\_724.1}, \text{Sheap}_{funcstart\_724.1}.\text{p1}, 177).\text{quot}) + (171 * \text{div}(\text{heapIs})
\frac{\text{heap}_{funcstart\_724,1}, \text{heap}_{funcstart\_724,1}.p1, 177).rem)}{1 + 32767}
\rightarrow [simplify]
[1.32] 0 < ([0 < ((-171 * div(heapIs $heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1}.\text{p1}, 177).\text{rem} + (2 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
\text{Sheap}_{funcstart_{724,1},p1, 177}, quot))]: 32767, [0 < ((-2 * \text{div}(\textbf{heapIs})))]
\text{Sheap}_{funcstart\_724.1}, \text{Sheap}_{funcstart\_724.1}.\text{p1}, 177).\text{quot}) + (171 * \text{div}(\text{heapIs})
\{\text{heap}_{funcstart\_724,1}, \{\text{heap}_{funcstart\_724,1}, \text{p1}, 177\}.\text{rem}\}\}: 32768\}
\rightarrow [move guard outside expression]
[1.33] ([0 < ((-171 * div(heapIs p_{funcstart_{-724,1}}, p_{funcstart_{-724,1}}, p_{funcstart_{-724,1}})
177).rem) + (2 * \text{div}(\mathbf{heapIs} \$ \text{heap}_{funcstart\_724,1}, \$ \text{heap}_{funcstart\_724,1}.\text{p1},
(177).\text{quot})]: 0 < 32767, [0 < ((-2 * \text{div}(\textbf{heapIs} \$ \text{heap}_{funcstart}, 724.1)])
\text{Sheap}_{funcstart\_724.1.p1}, 177).\text{quot} + (171 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724.1},
\frac{\text{sheap}_{funcstart\_724,1.p1, 177}.rem)}{177}: 0 < 32768}
\rightarrow [simplify]
\label{eq:continuous} \mbox{$[1.35]$ ([0 < ((-171 * div(\mathbf{heapIs} \ \$heap_{funcstart\_724,1}, \ \$heap_{funcstart\_724,1}.p1, \ ]) $$}
177).rem) + (2 * \text{div}(\mathbf{heapIs} \$ \text{heap}_{funcstart\_724.1}, \$ \text{heap}_{funcstart\_724.1}.\text{p1},
177).quot))]: true, [0 < ((-2 * div(\mathbf{heapIs} \$heap_{funcstart\_724.1}, 
\text{Sheap}_{funcstart\_724,1}.\text{p1}, 177).\text{quot} + (171 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
\frac{\text{sheap}_{funcstart\_724,1.p1, 177}.rem)}{\text{true}}
\rightarrow [all guards have equal guarded terms]
[1.36] true
```

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

```
limit of type 'int'
Condition generated at: C:\Escher\Customers\prang\prang.c (63,25)
Condition defined at:
To prove: minof(int) \le (asType < int > (\$heap_{724.1:744.8}.M1) *
\mathbf{asType} < \mathbf{int} > (\mathbf{static\_cast} < \mathbf{integer}) < (\mathbf{asType} < \mathbf{int} > (\$ \mathrm{heap}_{724,1:744.8}.\mathrm{p1}) < (\$ \mathrm{heap}_{724,1:744.8}.\mathrm{p2}) < (\$ \mathrm{heap}_{724,1:744.8}.\mathrm{p2})
(int)0)))
Given:
heap_{init}.LIMIT == (int)80
\theta
\theta_{init}.r1 == asType < short int > ((int)171)
\theta_{init}.a1 == asType<short int>((int)177)
\theta
heap_{init}.M2 == asType < short int > ((int)30307)
\theta_{init}.r2 == asType < short int > ((int)172)
\theta
\theta == asType<short int>((int)35)
\theta sheap<sub>init</sub>.M3 == asType<short int>((int)30323)
\theta_{init}.r3 == asType < short int > ((int)170)
\theta = asType < short int > ((int)178)
\theta = asType < short int > ((int)63)
\theta = asType < short int > ((int)1)
\theta
\theta = asType < short int > ((int)3)
invariant1(heapIs heap_{funcstart\_724,1})
\operatorname{div1} == \operatorname{div}(\mathbf{heapIs} \ \operatorname{\$heap}_{funcstart\_724,1},
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p1}),
asType < int > (\$heap_{funcstart\_724,1}.a1))
(asType<integer>(asType<int>($heap_{tuncstart\_724.1}.p1)) /
\mathbf{asType}{<}\mathbf{integer}{>}(\mathbf{asType}{<}\mathbf{int}{>}(\$\mathbf{heap}_{funcstart\_724,1}.\mathbf{a1}))) = =
asType<integer>(div1.quot)
(asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.p1)) \%
\mathbf{asType}{<}\mathbf{integer}{>}(\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{a1}))) ==
asType<integer>(div1.rem)
!(0 == asType < integer > (div1.rem)) || !(0 ==
```

asType<integer>(div1.quot))

```
div2 == div(\mathbf{heapIs} \ \text{$heap}_{funcstart\_724,1},
asType < int > (\$heap_{funcstart\_724,1}.p2),
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{a2}))
(asType<int>(asType<int>($heap_{tuncstart\_724.1}.p2)) /
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a2))) = =
asType<integer>(div2.quot)
(asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.p2)) \%
\mathbf{asType}{<}\mathbf{integer}{>}(\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{a2}))) ==
asType<integer>(div2.rem)
!(0 == asType < integer > (div2.rem)) || !(0 ==
asType<integer>(div2.quot))
div3 == div(\mathbf{heapIs} \$heap_{funcstart\_724,1},
asType < int > (\$heap_{funcstart\_724,1}.p3),
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{a3}))
(asType<integer>(asType<int>($heap_{tuncstart\_724.1}.p3)) /
asType < integer > (asType < int > (\$heap_{funcstart\_724.1}.a3))) = =
asType<integer>(div3.quot)
(asType < integer > (asType < int > (\$heap_{tuncstart\_724,1}.p3)) \%
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a3))) = =
asType<integer>(div3.rem)
!(0 == asType < integer > (div3.rem)) || !(0 ==
asType<integer>(div3.quot))
heap_{724,1:740,8} == heap_{funcstart\_724,1}.replace(p1 \rightarrow asType<short
int>((asType<int>(asType<short int>(div1.rem)) *
asType < int > (\$heap_{funcstart\_724,1}.r1)) - (asType < int > (asType < short)
int>(div1.quot)) * asType< int>($heap_{funcstart\_724,1}.b1))))
-asType < integer\ const > (\$heap_{724,1;740,8}.M1) < 1
asType < integer > ($heap_{724,1;740,8}.p1)
!(0 == asType < integer > (\$heap_{724,1:740.8}.p1))
asType<integer>($heap<sub>724.1:740.8</sub>.p1) <
asType<integer>($heap<sub>724,1:740,8</sub>.M1)
\text{$heap}_{724,1;742,8} == \text{$heap}_{724,1;740,8}. replace(p2 \rightarrow asType < short
int>((asType<int>(asType<short int>(div2.rem)) *
asType < int > (\$heap_{724.1:740.8}.r2)) - (asType < int > (asType < short)
int>(div2.quot)) * asType<int>($heap<sub>724.1:740.8</sub>.b2))))
-asType<integer const>($heap_{724,1:742,8}.M2) <
asType<integer>($heap<sub>724,1;742,8</sub>.p2)
!(0 == asType < integer > (\$heap_{724,1;742,8}.p2))
asType<integer>($heap<sub>724,1:742,8</sub>.p2) <
```

```
asType<integer>($heap<sub>724.1:742.8</sub>.M2)
heap_{724,1:744,8} == heap_{724,1:742,8}.replace(p3 \rightarrow asType<short
int>((asType<int>(asType<short int>(div3.rem)) *
\mathbf{asType} < \mathbf{int} > (\$ \mathrm{heap}_{724,1;742,8}.\mathrm{r3})) - (\mathbf{asType} < \mathbf{int} > (\mathbf{asType} < \mathbf{short}))
int>(div3.quot)) * asType<int>($heap<sub>724.1:742.8</sub>.b3))))
-asType < integer\ const > (\$heap_{724,1;744,8}.M3) < 100
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathrm{heap}_{724,1;744,8}.\mathrm{p3})
!(0 == \mathbf{asType} < \mathbf{integer} > (\$ heap_{724,1;744,8}.p3))
asType<integer>($heap<sub>724.1:744.8</sub>.p3) <
asType<integer>($heap<sub>724.1:744.8</sub>.M3)
Proof:
[Take given term]
[11.0] \operatorname{div1} == \operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724,1},
asType < int > (\$heap_{funcstart\_724,1}.p1),
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{a1}))
\rightarrow [simplify]
[11.1]~{\rm div1} == {\rm div}(\mathbf{heapIs}~\$ \mathrm{heap}_{funcstart\_724,1}, \$ \mathrm{heap}_{funcstart\_724,1}.\mathrm{p1},
asType < int > (\$heap_{funcstart\_724,1}.a1))
\rightarrow [const static or extern object]
[11.2] \ \mathrm{div1} == \mathrm{div}(\mathbf{heapIs} \ \$ \mathrm{heap}_{funcstart\_724,1}, \ \$ \mathrm{heap}_{funcstart\_724,1}.\mathrm{p1},
asType < int > (\$heap_{init}.a1))
\rightarrow [expand definition of constant 'a1' at prang.c (16,20)]
[11.3] \operatorname{div1} == \operatorname{div}(\mathbf{heapIs} \operatorname{\$heap}_{funcstart\_724,1}, \operatorname{\$heap}_{funcstart\_724,1}.p1,
asType<int>(asType<short int>((int)177)))
\rightarrow [simplify]
[11.6] div1 == div(heapIs heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p1, 177)
[Take given term]
[25.0] \operatorname{div2} == \operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724,1},
asType < int > (\$heap_{funcstart\_724,1}.p2),
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{a2}))
\rightarrow [simplify]
[25.1] \ \mathrm{div2} == \mathrm{div}(\mathbf{heapIs} \ \$ \mathrm{heap}_{funcstart\_724,1}, \ \$ \mathrm{heap}_{funcstart\_724,1}.\mathrm{p2},
asType < int > (\$heap_{funcstart\_724,1}.a2))
\rightarrow [const static or extern object]
\label{eq:continuous} \textit{[25.2]} \ \text{div2} == \ \text{div} (\mathbf{heapIs} \ \$ \text{heap}_{funcstart\_724,1}, \ \$ \text{heap}_{funcstart\_724,1}.\text{p2},
asType < int > (\$heap_{init}.a2))
```

```
\rightarrow [expand definition of constant 'a2' at prang.c (21,20)]
[25.3] div2 == div(heapIs \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}.p2,
asType<int>(asType<short int>((int)176)))
\rightarrow [simplify]
[25.6] div2 == div(heapIs $heap_{funcstart\_724.1}, $heap_{funcstart\_724.1}.p2, 176)
[Take given term]
[39.0] div3 == div(heapIs $heap_{funcstart\_724,1},
asType < int > (\$heap_{funcstart\_724,1}.p3),
asType < int > (\$heap_{funcstart\_724,1}.a3))
\rightarrow [simplify]
[39.1] \operatorname{div3} == \operatorname{div}(\mathbf{heapIs} \ \operatorname{\$heap}_{funcstart\_724,1}, \ \operatorname{\$heap}_{funcstart\_724,1}.p3,
asType < int > (\$heap_{funcstart\_724,1}.a3))
\rightarrow [const static or extern object]
[39.2] \ \mathrm{div3} == \mathrm{div}(\mathbf{heapIs} \ \$ \mathrm{heap}_{funcstart\_724,1}, \ \$ \mathrm{heap}_{funcstart\_724,1}.\mathrm{p3},
asType < int > (\$heap_{init}.a3))
\rightarrow [expand definition of constant 'a3' at prang.c (26,20)]
[39.3] \ \mathrm{div3} == \mathrm{div}(\mathbf{heapIs} \ \$ \mathrm{heap}_{funcstart\_724,1}, \ \$ \mathrm{heap}_{funcstart\_724,1}.\mathrm{p3},
asType<int>(asType<short int>((int)178)))
\rightarrow [simplify]
[39.6] div3 == div(heapIs heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p3, 178)
[Take given term]
[53.0] \rho_{1740,8} == \rho_{1740,8} == \rho_{1740,8} == \rho_{1740,8} - \rho_{1740,8} == \rho_{1740,8} == \rho_{1740,8} - \rho_{1740,8} == \rho_{1740,8} 
int>((asType<int>(asType<short int>(div1.rem)) *
asType < int > (\$heap_{funcstart\_724,1}.r1)) - (asType < int > (asType < short)
int>(div1.quot)) * asType< int>($heap_{funcstart\_724,1}.b1))))
\rightarrow [from term 11.6, div1 is equal to div(heapIs $heap_{funcstart\_724,1},
heap_{funcstart_{-724,1}}.p1, 177
[53.1] \text{heap}_{724,1;740,8} == \text{heap}_{funcstart\_724,1}._replace(p1 \rightarrow asType<short
int>((asType<int>(asType<short int>(div(heapIs $heap_{funcstart\_724,1},))
\text{Sheap}_{funcstart\_724,1}.\text{p1}, 177).\text{rem}) * asType<int>(\text{Sheap}_{funcstart\_724,1}.\text{r1})) -
(asType<int>(asType<short int>(div1.quot)) *
asType < int > (\$heap_{funcstart\_724.1}.b1))))
\rightarrow [simplify]
[53.3] \rho_{13,1;740,8} == \rho_{13,1;740,8} == \rho_{13,1;740,8} =- \rho_{
int>((div(heapIs \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1, 177).rem *
asType < int > (\$heap_{tuncstart\_724.1}.r1)) - (asType < int > (asType < short)
int>(div1.quot)) * asType< int>($heap_{tuncstart\_724.1}.b1))))
```

```
\rightarrow [const static or extern object]
[53.4] heap_{724,1:740,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow asType<short
int>((div(heapIs \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1, 177).rem *
asType < int > (\$heap_{init}.r1)) - (asType < int > (asType < short)
\mathbf{int}{>}(\mathbf{div1.quot})) * \mathbf{asType}{<} \mathbf{int}{>} (\$\mathbf{heap}_{funcstart\_724,1}.\mathbf{b1}))))
\rightarrow [expand definition of constant 'r1' at prang.c (15,20)]
[53.5] heap_{724,1:740.8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow asType<short
int>((div(heapIs \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1, 177).rem *
asType<int>(asType<short int>((int)171))) -
(asType < int > (asType < short int > (div1.quot)) *
asType < int > (\$heap_{funcstart\_724.1}.b1)))
\rightarrow [simplify]
[53.8] \rho_{724,1;740,8} == \rho_{funcstart\_724,1}.\_replace(p1 \rightarrow asType < short)
int>((div(heapIs \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1, 177).rem * 171)
- (asType<int>(asType<short int>(div1.quot)) *
asType < int > (\$heap_{funcstart\_724,1}.b1))))
\rightarrow [from term 11.6, div1 is equal to div(heapIs $heap_{funcstart\_724,1},
heap_{funcstart_{-724,1}}.p1, 177)
[53.9] heap_{724,1;740,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow asType<short
\mathbf{int} > ((171 * \operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724,1}, \$ \operatorname{heap}_{funcstart\_724,1}.\operatorname{p1}, 177).\operatorname{rem})
- (asType<int>(asType<short int>(div(heapIs $heap_{funcstart_724.1},
heap_{funcstart_{724,1},p1, 177}, quot)) *
asType < int > (\$heap_{funcstart\_724.1}.b1)))
\rightarrow [simplify]
[53.11] \theta_{13} = \theta_
int > ((171 * div(heapIs \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1, 177).rem)
- (\text{div}(\mathbf{heapIs} \$ \text{heap}_{funcstart\_724.1}, \$ \text{heap}_{funcstart\_724.1}. \text{p1}, 177).\text{quot} *
asType < int > (\$heap_{funcstart\_724.1}.b1)))
\rightarrow [const static or extern object]
[53.12] \theta_{12} = \theta_{124,1;740,8} = \theta_{124,1;74
int>((171 * div(heapIs $heap_{funcstart\_724,1}, $heap_{funcstart\_724,1}.p1, 177).rem)
- (\text{div}(\mathbf{heapIs} \$ \text{heap}_{funcstart\_724,1}, \$ \text{heap}_{funcstart\_724,1}.\text{p1}, 177).\text{quot} *
asType < int > (\$heap_{init}.b1)))
\rightarrow [expand definition of constant 'b1' at prang.c (17,20)]
[53.13] heap_{724,1;740,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow asType<short
int>((171 * div(heapIs $heap_{funcstart\_724,1}, $heap_{funcstart\_724,1}.p1, 177).rem)
- (\text{div}(\mathbf{heapIs} \$ \text{heap}_{funcstart\_724,1}, \$ \text{heap}_{funcstart\_724,1}.\text{p1}, 177).\text{quot} *
asType<int>(asType<short int>((int)2))))
\rightarrow [simplify]
```

```
[53.19] $heap<sub>724,1;740,8</sub> == $heap<sub>funcstart_724,1</sub>._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).rem)))
[Take given term]
[55.0]!(0 == asType < integer > (\$heap_{724.1:740.8}.p1))
\rightarrow [from term 53.19, $heap<sub>724,1;740,8</sub> is equal to
heap_{funcstart\_724,1}._replace(p1 \rightarrow (-2 * div(heapIs heap_{funcstart\_724,1}),
heap_{funcstart_{724,1},p1, 177}, quot) + (171 * div(heapIs p_{funcstart_{724,1},p1, 177}).
heap_{funcstart_{-724,1}.p1, 177).rem}
[55.1] !(0 == asType<integer>($heap_{funcstart\_724,1}.\_replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.\operatorname{p1}, \ 177).\operatorname{rem}))).\operatorname{p1}))
\rightarrow [simplify]
[55.3] !(0 == ((-2 * div(heapIs $heap<sub>funcstart_724,1</sub>, $heap<sub>funcstart_724,1</sub>.p1,
177).quot) + (171 * div(heapIs heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p1,
177).rem)))
[Take given term]
[57.0] $\text{heap}_{724,1;742,8} == $\text{heap}_{724,1;740,8}._\text{replace}(p2 \rightarrow \text{asType} < \text{short}
int>((asType<int>(asType<short int>(div2.rem)) *
asType < int > (\$heap_{724,1;740,8}.r2)) - (asType < int > (asType < short)
int>(div2.quot)) * asType<int>($heap<sub>724.1:740.8</sub>.b2))))
\rightarrow [from term 53.19, $heap<sub>724,1:740,8</sub> is equal to
heap_{funcstart\_724,1}._replace(p1 \rightarrow (-2 * div(heapIs heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1}.p1, 177).quot) + (171 * div(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
heap_{funcstart_{-724,1}.p1, 177}.rem)
[57.1] heap_{724,1;742,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).quot) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1,
(177).rem))._replace(p2 \rightarrow asType < short)
int>((asType<int>(asType<short int>(div2.rem)) *
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{724,1;740,8}.\mathrm{r2})) - (\mathbf{asType}{<}\mathbf{int}{>}(\mathbf{asType}{<}\mathbf{short}
int>(div2.quot)) * asType< int>($heap_{724,1:740,8}.b2))))
\rightarrow [from term 25.6, div2 is equal to div(heapIs $heap_{funcstart_724.1},
heap_{funcstart_{-724,1}}.p2, 176
[57.2] heap_{724,1;742,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).quot) + (171 *
\operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724,1}, \$ \operatorname{heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow asType<short
int>((asType<int>(asType<short int>(div(heapIs $heap_{funcstart\_724,1},
\text{sheap}_{funcstart\_724,1.p2, 176}.\text{rem}) * asType < int > (\text{sheap}_{724,1:740,8}.\text{r2})) -
(asType<int>(asType<short int>(div2.quot)) *
```

```
asType<int>($heap<sub>724.1:740.8</sub>.b2))))
\rightarrow [simplify]
[57.4] heap_{724,1;742,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).quot) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1,
177).rem)))._{\mathbf{replace}}(p2 \rightarrow \mathbf{asType} < \mathbf{short\ int} > ((\operatorname{div}(\mathbf{heapIs}))))
\text{Sheap}_{funcstart_{-724,1}}, \text{Sheap}_{funcstart_{-724,1}}.p2, 176).rem *
\mathbf{asType} < \mathbf{int} > (\$ \mathrm{heap}_{724,1;740,8}.\mathrm{r2})) - (\mathbf{asType} < \mathbf{int} > (\mathbf{asType} < \mathbf{short}))
int>(div2.quot)) * asType<int>($heap<sub>724.1:740.8</sub>.b2))))
\rightarrow [from term 53.19, $heap<sub>724,1;740,8</sub> is equal to
heap_{funcstart\_724,1}._replace(p1 \rightarrow (-2 * div(heapIs heap_{funcstart\_724,1}),
heap_{funcstart\_724,1}.p1, 177).quot + (171 * div(heapIs $heap_{funcstart\_724,1},
heap_{funcstart_{724,1}.p1, 177).rem}
[57.5] heap_{724,1;742,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}. \operatorname{p1}, \ 177).\operatorname{quot}) + (171 \ *
\operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724,1}, \$ \operatorname{heap}_{funcstart\_724,1}.p1,
177).rem))).\_\mathbf{replace}(p2 \to \mathbf{asType} < \mathbf{short\ int} > ((div(\mathbf{heapIs}
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.\text{p2}, 176).\text{rem} *
asType < int > (\$heap_{funcstart\_724,1}.\_replace(p1 \rightarrow ((-2 * div(heapIs))))))
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.\text{p1}, 177).\text{quot}) + (171 * \text{div}(\text{heapIs}))
\text{Sheap}_{funcstart_{-724,1}}, \text{Sheap}_{funcstart_{-724,1},p1, 177).rem})).r2)) -
(asType<int>(asType<short int>(div2.quot)) *
asType < int > (\$heap_{724.1:740.8}.b2))))
\rightarrow [const member of object with modified fields]
[57.6] heap_{724,1;742,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 \ *
\operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724,1}, \$ \operatorname{heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow asType<short int>((div(heapIs
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.p2, 176).rem *
asType < int > (\$heap_{funcstart\_724,1}.r2)) - (asType < int > (asType < short)
int>(div2.quot)) * asType<int>($heap<sub>724.1:740.8</sub>.b2))))
\rightarrow [const static or extern object]
[57.7] heap_{724,1;742,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 \ *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.p1,
177).rem)))._{\mathbf{replace}}(p2 \rightarrow \mathbf{asType} < \mathbf{short\ int} > ((\operatorname{div}(\mathbf{heapIs}))))
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.p2, 176).rem *
asType < int > (\$heap_{init}.r2)) - (asType < int > (asType < short)
int>(div2.quot)) * asType< int>($heap_{724.1:740.8}.b2))))
\rightarrow [expand definition of constant 'r2' at prang.c (20.20)]
[57.8] heap_{724,1;742,8} == heap_{funcstart\_724,1}.\_replace(p1 \to ((-2 *
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\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).quot) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow asType<short int>((div(heapIs
\theta_{funcstart_{724,1}}, \theta_{funcstart_{724,1}}, \theta_{funcstart_{724,1}}.p2, 176).rem *
asType<int>(asType<short int>((int)172))) -
(asType<int>(asType<short int>(div2.quot)) *
asType<int>($heap<sub>724.1:740.8</sub>.b2))))
\rightarrow [simplify]
[57.11] $\text{heap}_{724,1;742,8} == \text{$heap}_{funcstart_724,1}._\text{$replace}(p1 \to ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).quot) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.p1,
(177).rem))._replace(p2 \rightarrow asType<short int>((div(heapIs
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.p2, 176).rem * 172) -
(asType<int>(asType<short int>(div2.quot)) *
\mathbf{asType}{<}\mathbf{int}{>}(\${\rm heap}_{724,1;740,8}.{\rm b2}))))
\rightarrow [from term 25.6, div2 is equal to div(heapIs $heap_{tuncstart_724.1},
heap_{funcstart_{-724,1}}.p2, 176)
[57.12] $heap<sub>724,1;742,8</sub> == $heap<sub>funcstart_724,1</sub>._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}. p1, \ 177). \operatorname{quot}) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow asType<short int>((172 * div(heapIs
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.\text{p2}, 176).\text{rem}) -
(asType<int>(asType<short int>(div(heapIs $heap_{funcstart\_724,1},))
\text{Sheap}_{funcstart\_724,1}.\text{p2}, 176).\text{quot}) * asType<int>(\text{Sheap}_{724,1;740,8}.\text{b2}))))
\rightarrow [simplify]
[57.14] heap_{724,1;742,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 *
\operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724,1}, \$ \operatorname{heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow asType<short int>((172 * div(heapIs
\theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}.p2, 176).rem) - (div(heapIs
\theta_{funcstart_{724,1}}, \theta_{funcstart_{724,1}}, \theta_{funcstart_{724,1}}, \theta_{funcstart_{724,1}}
asType<int>($heap<sub>724,1:740,8</sub>.b2))))
\rightarrow [from term 53.19, $heap<sub>724,1:740,8</sub> is equal to
$heap_{funcstart\_724,1}$.$replace(p1 \rightarrow (-2 * div(heapIs $heap_{funcstart\_724,1},
heap_{funcstart\_724,1}.p1, 177).quot + (171 * div(heapIs $heap_{funcstart\_724,1},
$heap_{funcstart\_724,1}.p1, 177).rem))]
[57.15] $\text{heap}_{724,1;742,8} == \text{$heap}_{funcstart\_724,1}._\text{$replace}(p1 \to ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow asType<short int>((172 * div(heapIs
\theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}.p2, 176).rem) - (div(heapIs
heap_{funcstart_{724,1}}, heap_{funcstart_{724,1}}, 2, 176).quot *
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asType < int > (\$heap_{funcstart\_724,1}.\_replace(p1 \rightarrow ((-2 * div(heapIs))))))
\$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1, 177).quot) + (171 * div(\textbf{heapIs}) + (171 * div(\textbf{heapIs})) + (171
\$ heap_{funcstart\_724,1}, \$ heap_{funcstart\_724,1}.p1, 177).rem))).b2))))
→ [const member of object with modified fields]
[57.16] $\text{heap}_{724,1;742,8} == \text{$heap}_{funcstart\_724,1}._\text{replace}(p1 \to ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow asType<short int>((172 * div(heapIs
\theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}
heap_{funcstart_{724,1}}, heap_{funcstart_{724,1}}, 176).quot *
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{b2}))))
\rightarrow [const static or extern object]
[57.17] $heap<sub>724,1;742,8</sub> == $heap<sub>funcstart_724,1</sub>._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 *
\operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724,1}, \$ \operatorname{heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow asType<short int>((172 * div(heapIs
heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p2, 176).rem) - (div(heapIs
heap_{funcstart_{724,1}}, heap_{funcstart_{724,1}}, 2, 176).quot *
asType < int > (\$heap_{init}.b2)))
\rightarrow [expand definition of constant 'b2' at prang.c (22,20)]
[57.18] $\text{heap}_{724,1;742,8} == \text{$heap}_{funcstart\_724,1}._\text{$replace}(p1 \to ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow asType<short int>((172 * div(heapIs
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.\text{p2}, 176).\text{rem}) - (\text{div}(\text{heapIs})
heap_{funcstart_{-724,1}}, heap_{funcstart_{-724,1}}, 176).quot
asType<int>(asType<short int>((int)35)))))
\rightarrow [simplify]
[57.24] $heap<sub>724,1;742,8</sub> == $heap<sub>funcstart_724,1</sub>._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).quot) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow ((-35 * div(heapIs $heap_{funcstart_{-724,1}},
\text{Sheap}_{funcstart\_724.1.p2}, 176).\text{quot} + (172 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724.1},
heap_{funcstart_{724,1}}.p2, 176).rem)
[Take given term]
[61.0] $\text{heap}_{724,1;744,8} == \text{$heap}_{724,1;742,8}.$\text{$-replace}(p3 \to asType < short)$
int>((asType<int>(asType<short int>(div3.rem)) *
asType < int > (\$heap_{724,1;742,8}.r3)) - (asType < int > (asType < short)
int>(div3.quot)) * asType< int>($heap_{724.1:742.8}.b3))))
\rightarrow [from term 57.24, $heap<sub>724.1:742.8</sub> is equal to
heap_{funcstart\_724,1}.replace(p1 \rightarrow ((-2 * div(heapIs $heap_{funcstart\_724,1},
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\text{Sheap}_{funcstart_{-724,1},p1, 177}.\text{quot}) + (171 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart_{-724,1}})
\rho_{uncstart_{-724,1}.p1, 177).rem})._replace\rho_{uncstart_{-724,1}.p1, 177).rem}._replace
heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p2, 176).quot) + (172 * div(heapIs)
heap_{funcstart_{724,1}}, heap_{funcstart_{724,1}}, 2, 176).rem
[61.1] heap_{724,1;744,8} == heap_{funcstart\_724,1}.\_replace(p1 \to ((-2 * 
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}. p1, \ 177). \operatorname{quot}) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow ((-35 * div(heapIs $heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1}.\text{p2}, 176).\text{quot} + (172 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
\theta_{uncstart_724.1.p2, 176}.rem)._replace(p3 \rightarrow asType<short
int>((asType<int>(asType<short int>(div3.rem)) *
\mathbf{asType} < \mathbf{int} > (\$ \mathrm{heap}_{724,1;742.8}.\mathrm{r3})) - (\mathbf{asType} < \mathbf{int} > (\mathbf{asType} < \mathbf{short}))
int>(div3.quot)) * asType< int>($heap_{724.1:742.8}.b3))))
\rightarrow [from term 39.6, div3 is equal to div(heapIs $heap_{funcstart_{724,1}},
heap_{funcstart_{-724,1}}.p3, 178
[61.2] \theta == 
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 \ *
\operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724.1}, \$ \operatorname{heap}_{funcstart\_724.1}.p1,
177).rem)))._replace(p2 \rightarrow ((-35 * div(heapIs $heap_{funcstart\_724,1},
\rho_{funcstart_{724,1},p2, 176} = (172 * div(heapIs $heap_{funcstart_{724,1}}, 176).
\theta_{funcstart\_724,1}.p2, 176).rem))._replace(p3 \rightarrow asType<short
int>((asType<int>(asType<short int>(div(heapIs $heap_{funcstart_724,1},))
\text{sheap}_{funcstart\_724,1.p3}, 178).rem) * asType < int > (\text{sheap}_{724,1;742,8.r3})) -
(asType<int>(asType<short int>(div3.quot)) *
asType < int > (\$heap_{724,1;742,8}.b3))))
\rightarrow [simplify]
[61.4] $heap<sub>724,1:744,8</sub> == $heap<sub>funcstart_724,1</sub>._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 *
\label{eq:div_heap} \text{div}(\textbf{heapIs} \ \$ \text{heap}_{funcstart\_724,1}, \ \$ \text{heap}_{funcstart\_724,1}.\text{p1},
177).rem)))._replace(p2 \rightarrow ((-35 * div(heapIs $heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1.p2}, 176).\text{quot} + (172 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
\theta_{funcstart\_724,1}.p2, 176).rem))._replace(p3 \rightarrow asType<short
int>((div(heapIs \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p3, 178).rem *
asType < int > (\$heap_{724,1;742,8}.r3)) - (asType < int > (asType < short)
int>(div3.quot)) * asType<int>($heap_{724,1;742,8}.b3))))
\rightarrow [from term 57.24, $heap<sub>724.1:742.8</sub> is equal to
heap_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 * div(heapIs heap_{funcstart\_724,1},
heap_{funcstart\_724,1}.p1, 177).quot + (171 * div(heapIs $heap_{funcstart\_724,1}, 177).quot) + (171 * div(heapIs $heap_{funcstart\_724,1}, 177).quot)
\rho_{funcstart\_724,1}.p1, 177).rem))._replace(\rho_{funcstart\_724,1}.p1, 177).rem))
heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p2, 176).quot) + (172 * div(heapIs)
heap_{funcstart_{724,1}}, heap_{funcstart_{724,1}}, p2, 176).rem)
div(\mathbf{heapIs} \ \$heap_{funcstart\_724,1}, \ \$heap_{funcstart\_724,1}.p1, \ 177).quot) + (171 *
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\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow ((-35 * div(heapIs $heap_{funcstart\_724,1},
\rho_{funcstart\_724,1.p2}, 176).quot) + (172 * div(heapIs \rho_{funcstart\_724,1},
\theta_{funcstart\_724,1}.p2, 176).rem))._replace(p3 \rightarrow asType<short
int>((div(heapIs \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p3, 178).rem *
asType < int > (\$heap_{funcstart\_724,1}.\_replace(p1 \rightarrow ((-2 * div(heapIs)))))))
\theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}
\rho_{funcstart\_724,1}, \rho_{funcstart\_724,1}
* div(heapIs heap_{funcstart_{724,1}}, heap_{funcstart_{724,1}}, 176).quot) + (172 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p2, 176).rem))).r3)) -
(asType<int>(asType<short int>(div3.quot)) *
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{724,1;742,8}.\mathrm{b3}))))
→ [const member of object with modified fields]
[61.7] heap_{724,1;744,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 \ *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow ((-35 * div(heapIs $heap_{funcstart\_724,1},
\text{Sheap}_{funcstart_724,1}.\text{p2}, 176).\text{quot} + (172 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart_724,1},
\rho_{uncstart_724,1,p2,176,rem})._replace(p3 \rightarrow asType<short
int>((div(heapIs \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p3, 178).rem *
asType < int > (\$heap_{funcstart\_724.1}.r3)) - (asType < int > (asType < short)
int>(div3.quot)) * asType< int>($heap_{724.1:742.8}.b3))))
\rightarrow [const static or extern object]
[61.8] heap_{724,1;744,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).quot) + (171 *
\operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724,1}, \$ \operatorname{heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow ((-35 * div(heapIs $heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1}.\text{p2}, 176).\text{quot} + (172 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
\theta_{funcstart\_724,1.p2, 176}.rem))._replace(p3 \rightarrow asType<short
int>((div(heapIs \$heap_{funcstart\_724.1}, \$heap_{funcstart\_724.1}.p3, 178).rem *
asType < int > (\$heap_{init}.r3)) - (asType < int > (asType < short)
int > (div3.quot)) * asType < int > ($heap_{724,1;742,8}.b3))))
\rightarrow [expand definition of constant 'r3' at prang.c (25,20)]
[61.9] heap_{724,1:744,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).quot) + (171 *
\operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724.1}, \$ \operatorname{heap}_{funcstart\_724.1}.p1,
177).rem)))._replace(p2 \rightarrow ((-35 * div(heapIs $heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1}.\text{p2}, 176).\text{quot} + (172 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
\theta_{funcstart\_724,1}.p2, 176).rem))).replace(p3 \rightarrow asType < short)
int>((div(heapIs \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p3, 178).rem *
asType<int>(asType<short int>((int)170))) -
(asType<int>(asType<short int>(div3.quot)) *
\mathbf{asType}{<}\mathbf{int}{>}(\${\rm heap}_{724,1;742,8}.{\rm b3}))))
```

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\rightarrow [simplify]
[61.12] $heap<sub>724,1;744,8</sub> == $heap<sub>funcstart_724,1</sub>._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).quot) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow ((-35 * div(heapIs $heap_{tuncstart_724.1},
\text{Sheap}_{funcstart\_724,1}.\text{p2}, 176).\text{quot} + (172 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
\theta_{funcstart\_724,1.p2, 176}.rem))._replace(p3 \rightarrow asType<short
int>((div(heapIs \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p3, 178).rem * 170)
- (asType<int>(asType<short int>(div3.quot)) *
asType < int > (\$heap_{724,1;742,8}.b3))))
\rightarrow [from term 39.6, div3 is equal to div(heapIs $heap_{funcstart\_724,1},
heap_{funcstart_{-724,1}}.p3, 178
[61.13] heap_{724,1;744,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 *
div(\mathbf{heapIs} \ \$heap_{funcstart\_724.1}, \ \$heap_{funcstart\_724.1}.p1, \ 177).quot) + (171 *
\operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724.1}, \$ \operatorname{heap}_{funcstart\_724.1}.p1,
177).rem)))._replace(p2 \rightarrow ((-35 * div(heapIs $heap_{funcstart\_724,1},
\theta_{funcstart\_724,1.p2}, 176).quot) + (172 * div(heapIs \theta_{funcstart\_724,1},
\rho_{tuncstart=724.1.p2, 176}.rem)._replace(p3 \rightarrow asType<short int>((170
* div(heapIs heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p3, 178).rem) -
(asType < int > (asType < short int > (div(heapIs $heap_{funcstart\_724,1}, 
\text{sheap}_{funcstart\_724,1}.\text{p3}, 178).\text{quot}) * asType<int>(\text{sheap}_{724,1;742,8}.\text{b3}))))
\rightarrow [simplify]
[61.15] $\text{heap}_{724,1;744,8} == \text{$heap}_{funcstart\_724,1}._\text{$replace}(p1 \to ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).quot) + (171 *
\operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724,1}, \$ \operatorname{heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow ((-35 * div(heapIs $heap_{funcstart_724,1},
\text{Sheap}_{funcstart\_724,1.p2}, 176).\text{quot} + (172 * \text{div}(\text{heapIs} \text{Sheap}_{funcstart\_724,1},
\rho_{funcstart\_724,1}.p2, 176).rem))._replace(p3 \rightarrow asType<short int>((170)
* \operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p3, \ 178).rem) -
(div(heapIs \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1.p3}, 178).quot *
asType < int > (\$heap_{724,1;742,8}.b3)))
\rightarrow [from term 57.24, $heap<sub>724.1:742.8</sub> is equal to
heap_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 * div(heapIs *heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1}.\text{p1}, 177).\text{quot} + (171 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
heap_{funcstart\_724,1}.p1, 177).rem))._replace(p2 \rightarrow (-35 * div(heapIs)))._
heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p2, 176).quot) + (172 * div(heapIs)
heap_{funcstart_{724,1}}, heap_{funcstart_{724,1}}, 2, 176).rem
[61.16] $heap<sub>724,1;744,8</sub> == $heap<sub>funcstart_724,1</sub>._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 *
\operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724,1}, \$ \operatorname{heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow ((-35 * div(heapIs $heap_{funcstart_724.1},
\text{Sheap}_{funcstart\_724,1}.\text{p2}, 176).\text{quot} + (172 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
\rho_{uncstart\_724,1.p2, 176).rem}))._replace(p3 \rightarrow asType<short int>((170
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* div(heapIs heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p3, 178).rem) –
(\text{div}(\mathbf{heapIs} \$ \text{heap}_{funcstart\_724,1}, \$ \text{heap}_{funcstart\_724,1}.\text{p3}, 178).\text{quot} *
asType < int > (\$heap_{funcstart\_724,1}.\_replace(p1 \rightarrow ((-2 * div(heapIs))))))
\theta_{funcstart_{724,1}}, \theta_{funcstart_{724,1},p1, 177}.quot) + (171 * div(heapIs)
\rho_{funcstart\_724,1}, \rho_{funcstart\_724,1}, \rho_{funcstart\_724,1}, \rho_{funcstart\_724,1}, \rho_{funcstart\_724,1}, \rho_{funcstart\_724,1}, \rho_{funcstart\_724,1}
* div(heapIs heap_{funcstart_{724,1}}, heap_{funcstart_{724,1}}, 176).quot) + (172 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p2, 176).rem))).b3))))
\rightarrow [const member of object with modified fields]
[61.18] $\text{heap}_{724,1:744,8} == $\text{heap}_{funcstart\_724,1}._\text{replace}(p1 \to ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 *
\operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724,1}, \$ \operatorname{heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow ((-35 * div(heapIs $heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1.p2}, 176).\text{quot} + (172 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
\rho_{funcstart_{-724,1},p2,176,rem})._replace(p3 \rightarrow asType<short int>((170
* \operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p3, \ 178).rem) -
(\text{div}(\mathbf{heapIs} \$ \text{heap}_{funcstart\_724,1}, \$ \text{heap}_{funcstart\_724,1}.\text{p3}, 178).\text{quot} *
asType < int > (\$heap_{funcstart\_724,1}.b3))))
\rightarrow [const static or extern object]
[61.19] $\text{heap}_{724,1:744,8} == $\text{heap}_{funcstart\_724,1}._\text{replace}(p1 \to ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).quot) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow ((-35 * div(heapIs $heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724.1.p2}, 176).\text{quot} + (172 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724.1},
\rho_{tuncstart_{724,1},p2,176,rem})._replace(p3 \rightarrow asType<short int>((170
* div(heapIs heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p3, 178).rem) –
(\text{div}(\mathbf{heapIs} \$ \text{heap}_{funcstart\_724,1}, \$ \text{heap}_{funcstart\_724,1}.\text{p3}, 178).\text{quot} *
asType < int > (\$heap_{init}.b3)))
\rightarrow [expand definition of constant 'b3' at prang.c (27,20)]
[61.20] $heap<sub>724,1;744,8</sub> == $heap<sub>funcstart_724,1</sub>._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 \ *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow ((-35 * div(heapIs $heap_{tuncstart_724.1},
\text{Sheap}_{funcstart\_724.1.p2}, 176).\text{quot} + (172 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724.1},
\rho_{uncstart\_724,1.p2, 176).rem}))._replace(p3 \rightarrow asType<short int>((170
* div(heapIs heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p3, 178).rem) –
(\text{div}(\mathbf{heapIs} \$ \text{heap}_{funcstart\_724.1}, \$ \text{heap}_{funcstart\_724.1}.\text{p3}, 178).\text{quot} *
asType<int>(asType<short int>((int)63)))))
\rightarrow [simplify]
[61.26] $heap<sub>724,1;744,8</sub> == $heap<sub>funcstart_724,1</sub>._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).quot) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}. \operatorname{pl},
177).rem)))._replace(p2 \rightarrow ((-35 * div(heapIs $heap_{funcstart\_724,1},
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\text{Sheap}_{funcstart_{-724,1},p2, 176}.quot) + (172 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart_{-724,1}},
\theta_{funcstart\_724,1}.p2, 176).rem))).\_replace(p3 \rightarrow ((-63 * div(heapIs)))._replace(p3 \rightarrow ((-63 * div(heapIs))))._replace(p3 \rightarrow ((-63 * div(heapIs))))._replace(p3 \rightarrow ((-63 * div(heapIs)))))._replace(p3 \rightarrow ((-63 * div(heapIs)))))._replace(p3 \rightarrow ((-63 * div(heapIs)))))._replace(p3 \rightarrow ((-63 * div(heapIs)))))
\theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}
\theta_{funcstart\_724,1}, \theta_{funcstart\_724,1.p3}, 178).rem
[Take goal term]
[1.0]  minof(int) \leq (asType < int > (\$heap_{724,1:744,8}.M1) *
asType<int>(static_cast<integer>(asType<int>($heap_{724,1:744,8}.p1) <
(int)0)))
\rightarrow [simplify]
[1.1] -32768 \leq (asType<int>($heap<sub>724.1:744.8</sub>.M1) *
asType<int>(static_cast<integer>(asType<int>($heap<sub>724.1.744.8.p1</sub>) <
\rightarrow [from term 61.26, $heap<sub>724,1;744,8</sub> is equal to
heap_{funcstart\_724,1}.replace(p1 \rightarrow ((-2 * div(heapIs $heap_{funcstart\_724,1},
heap_{funcstart_{724,1},p1,177}, quot) + (171 * div(heapIs p_{funcstart_{724,1},p1,177}).
\rho_{funcstart\_724.1}.p1, 177).rem))._replace\rho_{funcstart\_724.1}.p1, 177).rem))
heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p2, 176).quot) + (172 * div(heapIs)
\rho_{uncstart\_724,1}, \rho_{uncstart\_724,1},
div(\mathbf{heapIs} \ \$heap_{funcstart\_724,1}, \ \$heap_{funcstart\_724,1}.p3, \ 178).quot) + (170 *
\operatorname{div}(\mathbf{heapIs} \ \$ heap_{funcstart\_724.1}, \ \$ heap_{funcstart\_724.1}.p3, \ 178).rem))]
[1.2] -32768 \leq (asType<int>($heap<sub>funcstart 724.1</sub>._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 \ *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow ((-35 * div(heapIs $heap_{funcstart_724,1},
\text{Sheap}_{funcstart\_724,1}.\text{p2}, 176).\text{quot} + (172 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
\theta_{funcstart\_724,1}.p2, 176).rem))).\_replace(p3 \rightarrow ((-63 * div(heapIs)))._replace(p3 \rightarrow ((-63 * div(heapIs))))._replace(p3 \rightarrow ((-63 * div(heapIs))))._replace(p3 \rightarrow ((-63 * div(heapIs)))))._replace(p3 \rightarrow ((-63 * div(heapIs)))))._replace(p3 \rightarrow ((-63 * div(heapIs)))))._replace(p3 \rightarrow ((-63 * div(heapIs)))))
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.p3, 178).quot) + (170 * div(heapIs)
\text{Sheap}_{funcstart_{724,1}}, \text{Sheap}_{funcstart_{724,1}}.p3, 178).rem))).M1) *
asType<int>(static_cast<integer>(asType<int>($heap<sub>724.1:744.8</sub>.p1) <
(\mathbf{int})(0)
\rightarrow [const member of object with modified fields]
[1.5] -32768 \leq (asType<int>($heap<sub>funcstart_724,1</sub>.M1) *
\mathbf{asType} < \mathbf{int} > (\mathbf{static\_cast} < \mathbf{integer}) < (\mathbf{asType} < \mathbf{int} > (\$ \mathrm{heap}_{724,1;744,8}.\mathrm{p1}) < (\$ \mathrm{heap}_{724,1;744,8}.\mathrm{p2}) < (\$ \mathrm{heap}_{724,1;744,8}.\mathrm{p2})
(int)0)))
\rightarrow [const static or extern object]
[1.6] -32768 \le (asType < int > (\$heap_{init}.M1) *
\mathbf{asType} < \mathbf{int} > (\mathbf{static\_cast} < \mathbf{integer}) < (\mathbf{asType} < \mathbf{int} > (\$ \mathrm{heap}_{724,1:744.8}.\mathrm{p1}) < (\$ \mathrm{heap}_{724,1:744.8}.\mathrm{p2}) < (\$ \mathrm{heap}_{724,1:744.8}.\mathrm{p2})
(int)0)))
\rightarrow [expand definition of constant 'M1' at prang.c (14,20)]
[1.7] -32768 \leq (asType\leqint>(asType\leqshort int>((int)30269)) *
asType<int>(static_cast<integer>(asType<int>($heap<sub>724,1:744,8</sub>.p1) <
```

```
(\mathbf{int})(0)
\rightarrow [simplify]
[1.10] -32768 < (30269 *)
asType<int>(static_cast<integer>(asType<int>($heap<sub>724.1:744.8</sub>.p1) <
(\mathbf{int})(0)
\rightarrow [from term 61.26, $heap<sub>724,1:744,8</sub> is equal to
heap_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 * div(heapIs $heap_{funcstart\_724,1},
heap_{funcstart\_724,1}.p1, 177).quot + (171 * div(heapIs $heap_{funcstart\_724,1}, 177).quot) + (171 * div(heapIs $heap_{funcstart\_724,1}, 17
\rho_{funcstart\_724,1.p1, 177}.rem))._replace\rho_{funcstart\_724,1.p1, 177}.rem))._replace
heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p2, 176).quot) + (172 * div(heapIs)
heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p2, 176).rem)))._replace(p3 \rightarrow (-63 *
div(\mathbf{heapIs} \ \$heap_{funcstart\_724,1}, \ \$heap_{funcstart\_724,1}.p3, \ 178).quot) + (170 *
div(\mathbf{heapIs} \ \$heap_{funcstart\_724,1}, \ \$heap_{funcstart\_724,1}.p3, \ 178).rem))]
[1.11] -32768 \le (30269 *
\mathbf{asType} < \mathbf{int} > (\mathbf{static\_cast} < \mathbf{integer} > (\mathbf{asType} < \mathbf{int} > (\$ \mathbf{heap}_{funcstart\_724,1}. \mathbf{\_replace} (\mathbf{p1})) + (\$ \mathbf{heap
\rightarrow ((-2 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_724,1}, \text{\$heap}_{funcstart\_724,1}.\text{p1}, 177).\text{quot}) +
(171 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_724,1}, \text{\$heap}_{funcstart\_724,1}.\text{p1},
177).rem)))._replace(p2 \rightarrow ((-35 * div(heapIs $heap_{funcstart\_724,1},
\text{Sheap}_{funcstart_{724,1},p2,176}, quot) + (172 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart_{724,1}})
\rho_{tuncstart_{-724,1},p2, 176,rem})._replace(p3 \rightarrow ((-63 * div(heapIs
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.p3, 178).quot) + (170 * div(heapIs)
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.p3, 178).rem))).p1) < (int)0)))
\rightarrow [simplify]
[1.23] -32768 \leq (30269 * asType<int>(([0 < ((-171 * div(heapIs
\theta_{funcstart\_724.1}, \theta_{funcstart\_724.1}, \theta_{funcstart\_724.1}, \theta_{funcstart\_724.1}, \theta_{funcstart\_724.1}
heap_{funcstart_{-724,1}}, heap_{funcstart_{-724,1}}, 1, 177).quot): 1, []: 0)))
→ [explicitly assert falsehood of skipped guards in subsequent guards]
[1.24] -32768 \leq (30269 * asType<int>(([0 < ((-171 * div(heapIs)))))
\theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}.p1, 177).rem) + (2 * div(heapIs
\theta_{funcstart_{724,1}}, \theta_{funcstart_{724,1},p1, 177}.quot): 1, [!(0 < ((-171 *
div(heapIs \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1, 177).rem) + (2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot})))]: 0)))
\rightarrow [simplify]
[1.29] -32768 \leq (30269 * asType<int>(([0 < ((-171 * div(heapIs
\theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}
\rho_{funcstart_{-724,1}}, \rho_{funcstart_{-724,1}}, \rho_{funcstart_{-724,1}}, \rho_{funcstart_{-724,1}}, \rho_{funcstart_{-724,1}}, \rho_{funcstart_{-724,1}}, \rho_{funcstart_{-724,1}}, \rho_{funcstart_{-724,1}}
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).rem) + (-2 *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}))]: 0)))
\rightarrow [from term 55.3, -1 < ((-2 * div(heapIs $heap_{tuncstart_724.1},
heap_{funcstart_{-724,1},p1, 177}, quot) + (171 * div(heapIs p_{funcstart_{-724,1},p1, 177}), quot)
heap_{funcstart\_724,1}.p1, 177).rem) is true if and only if 0 < ((-2 * div(heapIs)))
```

```
heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p1, 177).quot) + (171 * div(heapIs)
heap_{funcstart_{724,1}}, heap_{funcstart_{724,1},p1, 177}.rem)
[1.30] -32768 \leq (30269 * asType<int>(([0 < ((-171 * div(heapIs
\theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}
\{\text{heap}_{funcstart}, \text{24.1}, \text{heap}_{funcstart}, \text{24.1.p1}, \text{177}, \text{quot}\}\}: 1, [0 < ((-2 * 
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).quot) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.p1, \ 177).rem))]: 0)))
\rightarrow [simplify]
[1.31] -32768 \leq (30269 * ([0 < ((-171 * div(\mathbf{heapIs} \$heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1}.\text{p1}, 177).\text{rem} + (2 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724.1}.\text{p1}, 177).\text{quot}): 1, [0 < ((-2 * \text{div}(\textbf{heapIs})))]: 1, [0 < ((-2 * \text{div}(\textbf{heapIs}))]: 1, [0 < ((-2 * \text{div}(\textbf{heapIs})))]: 1, [0 < ((-2 * \text{div}(\textbf{heapIs})))]: 1, [0 < ((-2 * \text{div}(\textbf{heapIs}))]: 1, [0 < ((-2 * \text{div}(\textbf{heapIs})))]: 1, [0 < ((-2 * \text{div}(\textbf{heapIs}))]: 1, [0 < ((-2 * \text{div}(\textbf{heapIs})))]: 1, [0 <
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.\text{p1}, 177).\text{quot}) + (171 * \text{div}(\text{heapIs})
\frac{\text{sheap}_{funcstart_{724.1}}, \text{sheap}_{funcstart_{724.1}, p1, 177).rem}}{\text{constart}_{724.1}}
\rightarrow [move guard outside expression]
[1.32] -32768 \leq ([0 < ((-171 * div(heapIs $heap<sub>funcstart_724.1</sub>,
\text{Sheap}_{funcstart\_724.1.pl}, 177).\text{rem} + (2 * \text{div}(\text{heapIs} \text{Sheap}_{funcstart\_724.1},
\frac{\text{sheap}_{funcstart\_724.1.p1, 177.quot}}{1.77.quot}: 1 * 30269, [0 < ((-2 * div(\mathbf{heapIs}))]
\theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}
\label{eq:heap-funcstart_724,1} $ heap_{funcstart\_724,1}.p1,\ 177).rem))]:\ 0\ *\ 30269)
\rightarrow [simplify]
[1.36] -32769 < ([0 < ((-171 * div(\mathbf{heapIs} \$heap_{funcstart\_724.1},
\text{Sheap}_{funcstart\_724.1.p1, 177}.\text{rem}) + (2 * \text{div}(\text{heapIs} \text{Sheap}_{funcstart\_724.1,})
\rho_{funcstart_{-724,1},p1, 177}.quot): 30269, [0 < ((-2 * div(heapIs))]: 30269, [0 < ((-2 * div(heapIs))]
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.\text{p1}, 177).\text{quot}) + (171 * \text{div}(\text{heapIs})
heap_{funcstart_{724,1}}, heap_{funcstart_{724,1},p1, 177}.rem): 0)
\rightarrow [move guard outside expression]
 [1.37] \; ([0 < ((-171 * \operatorname{div}(\mathbf{heapIs} \; \$ \operatorname{heap}_{funcstart\_724,1}, \, \$ \operatorname{heap}_{funcstart\_724,1}.\operatorname{p1}, \,
177).rem) + (2 * \text{div}(\mathbf{heapIs} \$ \text{heap}_{funcstart\_724,1}, \$ \text{heap}_{funcstart\_724,1}.p1,
(177).quot): -32769 < 30269, [0 < ((-2 * div(heapIs $heap_{funcstart\_724.1}, 1.5)])
\text{Sheap}_{funcstart\_724.1.p1}, 177).\text{quot} + (171 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724.1},
\frac{\text{sheap}_{funcstart_{724,1},p1, 177}.rem)}{\text{:} -32769 < 0}
\rightarrow [simplify]
[1.39] ([0 < ((-171 * div(heapIs $heap_{funcstart\_724.1}, $heap_{funcstart\_724.1}.p1,
177).rem) + (2 * \text{div}(\mathbf{heapIs} \$ \text{heap}_{funcstart\_724,1}, \$ \text{heap}_{funcstart\_724,1}.p1,
177).quot))]: true, [0 < ((-2 * div(\mathbf{heapIs} \$heap_{funcstart\_724,1}, 
\text{Sheap}_{funcstart\_724,1}.\text{p1}, 177).\text{quot} + (171 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
heap_{funcstart_{-724,1}.p1, 177).rem}): true
\rightarrow [all guards have equal guarded terms]
[1.40] true
```

```
limit of type 'int'
Condition generated at: C:\Escher\Customers\prang\prang.c (63,25)
Condition defined at:
To prove: (asType<int>($heap_{724,1;744,8}.M1) *
asType<int>(static_cast<integer>(asType<int>($heap_{724.1:744.8}.p1) <
(int)(0)) \le maxof(int)
Given:
heap_{init}.LIMIT == (int)80
heap_{init}.M1 == asType < short int > ((int)30269)
\theta_{init}.r1 == asType < short int > ((int)171)
\theta_{init}.a1 == asType<short int>((int)177)
heap_{init}.M2 == asType < short int > ((int)30307)
\theta_{init}.r2 == asType < short int > ((int)172)
\theta_{init}.a2 == asType<short int>((int)176)
\theta == asType<short int>((int)35)
heap_{init}.M3 == asType < short int > ((int)30323)
heap_{init}.r3 == asType < short int > ((int)170)
heap_{init}.a3 == asType < short int > ((int)178)
\theta = asType < short int > ((int)63)
\theta
\theta
\theta = asType < short int > ((int)3)
invariant1(heapIs $heap_{tuncstart_724.1})
\operatorname{div1} == \operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1},
asType < int > (\$heap_{funcstart\_724,1}.p1),
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{a1}))
(\mathbf{asType}{<}\mathbf{int}{>}(\mathbf{asType}{<}\mathbf{int}{>}(\$\mathbf{heap}_{funcstart\_724,1}.\mathbf{p1})) \ / \\
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a1))) = =
asType<integer>(div1.quot)
(\mathbf{asType} {<} \mathbf{int} {>} (\mathbf{asType} {<} \mathbf{int} {>} (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p1})) \ \%
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a1))) = =
asType<integer>(div1.rem)
!(0 == asType < integer > (div1.rem)) || !(0 ==
```

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

```
asType<integer>(div1.quot))
div2 == div(\mathbf{heapIs} \$heap_{funcstart\_724,1},
asType < int > (\$heap_{funcstart\_724,1}.p2),
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{a2}))
(asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.p2)) /
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a2))) = =
asType<integer>(div2.quot)
(\mathbf{asType} {<} \mathbf{integer} {>} (\mathbf{asType} {<} \mathbf{int} {>} (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p2})) \ \%
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a2))) = =
asType<integer>(div2.rem)
!(0 == asType < integer > (div2.rem)) || !(0 ==
asType<integer>(div2.quot))
div3 == div(\mathbf{heapIs} \$ heap_{funcstart\_724,1},
asType < int > (\$heap_{funcstart\_724,1}.p3),
asType < int > (\$heap_{funcstart\_724,1}.a3))
(asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.p3)) /
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a3))) = =
asType<integer>(div3.quot)
(\mathbf{asType} < \mathbf{integer} > (\mathbf{asType} < \mathbf{int} > (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p3})) \ \%
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a3))) = =
asType<integer>(div3.rem)
!(0 == asType < integer > (div3.rem)) || !(0 ==
asType<integer>(div3.quot))
\text{Sheap}_{724,1;740,8} == \text{Sheap}_{funcstart\_724,1}.\_\mathbf{replace}(\text{p1} \to \mathbf{asType} < \mathbf{short})
int>((asType<int>(asType<short int>(div1.rem)) *
asType < int > (\$heap_{funcstart\_724,1}.r1)) - (asType < int > (asType < short)
int>(div1.quot)) * asType<int>($heap_{funcstart\_724,1}.b1)))
-asType < integer const > (\$heap_{724.1:740.8}.M1) < 
asType<integer>($heap<sub>724,1:740,8</sub>.p1)
!(0 == \mathbf{asType} {<} \mathbf{integer} {>} (\$ \mathrm{heap}_{724,1;740,8}.\mathrm{p1}))
asType<integer>($heap<sub>724.1:740.8</sub>.p1) <
\mathbf{asType} < \mathbf{integer} > (\$ \mathrm{heap}_{724,1;740,8}.\mathrm{M1})
heap_{724,1:742,8} == heap_{724,1:740,8}.replace(p2 \rightarrow asType<short
int>((asType<int>(asType<short int>(div2.rem)) *
asType < int > (\$heap_{724.1:740.8}.r2)) - (asType < int > (asType < short)
int > (div2.quot)) * asType < int > ($heap_{724,1:740.8}.b2))))
-asType<integer const>($heap<sub>724.1:742.8</sub>.M2) <
asType<integer>($heap<sub>724.1:742.8</sub>.p2)
!(0 == asType < integer > (\$heap_{724,1:742,8}.p2))
```

```
{\bf asType}{<} {\bf integer}{>} (\$ {\rm heap}_{724,1;742,8}.{\rm p2}) <
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathrm{heap}_{724,1;742,8}.\mathrm{M2})
heap_{724,1:744,8} == heap_{724,1:742,8}.replace(p3 \rightarrow asType<short
int>((asType<int>(asType<short int>(div3.rem)) *
asType < int > (\$heap_{724.1:742.8}.r3)) - (asType < int > (asType < short)
int>(div3.quot)) * asType< int>($heap_{724,1:742,8}.b3))))
-asType < integer const > (\$heap_{724,1:744,8}.M3) < 
asType<integer>($heap<sub>724,1:744,8</sub>.p3)
!(0 == \mathbf{asType} {<} \mathbf{integer} {>} (\$ \mathrm{heap}_{724,1;744,8}.\mathrm{p3}))
asType<integer>($heap<sub>724.1:744.8</sub>.p3) <
asType<integer>($heap<sub>724.1:744.8</sub>.M3)
Proof:
[Take given term]
[11.0] \operatorname{div1} == \operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724,1},
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p1}),
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{a1}))
\rightarrow [simplify]
[11.1]~{\rm div1} == {\rm div}(\mathbf{heapIs}~\$ \mathrm{heap}_{funcstart\_724,1},~\$ \mathrm{heap}_{funcstart\_724,1}.\mathrm{p1},
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{a1}))
\rightarrow [const static or extern object]
\textit{[11.2]} \ \text{div1} == \text{div}(\mathbf{heapIs} \ \$ \text{heap}_{funcstart\_724,1}, \ \$ \text{heap}_{funcstart\_724,1}.\text{p1},
asType < int > (\$heap_{init}.a1))
\rightarrow [expand definition of constant 'a1' at prang.c (16,20)]
[11.3] \ \mathrm{div1} == \mathrm{div}(\mathbf{heapIs} \ \$ \mathrm{heap}_{funcstart\_724,1}, \ \$ \mathrm{heap}_{funcstart\_724,1}.\mathrm{p1},
asType<int>(asType<short int>((int)177)))
\rightarrow [simplify]
[11.6] \operatorname{div1} == \operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724,1}, \$ \operatorname{heap}_{funcstart\_724,1}.\operatorname{p1}, 177)
[Take given term]
[25.0] div2 == div(heapIs $heap_{funcstart\_724,1},
asType < int > (\$heap_{funcstart\_724,1}.p2),
asType < int > (\$heap_{funcstart\_724,1}.a2))
\rightarrow [simplify]
[25.1] \operatorname{div2} == \operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p2,
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{a2}))
\rightarrow [const static or extern object]
[25.2] \operatorname{div2} == \operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p2,
asType < int > (\$heap_{init}.a2))
```

```
\rightarrow [expand definition of constant 'a2' at prang.c (21,20)]
[25.3] div2 == div(heapIs \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}.p2,
asType<int>(asType<short int>((int)176)))
\rightarrow [simplify]
[25.6] div2 == div(heapIs $heap_{funcstart\_724.1}, $heap_{funcstart\_724.1}.p2, 176)
[Take given term]
[39.0] div3 == div(heapIs $heap_{funcstart\_724,1},
asType < int > (\$heap_{funcstart\_724,1}.p3),
asType < int > (\$heap_{funcstart\_724,1}.a3))
\rightarrow [simplify]
[39.1] \operatorname{div3} == \operatorname{div}(\mathbf{heapIs} \ \operatorname{\$heap}_{funcstart\_724,1}, \ \operatorname{\$heap}_{funcstart\_724,1}.p3,
asType < int > (\$heap_{funcstart\_724,1}.a3))
\rightarrow [const static or extern object]
[39.2] \ \mathrm{div3} == \mathrm{div}(\mathbf{heapIs} \ \$ \mathrm{heap}_{funcstart\_724,1}, \ \$ \mathrm{heap}_{funcstart\_724,1}.\mathrm{p3},
asType < int > (\$heap_{init}.a3))
\rightarrow [expand definition of constant 'a3' at prang.c (26,20)]
[39.3] \ \mathrm{div3} == \mathrm{div}(\mathbf{heapIs} \ \$ \mathrm{heap}_{funcstart\_724,1}, \ \$ \mathrm{heap}_{funcstart\_724,1}.\mathrm{p3},
asType<int>(asType<short int>((int)178)))
\rightarrow [simplify]
[39.6] div3 == div(heapIs heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p3, 178)
[Take given term]
[53.0] \rho_{1740,8} == \rho_{1740,8} == \rho_{1740,8} == \rho_{1740,8} - \rho_{1740,8} == \rho_{1740,8} == \rho_{1740,8} - \rho_{1740,8} == \rho_{1740,8} 
int>((asType<int>(asType<short int>(div1.rem)) *
asType < int > (\$heap_{funcstart\_724,1}.r1)) - (asType < int > (asType < short)
int>(div1.quot)) * asType< int>($heap_{funcstart\_724,1}.b1))))
\rightarrow [from term 11.6, div1 is equal to div(heapIs $heap_{funcstart\_724,1},
heap_{funcstart_{-724,1}}.p1, 177
[53.1] \text{heap}_{724,1;740,8} == \text{heap}_{funcstart\_724,1}._replace(p1 \rightarrow asType<short
int>((asType<int>(asType<short int>(div(heapIs $heap_{funcstart\_724,1},))
\text{Sheap}_{funcstart\_724,1}.\text{p1}, 177).\text{rem}) * asType<int>(\text{Sheap}_{funcstart\_724,1}.\text{r1})) -
(asType<int>(asType<short int>(div1.quot)) *
asType < int > (\$heap_{funcstart\_724.1}.b1))))
\rightarrow [simplify]
[53.3] \rho_{13,1;740,8} == \rho_{13,1;740,8} == \rho_{13,1;740,8} =- \rho_{
int>((div(heapIs \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1, 177).rem *
asType < int > (\$heap_{tuncstart\_724.1}.r1)) - (asType < int > (asType < short)
int>(div1.quot)) * asType< int>($heap_{tuncstart\_724.1}.b1))))
```

```
\rightarrow [const static or extern object]
[53.4] heap_{724,1:740,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow asType<short
int>((div(heapIs \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1, 177).rem *
asType < int > (\$heap_{init}.r1)) - (asType < int > (asType < short)
int>(div1.quot)) * asType<int>($heap_{funcstart\_724,1}.b1)))
\rightarrow [expand definition of constant 'r1' at prang.c (15,20)]
[53.5] heap_{724,1:740.8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow asType<short
int>((div(heapIs \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1, 177).rem *
asType < int > (asType < short int > ((int)171))) -
(asType < int > (asType < short int > (div1.quot)) *
asType < int > (\$heap_{funcstart\_724.1}.b1)))
\rightarrow [simplify]
[53.8] \rho_{13,1;740,8} == \rho_{13,1;740,8} == \rho_{13,1;740,8} =- \rho_{
int>((div(heapIs \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1, 177).rem * 171)
- (asType<int>(asType<short int>(div1.quot)) *
asType < int > (\$heap_{funcstart\_724,1}.b1))))
\rightarrow [from term 11.6, div1 is equal to div(heapIs $heap_{funcstart\_724,1},
heap_{funcstart_{-724,1}}.p1, 177)
[53.9] heap_{724,1;740,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow asType<short
\mathbf{int} > ((171 * \operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724,1}, \$ \operatorname{heap}_{funcstart\_724,1}.\operatorname{p1}, 177).\operatorname{rem})
- (asType<int>(asType<short int>(div(heapIs $heap_{funcstart_724.1},
heap_{funcstart_{724,1},p1, 177}, quot)) *
asType < int > (\$heap_{funcstart\_724.1}.b1)))
\rightarrow [simplify]
[53.11] \theta_{13} = \theta_
int > ((171 * div(heapIs \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1, 177).rem)
- (\text{div}(\mathbf{heapIs} \$ \text{heap}_{funcstart\_724.1}, \$ \text{heap}_{funcstart\_724.1}. \text{p1}, 177).\text{quot} *
asType < int > (\$heap_{funcstart\_724.1}.b1)))
\rightarrow [const static or extern object]
[53.12] \theta_{12} = \theta_{124,1;740,8} = \theta_{124,1;74
int>((171 * div(heapIs $heap_{funcstart\_724,1}, $heap_{funcstart\_724,1}.p1, 177).rem)
- (\text{div}(\mathbf{heapIs} \$ \text{heap}_{funcstart\_724,1}, \$ \text{heap}_{funcstart\_724,1}.\text{p1}, 177).\text{quot} *
asType < int > (\$heap_{init}.b1)))
\rightarrow [expand definition of constant 'b1' at prang.c (17,20)]
[53.13] heap_{724,1;740,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow asType<short
int>((171 * div(heapIs $heap_{funcstart\_724,1}, $heap_{funcstart\_724,1}.p1, 177).rem)
- (\text{div}(\mathbf{heapIs} \$ \text{heap}_{funcstart\_724,1}, \$ \text{heap}_{funcstart\_724,1}.\text{p1}, 177).\text{quot} *
asType<int>(asType<short int>((int)2))))
\rightarrow [simplify]
```

```
[53.19] $heap<sub>724,1;740,8</sub> == $heap<sub>funcstart_724,1</sub>._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).rem)))
[Take given term]
[55.0]!(0 == asType < integer > (\$heap_{724.1:740.8}.p1))
\rightarrow [from term 53.19, $heap<sub>724,1;740,8</sub> is equal to
heap_{funcstart\_724,1}._replace(p1 \rightarrow (-2 * div(heapIs heap_{funcstart\_724,1}),
heap_{funcstart_{724,1},p1, 177}, quot) + (171 * div(heapIs p_{funcstart_{724,1},p1, 177}).
heap_{funcstart_{-724,1}.p1, 177).rem}
[55.1] !(0 == asType<integer>($heap_{funcstart\_724,1}.\_replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724.1}, \ \text{\$heap}_{funcstart\_724.1}.p1, \ 177).quot) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.\operatorname{p1}, \ 177).\operatorname{rem}))).\operatorname{p1}))
\rightarrow [simplify]
[55.3] !(0 == ((-2 * div(heapIs $heap<sub>funcstart_724,1</sub>, $heap<sub>funcstart_724,1</sub>.p1,
177).quot) + (171 * div(heapIs \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}.p1,
177).rem)))
[Take given term]
[57.0] $\text{heap}_{724,1;742,8} == $\text{heap}_{724,1;740,8}._\text{replace}(p2 \to \text{asType} < \text{short}
int>((asType<int>(asType<short int>(div2.rem)) *
asType < int > (\$heap_{724,1;740,8}.r2)) - (asType < int > (asType < short)
int>(div2.quot)) * asType<int>($heap<sub>724.1:740.8</sub>.b2))))
\rightarrow [from term 53.19, $heap<sub>724,1:740,8</sub> is equal to
heap_{funcstart\_724,1}._replace(p1 \rightarrow (-2 * div(heapIs heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1}.p1, 177).quot) + (171 * div(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
heap_{funcstart_{-724,1}.p1, 177).rem}
[57.1] heap_{724,1;742,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).quot) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1,
(177).rem))._replace(p2 \rightarrow asType < short)
int>((asType<int>(asType<short int>(div2.rem)) *
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{724,1;740,8}.\mathrm{r2})) - (\mathbf{asType}{<}\mathbf{int}{>}(\mathbf{asType}{<}\mathbf{short}
int>(div2.quot)) * asType< int>($heap_{724,1:740,8}.b2))))
\rightarrow [from term 25.6, div2 is equal to div(heapIs $heap_{tuncstart_{724.1}},
heap_{funcstart_{724,1}}.p2, 176
[57.2] heap_{724,1;742,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).quot) + (171 *
\operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724,1}, \$ \operatorname{heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow asType<short
int>((asType<int>(asType<short int>(div(heapIs $heap_{funcstart\_724,1},
\text{sheap}_{funcstart\_724,1.p2, 176}.\text{rem}) * asType < int > (\text{sheap}_{724,1:740,8}.\text{r2})) -
(asType<int>(asType<short int>(div2.quot)) *
```

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asType<int>($heap<sub>724.1:740.8</sub>.b2))))
\rightarrow [simplify]
[57.4] heap_{724,1;742,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).quot) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.p1,
177).rem)))._{\mathbf{replace}}(p2 \rightarrow \mathbf{asType} < \mathbf{short\ int} > ((\operatorname{div}(\mathbf{heapIs}))))
\text{Sheap}_{funcstart_{-724,1}}, \text{Sheap}_{funcstart_{-724,1}}.p2, 176).rem *
\mathbf{asType} < \mathbf{int} > (\$ \mathrm{heap}_{724,1;740,8}.\mathrm{r2})) - (\mathbf{asType} < \mathbf{int} > (\mathbf{asType} < \mathbf{short}))
int>(div2.quot)) * asType<int>($heap<sub>724.1:740.8</sub>.b2))))
\rightarrow [from term 53.19, $heap<sub>724,1;740,8</sub> is equal to
heap_{funcstart\_724,1}._replace(p1 \rightarrow (-2 * div(heapIs heap_{funcstart\_724,1}),
heap_{funcstart\_724,1}.p1, 177).quot + (171 * div(heapIs $heap_{funcstart\_724,1},
heap_{funcstart_{724,1}.p1, 177).rem}
[57.5] heap_{724,1;742,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}. \operatorname{p1}, \ 177).\operatorname{quot}) + (171 \ *
\operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724,1}, \$ \operatorname{heap}_{funcstart\_724,1}.p1,
177).rem))).\_\mathbf{replace}(p2 \to \mathbf{asType} < \mathbf{short\ int} > ((div(\mathbf{heapIs}))))
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.\text{p2}, 176).\text{rem} *
asType < int > (\$heap_{funcstart\_724,1}.\_replace(p1 \rightarrow ((-2 * div(heapIs))))))
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.\text{p1}, 177).\text{quot}) + (171 * \text{div}(\text{heapIs}))
\text{Sheap}_{funcstart_{-724,1}}, \text{Sheap}_{funcstart_{-724,1},p1, 177).rem})).r2)) -
(asType<int>(asType<short int>(div2.quot)) *
asType < int > (\$heap_{724.1:740.8}.b2))))
\rightarrow [const member of object with modified fields]
[57.6] heap_{724,1;742,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 \ *
\operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724,1}, \$ \operatorname{heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow asType<short int>((div(heapIs
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.p2, 176).rem *
asType < int > (\$heap_{funcstart\_724,1}.r2)) - (asType < int > (asType < short)
int>(div2.quot)) * asType<int>($heap<sub>724.1:740.8</sub>.b2))))
\rightarrow [const static or extern object]
[57.7] heap_{724,1;742,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 \ *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.p1,
177).rem)))._{\mathbf{replace}}(p2 \rightarrow \mathbf{asType} < \mathbf{short\ int} > ((\operatorname{div}(\mathbf{heapIs}))))
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.p2, 176).rem *
asType < int > (\$heap_{init}.r2)) - (asType < int > (asType < short)
int>(div2.quot)) * asType< int>($heap_{724.1:740.8}.b2))))
\rightarrow [expand definition of constant 'r2' at prang.c (20.20)]
[57.8] heap_{724,1;742,8} == heap_{funcstart\_724,1}.\_replace(p1 \to ((-2 *
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\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).quot) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow asType<short int>((div(heapIs
\theta_{funcstart_{724,1}}, \theta_{funcstart_{724,1}}, \theta_{funcstart_{724,1}}.p2, 176).rem *
asType<int>(asType<short int>((int)172))) -
(asType<int>(asType<short int>(div2.quot)) *
asType<int>($heap<sub>724.1:740.8</sub>.b2))))
\rightarrow [simplify]
[57.11] $\text{heap}_{724,1;742,8} == \text{$heap}_{funcstart_724,1}._\text{$replace}(p1 \to ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).quot) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.p1,
(177).rem))._replace(p2 \rightarrow asType<short int>((div(heapIs
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.p2, 176).rem * 172) -
(asType<int>(asType<short int>(div2.quot)) *
\mathbf{asType}{<}\mathbf{int}{>}(\${\rm heap}_{724,1;740,8}.{\rm b2}))))
\rightarrow [from term 25.6, div2 is equal to div(heapIs $heap_{tuncstart_724.1},
heap_{funcstart_{-724,1}}.p2, 176)
[57.12] $heap<sub>724,1;742,8</sub> == $heap<sub>funcstart_724,1</sub>._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}. p1, \ 177). \operatorname{quot}) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow asType<short int>((172 * div(heapIs
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.\text{p2}, 176).\text{rem}) -
(asType<int>(asType<short int>(div(heapIs $heap_{funcstart\_724,1},))
\text{Sheap}_{funcstart\_724,1}.\text{p2}, 176).\text{quot}) * asType<int>(\text{Sheap}_{724,1;740,8}.\text{b2}))))
\rightarrow [simplify]
[57.14] heap_{724,1;742,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 *
\operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724,1}, \$ \operatorname{heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow asType<short int>((172 * div(heapIs
\theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}.p2, 176).rem) - (div(heapIs
\theta_{funcstart_{724,1}}, \theta_{funcstart_{724,1}}, \theta_{funcstart_{724,1}}, \theta_{funcstart_{724,1}}
asType<int>($heap<sub>724,1:740,8</sub>.b2))))
\rightarrow [from term 53.19, $heap<sub>724,1:740,8</sub> is equal to
$heap_{funcstart\_724,1}$.$replace(p1 \rightarrow (-2 * div(heapIs $heap_{funcstart\_724,1},
heap_{funcstart\_724,1}.p1, 177).quot + (171 * div(heapIs $heap_{funcstart\_724,1},
$heap_{funcstart\_724,1}.p1, 177).rem))]
[57.15] $\text{heap}_{724,1;742,8} == \text{$heap}_{funcstart\_724,1}._\text{$replace}(p1 \to ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow asType<short int>((172 * div(heapIs
\theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}.p2, 176).rem) - (div(heapIs
heap_{funcstart_{724,1}}, heap_{funcstart_{724,1}}, 2, 176).quot *
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asType < int > (\$heap_{funcstart\_724,1}.\_replace(p1 \rightarrow ((-2 * div(heapIs))))))
\$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1, 177).quot) + (171 * div(\textbf{heapIs}) + (171 * div(\textbf{heapIs})) + (171
\$ heap_{funcstart\_724,1}, \$ heap_{funcstart\_724,1}.p1, 177).rem))).b2))))
→ [const member of object with modified fields]
[57.16] $\text{heap}_{724,1;742,8} == \text{$heap}_{funcstart\_724,1}._\text{$replace}(p1 \to ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow asType<short int>((172 * div(heapIs
\theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}
heap_{funcstart_{724,1}}, heap_{funcstart_{724,1}}, 176).quot *
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{b2}))))
\rightarrow [const static or extern object]
[57.17] $heap<sub>724,1;742,8</sub> == $heap<sub>funcstart_724,1</sub>._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 *
\operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724,1}, \$ \operatorname{heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow asType<short int>((172 * div(heapIs
heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p2, 176).rem) - (div(heapIs
heap_{funcstart_{724,1}}, heap_{funcstart_{724,1}}, 2, 176).quot *
asType < int > (\$heap_{init}.b2)))
\rightarrow [expand definition of constant 'b2' at prang.c (22,20)]
[57.18] $\text{heap}_{724,1;742,8} == \text{$heap}_{funcstart\_724,1}._\text{$replace}(p1 \to ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow asType<short int>((172 * div(heapIs
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.\text{p2}, 176).\text{rem}) - (\text{div}(\text{heapIs})
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.p2, 176).quot^*
asType<int>(asType<short int>((int)35)))))
\rightarrow [simplify]
[57.24] $heap<sub>724,1;742,8</sub> == $heap<sub>funcstart_724,1</sub>._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).quot) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow ((-35 * div(heapIs $heap_{funcstart_{-724,1}},
\text{Sheap}_{funcstart\_724.1.p2}, 176).\text{quot} + (172 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724.1},
heap_{funcstart_{724,1}}.p2, 176).rem)
[Take given term]
[61.0] $heap<sub>724,1;744,8</sub> == $heap<sub>724,1;742,8</sub>._replace(p3 \rightarrow asType<short
int>((asType<int>(asType<short int>(div3.rem)) *
asType < int > (\$heap_{724,1;742,8}.r3)) - (asType < int > (asType < short)
int>(div3.quot)) * asType< int>($heap_{724.1:742.8}.b3))))
\rightarrow [from term 57.24, $heap<sub>724.1:742.8</sub> is equal to
heap_{funcstart\_724,1}.replace(p1 \rightarrow ((-2 * div(heapIs $heap_{funcstart\_724,1},
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\text{Sheap}_{funcstart_{-724,1},p1, 177}.\text{quot}) + (171 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart_{-724,1}})
\rho_{uncstart_{-724,1}.p1, 177).rem})._replace\rho_{uncstart_{-724,1}.p1, 177).rem}._replace
heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p2, 176).quot) + (172 * div(heapIs)
heap_{funcstart_{724,1}}, heap_{funcstart_{724,1}}, 2, 176).rem
[61.1] heap_{724,1;744,8} == heap_{funcstart\_724,1}.\_replace(p1 \to ((-2 * 
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}. p1, \ 177). \operatorname{quot}) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow ((-35 * div(heapIs $heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1.p2}, 176).\text{quot} + (172 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
\theta_{uncstart_724.1.p2, 176}.rem)._replace(p3 \rightarrow asType<short
int>((asType<int>(asType<short int>(div3.rem)) *
\mathbf{asType} < \mathbf{int} > (\$ \mathrm{heap}_{724,1;742.8}.\mathrm{r3})) - (\mathbf{asType} < \mathbf{int} > (\mathbf{asType} < \mathbf{short}))
int>(div3.quot)) * asType< int>($heap_{724.1:742.8}.b3))))
\rightarrow [from term 39.6, div3 is equal to div(heapIs $heap_{funcstart_{724,1}},
heap_{funcstart_{-724,1}}.p3, 178
[61.2] \theta == 
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 \ *
\operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724.1}, \$ \operatorname{heap}_{funcstart\_724.1}.p1,
177).rem)))._replace(p2 \rightarrow ((-35 * div(heapIs $heap_{funcstart\_724,1},
\rho_{funcstart_{724,1},p2, 176} = (172 * div(heapIs $heap_{funcstart_{724,1}}, 176).
\rho_{funcstart\_724,1.p2, 176}.rem))._replace(p3 \rightarrow asType<short
int>((asType<int>(asType<short int>(div(heapIs $heap_{tuncstart_724,1},))
\text{sheap}_{funcstart\_724,1.p3}, 178).rem) * asType < int > (\text{sheap}_{724,1;742,8.r3})) -
(asType<int>(asType<short int>(div3.quot)) *
asType < int > (\$heap_{724,1;742,8}.b3))))
\rightarrow [simplify]
[61.4] $heap<sub>724,1:744,8</sub> == $heap<sub>funcstart_724,1</sub>._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 *
\label{eq:div_heap} \text{div}(\textbf{heapIs} \ \$ \text{heap}_{funcstart\_724,1}, \ \$ \text{heap}_{funcstart\_724,1}.\text{p1},
177).rem)))._replace(p2 \rightarrow ((-35 * div(heapIs $heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1.p2}, 176).\text{quot} + (172 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
\theta_{funcstart\_724,1}.p2, 176).rem))._replace(p3 \rightarrow asType<short
int>((div(heapIs \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p3, 178).rem *
asType < int > (\$heap_{724,1;742,8}.r3)) - (asType < int > (asType < short)
int > (div3.quot)) * asType < int > (\$heap_{724,1;742,8}.b3))))
\rightarrow [from term 57.24, $heap<sub>724.1:742.8</sub> is equal to
heap_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 * div(heapIs heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1}.\text{p1}, 177).\text{quot} + (171 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
\rho_{funcstart\_724,1}.p1, 177).rem))._replace(\rho_{funcstart\_724,1}.p1, 177).rem))
heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p2, 176).quot) + (172 * div(heapIs)
heap_{funcstart_{724,1}}, heap_{funcstart_{724,1}}, p2, 176).rem)
div(\mathbf{heapIs} \ \$heap_{funcstart\_724,1}, \ \$heap_{funcstart\_724,1}.p1, \ 177).quot) + (171 *
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\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow ((-35 * div(heapIs $heap_{funcstart\_724,1},
\rho_{funcstart\_724,1.p2}, 176).quot) + (172 * div(heapIs \rho_{funcstart\_724,1},
\theta_{funcstart\_724,1}.p2, 176).rem))._replace(p3 \rightarrow asType<short
int>((div(heapIs \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p3, 178).rem *
asType < int > (\$heap_{funcstart\_724,1}.\_replace(p1 \rightarrow ((-2 * div(heapIs)))))))
\theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}
\rho_{funcstart\_724,1}, \rho_{funcstart\_724,1}
* div(heapIs heap_{funcstart_{724,1}}, heap_{funcstart_{724,1}}, 176).quot) + (172 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p2, 176).rem))).r3)) -
(asType<int>(asType<short int>(div3.quot)) *
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{724,1;742,8}.\mathrm{b3}))))
→ [const member of object with modified fields]
[61.7] heap_{724,1;744,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 \ *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow ((-35 * div(heapIs $heap_{funcstart\_724,1},
\text{Sheap}_{funcstart_724,1}.\text{p2}, 176).\text{quot} + (172 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart_724,1},
\rho_{uncstart_724,1,p2,176,rem})._replace(p3 \rightarrow asType<short
int>((div(heapIs \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p3, 178).rem *
asType < int > (\$heap_{funcstart\_724.1}.r3)) - (asType < int > (asType < short)
int>(div3.quot)) * asType< int>($heap_{724.1:742.8}.b3))))
\rightarrow [const static or extern object]
[61.8] heap_{724,1;744,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).quot) + (171 *
\operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724,1}, \$ \operatorname{heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow ((-35 * div(heapIs $heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1}.\text{p2}, 176).\text{quot} + (172 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
\theta_{funcstart\_724,1.p2, 176}.rem))._replace(p3 \rightarrow asType<short
int>((div(heapIs \$heap_{funcstart\_724.1}, \$heap_{funcstart\_724.1}.p3, 178).rem *
asType < int > (\$heap_{init}.r3)) - (asType < int > (asType < short)
int > (div3.quot)) * asType < int > ($heap_{724,1;742,8}.b3))))
\rightarrow [expand definition of constant 'r3' at prang.c (25,20)]
[61.9] heap_{724,1:744,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).quot) + (171 *
\operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724.1}, \$ \operatorname{heap}_{funcstart\_724.1}.p1,
177).rem)))._replace(p2 \rightarrow ((-35 * div(heapIs $heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1}.\text{p2}, 176).\text{quot} + (172 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
\theta_{funcstart\_724,1}.p2, 176).rem))._replace(p3 \rightarrow asType<short
int>((div(heapIs \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p3, 178).rem *
asType<int>(asType<short int>((int)170))) -
(asType<int>(asType<short int>(div3.quot)) *
\mathbf{asType}{<}\mathbf{int}{>}(\${\rm heap}_{724,1;742,8}.{\rm b3}))))
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\rightarrow [simplify]
[61.12] $heap<sub>724,1;744,8</sub> == $heap<sub>funcstart_724,1</sub>._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).quot) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow ((-35 * div(heapIs $heap_{tuncstart_724.1},
\text{Sheap}_{funcstart\_724,1}.\text{p2}, 176).\text{quot} + (172 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
\theta_{funcstart\_724,1.p2, 176}.rem))._replace(p3 \rightarrow asType<short
int>((div(heapIs \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p3, 178).rem * 170)
- (asType<int>(asType<short int>(div3.quot)) *
asType<int>($heap<sub>724.1:742.8</sub>.b3))))
\rightarrow [from term 39.6, div3 is equal to div(heapIs $heap_{funcstart\_724,1},
heap_{funcstart_{-724,1}}.p3, 178
[61.13] heap_{724,1;744,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 *
div(\mathbf{heapIs} \ \$heap_{funcstart\_724.1}, \ \$heap_{funcstart\_724.1}.p1, \ 177).quot) + (171 *
\operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724.1}, \$ \operatorname{heap}_{funcstart\_724.1}.p1,
177).rem)))._replace(p2 \rightarrow ((-35 * div(heapIs $heap_{funcstart\_724,1},
\theta_{funcstart\_724,1.p2}, 176).quot) + (172 * div(heapIs \theta_{funcstart\_724,1},
\rho_{tuncstart=724.1.p2, 176}.rem)._replace(p3 \rightarrow asType<short int>((170
* div(heapIs heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p3, 178).rem) -
(asType<int>(asType<short int>(div(heapIs $heap_{funcstart\_724,1},))
\text{sheap}_{funcstart\_724,1}.\text{p3}, 178).\text{quot}) * asType<int>(\text{sheap}_{724,1;742,8}.\text{b3}))))
\rightarrow [simplify]
[61.15] $\text{heap}_{724,1;744,8} == \text{$heap}_{funcstart\_724,1}._\text{$replace}(p1 \to ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).quot) + (171 *
\operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724,1}, \$ \operatorname{heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow ((-35 * div(heapIs $heap_{funcstart_724,1},
\text{Sheap}_{funcstart\_724,1.p2}, 176).\text{quot} + (172 * \text{div}(\text{heapIs} \text{Sheap}_{funcstart\_724,1},
\rho_{funcstart\_724,1}.p2, 176).rem))._replace(p3 \rightarrow asType<short int>((170)
* \operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p3, \ 178).rem) -
(div(heapIs \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1.p3}, 178).quot *
asType < int > (\$heap_{724,1;742,8}.b3)))
\rightarrow [from term 57.24, $heap<sub>724.1:742.8</sub> is equal to
heap_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 * div(heapIs *heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1}.\text{p1}, 177).\text{quot} + (171 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
heap_{funcstart\_724,1}.p1, 177).rem))._replace(p2 \rightarrow (-35 * div(heapIs)))._
heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p2, 176).quot) + (172 * div(heapIs)
heap_{funcstart_{724,1}}, heap_{funcstart_{724,1}}, 2, 176).rem
[61.16] $heap<sub>724,1;744,8</sub> == $heap<sub>funcstart_724,1</sub>._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 *
\operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724,1}, \$ \operatorname{heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow ((-35 * div(heapIs $heap_{funcstart_724.1},
\text{Sheap}_{funcstart\_724,1}.\text{p2}, 176).\text{quot} + (172 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
\rho_{uncstart\_724,1.p2, 176}.rem))._replace(p3 \rightarrow asType<short int>((170
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* div(heapIs heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p3, 178).rem) –
(\text{div}(\mathbf{heapIs} \$ \text{heap}_{funcstart\_724,1}, \$ \text{heap}_{funcstart\_724,1}.\text{p3}, 178).\text{quot} *
asType < int > (\$heap_{funcstart\_724,1}.\_replace(p1 \rightarrow ((-2 * div(heapIs))))))
\theta_{funcstart_{724,1}}, \theta_{funcstart_{724,1},p1, 177}.quot) + (171 * div(heapIs)
\rho_{funcstart\_724,1}, \rho_{funcstart\_724,1}, \rho_{funcstart\_724,1}, \rho_{funcstart\_724,1}, \rho_{funcstart\_724,1}, \rho_{funcstart\_724,1}, \rho_{funcstart\_724,1}
* div(heapIs heap_{funcstart_{724,1}}, heap_{funcstart_{724,1}}, 176).quot) + (172 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p2, 176).rem))).b3))))
\rightarrow [const member of object with modified fields]
[61.18] $\text{heap}_{724,1:744,8} == $\text{heap}_{funcstart\_724,1}._\text{replace}(p1 \to ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 *
\operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724,1}, \$ \operatorname{heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow ((-35 * div(heapIs $heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1.p2}, 176).\text{quot} + (172 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
\rho_{funcstart_{-724,1},p2,176,rem})._replace(p3 \rightarrow asType<short int>((170
* \operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p3, \ 178).rem) -
(\text{div}(\mathbf{heapIs} \$ \text{heap}_{funcstart\_724,1}, \$ \text{heap}_{funcstart\_724,1}.\text{p3}, 178).\text{quot} *
asType < int > (\$heap_{funcstart\_724,1}.b3))))
\rightarrow [const static or extern object]
[61.19] $\text{heap}_{724,1:744,8} == $\text{heap}_{funcstart\_724,1}._\text{replace}(p1 \to ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).quot) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow ((-35 * div(heapIs $heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724.1.p2}, 176).\text{quot} + (172 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724.1},
\rho_{tuncstart_{724,1},p2,176,rem})._replace(p3 \rightarrow asType<short int>((170
* div(heapIs heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p3, 178).rem) –
(\text{div}(\mathbf{heapIs} \$ \text{heap}_{funcstart\_724,1}, \$ \text{heap}_{funcstart\_724,1}.\text{p3}, 178).\text{quot} *
asType < int > (\$heap_{init}.b3)))
\rightarrow [expand definition of constant 'b3' at prang.c (27,20)]
[61.20] $heap<sub>724,1;744,8</sub> == $heap<sub>funcstart_724,1</sub>._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow ((-35 * div(heapIs $heap_{tuncstart_724.1},
\text{Sheap}_{funcstart\_724.1.p2}, 176).\text{quot} + (172 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724.1},
\rho_{uncstart\_724,1.p2, 176).rem}))._replace(p3 \rightarrow asType<short int>((170
* div(heapIs heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p3, 178).rem) –
(\text{div}(\mathbf{heapIs} \$ \text{heap}_{funcstart\_724.1}, \$ \text{heap}_{funcstart\_724.1}. \text{p3}, 178).\text{quot} *
asType<int>(asType<short int>((int)63)))))
\rightarrow [simplify]
[61.26] $heap<sub>724,1;744,8</sub> == $heap<sub>funcstart_724,1</sub>._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).quot) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}. \operatorname{pl},
177).rem)))._replace(p2 \rightarrow ((-35 * div(heapIs $heap_{funcstart\_724,1},
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\text{Sheap}_{funcstart_{-724,1},p2, 176}.quot) + (172 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart_{-724,1}},
\theta_{funcstart\_724,1}.p2, 176).rem))).\_replace(p3 \rightarrow ((-63 * div(heapIs)))._replace(p3 \rightarrow ((-63 * div(heapIs))))._replace(p3 \rightarrow ((-63 * div(heapIs))))._replace(p3 \rightarrow ((-63 * div(heapIs)))))._replace(p3 \rightarrow ((-63 * div(heapIs)))))._replace(p3 \rightarrow ((-63 * div(heapIs)))))._replace(p3 \rightarrow ((-63 * div(heapIs)))))
\theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}
heap_{funcstart_{-724,1}}, heap_{funcstart_{-724,1}}, 178).rem)
[Take goal term]
[1.0] (asType<int>($heap<sub>724.1:744.8</sub>.M1) *
asType<int>(static_cast<integer>(asType<int>($heap<sub>724.1:744.8</sub>.p1) <
(int)(0)) \le maxof(int)
\rightarrow [from term 61.26, heap_{724,1;744,8} is equal to
heap_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 * div(heapIs $heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724.1}.p1, 177).quot) + (171 * div(\text{heapIs } \text{Sheap}_{funcstart\_724.1},
\rho_{uncstart\_724,1}.p1, 177).rem))).\_replace(p2 \rightarrow ((-35 * div(heapIs))).\_replace(p2 \rightarrow ((-35 * div(heapIs)))).\_replace(p2 \rightarrow ((-35 * div(heapIs)))))
heap_{funcstart\_724.1}, heap_{funcstart\_724.1}.p2, 176).quot) + (172 * div(heapIs)
heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p2, 176).rem)))._replace(p3 \rightarrow (-63 *
div(\mathbf{heapIs} \ \$heap_{funcstart\_724,1}, \ \$heap_{funcstart\_724,1}.p3, \ 178).quot) + (170 *
div(\mathbf{heapIs} \ \$heap_{funcstart\_724,1}, \ \$heap_{funcstart\_724,1}.p3, \ 178).rem))]
[1.1] (asType<int>($heap_{funcstart\_724,1}.\_replace(p1 \rightarrow ((-2 * div(heapIs
\theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}.p1, 177).quot) + (171 * div(heapIs
\rho_{funcstart\_724,1}, \rho_{funcstart\_724,1}, \rho_{funcstart\_724,1}, \rho_{funcstart\_724,1}, \rho_{funcstart\_724,1}, \rho_{funcstart\_724,1}, \rho_{funcstart\_724,1}
* div(heapIs heap_{funcstart_{724,1}}, heap_{funcstart_{724,1}}, 176).quot) + (172 *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.p2,
176).rem)))._replace(p3 \rightarrow ((-63 * div(heapIs $heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724.1.p3}, 178).\text{quot} + (170 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724.1},
heap_{funcstart_{724,1}.p3, 178.rem})).M1) *
asType<int>(static_cast<integer>(asType<int>($heap_{724.1:744.8}.p1) <
(int)(0)) \le maxof(int)
\rightarrow [const member of object with modified fields]
[1.4] (asType<int>(\ensuremath{\text{sheap}}_{funcstart\_724,1}.M1) *
asType<int>(static_cast<integer>(asType<int>($heap<sub>724.1:744.8</sub>.p1) <
(int)(0)) \le maxof(int)
\rightarrow [const static or extern object]
[1.5] (asType<int>($heap_{init}.M1) *
asType<int>(static_cast<integer>(asType<int>($heap_{724.1:744.8}.p1) <
(int)(0)) < maxof(int)
\rightarrow [expand definition of constant 'M1' at prang.c (14,20)]
[1.6] (asType<int>(asType<short int>((int)30269)) *
asType<int>(static_cast<integer>(asType<int>($heap<sub>724,1:744.8</sub>.p1) <
(int)(0)) \le maxof(int)
\rightarrow [simplify]
[1.9] (30269 *
asType<int>(static_cast<integer>(asType<int>($heap_{724,1:744,8}.p1) <
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(int)(0)) < maxof(int)
\rightarrow [from term 61.26, $heap<sub>724.1:744.8</sub> is equal to
heap_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 * div(heapIs $heap_{funcstart\_724,1},
heap_{funcstart_{724,1},p1,177}, quot) + (171 * div(heapIs p_{funcstart_{724,1},p1,177}).
\rho_{funcstart\_724.1}.p1, 177).rem))._replace\rho_{funcstart\_724.1}.p1, 177).rem))
heap_{funcstart\_724,1}, heap_{funcstart\_724,1}. p2, p2, p3, p4, p2, p3, p4, 
heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p2, 176).rem)))._replace(p3 \rightarrow (-63 *
div(\mathbf{heapIs} \ \$heap_{funcstart\_724,1}, \ \$heap_{funcstart\_724,1}.p3, \ 178).quot) + (170 *
\operatorname{div}(\mathbf{heapIs} \ \$heap_{funcstart\_724,1}, \ \$heap_{funcstart\_724,1}.p3, \ 178).rem))]
[1.10] (30269 *
\mathbf{asType} < \mathbf{int} > (\mathbf{static\_cast} < \mathbf{integer} > (\mathbf{asType} < \mathbf{int} > (\$ \mathbf{heap}_{funcstart\_724,1}. \mathbf{\_replace} (\mathbf{p1})) + (\$ \mathbf{heap
\rightarrow ((-2 * div(heapIs $heap_{funcstart\_724,1}, $heap_{funcstart\_724,1}.p1, 177).quot) +
(171 * div(heapIs heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow ((-35 * div(heapIs $heap_{funcstart_724,1},
\text{Sheap}_{funcstart\_724,1}.\text{p2}, 176).\text{quot} + (172 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
\rho_{funcstart\_724,1.p2, 176}.rem)._replace(p3 \rightarrow ((-63 * div(heapIs
\theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}.p3, 178).quot) + (170 * div(heapIs
\text{Sheap}_{funcstart\_724.1}, \text{Sheap}_{funcstart\_724.1}.p3, 178).rem))).p1) < (int)0))) \le
maxof(int)
\rightarrow [simplify]
[1.22] (30269 * asType<int>(([0 < ((-171 * div(heapIs heapIs funcstart_{-724,1},
heap_{funcstart\_724,1}.p1, 177).rem + (2 * div(heapIs $heap_{funcstart\_724,1}, 177).rem) + (2 * div(heapIs $heap_{funcstart\_724,1}, 177)
\text{Sheap}_{funcstart_{724,1},p1, 177,quot}): 1, []: 0))) \leq \text{maxof}(\text{int})
→ [explicitly assert falsehood of skipped guards in subsequent guards]
[1.23] (30269 * asType<int>(([0 < ((-171 * div(heapIs $heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1}.\text{p1}, 177).\text{rem} + (2 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1.p1, 177}.\text{quot}): 1, [!(0 < ((-171 * div(heapIs
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.\text{p1}, 177).\text{rem}) + (2 * \text{div}(\text{heapIs}))
\{\text{heap}_{funcstart\_724,1}, \{\text{heap}_{funcstart\_724,1}.p1, 177).quot\}\}\} : 0))) \le \max(\text{int})
\rightarrow [simplify]
[1.28] (30269 * asType<int>(([0 < ((-171 * div(heapIs $heap_{tuncstart\_724,1}, 
\text{Sheap}_{funcstart\_724,1}.\text{p1}, 177).\text{rem} + (2 * \text{div}(\text{heapIs} \text{Sheap}_{funcstart\_724,1},
heap_{funcstart\_724.1.p1, 177}.quot): 1, [-1 < ((171 * div(heapIs))
\theta_{funcstart_{724.1}}, \theta_{funcstart_{724.1}}, \theta_{funcstart_{724.1}}, \theta_{funcstart_{724.1}}, \theta_{funcstart_{724.1}}
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.p1, 177).quot))]: 0))) \leq \max(\text{int})
\rightarrow [from term 55.3, -1 < ((-2 * div(heapIs $heap_{funcstart\_724,1},
heap_{funcstart\_724,1}.p1, 177).quot + (171 * div(heapIs $heap_{funcstart\_724,1}, 177).quot) + (171 * div(heapIs $heap_{funcstart\_724,1}, 17
$heap<sub>funcstart_724,1</sub>.p1, 177).rem)) is true if and only if 0 < ((-2 * div(\mathbf{heapIs})))
heap_{funcstart\ 724.1}, heap_{funcstart\ 724.1}, p_{funcstart\ 724.1}, p_{funcstart\ 724.1}, p_{funcstart\ 724.1}
heap_{funcstart_{-724,1}}, heap_{funcstart_{-724,1},p1, 177}.rem)
[1.29] (30269 * asType<int>(([0 < ((-171 * div(heapIs $heap<sub>funcstart_724,1</sub>,
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\text{Sheap}_{funcstart\_724.1.p1, 177}.\text{rem}) + (2 * \text{div}(\text{heapIs} \text{Sheap}_{funcstart\_724.1,})
heap_{funcstart_{-724,1}}, p_1, p_1, p_2, p_3 ((-2 * div(heapIs
\$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1, 177).quot) + (171 * div(\textbf{heapIs}) + (171 * div(\textbf{heapIs})) + (171
\{\text{heap}_{funcstart\_724,1}, \{\text{heap}_{funcstart\_724,1}.p1, 177\}.rem\}\} : 0\} \le \max(\text{int})
\rightarrow [simplify]
[1.30] (30269 * ([0 < ((-171 * div(heapIs $heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1}.\text{p1}, 177).\text{rem} + (2 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1.p1}, 177).\text{quot}): 1, [0 < ((-2 * \text{div}(\textbf{heapIs})))]: 1, [0 < ((-2 * \text{div}(\textbf{heapIs})))]:
\theta_{funcstart_{724,1}}, \theta_{funcstart_{724,1},p1, 177}.quot + (171 * div(heapIs))
\{\text{heap}_{funcstart\_724,1}, \{\text{heap}_{funcstart\_724,1}.p1, 177\}.rem)\}: 0)) \leq \max(\text{int})
\rightarrow [move guard outside expression]
 \label{eq:continuous} $$[1.31]$ ([0 < ((-171 * div(\mathbf{heapIs} \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1,
177).rem) + (2 * \text{div}(\mathbf{heapIs} \$ \text{heap}_{funcstart\_724,1}, \$ \text{heap}_{funcstart\_724,1}.\text{p1},
177).quot))]: 1 * 30269, [0 < ((-2 * div(\mathbf{heapIs} \$heap_{funcstart\_724,1}, 
\text{Sheap}_{funcstart\_724,1}.\text{p1}, 177).\text{quot} + (171 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
\{\text{heap}_{funcstart\_724,1}.\text{p1}, 177\}.\text{rem}\}: 0 * 30269 \le \text{maxof(int)}
\rightarrow [simplify]
[1.35] (-1 + ([0 < ((-171 * div(heapIs $heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1}.\text{p1}, 177).\text{rem} + (2 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
heap_{funcstart\_724,1}.p1, 177).quot): 30269, [0 < ((-2 * div(heapIs))]: 30269, [0 < ((-2 * div(heapIs))]:
\text{Sheap}_{funcstart\ 724.1}, \text{Sheap}_{funcstart\ 724.1}, \text{p1}, 177).\text{quot}) + (171 * \text{div}(\text{heapIs})
\{\text{heap}_{funcstart\_724,1}, \{\text{heap}_{funcstart\_724,1}.p1, 177\}.rem\}\}: 0)) < 32767
\rightarrow [move guard outside expression]
\label{eq:continuous} \textit{[1.36]} \; ([0 < ((-171 \; * \; \mathrm{div}(\mathbf{heapIs} \; \$ \mathrm{heap}_{funcstart\_724,1}, \; \$ \mathrm{heap}_{funcstart\_724,1}.\mathrm{p1}, \;
177).rem) + (2 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_724,1}, \text{\$heap}_{funcstart\_724,1}.p1,
177).quot))]: -1 + 30269, [0 < ((-2 * div(\mathbf{heapIs} \$heap_{funcstart\_724,1}, 
\text{Sheap}_{funcstart\_724,1.p1}, 177).\text{quot} + (171 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
\frac{\text{heap}_{funcstart\_724,1.p1, 177}.rem)}{\text{rem}} : -1 + 0) < 32767
\rightarrow [simplify]
[1.39] \ 0 < (32767 + -([0 < ((-171 * div(heapIs $heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1}.\text{p1}, 177).\text{rem} + (2 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
\frac{\text{heap}_{funcstart\_724,1.p1, 177}.\text{quot}}{1}: 30268, [0 < ((-2 * \text{div}(\textbf{heapIs})))]:
\theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}
\rightarrow [move guard outside expression]
[1.40] 0 < (32767 + ([0 < ((-171 * div(heapIs $heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1}.\text{p1}, 177).\text{rem} + (2 * \text{div}(\text{heapIs} \text{Sheap}_{funcstart\_724,1},
\frac{\text{heap}_{funcstart\_724,1.p1, 177}.\text{quot}}{\text{loc}}: -30268, [0 < ((-2 * \text{div}(\text{heapIs})))]
\theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}.p1, 177).quot) + (171 * div(heapIs
heap_{funcstart_{-724,1}}, heap_{funcstart_{-724,1}}, 177).rem): --1))
```

```
\rightarrow [simplify]
[1.42] \ 0 < (32767 + ([0 < ((-171 * div(heapIs $heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1}.\text{p1}, 177).\text{rem} + (2 * \text{div}(\text{heapIs} \text{Sheap}_{funcstart\_724,1},
\rho_{uncstart_{-724,1},p1,177,quot}: -30268, \rho_{uncstart_{-724,1},p1,177,quot}: -30268, \rho_{uncstart_{-724,1},p1,177,quot}:
\theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.p1, 177).rem): 1))
\rightarrow [move guard outside expression]
[1.43] 0 < ([0 < ((-171 * div(heapIs $heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1}.\text{p1}, 177).\text{rem} + (2 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1.p1}, 177).\text{quot}): -30268 + 32767, [0 < ((-2 * \text{div}(\textbf{heapIs})))]: -30268 + 32767, [0 < ((-2 * \text{div}(\textbf{heapIs})))]: -30268 + 32767, [0 < ((-2 * \text{div}(\textbf{heapIs})))]:
\theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}.p1, 177).quot) + (171 * div(heapIs
\frac{\text{heap}_{funcstart\_724,1}, \text{heap}_{funcstart\_724,1.p1, 177}.rem)}{1 + 32767}
\rightarrow [simplify]
[1.45] 0 < ([0 < ((-171 * div(heapIs $heap_{funcstart\_724,1},
\text{Sheap}_{funcstart_724,1}.\text{p1}, 177).\text{rem} + (2 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart_724,1},
\rho_{uncstart_{-724,1},p1, 177,quot}): 2499, \rho_{uncstart_{-724,1},p1, 177,quot}: 2499, \rho_{uncstart_{-724,1},p1, 177,quot}:
\theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}
\{\text{heap}_{funcstart\_724,1}, \{\text{heap}_{funcstart\_724,1}, \text{p1}, 177\}.\text{rem}\}\}: 32768\}
\rightarrow [move guard outside expression]
[1.46] \; ([0 < ((-171 * \operatorname{div}(\mathbf{heapIs} \; \$ \operatorname{heap}_{funcstart\_724,1}, \; \$ \operatorname{heap}_{funcstart\_724,1}.\operatorname{p1}, \;
177).rem) + (2 * \text{div}(\mathbf{heapIs} \$ \text{heap}_{funcstart\_724,1}, \$ \text{heap}_{funcstart\_724,1}.\text{p1},
(177).quot): 0 < 2499, [0 < ((-2 * div(heapIs $heap_{funcstart\_724.1}, 1.5])]
\theta_{funcstart\_724,1}.p1, 177).quot + (171 * div(heapIs $heap_{funcstart\_724,1}, 177).quot) + (171 * div(heapIs $heap_{funcstart\_724,1}, 177).
\frac{\text{sheap}_{funcstart\_724,1.p1, 177}.rem)}{177}: 0 < 32768}
\rightarrow [simplify]
 \label{eq:continuous}  \mbox{$[1.48]$ ([0 < ((-171 * div(\mathbf{heapIs} \ \$heap_{funcstart\_724,1}, \ \$heap_{funcstart\_724,1}.p1, \ ]) ) ) ) $$}  \mbox{$[1.48]$ ([0 < ((-171 * div(\mathbf{heapIs} \ \$heap_{funcstart\_724,1}, \ \$heap_{funcstart\_724,1}.p1, \ ]) ] ) ] $$}  \mbox{$[1.48]$ ([0 < ((-171 * div(\mathbf{heapIs} \ \$heap_{funcstart\_724,1}, \ \$heap_{funcs
177).rem) + (2 * \text{div}(\mathbf{heapIs} \$ \text{heap}_{funcstart\_724.1}, \$ \text{heap}_{funcstart\_724.1}.\text{p1},
177).quot))]: true, [0 < ((-2 * div(\mathbf{heapIs} \$heap_{funcstart\_724,1}, 
\theta_{funcstart\_724,1.p1}, 177).quot) + (171 * div(heapIs \theta_{funcstart\_724,1},
\frac{\text{sheap}_{funcstart_{724.1}.p1, 177}.rem)}{\text{true}}
\rightarrow [all guards have equal guarded terms]
[1.49] true
Proof of verification condition: Type constraint satisfied in implicit
conversion from 'short int' to 'int'
```

Condition generated at: C:\Escher\Customers\prang\prang.c (63,5)

Condition defined at:

To prove:  $minof(int) \le \$heap_{724,1;744,8}.p1$ Given:

```
heap_{init}.LIMIT == (int)80
heap_{init}.M1 == asType < short int > ((int)30269)
\theta_{init}.r1 == asType < short int > ((int)171)
heap_{init}.a1 == asType < short int > ((int)177)
heap_{init}.M2 == asType < short int > ((int)30307)
\theta_{init}.r2 == asType<short int>((int)172)
heap_{init}.a2 == asType < short int > ((int)176)
\theta = asType < short int > ((int)35)
heap_{init}.M3 == asType < short int > ((int)30323)
heap_{init}.r3 == asType < short int > ((int)170)
heap_{init}.a3 == asType < short int > ((int)178)
\theta = asType < short int > ((int)63)
\theta = asType < short int > ((int)1)
\theta
\theta = asType < short int > ((int)3)
invariant1(heapIs heap_{funcstart\_724,1})
\operatorname{div1} == \operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724,1},
asType < int > (\$heap_{funcstart\_724,1}.p1),
asType < int > (\$heap_{funcstart\_724,1}.a1))
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a1))) = =
asType<integer>(div1.quot)
(asType<integer>(asType<int>($heap_{tuncstart\_724.1}.p1)) %
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a1))) = =
asType<integer>(div1.rem)
!(0 == asType < integer > (div1.rem)) || !(0 ==
asType<integer>(div1.quot))
div2 == div(\mathbf{heapIs} \$heap_{funcstart\_724,1},
asType < int > (\$heap_{funcstart\_724,1}.p2),
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{a2}))
(\mathbf{asType} < \mathbf{integer} > (\mathbf{asType} < \mathbf{int} > (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p2})) \ / \\
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a2))) = =
asType<integer>(div2.quot)
(asType<int>(asType<int>($heap_{funcstart\_724.1}.p2)) %
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a2))) = =
```

```
asType<integer>(div2.rem)
!(0 == asType < integer > (div2.rem)) || !(0 ==
asType<integer>(div2.quot))
div3 == div(\mathbf{heapIs} \$ heap_{funcstart\_724,1},
asType < int > (\$heap_{funcstart\_724,1}.p3),
asType < int > (\$heap_{funcstart\_724,1}.a3))
(\mathbf{asType}{<}\mathbf{integer}{>}(\mathbf{asType}{<}\mathbf{int}{>}(\$\mathbf{heap}_{funcstart\_724,1}.\mathbf{p3})) \ / \\
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a3))) = =
asType<integer>(div3.quot)
(asType<integer>(asType<int>($heap_{tuncstart\_724.1}.p3)) %
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a3))) = =
asType<integer>(div3.rem)
!(0 == asType < integer > (div3.rem)) || !(0 ==
asType<integer>(div3.quot))
heap_{724,1;740,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow asType<short
int>((asType<int>(asType<short int>(div1.rem)) *
asType < int > (\$heap_{tuncstart\_724.1}.r1)) - (asType < int > (asType < short)
int>(div1.quot)) * asType< int>($heap_{funcstart\_724,1}.b1))))
-{\bf asType}{<}{\bf integer~const}{>}(\${\rm heap}_{724,1;740,8}.{\rm M1})<
asType<integer>($heap<sub>724,1:740,8</sub>.p1)
!(0 == asType < integer > (\$heap_{724,1;740,8}.p1))
asType<integer>($heap<sub>724,1:740,8</sub>.p1) <
asType<integer>($heap<sub>724,1;740,8</sub>.M1)
\text{heap}_{724.1:742.8} == \text{heap}_{724.1:740.8}._replace(p2 \rightarrow asType<short)
int>((asType<int>(asType<short int>(div2.rem)) *
asType < int > (\$heap_{724,1;740,8}.r2)) - (asType < int > (asType < short)
int>(div2.quot)) * asType<int>($heap<sub>724.1:740.8</sub>.b2))))
-asType < integer const > (\$heap_{724,1:742.8}.M2) < 
asType<integer>($heap<sub>724.1:742.8</sub>.p2)
!(0 == asType < integer > (\$heap_{724,1;742,8}.p2))
asType<integer>($heap<sub>724.1:742.8</sub>.p2) <
asType<integer>($heap<sub>724.1:742.8</sub>.M2)
\text{$heap}_{724,1;744,8} == \text{$heap}_{724,1;742,8}.\_\textbf{replace}(p3 \to \textbf{asType} < \textbf{short}
int>((asType<int>(asType<short int>(div3.rem)) *
asType < int > (\$heap_{724.1:742.8}.r3)) - (asType < int > (asType < short)
int>(div3.quot)) * asType<int>($heap_{724,1;742,8}.b3))))
-asType<integer const>($heap_{724,1:744,8}.M3) <
asType<integer>($heap<sub>724,1;744,8</sub>.p3)
!(0 == asType < integer > (\$heap_{724,1;744,8}.p3))
```

```
asType<integer>($heap<sub>724,1;744,8</sub>.p3) <
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathrm{heap}_{724,1;744,8}.\mathrm{M3})
Proof:
[Take given term]
[11.0] \text{ div1} == \text{div}(\mathbf{heapIs} \$ \text{heap}_{funcstart\_724,1},
asType < int > (\$heap_{funcstart\_724,1}.p1),
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{a1}))
\rightarrow [simplify]
[11.1] \ \mathrm{div1} == \mathrm{div}(\mathbf{heapIs} \ \$ \mathrm{heap}_{funcstart\_724,1}, \ \$ \mathrm{heap}_{funcstart\_724,1}.\mathrm{p1},
asType < int > (\$heap_{funcstart\_724,1}.a1))
\rightarrow [const static or extern object]
[11.2] \operatorname{div1} == \operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1,
asType < int > (\$heap_{init}.a1))
\rightarrow [expand definition of constant 'a1' at prang.c (16,20)]
[11.3] \operatorname{div1} == \operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724,1}, \$ \operatorname{heap}_{funcstart\_724,1}.p1,
asType<int>(asType<short int>((int)177)))
\rightarrow [simplify]
[11.6] div1 == div(heapIs \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}.p1, 177)
[Take given term]
[25.0] \operatorname{div2} == \operatorname{div}(\mathbf{heapIs} \ \operatorname{\$heap}_{funcstart\_724,1},
asType < int > (\$heap_{funcstart\_724,1}.p2),
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{a2}))
\rightarrow [simplify]
[25.1] div2 == div(heapIs heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p2,
asType < int > (\$heap_{funcstart\_724,1}.a2))
\rightarrow [const static or extern object]
[25.2] div2 == div(heapIs \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}.p2,
asType < int > (\$heap_{init}.a2))
\rightarrow [expand definition of constant 'a2' at prang.c (21,20)]
\label{eq:continuous} \textit{[25.3]} \ \text{div2} == \ \text{div}(\mathbf{heapIs} \ \$ \text{heap}_{funcstart\_724,1}, \ \$ \text{heap}_{funcstart\_724,1}.\text{p2},
asType < int > (asType < short int > ((int)176)))
\rightarrow [simplify]
[25.6]~{\rm div2} == {\rm div}(\mathbf{heapIs}~\$ \mathrm{heap}_{funcstart\_724,1},~\$ \mathrm{heap}_{funcstart\_724,1}.\mathrm{p2},~176)
[Take given term]
[39.0] div3 == div(heapIs heap_{funcstart\_724,1},
asType < int > (\$heap_{funcstart\_724,1}.p3),
```

```
asType < int > (\$heap_{funcstart\_724.1}.a3))
\rightarrow [simplify]
[39.1] div3 == div(heapIs heap_{funcstart_{-724,1}}, heap_{funcstart_{-724,1}}.p3,
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{a3}))
\rightarrow [const static or extern object]
[39.2] \operatorname{div3} == \operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.p3,
asType < int > (\$heap_{init}.a3))
\rightarrow [expand definition of constant 'a3' at prang.c (26,20)]
[39.3] \operatorname{div3} == \operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.p3,
asType<int>(asType<short int>((int)178)))
\rightarrow [simplify]
[39.6] div3 == div(heapIs $heap_{funcstart\_724,1}, $heap_{funcstart\_724,1}.p3, 178)
[Take given term]
[53.0] \rho_{1740,8} == \rho_{1740,8} == \rho_{1740,8} == \rho_{1740,8} - \rho_{1740,8} == \rho_{1740,8} == \rho_{1740,8} - \rho_{1740,8} == \rho_{1740,8} 
int>((asType<int>(asType<short int>(div1.rem)) *
asType < int > (\$heap_{funcstart\_724,1}.r1)) - (asType < int > (asType < short)
\mathbf{int}{>}(\mathbf{div1.quot})) * \mathbf{asType}{<} \mathbf{int}{>} (\$\mathbf{heap}_{funcstart\_724,1}.\mathbf{b1}))))
\rightarrow [from term 11.6, div1 is equal to div(heapIs $heap_{funcstart\_724,1},
heap_{funcstart_{-724,1}}.p1, 177
[53.1] \text{heap}_{724,1;740,8} == \text{heap}_{funcstart\_724,1}._replace(p1 \rightarrow asType<short
int>((asType<int>(asType<short int>(div(heapIs $heap_{funcstart\_724,1},
\theta_{funcstart\_724,1}.p1, 177).rem ** asType<int>($\text{heap}_{funcstart\_724,1}.r1)) -
(asType<int>(asType<short int>(div1.quot)) *
asType < int > (\$heap_{funcstart\_724,1}.b1))))
\rightarrow [simplify]
[53.3] \theta == 
int>((div(heapIs \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1, 177).rem *
asType < int > (\$heap_{funcstart\_724.1}.r1)) - (asType < int > (asType < short)
\mathbf{int}{>}(\mathbf{div1.quot})) * \mathbf{asType}{<}\mathbf{int}{>}(\$\mathbf{heap}_{funcstart\_724,1}.\mathbf{b1}))))
\rightarrow [const static or extern object]
[53.4] heap_{724,1;740,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow asType<short
int>((div(heapIs \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1, 177).rem *
asType < int > (\$heap_{init}.r1)) - (asType < int > (asType < short)
int>(div1.quot)) * asType< int>($heap_{funcstart\_724,1}.b1))))
\rightarrow [expand definition of constant 'r1' at prang.c (15,20)]
[53.5] \rho_{1740,8} == \rho_{1740,8} == \rho_{1740,8} == \rho_{1740,8} - \rho_{1740,8} == \rho_{1740,8} == \rho_{1740,8} - \rho_{1740,8} == \rho_{1740,8} 
int>((div(heapIs \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1, 177).rem *
asType<int>(asType<short int>((int)171))) -
```

```
(asType<int>(asType<short int>(div1.quot)) *
asType < int > (\$heap_{funcstart\_724,1}.b1))))
\rightarrow [simplify]
[53.8] heap_{724,1;740,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow asType<short
int>((div(heapIs \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1, 177).rem * 171)
- (asType<int>(asType<short int>(div1.quot)) *
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{b1}))))
\rightarrow [from term 11.6, div1 is equal to div(heapIs $heap_{funcstart_{724,1}},
heap_{funcstart_{-724,1}}.p1, 177
[53.9] heap_{724,1;740,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow asType<short
int>((171 * div(heapIs \$heap_{funcstart\_724.1}, \$heap_{funcstart\_724.1}, p1, 177).rem)
- (asType<int>(asType<short int>(div(heapIs $heap_{funcstart_724.1},
heap_{funcstart_{724,1}}.p1, 177).quot)) *
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{b1}))))
\rightarrow [simplify]
[53.11] \$ heap_{724,1;740,8} == \$ heap_{funcstart\_724,1}.\_\mathbf{replace} (p1 \to \mathbf{asType} < \mathbf{short})
int>((171 * div(heapIs $heap_{funcstart\_724,1}, $heap_{funcstart\_724,1}.p1, 177).rem)
- (\text{div}(\mathbf{heapIs} \$ \text{heap}_{funcstart\_724,1}, \$ \text{heap}_{funcstart\_724,1}.\text{p1}, 177).\text{quot} *
asType < int > (\$heap_{funcstart\_724,1}.b1))))
\rightarrow [const static or extern object]
[53.12] heap_{724,1;740,8} == heap_{funcstart\_724,1}. replace(p1 \rightarrow asType<short
int>((171 * div(heapIs $heap_{funcstart\_724,1}, $heap_{funcstart\_724,1}.p1, 177).rem)
- (\text{div}(\mathbf{heapIs} \$ \text{heap}_{funcstart\_724,1}, \$ \text{heap}_{funcstart\_724,1}.\text{p1}, 177).\text{quot} *
asType < int > (\$heap_{init}.b1)))
\rightarrow [expand definition of constant 'b1' at prang.c (17,20)]
[53.13] heap_{724,1;740,8} == heap_{funcstart\_724,1}.replace(p1 \rightarrow asType<short
int>((171 * div(heapIs \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1, 177).rem)
- (\text{div}(\mathbf{heapIs} \$ \text{heap}_{funcstart\_724,1}, \$ \text{heap}_{funcstart\_724,1}.\text{p1}, 177).\text{quot} *
asType<int>(asType<short int>((int)2))))
\rightarrow [simplify]
[53.19] $heap<sub>724,1;740,8</sub> == $heap<sub>funcstart_724,1</sub>._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724.1}, \ \text{\$heap}_{funcstart\_724.1}, 177).rem)))
[Take given term]
[54.0] -asType<integer const>($heap_{724,1;740,8}.M1) <
asType<integer>($heap<sub>724,1.740,8.</sub>p1)
\rightarrow [from term 53.19, $heap<sub>724,1:740,8</sub> is equal to
heap_{funcstart\_724,1}._replace(p1 \rightarrow (-2 * div(heapIs heap_{funcstart\_724,1}),
heap_{funcstart\_724,1}.p1, 177).quot + (171 * div(heapIs $heap_{funcstart\_724,1},
```

```
heap_{funcstart_{-724,1}.p1, 177).rem}
[54.1] -asType<integer const>(p1 \rightarrow (-2 * p1))
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).quot) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).rem))).M1) <
asType<integer>($heap<sub>724,1:740,8</sub>.p1)
→ [const member of object with modified fields]
[54.2] - \mathbf{asType} < \mathbf{integer\ const} > (\$ \mathrm{heap}_{funcstart\_724,1}.\mathrm{M1}) <
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathrm{heap}_{724,1;740,8}.\mathrm{p1})
\rightarrow [const static or extern object]
[54.3] -asType<integer const>($heap_{init}.M1) <
asType<integer>($heap<sub>724,1:740,8</sub>.p1)
\rightarrow [expand definition of constant 'M1' at prang.c (14,20)]
[54.4] -asType<integer const>(asType<short int>((int)30269)) <
asType<integer>($heap<sub>724,1;740,8</sub>.p1)
\rightarrow [simplify]
[54.8] -30269 < asType < integer > ($heap_{724.1:740.8}.p1)
\rightarrow [from term 53.19, $heap<sub>724,1:740.8</sub> is equal to
heap_{funcstart\_724,1}._replace(p1 \rightarrow (-2 * div(heapIs heap_{funcstart\_724,1}),
\text{Sheap}_{funcstart\_724,1.p1}, 177).\text{quot} + (171 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
heap_{funcstart_{-724,1}}.p1, 177).rem)
[54.9] -30269 < asType<integer>($heap_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).quot) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).rem))).p1)
\rightarrow [simplify]
 \label{eq:continuous} \mbox{ $[54.11]$ -30269 } < ((-2 * \mbox{div}(\mathbf{heapIs} \ \$ \mbox{heap}_{funcstart\_724,1}, \ \$ \mbox{ $heap}_{funcstart\_724,1}.p1, 
177).quot) + (171 * div(heapIs \theta_{funcstart_{-724,1}}, \theta_{funcstart_{-724,1}}, p1,
177).rem))
[Take given term]
[57.0] $\text{heap}_{724,1;742,8} == $\text{heap}_{724,1;740,8}._\text{replace}(p2 \rightarrow \text{asType} < \text{short}
int>((asType<int>(asType<short int>(div2.rem)) *
asType < int > (\$heap_{724.1:740.8}.r2)) - (asType < int > (asType < short)
int>(div2.quot)) * asType< int>($heap_{724.1:740.8}.b2))))
\rightarrow [from term 53.19, $heap<sub>724,1:740,8</sub> is equal to
heap_{funcstart\_724,1}._replace(p1 \rightarrow (-2 * div(heapIs heap_{funcstart\_724,1}),
heap_{funcstart_{-724,1},p1,177}, quot) + (171 * div(heapIs p_{funcstart_{-724,1},p1,177})
heap_{funcstart_{-724,1}}.p1, 177).rem)
[57.1] $\text{heap}_{724,1;742,8} == $\text{heap}_{funcstart\_724,1}._\text{replace}(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 *
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\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow asType<short
int>((asType<int>(asType<short int>(div2.rem)) *
asType < int > (\$heap_{724,1:740.8}.r2)) - (asType < int > (asType < short)
int>(div2.quot)) * asType< int>($heap_{724,1:740,8}.b2))))
\rightarrow [from term 25.6, div2 is equal to div(heapIs $heap_{funcstart\_724,1},
heap_{funcstart_{-724,1}}.p2, 176)
[57.2] heap_{724,1;742,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).quot) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.p1,
177).rem))).\_replace(p2 \rightarrow asType < short
int>((asType<int>(asType<short int>(div(heapIs $heap_{funcstart\_724,1},
\text{sheap}_{funcstart\_724,1.p2, 176}.\text{rem}) * asType<int>(\text{sheap}_{724,1:740,8.r2})) -
(asType<int>(asType<short int>(div2.quot)) *
\mathbf{asType}{<}\mathbf{int}{>}(\${\rm heap}_{724,1;740,8}.{\rm b2}))))
\rightarrow [simplify]
[57.4] heap_{724,1;742,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 *
\operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724.1}, \$ \operatorname{heap}_{funcstart\_724.1}.p1,
177).rem)))._{\mathbf{replace}}(p2 \rightarrow \mathbf{asType} < \mathbf{short\ int} > ((\operatorname{div}(\mathbf{heapIs}))))
heap_{funcstart_{724,1}}, heap_{funcstart_{724,1}}.p2, 176).rem *
asType < int > (\$heap_{724.1:740.8}.r2)) - (asType < int > (asType < short)
int>(div2.quot)) * asType< int>($heap_{724.1:740.8}.b2))))
\rightarrow [from term 53.19, $heap<sub>724,1;740,8</sub> is equal to
heap_{funcstart\_724,1}._replace(p1 \rightarrow (-2 * div(heapIs heap_{funcstart\_724,1}),
heap_{funcstart_{724,1},p1, 177}, quot) + (171 * div(heapIs heap_{funcstart_{724,1},p1, 177})
heap_{funcstart_{-724,1}}.p1, 177).rem)
[57.5] $heap<sub>724,1;742,8</sub> == $heap<sub>funcstart_724,1</sub>._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1,
177).rem)))._{\mathbf{replace}}(p2 \rightarrow \mathbf{asType} < \mathbf{short\ int} > ((\operatorname{div}(\mathbf{heapIs}))))
\theta_{funcstart_{724,1}}, \theta_{funcstart_{724,1}}, \theta_{funcstart_{724,1}}, \theta_{funcstart_{724,1}}
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathbf{\_replace}(\mathrm{p1} \rightarrow ((\text{-}2\ *\ \mathrm{div}(\mathbf{heapIs}
\theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}
\theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}.p1, 177).rem))).r2)) -
(asType<int>(asType<short int>(div2.quot)) *
asType < int > (\$heap_{724,1;740,8}.b2))))
\rightarrow [const member of object with modified fields]
[57.6] heap_{724,1;742,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}. p1, \ 177). \operatorname{quot}) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow asType<short int>((div(heapIs
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\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.p2, 176).rem *
\mathbf{asType} \hspace{-0.1em}<\hspace{-0.1em} \mathbf{int} \hspace{-0.1em}> \hspace{-0.1em} (\$ heap_{funcstart\_724,1}.r2)) - (\mathbf{asType} \hspace{-0.1em}<\hspace{-0.1em} \mathbf{int} \hspace{-0.1em}> \hspace{-0.1em} (\mathbf{asType} \hspace{-0.1em}<\hspace{-0.1em} \mathbf{short})
int>(div2.quot)) * asType<int>($heap<sub>724,1:740,8</sub>.b2))))
\rightarrow [const static or extern object]
[57.7] $heap<sub>724,1;742,8</sub> == $heap<sub>funcstart_724,1</sub>._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 *
\operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724,1}, \$ \operatorname{heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow asType<short int>((div(heapIs
\rho_{funcstart_{724,1}}, \rho_{funcstart_{724,1}}, \rho_{funcstart_{724,1}}, \rho_{funcstart_{724,1}}, \rho_{funcstart_{724,1}}
asType < int > (\$heap_{init}.r2)) - (asType < int > (asType < short)
int>(div2.quot)) * asType< int>($heap_{724.1:740.8}.b2))))
\rightarrow [expand definition of constant 'r2' at prang.c (20,20)]
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 *
\operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724,1}, \$ \operatorname{heap}_{funcstart\_724,1}.p1,
(177).rem))._replace(p2 \rightarrow asType<short int>((div(heapIs)
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.p2, 176).rem *
asType<int>(asType<short int>((int)172))) -
(asType<int>(asType<short int>(div2.quot)) *
asType<int>($heap<sub>724.1:740.8</sub>.b2))))
\rightarrow [simplify]
[57.11] $\text{heap}_{724,1;742,8} == \text{$heap}_{funcstart_724,1}. \text{$\bf replace}(p1 \to ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).quot) + (171 *
\operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724,1}, \$ \operatorname{heap}_{funcstart\_724,1}.p1,
177).rem))).replace(p2 \rightarrow asType < short int > ((div(heapIs)))
heap_{funcstart_{-724,1}}, heap_{funcstart_{-724,1}}.p2, 176).rem * 172) -
(asType<int>(asType<short int>(div2.quot)) *
asType < int > (\$heap_{724.1:740.8}.b2))))
\rightarrow [from term 25.6, div2 is equal to div(heapIs $heap_{tuncstart_724.1},
heap_{funcstart_{-724,1},p2,176}
[57.12] $\text{heap}_{724,1:742,8} == $\text{heap}_{funcstart_724,1}._\text{replace}(p1 \to ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).quot) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow asType<short int>((172 * div(heapIs
heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p2, 176).rem) –
(asType<int>(asType<short int>(div(heapIs $heap_{funcstart\_724,1},))
\text{sheap}_{funcstart\_724,1.p2, 176}.\text{quot}) * asType < int > (\text{sheap}_{724,1:740,8}.\text{b2}))))
\rightarrow [simplify]
[57.14] $\text{heap}_{724,1;742,8} == \text{$heap}_{funcstart\_724,1}._\text{replace}(p1 \to ((-2 *
div(\mathbf{heapIs} \ \$heap_{funcstart\_724,1}, \ \$heap_{funcstart\_724,1}.p1, \ 177).quot) + (171 *
\operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724,1}, \$ \operatorname{heap}_{funcstart\_724,1}.p1,
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177).rem)))._replace(p2 \rightarrow asType<short int>((172 * div(heapIs
\theta_{funcstart_{724,1}}, \theta_{funcstart_{724,1}}, \theta_{funcstart_{724,1}}.p2, 176).rem – (div(heapIs
heap_{funcstart_{724,1}}, heap_{funcstart_{724,1}}, 2, 176).quot *
asType < int > (\$heap_{724,1;740,8}.b2))))
\rightarrow [from term 53.19, $heap<sub>724.1:740.8</sub> is equal to
heap_{funcstart\_724,1}._replace(p1 \rightarrow (-2 * div(heapIs heap_{funcstart\_724,1}),
\text{Sheap}_{funcstart\_724,1}.\text{p1}, 177).\text{quot} + (171 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
heap_{funcstart_{-724,1}}.p1, 177).rem)
[57.15] $\text{heap}_{724,1:742,8} == \text{$heap}_{funcstart\_724,1}._\text{$replace}(p1 \to ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 *
\label{eq:div_heap} \text{div}(\textbf{heapIs} \ \$ \text{heap}_{funcstart\_724,1}, \ \$ \text{heap}_{funcstart\_724,1}.\text{p1},
177).rem)))._replace(p2 \rightarrow asType<short int>((172 * div(heapIs
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.\text{p2}, 176).\text{rem}) - (\text{div}(\text{heapIs})
heap_{funcstart_{724,1}}, heap_{funcstart_{724,1}}.p2, 176).quot *
asType < int > (\$heap_{funcstart\_724,1}.\_replace(p1 \rightarrow ((-2 * div(heapIs))))))
\$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1, 177).quot) + (171 * div(\textbf{heapIs})
heap_{funcstart_{-724,1}}, heap_{funcstart_{-724,1}}, 177).rem)).b2))))
→ [const member of object with modified fields]
[57.16] $\text{heap}_{724,1:742,8} == \text{$heap}_{funcstart\_724,1}._\text{$replace}(p1 \to ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow asType<short int>((172 * div(heapIs
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.\text{p2}, 176).\text{rem}) - (\text{div}(\text{heapIs})
heap_{funcstart_{24,1}}, heap_{funcstart_{24,1}}, 176).quot *
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{b2}))))
\rightarrow [const static or extern object]
[57.17] heap_{724,1;742,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.p1,
177).rem)))._{\mathbf{replace}}(p2 \rightarrow \mathbf{asType} < \mathbf{short\ int} > ((172 * div(\mathbf{heapIs}))))
\theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}.p2, 176).rem) - (div(heapIs
heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p2, 176).quot *
asType < int > (\$heap_{init}.b2))))
\rightarrow [expand definition of constant 'b2' at prang.c (22,20)]
[57.18] heap_{724,1;742,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 \ *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow asType<short int>((172 * div(heapIs
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.\text{p2}, 176).\text{rem}) - (\text{div}(\text{heapIs})
heap_{funcstart_{724,1}}, heap_{funcstart_{724,1}}.p2, 176).quot *
asType<int>(asType<short int>((int)35)))))
\rightarrow [simplify]
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[57.24] $heap<sub>724,1;742,8</sub> == $heap<sub>funcstart_724,1</sub>._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 \ *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow ((-35 * div(heapIs $heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1}.\text{p2}, 176).\text{quot} + (172 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
heap_{funcstart_{-724,1}}.p2, 176).rem))
[Take given term]
[61.0] $\text{heap}_{724,1:744,8} == $\text{heap}_{724,1:742,8}._\text{replace}(p3 \to \text{asType} < \text{short}
int>((asType<int>(asType<short int>(div3.rem)) *
asType < int > (\$heap_{724.1:742.8}.r3)) - (asType < int > (asType < short)
\mathbf{int}{>}(\text{div3.quot})) * \mathbf{asType}{<} \mathbf{int}{>} (\$\text{heap}_{724,1;742,8}.\text{b3}))))
\rightarrow [from term 57.24, $heap<sub>724,1;742,8</sub> is equal to
heap_{funcstart\_724.1}._replace(p1 \rightarrow ((-2 * div(heapIs $heap_{funcstart\_724.1},
heap_{funcstart\_724.1.p1}, 177).quot + (171 * div(heapIs $heap_{funcstart\_724.1}, 177).quot) + (171 * div(heapIs $heap_{funcstart\_724.1}, 17
\rho_{funcstart\_724.1}.p1, 177).rem)._replace\rho_{funcstart\_724.1}.p1, 177).rem)._replace
\$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p2, 176).quot) + (172 * div(\textbf{heapIs}))
heap_{funcstart_{-724,1}}, heap_{funcstart_{-724,1}}, p2, 176).rem)
[61.1] heap_{724,1;744,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}. p1, \ 177). \operatorname{quot}) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow ((-35 * div(heapIs $heap_{funcstart_724,1},
\theta_{funcstart\_724,1.p2}, 176).quot) + (172 * div(heapIs \theta_{funcstart\_724,1},
\theta_{uncstart_724.1.p2, 176}.rem)._replace(p3 \rightarrow asType<short
int>((asType<int>(asType<short int>(div3.rem))
asType < int > (\$heap_{724,1;742,8}.r3)) - (asType < int > (asType < short)
int>(div3.quot)) * asType<int>($heap<sub>724.1:742.8</sub>.b3))))
\rightarrow [from term 39.6, div3 is equal to div(heapIs $heap_{funcstart\_724,1},
heap_{funcstart_{-724,1}}.p3, 178
[61.2] heap_{724,1;744,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow ((-35 * div(heapIs $heap_{funcstart_724.1},
\text{Sheap}_{funcstart\_724.1.p2}, 176).\text{quot} + (172 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724.1},
\theta_{funcstart\_724,1.p2, 176}.rem))._replace(p3 \rightarrow asType<short
int>((asType<int>(asType<short int>(div(heapIs $heap_{funcstart\_724,1},
\text{Sheap}_{funcstart_724,1.p3}, 178).\text{rem}) * asType < int > (\text{Sheap}_{724,1:742.8}.\text{r3})) -
(asType<int>(asType<short int>(div3.quot)) *
asType < int > (\$heap_{724,1;742,8}.b3))))
\rightarrow [simplify]
[61.4] heap_{724,1;744,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 *
\operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724,1}, \$ \operatorname{heap}_{funcstart\_724,1}.p1,
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177).rem)))._replace(p2 \rightarrow ((-35 * div(heapIs $heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1.p2}, 176).\text{quot} + (172 * \text{div}(\text{heapIs} \text{Sheap}_{funcstart\_724,1},
\theta_{funcstart\_724,1}.p2, 176).rem))._replace(p3 \rightarrow asType<short
int>((div(heapIs \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p3, 178).rem *
asType < int > (\$heap_{724,1:742,8}.r3)) - (asType < int > (asType < short)
int > (div3.quot)) * asType < int > (\$heap_{724,1;742,8}.b3))))
\rightarrow [from term 57.24, $\$heap_{724,1;742,8}$ is equal to
heap_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 * div(heapIs *heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724.1}.p1, 177).quot) + (171 * div(\text{heapIs } \text{Sheap}_{funcstart\_724.1},
\rho_{months, replace}(p2 \rightarrow (-35 * div(\mathbf{heapIs}))).
heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p2, 176).quot) + (172 * div(heapIs)
heap_{funcstart_{724.1}}, heap_{funcstart_{724.1}}, 2, 176).rem
[61.5] $heap<sub>724,1:744,8</sub> == $heap<sub>funcstart_724,1</sub>._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.\operatorname{p1}, \ 177).\operatorname{quot}) + (171 \ *
\operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724,1}, \$ \operatorname{heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow ((-35 * div(heapIs $heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1}.\text{p2}, 176).\text{quot} + (172 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
\theta_{uncstart_724.1.p2, 176}.rem)._replace(p3 \rightarrow asType<short
int>((div(heapIs \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p3, 178).rem *
\mathbf{asType}{<}\mathbf{int}{>}(\$\text{heap}_{funcstart\_724,1}.\_\mathbf{replace}(\text{p1} \rightarrow ((\text{-2} * \text{div}(\mathbf{heapIs}
\$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1, 177).quot) + (171 * div(\mathbf{heapIs})
\theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}
* div(heapIs heap_{funcstart_{-724,1}}, heap_{funcstart_{-724,1}}, p2, 176).quot) + (172 *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.\operatorname{p2}, \ 176).\operatorname{rem}))).\operatorname{r3})) \ -
(asType<int>(asType<short int>(div3.quot)) *
asType < int > (\$heap_{724,1;742,8}.b3))))
\rightarrow [const member of object with modified fields]
[61.7] heap_{724,1;744,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.\operatorname{p1}, \ 177).\operatorname{quot}) + (171 \ *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724.1}, \ \$ \operatorname{heap}_{funcstart\_724.1}.p1,
177).rem)))._replace(p2 \rightarrow ((-35 * div(heapIs $heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1}.\text{p2}, 176).\text{quot} + (172 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
\theta_{funcstart\_724,1}.p2, 176).rem))._replace(p3 \rightarrow asType<short
int>((div(heapIs \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p3, 178).rem *
asType < int > (\$heap_{funcstart\_724,1}.r3)) - (asType < int > (asType < short)
int > (div3.quot)) * asType < int > (\$heap_{724,1;742,8}.b3))))
\rightarrow [const static or extern object]
[61.8] heap_{724,1;744,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 \ *
\operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724,1}, \$ \operatorname{heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow ((-35 * div(heapIs $heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1.p2}, 176).\text{quot} + (172 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
\theta_{funcstart\_724,1.p2, 176).rem}))._replace(p3 \rightarrow asType<short
```

```
int>((div(heapIs \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p3, 178).rem *
\mathbf{asType} {<} \mathbf{int} {>} (\$ \mathbf{heap}_{init}.\mathbf{r3})) - (\mathbf{asType} {<} \mathbf{int} {>} (\mathbf{asType} {<} \mathbf{short}
int>(div3.quot)) * asType<int>($heap<sub>724,1:742,8</sub>.b3))))
\rightarrow [expand definition of constant 'r3' at prang.c (25,20)]
[61.9] $heap<sub>724,1;744,8</sub> == $heap<sub>funcstart_724,1</sub>._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow ((-35 * div(heapIs $heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1.p2}, 176).\text{quot} + (172 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
\rho_{tuncstart, 724,1}, p2, 176).rem))._replace(p3 \rightarrow asType<short
\mathbf{int} > ((\mathrm{div}(\mathbf{heapIs} \ \$ \mathrm{heap}_{funcstart\_724,1}, \ \$ \mathrm{heap}_{funcstart\_724,1}.\mathrm{p3}, \ 178).\mathrm{rem} \ *
asType<int>(asType<short int>((int)170))) -
(\mathbf{asType} < \mathbf{int} > (\mathbf{asType} < \mathbf{short\ int} > (\mathbf{div3.quot})) \ ^*
asType < int > (\$heap_{724,1;742,8}.b3))))
\rightarrow [simplify]
[61.12] $\text{heap}_{724,1;744,8} == \text{$heap}_{funcstart\_724,1}.$\text{$_-\text{replace}(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow ((-35 * div(heapIs $heap_{tuncstart_724.1},
\text{Sheap}_{funcstart\_724,1.p2}, 176).\text{quot} + (172 * \text{div}(\text{heapIs} \text{Sheap}_{funcstart\_724,1}),
\rho_{funcstart\_724,1.p2, 176}.rem))._replace(p3 \rightarrow asType<short
int>((div(heapIs \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p3, 178).rem * 170)
- (asType<int>(asType<short int>(div3.quot))
asType < int > (\$heap_{724,1;742,8}.b3))))
\rightarrow [from term 39.6, div3 is equal to div(heapIs $heap_{funcstart\_724,1},
heap_{funcstart_{-724,1}}.p3, 178
[61.13] $heap<sub>724,1;744,8</sub> == $heap<sub>funcstart_724,1</sub>._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 *
\operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724.1}, \$ \operatorname{heap}_{funcstart\_724.1}.p1,
177).rem)))._replace(p2 \rightarrow ((-35 * div(heapIs $heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724.1.p2}, 176).\text{quot} + (172 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724.1},
\rho_{tuncstart\_724.1.p2, 176).rem})._replace(p3 \rightarrow asType<short int>((170
* div(heapIs heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p3, 178).rem) –
(asType<int>(asType<short int>(div(heapIs $heap_{funcstart\_724,1},))
\text{sheap}_{funcstart\_724,1.p3}, 178).\text{quot}) * asType < int > (\text{sheap}_{724,1:742,8}.b3))))
\rightarrow [simplify]
[61.15] $\text{heap}_{724,1;744,8} == \text{$heap}_{funcstart\_724,1}._\text{$replace}(p1 \to ((-2 *
div(\mathbf{heapIs} \ \$heap_{funcstart\_724,1}, \ \$heap_{funcstart\_724,1}.p1, \ 177).quot) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow ((-35 * div(heapIs $heap_{funcstart_724,1},
\theta_{funcstart\_724,1}.p2, 176.quot) + (172 * div(heapIs \theta_{funcstart\_724,1},
\theta_{funcstart\_724,1.p2, 176}.rem)._replace(p3 \rightarrow asType<short int>((170
```

```
* div(heapIs heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p3, 178).rem) –
(\text{div}(\mathbf{heapIs} \$ \text{heap}_{funcstart\_724,1}, \$ \text{heap}_{funcstart\_724,1}.\text{p3}, 178).\text{quot} *
asType < int > (\$heap_{724,1;742,8}.b3))))
\rightarrow [from term 57.24, $heap_{724,1;742,8}$ is equal to
\text{Sheap}_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 * div(heapIs $heap_{funcstart\_724,1}), the sheap_{funcstart\_724,1}).
heap_{funcstart\_724,1}.p1, 177).quot + (171 * div(heapIs $heap_{funcstart\_724,1},
heap_{funcstart\_724,1}.p1, 177).rem))).\_replace(p2 \rightarrow (-35 * div(heapIs))).
heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p2, 176).quot) + (172 * div(heapIs)
heap_{funcstart_{724,1}}, heap_{funcstart_{724,1},p2, 176}.rem))]
[61.16] $heap<sub>724,1:744,8</sub> == $heap<sub>funcstart_724,1</sub>._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 *
\operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724,1}, \$ \operatorname{heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow ((-35 * div(heapIs $heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1}.\text{p2}, 176).\text{quot} + (172 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
\rho_{uncstart_{-724,1},p2, 176,rem})._replace(p3 \rightarrow asType<short int>((170
* div(heapIs heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p3, 178).rem) –
(\text{div}(\mathbf{heapIs} \$ \text{heap}_{funcstart\_724,1}, \$ \text{heap}_{funcstart\_724,1}.\text{p3}, 178).\text{quot} *
asType<int>($heap<sub>funcstart_724.1</sub>._replace(p1 \rightarrow ((-2 * div(heapIs
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.\text{p1}, 177).\text{quot}) + (171 * \text{div}(\text{heapIs})
\rho_{uncstart\_724,1}, \rho_{uncstart\_724,1}, \rho_{uncstart\_724,1}, \rho_{uncstart\_724,1}, \rho_{uncstart\_724,1}, \rho_{uncstart\_724,1}
* div(heapIs heap_{funcstart_{-724,1}}, heap_{funcstart_{-724,1}}, p2, 176).quot) + (172 *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.p2, \ 176).rem))).b3))))
→ [const member of object with modified fields]
[61.18] $\text{heap}_{724,1;744,8} == \text{$heap}_{funcstart\_724,1}._\text{$replace}(p1 \to ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 \ *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow ((-35 * div(heapIs $heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1.p2}, 176).quot) + (172 * div(heapIs \text{Sheap}_{funcstart\_724,1},
\theta_{uncstart_724,1.p2, 176).rem}))._replace(p3 \rightarrow asType<short int>((170
* div(heapIs heap_{funcstart_724.1}, heap_{funcstart_724.1}, n_{funcstart_724.1}, n_{funcstart_724.1}
(\text{div}(\mathbf{heapIs} \$ \text{heap}_{funcstart\_724,1}, \$ \text{heap}_{funcstart\_724,1}.p3, 178).\text{quot} *
asType < int > (\$heap_{funcstart\_724,1}.b3))))
\rightarrow [const static or extern object]
[61.19] $heap<sub>724,1;744,8</sub> == $heap<sub>funcstart_724,1</sub>._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).quot) + (171 *
\operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724.1}, \$ \operatorname{heap}_{funcstart\_724.1}.p1,
177).rem)))._replace(p2 \rightarrow ((-35 * div(heapIs $heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1}.\text{p2}, 176).\text{quot} + (172 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
\rho_{funcstart\_724,1}.p2, 176).rem))._replace(p3 \rightarrow asType<short int>((170)
* div(heapIs heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p3, 178).rem) –
(\text{div}(\mathbf{heapIs} \$ \text{heap}_{funcstart\_724,1}, \$ \text{heap}_{funcstart\_724,1}.\text{p3}, 178).\text{quot} *
asType < int > (\$heap_{init}.b3)))
\rightarrow [expand definition of constant 'b3' at prang.c (27,20)]
```

```
[61.20] $heap<sub>724,1;744,8</sub> == $heap<sub>funcstart_724,1</sub>._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 \ *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow ((-35 * div(heapIs $heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1}.\text{p2}, 176).\text{quot} + (172 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
\frac{\text{sheap}_{funcstart\_724,1.p2, 176}.rem)}{\text{.replace}(p3 \rightarrow asType < short int} > ((170))
* div(heapIs heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p3, 178).rem) –
(\text{div}(\mathbf{heapIs} \$ \text{heap}_{funcstart\_724.1}, \$ \text{heap}_{funcstart\_724.1}. \text{p3}, 178).\text{quot} *
asType<int>(asType<short int>((int)63)))))
[61.26] $heap<sub>724,1;744,8</sub> == $heap<sub>funcstart_724,1</sub>._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 *
\operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724,1}, \$ \operatorname{heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow ((-35 * div(heapIs $heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1}.\text{p2}, 176).\text{quot} + (172 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
\rho_{funcstart\_724,1.p2, 176}.rem)._replace(p3 \rightarrow ((-63 * div(heapIs
\theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}
heap_{funcstart_{-724,1}}, heap_{funcstart_{-724,1}}, 178).rem)
[Take goal term]
[1.0] minof(int) \leq $heap<sub>724.1:744.8</sub>.p1
\rightarrow [simplify]
[1.1] -32768 \leq $heap<sub>724.1:744.8</sub>.p1
\rightarrow [from term 61.26, $heap<sub>724.1:744.8</sub> is equal to
heap_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 * div(heapIs *heap_{funcstart\_724,1},
heap_{funcstart\_724,1}.p1, 177).quot + (171 * div(heapIs $heap_{funcstart\_724,1},
\rho_{tuncstart\_724.1.p1, 177).rem}))._replace\rho_{tuncstart\_724.1.p1, 177).rem})
heap_{funcstart_{-724,1}}, p_{funcstart_{-724,1}}, p_{funcstart_{-724,1}}, p_{funcstart_{-724,1}}, p_{funcstart_{-724,1}}, p_{funcstart_{-724,1}}
heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p2, 176).rem)))._replace(p3 \rightarrow (-63 *
div(\mathbf{heapIs} \ \$heap_{funcstart\_724.1}, \ \$heap_{funcstart\_724.1}.p3, \ 178).quot) + (170 *
\operatorname{div}(\mathbf{heapIs} \ \$ heap_{funcstart\_724,1}, \ \$ heap_{funcstart\_724,1}.p3, \ 178).rem))]
[1.2] -32768 \leq $heap<sub>funcstart_724,1</sub>._replace(p1 \rightarrow ((-2 * div(heapIs
\theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}.p1, 177).quot) + (171 * div(heapIs
\theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}
* div(heapIs heap_{funcstart_{-724,1}}, heap_{funcstart_{-724,1}}, p2, 176).quot) + (172 *
\operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724,1}, \$ \operatorname{heap}_{funcstart\_724,1}.p2,
176).rem)))._replace(p3 \rightarrow ((-63 * div(heapIs $heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1}.\text{p3}, 178).\text{quot} + (170 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
heap_{funcstart_{-724,1}.p3, 178.rem})).p1
\rightarrow [simplify]
[1.7] -32769 < ((-2 * div(heapIs $heap_{funcstart\_724,1}, $heap_{funcstart\_724,1}.p1,
177).quot) + (171 * div(heapIs heapIs = f_{uncstart_{-724,1}}, heap_{funcstart_{-724,1}}.p1,
```

```
177).rem))
\rightarrow [from term 54.11, literala < ((-2 * div(heapIs $heap_{funcstart\_724,1},
heap_{funcstart_{-724,1},p1,177}, quot) + (171 * div(heapIs p_{funcstart_{-724,1},p1,177})
\rho_{funcstart\_724,1.p1, 177).rem} is true whenever (-1 + literala) < -30269
   Proof of rule precondition:
   [1.7.0](-32769 + -1) < -30269
   \rightarrow [simplify]
   [1.7.2] true
[1.8] true
Proof of verification condition: Type constraint satisfied in implicit
conversion from 'short int' to 'int'
Condition generated at: C:\Escher\Customers\prang\prang.c (63,5)
Condition defined at:
To prove: heap_{724,1;744,8}.p1 \le maxof(int)
Given:
heap_{init}.LIMIT == (int)80
heap_{init}.M1 == asType < short int > ((int)30269)
\theta_{init}.r1 == asType < short int > ((int)171)
heap_{init}.a1 == asType < short int > ((int)177)
\theta
\theta sheap<sub>init</sub>.M2 == asType<short int>((int)30307)
\theta_{init}.r2 == asType<short int>((int)172)
heap_{init}.a2 == asType < short int > ((int)176)
\theta = asType < short int > ((int)35)
heap_{init}.M3 == asType < short int > ((int)30323)
\theta_{init}.r3 == asType<short int>((int)170)
\theta = asType < short int > ((int)178)
\theta = asType < short int > ((int)63)
\theta
\theta
\theta = asType < short int > ((int)3)
invariant1(heapIs heap_{funcstart_{-724.1}})
```

```
div1 == div(\mathbf{heapIs} \$heap_{funcstart\_724,1},
asType < int > (\$heap_{funcstart\_724,1}.p1),
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{a1}))
(asType<int>(asType<int>($heap_{tuncstart\_724.1}.p1)) /
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a1))) = =
asType<integer>(div1.quot)
(\mathbf{asType}{<}\mathbf{int}{>}(\mathbf{asType}{<}\mathbf{int}{>}(\$\mathbf{heap}_{funcstart\_724,1}.\mathbf{p1}))~\%
\mathbf{asType}{<}\mathbf{integer}{>}(\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{a1}))) = =
asType<integer>(div1.rem)
!(0 == asType < integer > (div1.rem)) || !(0 ==
asType<integer>(div1.quot))
div2 == div(\mathbf{heapIs} \$heap_{funcstart\_724,1},
asType < int > (\$heap_{funcstart\_724,1}.p2),
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{a2}))
(asType<integer>(asType<int>($heap_{tuncstart\_724.1}.p2)) /
asType < integer > (asType < int > (\$heap_{funcstart\_724.1}.a2))) = =
asType<integer>(div2.quot)
(asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.p2)) \%
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a2))) = =
asType < integer > (div2.rem)
!(0 == asType < integer > (div2.rem)) || !(0 ==
asType<integer>(div2.quot))
div3 == div(\mathbf{heapIs} \$heap_{funcstart\_724,1},
asType < int > (\$heap_{funcstart\_724,1}.p3),
asType < int > (\$heap_{funcstart\_724,1}.a3))
(asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.p3)) /
asType < integer > (asType < int > (\$heap_{funcstart\_724.1}.a3))) = =
asType<integer>(div3.quot)
(asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.p3)) \%
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a3))) = = 
asType<integer>(div3.rem)
!(0 == asType < integer > (div3.rem)) || !(0 ==
asType<integer>(div3.quot))
\$heap_{724,1;740,8} == \$heap_{funcstart\_724,1}.\_\mathbf{replace}(p1 \to \mathbf{asType} < \mathbf{short}
int>((asType<int>(asType<short int>(div1.rem)) *
asType < int > (\$heap_{funcstart\_724,1}.r1)) - (asType < int > (asType < short)
\mathbf{int}{>}(\mathbf{div1}.\mathbf{quot})) \ * \ \mathbf{asType}{<} \mathbf{int}{>} (\$\mathbf{heap}_{funcstart\_724,1}.\mathbf{b1}))))
-asType < integer\ const > (\$heap_{724,1;740,8}.M1) < 1
asType<integer>($heap<sub>724.1:740.8</sub>.p1)
!(0 == asType < integer > (\$heap_{724,1:740.8}.p1))
```

```
asType<integer>($heap<sub>724.1:740.8</sub>.p1) <
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathrm{heap}_{724,1;740,8}.\mathrm{M1})
heap_{724,1:742,8} == heap_{724,1:740,8}.replace(p2 \rightarrow asType<short
int>((asType<int>(asType<short int>(div2.rem)) *
asType < int > (\$heap_{724.1:740.8}.r2)) - (asType < int > (asType < short)
int>(div2.quot)) * asType< int>($heap_{724,1;740,8}.b2))))
-asType < integer const > (\$heap_{724,1:742,8}.M2) < 
asType<integer>($heap<sub>724.1:742.8</sub>.p2)
!(0 == asType < integer > (\$heap_{724,1:742,8}.p2))
asType<integer>($heap<sub>724.1:742.8</sub>.p2) <
asType < integer > (\$heap_{724,1;742,8}.M2)
\text{sheap}_{724,1;744,8} == \text{sheap}_{724,1;742,8}. \text{replace}(p3 \to asType < short)
int>((asType<int>(asType<short int>(div3.rem)) *
asType < int > (\$heap_{724,1:742,8}.r3)) - (asType < int > (asType < short)
int>(div3.quot)) * asType<int>($heap<sub>724.1:742.8</sub>.b3))))
-asType < integer\ const > (\$heap_{724,1;744,8}.M3) < 100
asType < integer > ($heap_{724,1;744,8}.p3)
!(0 == asType < integer > (\$heap_{724,1:744.8}.p3))
asType<integer>($heap<sub>724.1:744.8</sub>.p3) <
asType < integer > (\$heap_{724,1;744,8}.M3)
Proof:
[Take given term]
[11.0] \operatorname{div1} == \operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724,1},
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p1}),
asType < int > (\$heap_{funcstart\_724,1}.a1))
\rightarrow [simplify]
[11.1] \operatorname{div1} == \operatorname{div}(\mathbf{heapIs} \operatorname{\$heap}_{funcstart\_724,1}, \operatorname{\$heap}_{funcstart\_724,1}.p1,
asType < int > (\$heap_{funcstart\_724,1}.a1))
\rightarrow [const static or extern object]
\textit{[11.2]} \ \text{div1} == \text{div}(\mathbf{heapIs} \ \$ \text{heap}_{funcstart\_724,1}, \ \$ \text{heap}_{funcstart\_724,1}.\text{p1},
asType < int > (\$heap_{init}.a1))
\rightarrow [expand definition of constant 'a1' at prang.c (16,20)]
[11.3] \ \mathrm{div1} == \mathrm{div}(\mathbf{heapIs} \ \$ \mathrm{heap}_{funcstart\_724,1}, \ \$ \mathrm{heap}_{funcstart\_724,1}.\mathrm{p1},
asType<int>(asType<short int>((int)177)))
\rightarrow [simplify]
[11.6] div1 == div(heapIs heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p1, 177)
[Take given term]
```

```
[25.0] div2 == div(heapIs $heap_{funcstart\_724,1},
asType < int > (\$heap_{funcstart\_724,1}.p2),
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{a2}))
\rightarrow [simplify]
[25.1] \operatorname{div2} == \operatorname{div}(\mathbf{heapIs} \operatorname{\$heap}_{funcstart\_724,1}, \operatorname{\$heap}_{funcstart\_724,1}.p2,
asType < int > (\$heap_{funcstart\_724,1}.a2))
\rightarrow [const static or extern object]
[25.2] div2 == div(heapIs $heap_{funcstart\_724,1}, $heap_{funcstart\_724,1}.p2,
asType < int > (\$heap_{init}.a2))
\rightarrow [expand definition of constant 'a2' at prang.c (21,20)]
\label{eq:continuous_section} \textit{[25.3]} \ \text{div2} == \ \text{div} \big( \mathbf{heapIs} \ \$ \text{heap}_{funcstart\_724,1}, \ \$ \text{heap}_{funcstart\_724,1}. \text{p2},
asType<int>(asType<short int>((int)176)))
\rightarrow [simplify]
[25.6] div2 == div(heapIs heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p2, 176)
[Take given term]
[39.0] div3 == div(heapIs $heap_{funcstart\_724,1},
asType < int > (\$heap_{funcstart\_724,1}.p3),
asType < int > (\$heap_{funcstart\_724,1}.a3))
\rightarrow [simplify]
[39.1] \ \mathrm{div3} == \mathrm{div}(\mathbf{heapIs} \ \$ \mathrm{heap}_{funcstart\_724,1}, \ \$ \mathrm{heap}_{funcstart\_724,1}.\mathrm{p3},
asType < int > (\$heap_{funcstart\_724,1}.a3))
\rightarrow [const static or extern object]
[39.2] \ \mathrm{div3} == \ \mathrm{div}(\mathbf{heapIs} \ \$ \mathrm{heap}_{funcstart\_724,1}, \ \$ \mathrm{heap}_{funcstart\_724,1}.\mathrm{p3},
asType < int > (\$heap_{init}.a3))
\rightarrow [expand definition of constant 'a3' at prang.c (26,20)]
[39.3] div3 == div(heapIs heap_{funcstart_{724,1}}, heap_{funcstart_{724,1}}.p3,
asType<int>(asType<short int>((int)178)))
\rightarrow [simplify]
[39.6] div3 == div(heapIs heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p3, 178)
[Take given term]
[53.0] \rho_{13,1;740,8} == \rho_{13,1;740,8} == \rho_{13,1;740,8} =- \rho_{
int>((asType<int>(asType<short int>(div1.rem)) *
asType < int > (\$heap_{funcstart\_724,1}.r1)) - (asType < int > (asType < short)
\mathbf{int}{>}(\mathbf{div1.quot})) \ * \ \mathbf{asType}{<} \mathbf{int}{>} (\$\mathbf{heap}_{funcstart\_724,1}.\mathbf{b1}))))
\rightarrow [from term 11.6, div1 is equal to div(heapIs $heap_{funcstart\_724,1},
heap_{funcstart_{-724,1}}.p1, 177
```

```
[53.1] \theta == 
int>((asType<int>(asType<short int>(div(heapIs $heap_{funcstart_724,1},))
\theta_{funcstart\_724,1.p1, 177}.rem) * asType < int > (\theta_{funcstart\_724,1.r1}) - (\theta_{funcstart\_724,1.r1}
(asType<int>(asType<short int>(div1.quot)) *
asType < int > (\$heap_{funcstart\_724,1}.b1))))
\rightarrow [simplify]
[53.3] heap_{724,1:740,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow asType<short
int>((div(heapIs \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1, 177).rem *
\mathbf{asType} < \mathbf{int} > (\$ \mathrm{heap}_{funcstart\_724,1}.\mathrm{r1})) - (\mathbf{asType} < \mathbf{int} > (\mathbf{asType} < \mathbf{short}))
int>(div1.quot)) * asType<int>($heap_{tuncstart, 724,1}.b1))))
\rightarrow [const static or extern object]
[53.4] heap_{724,1;740,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow asType<short
int>((div(heapIs \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1, 177).rem *
asType < int > (\$heap_{init}.r1)) - (asType < int > (asType < short)
\mathbf{int}{>}(\mathbf{div1}.\mathbf{quot})) \ * \ \mathbf{asType}{<} \mathbf{int}{>} (\$\mathbf{heap}_{funcstart\_724,1}.\mathbf{b1}))))
\rightarrow [expand definition of constant 'r1' at prang.c (15,20)]
[53.5] heap_{724,1;740,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow asType<short
int>((div(heapIs \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1, 177).rem *
asType < int > (asType < short int > ((int)171))) -
(asType<int>(asType<short int>(div1.quot)) *
asType < int > (\$heap_{funcstart\ 724.1}.b1))))
\rightarrow [simplify]
[53.8] heap_{724,1:740.8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow asType<short
int>((div(heapIs \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1, 177).rem * 171)
 - (asType<int>(asType<short int>(div1.quot)) *
asType < int > (\$heap_{funcstart\_724,1}.b1))))
\rightarrow [from term 11.6, div1 is equal to div(heapIs $heap_{funcstart\_724,1},
heap_{funcstart_{-724,1}}.p1, 177
[53.9] heap_{724,1;740,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow asType<short
int>((171 * div(heapIs $heap_{funcstart\_724,1}, $heap_{funcstart\_724,1}.p1, 177).rem)
 - (asType < int > (asType < short int > (div(heapIs $heap_{funcstart\_724,1},
heap_{funcstart_{-724,1}}.p1, 177).quot)
asType < int > (\$heap_{funcstart_{724,1}}.b1)))
\rightarrow [simplify]
[53.11] \$ heap_{724,1;740,8} == \$ heap_{funcstart\_724,1}.\_\mathbf{replace} (p1 \to \mathbf{asType} < \mathbf{short})
int>((171 * div(heapIs $heap_{funcstart\_724,1}, $heap_{funcstart\_724,1}.p1, 177).rem)
- (div(heapIs \rho_{funcstart\_724,1}, \rho_{funcstart\_724,1.p1}, 177).quot *
asType < int > (\$heap_{funcstart\_724,1}.b1)))
\rightarrow [const static or extern object]
[53.12] $\text{heap}_{724,1:740.8} == \text{heap}_{funcstart\_724,1}._\text{replace}(p1 \rightarrow \text{asType} < \text{short}
```

```
int>((171 * div(heapIs \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1, 177).rem)
- (\text{div}(\mathbf{heapIs} \$ \text{heap}_{funcstart\_724,1}, \$ \text{heap}_{funcstart\_724,1}.\text{p1}, 177).\text{quot} *
asType < int > (\$heap_{init}.b1)))
\rightarrow [expand definition of constant 'b1' at prang.c (17,20)]
[53.13] heap_{724,1;740,8} == heap_{funcstart\_724,1}.replace(p1 \rightarrow asType<short
int>((171 * div(heapIs \$heap_{tuncstart\_724.1}, \$heap_{tuncstart\_724.1}, p1, 177).rem)
- (\text{div}(\mathbf{heapIs} \$ \text{heap}_{funcstart\_724,1}, \$ \text{heap}_{funcstart\_724,1}.\text{p1}, 177).\text{quot} *
asType<int>(asType<short int>((int)2))))
\rightarrow [simplify]
[53.19] $\text{heap}_{724,1;740,8} == \text{$heap}_{funcstart\_724,1}._\text{$replace}(p1 \to ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 \ *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.\operatorname{p1}, \ 177).\operatorname{rem})))
[Take given term]
[56.0] asType<integer>($heap<sub>724.1:740.8</sub>.p1) <
asType<integer>($heap<sub>724.1:740.8</sub>.M1)
\rightarrow [from term 53.19, $heap<sub>724,1;740.8</sub> is equal to
heap_{funcstart\_724,1}._replace(p1 \rightarrow (-2 * div(heapIs heap_{funcstart\_724,1}),
heap_{funcstart\_724.1}.p1, 177).quot + (171 * div(heapIs p_{funcstart\_724.1})
heap_{funcstart_{-724,1}}.p1, 177).rem)
\operatorname{div}(\mathbf{heapIs} \ \operatorname{heap}_{funcstart\_724,1}, \ \operatorname{heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 \ *
div(\mathbf{heapIs} \ \$heap_{funcstart\_724.1}, \ \$heap_{funcstart\_724.1}.p1, \ 177).rem))).p1) <
asType<integer>($heap<sub>724,1:740,8</sub>.M1)
\rightarrow [simplify]
[56.3] ((-2 * div(heapIs heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p1,
177).quot) + (171 * div(heapIs heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p1,
(177).rem) < asType < integer > (\$heap_{724.1:740.8}.M1)
\rightarrow [from term 53.19, $heap<sub>724,1;740,8</sub> is equal to
heap_{funcstart\_724,1}._replace(p1 \rightarrow (-2 * div(heapIs heap_{funcstart\_724,1}),
heap_{funcstart\_724,1}.p1, 177).quot + (171 * div(heapIs $heap_{funcstart\_724,1}, 177).quot) + (171 * div(heapIs $heap_{funcstart\_724,1}, 17
heap_{funcstart_{-724,1}}.p1, 177).rem)
\label{eq:continuous} \textit{[56.4]} \ ((-2\ ^* \ \mathrm{div}(\mathbf{heapIs}\ \$ \mathrm{heap}_{funcstart\_724,1},\ \$ \mathrm{heap}_{funcstart\_724,1}.\mathrm{p1},
177).quot) + (171 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_724.1}, \text{\$heap}_{funcstart\_724.1}.\text{p1},
177).rem)) < asType<integer>($heap<sub>funcstart_724,1</sub>._replace(p1 \rightarrow ((-2 *
div(\mathbf{heapIs} \ \text{$heap}_{funcstart\_724,1}, \ \text{$heap}_{funcstart\_724,1}.p1, \ 177).quot) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.\operatorname{p1}, \ 177).\operatorname{rem}))).\operatorname{M1})
→ [const member of object with modified fields]
\textit{[56.5]} \ (\textit{(-2*div}(\textbf{heapIs}\ \$\text{heap}_{funcstart\_724,1},\ \$\text{heap}_{funcstart\_724,1}.\text{p1},
177).quot) + (171 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_724.1}, \text{\$heap}_{funcstart\_724.1}, \text{p1},
(177).rem) < asType < integer > (\$heap_{funcstart\_724,1}.M1)
```

```
\rightarrow [const static or extern object]
[56.6] ((-2 * div(heapIs heap_{funcstart_{-724,1}}, heap_{funcstart_{-724,1}}, p1,
177).quot) + (171 * div(heapIs heap_{funcstart}, heap_{funcstart}, heap_{funcstart}, p_1,
(177).rem) < asType < integer > (\$heap_{init}.M1)
\rightarrow [expand definition of constant 'M1' at prang.c (14,20)]
[56.7] ((-2 * div(heapIs heap_{funcstart_{724,1}}, heap_{funcstart_{724,1}}, ]
177).quot) + (171 * div(heapIs $heap_{funcstart\_724,1}, $heap_{funcstart\_724,1}.p1,
177).rem)) < \mathbf{asType} < \mathbf{integer} > (\mathbf{asType} < \mathbf{short\ int} > ((\mathbf{int})30269))
\rightarrow [simplify]
[56.17] -30269 < ((-171 * div(heapIs $heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1}.\text{p1}, 177).\text{rem} + (2 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
heap_{funcstart_{-724,1}}.p1, 177).quot)
[Take given term]
[57.0] $\text{heap}_{724,1:742,8} == $\text{heap}_{724,1:740.8}._\text{replace}(p2 \to \text{asType} < \text{short}
int>((asType<int>(asType<short int>(div2.rem)) *
asType < int > (\$heap_{724,1:740,8}.r2)) - (asType < int > (asType < short)
int>(div2.quot)) * asType<int>($heap<sub>724.1:740.8</sub>.b2))))
\rightarrow [from term 53.19, $heap<sub>724,1;740,8</sub> is equal to
heap_{funcstart\_724,1}._replace(p1 \rightarrow (-2 * div(heapIs heap_{funcstart\_724,1}),
heap_{funcstart\_724,1}.p1, 177).quot + (171 * div(heapIs $heap_{funcstart\_724,1},
heap_{funcstart_{-724,1},p1,177,rem})
[57.1] \rho_{17.42,8} == \rho_{17.42,1}.\_replace = \rho_{17.42,1}.\_replace
div(\mathbf{heapIs} \ \$heap_{funcstart\_724,1}, \ \$heap_{funcstart\_724,1}.p1, \ 177).quot) + (171 *
\operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724,1}, \$ \operatorname{heap}_{funcstart\_724,1}.p1,
177).rem))).\_replace(p2 \rightarrow asType < short
int>((asType<int>(asType<short\ int>(div2.rem))*
\mathbf{asType} < \mathbf{int} > (\$ heap_{724,1;740,8}.r2)) - (\mathbf{asType} < \mathbf{int} > (\mathbf{asType} < \mathbf{short})
int>(div2.quot)) * asType< int>($heap_{724,1;740,8}.b2))))
\rightarrow [from term 25.6, div2 is equal to div(heapIs $heap_{funcstart_724,1},
heap_{funcstart_{724,1}}.p2, 176
[57.2] heap_{724,1;742,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 *
\operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724.1}, \$ \operatorname{heap}_{funcstart\_724.1}.p1,
177).rem)))._replace(p2 \rightarrow asType<short
int>((asType<int>(asType<short int>(div(heapIs $heap_{funcstart\_724,1},))
\text{sheap}_{funcstart\_724,1.p2, 176}.\text{rem}) * asType < int > (\text{sheap}_{724,1;740,8.r2})) -
(asType<int>(asType<short int>(div2.quot)) *
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{724,1;740,8}.\mathrm{b2}))))
\rightarrow [simplify]
[57.4] $heap<sub>724.1:742.8</sub> == $heap<sub>funcstart_724.1</sub>._replace(p1 \rightarrow ((-2 *
```

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\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).quot) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow asType<short int>((div(heapIs
\text{Sheap}_{funcstart_{-724,1}}, \text{Sheap}_{funcstart_{-724,1}}.p2, 176).rem *
asType < int > (\$heap_{724,1:740,8}.r2)) - (asType < int > (asType < short)
int>(div2.quot)) * asType< int>($heap_{724,1;740,8}.b2))))
\rightarrow [from term 53.19, $heap<sub>724,1;740,8</sub> is equal to
heap_{funcstart\_724,1}._replace(p1 \rightarrow (-2 * div(heapIs heap_{funcstart\_724,1}),
\text{Sheap}_{funcstart\_724,1}.p1, 177).quot) + (171 * div(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
heap_{funcstart_{-724,1}}.p1, 177).rem)
[57.5] heap_{724,1;742,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 \ *
\operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724,1}, \$ \operatorname{heap}_{funcstart\_724,1}.p1,
(177).rem))._replace(p2 \rightarrow asType<short int>((div(heapIs)))._replace(p2 \rightarrow asType
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.p2, 176).rem *
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathbf{\_replace}(\mathrm{p1} \rightarrow ((-2 * \mathrm{div}(\mathbf{heapIs}
\theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}
heap_{funcstart_{724.1}}, heap_{funcstart_{724.1}}, 177).rem)).r2)) -
(asType<int>(asType<short int>(div2.quot)) *
asType<int>($heap<sub>724.1:740.8</sub>.b2))))
\rightarrow [const member of object with modified fields]
[57.6] heap_{724,1;742,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.\operatorname{p1}, \ 177).\operatorname{quot}) + (171 \ *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1,
177).rem)))._{\mathbf{replace}}(p2 \rightarrow \mathbf{asType} < \mathbf{short\ int} > ((\operatorname{div}(\mathbf{heapIs}))))
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.p2, 176).rem *
asType < int > (\$heap_{tuncstart\_724.1}.r2)) - (asType < int > (asType < short)
int>(div2.quot)) * asType< int>($heap_{724.1:740.8}.b2))))
\rightarrow [const static or extern object]
[57.7] heap_{724,1;742,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 \ *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724.1}, \ \$ \operatorname{heap}_{funcstart\_724.1}.p1,
177).rem)))._{\mathbf{replace}}(p2 \rightarrow \mathbf{asType} < \mathbf{short\ int} > ((\operatorname{div}(\mathbf{heapIs}))))
heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p2, 176).rem *
asType < int > (\$heap_{init}.r2)) - (asType < int > (asType < short)
int>(div2.quot)) * asType<int>($heap<sub>724.1:740.8</sub>.b2))))
\rightarrow [expand definition of constant 'r2' at prang.c (20,20)]
[57.8] heap_{724,1;742,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1,
177).rem)))._{\mathbf{replace}}(p2 \rightarrow \mathbf{asType} < \mathbf{short\ int} > ((\operatorname{div}(\mathbf{heapIs}))))
heap_{funcstart_{724,1}}, heap_{funcstart_{724,1}}, 176).rem *
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asType<int>(asType<short int>((int)172))) -
(asType<int>(asType<short int>(div2.quot)) *
asType < int > (\$heap_{724,1;740,8}.b2))))
\rightarrow [simplify]
[57.11] $\text{heap}_{724,1;742,8} == \text{$heap}_{funcstart\_724,1}._\text{$replace}(p1 \to ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow asType<short int>((div(heapIs
heap_{funcstart_{724,1}}, heap_{funcstart_{724,1}}, p2, 176).rem * 172) -
(asType<int>(asType<short int>(div2.quot)) *
asType<int>($heap<sub>724,1:740,8</sub>.b2))))
\rightarrow [from term 25.6, div2 is equal to div(heapIs $heap_{funcstart\_724,1},
heap_{funcstart_{-724,1},p2,176}
[57.12] $heap<sub>724,1;742,8</sub> == $heap<sub>funcstart_724,1</sub>._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).quot) + (171 *
\operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724,1}, \$ \operatorname{heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow asType<short int>((172 * div(heapIs
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.p2, 176).rem) -
(asType<int>(asType<short int>(div(heapIs $heap_{tuncstart_724.1},
\text{sheap}_{funcstart\_724,1}.\text{p2}, 176).\text{quot})) * asType < int > (\text{sheap}_{724,1:740.8}.\text{b2}))))
\rightarrow [simplify]
[57.14] $heap<sub>724,1;742,8</sub> == $heap<sub>funcstart_724,1</sub>._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).quot) + (171 *
\operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724,1}, \$ \operatorname{heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow asType<short int>((172 * div(heapIs
heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p2, 176).rem) - (div(heapIs
heap_{funcstart_{724,1}}, heap_{funcstart_{724,1}}.p2, 176).quot *
asType < int > (\$heap_{724,1;740,8}.b2))))
\rightarrow [from term 53.19, $heap<sub>724.1:740.8</sub> is equal to
heap_{funcstart\_724,1}._replace(p1 \rightarrow (-2 * div(heapIs \$heap_{funcstart\_724,1},
heap_{funcstart_{724,1},p1, 177}, quot) + (171 * div(heapIs heap_{funcstart_{724,1},p1, 177})
heap_{funcstart_{-724,1}}.p1, 177).rem)
[57.15] $heap<sub>724,1;742,8</sub> == $heap<sub>funcstart_724,1</sub>._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1,
177).rem)))._{\mathbf{replace}}(p2 \rightarrow \mathbf{asType} < \mathbf{short\ int} > ((172 * div(\mathbf{heapIs}))))
\theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}.p2, 176).rem) - (div(heapIs
heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p2, 176).quot *
asType < int > (\$heap_{funcstart\_724,1}.\_replace(p1 \rightarrow ((-2 * div(heapIs)))))))
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.\text{p1}, 177).\text{quot}) + (171 * \text{div}(\text{heapIs}))
\text{Sheap}_{funcstart_{-724,1}}, \text{Sheap}_{funcstart_{-724,1}}.p1, 177).rem))).b2))))
\rightarrow [const member of object with modified fields]
```

```
[57.16] $heap<sub>724,1;742,8</sub> == $heap<sub>funcstart_724,1</sub>._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 \ *
\label{eq:div_heap} \text{div}(\textbf{heapIs} \ \$ \text{heap}_{funcstart\_724,1}, \ \$ \text{heap}_{funcstart\_724,1}.\text{p1},
177).rem)))._replace(p2 \rightarrow asType<short int>((172 * div(heapIs
\theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}.p2, 176).rem) - \theta_{funcstart\_724,1}.p2, 176).rem) - \theta_{funcstart\_724,1}
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.p2, 176).quot *
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{b2}))))
\rightarrow [const static or extern object]
[57.17] $heap<sub>724,1;742,8</sub> == $heap<sub>funcstart_724,1</sub>._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 *
\operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724,1}, \$ \operatorname{heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow asType<short int>((172 * div(heapIs
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.\text{p2}, 176).\text{rem}) - (\text{div}(\text{heapIs})
heap_{funcstart_{724,1}}, heap_{funcstart_{724,1}}, 2, 176, quot
\mathbf{asType} < \mathbf{int} > (\$ \mathrm{heap}_{init}.\mathrm{b2}))))
\rightarrow [expand definition of constant 'b2' at prang.c (22,20)]
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 \ *
\operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724.1}, \$ \operatorname{heap}_{funcstart\_724.1}.p1,
177).rem)))._replace(p2 \rightarrow asType<short int>((172 * div(heapIs
\theta_{funcstart_{-724,1}}, \theta_{funcstart_{-724,1},p2, 176}.rem - (div(heapIs)) - (div(heapIs))
\theta_{funcstart_{724,1}}, \theta_{funcstart_{724,1},p2,176}.quot *
asType<int>(asType<short int>((int)35)))))
\rightarrow [simplify]
[57.24] $\text{heap}_{724,1;742,8} == \text{$heap}_{funcstart\_724,1}._\text{$-replace}(p1 \to ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 \ *
\operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724,1}, \$ \operatorname{heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow ((-35 * div(heapIs $heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1}.\text{p2}, 176).\text{quot} + (172 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
heap_{funcstart_{-724,1}}.p2, 176).rem))
[Take given term]
[61.0] $\text{heap}_{724,1:744,8} == $\text{heap}_{724,1:742,8}.$\text{-replace}(p3 \to asType < short)
int>((asType<int>(asType<short int>(div3.rem)) *
asType < int > (\$heap_{724.1:742.8}.r3)) - (asType < int > (asType < short)
int>(div3.quot)) * asType< int>($heap_{724.1:742.8}.b3))))
\rightarrow [from term 57.24, $heap<sub>724,1;742,8</sub> is equal to
heap_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 * div(heapIs $heap_{funcstart\_724,1},
heap_{funcstart\_724,1}.p1, 177).quot + (171 * div(heapIs $heap_{funcstart\_724,1}, 177).quot) + (171 * div(heapIs $heap_{funcstart\_724,1}, 17
\rho_{uncstart\_724,1}.p1, 177).rem))).\_replace(p2 \rightarrow (-35 * div(heapIs))).
heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p2, 176).quot) + (172 * div(heapIs)
heap_{funcstart_{724,1}}, heap_{funcstart_{724,1}}, p_2, 176).rem)
```

```
[61.1] heap_{724,1;744,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).quot) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow ((-35 * div(heapIs $heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1}.\text{p2}, 176).\text{quot} + (172 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
\theta_{funcstart\_724,1}.p2, 176).rem))._replace(p3 \rightarrow asType<short
int>((asType<int>(asType<short int>(div3.rem)) *
asType < int > (\$heap_{724,1:742.8}.r3)) - (asType < int > (asType < short)
int>(div3.quot)) * asType<int>($heap<sub>724.1:742.8</sub>.b3))))
\rightarrow [from term 39.6, div3 is equal to div(heapIs $heap_{funcstart\_724,1},
heap_{funcstart_{-724,1}}.p3, 178
[61.2] heap_{724,1;744,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 \ *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow ((-35 * div(heapIs $heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1}.\text{p2}, 176).\text{quot}) + (172 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
\rho_{funcstart\_724,1.p2, 176}.rem))._replace(p3 \rightarrow asType<short
int>((asType<int>(asType<short int>(div(heapIs $heap_{funcstart\_724,1},))
\rho_{tuncstart_{724,1},p3,178,rem} ** asType<int>($\phi_{tuncstart_{724,1},742,8}.r3)) -
(asType<int>(asType<short int>(div3.quot)) *
asType<int>($heap<sub>724.1:742.8</sub>.b3))))
\rightarrow [simplify]
[61.4] heap_{724,1;744,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).quot) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow ((-35 * div(heapIs $heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1}.\text{p2}, 176).\text{quot} + (172 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
\theta_{funcstart\_724,1.p2, 176}.rem))._replace(p3 \rightarrow asType<short
int>((div(heapIs \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p3, 178).rem *
asType < int > (\$heap_{724.1:742.8}.r3)) - (asType < int > (asType < short)
int>(div3.quot)) * asType<int>($heap<sub>724,1:742,8</sub>.b3))))
\rightarrow [from term 57.24, $\$heap_{724,1;742,8}$ is equal to
heap_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 * div(heapIs $heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1}.\text{p1}, 177).\text{quot} + (171 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
\rho_{funcstart\_724,1}.p1, 177).rem))._replace\rho_{funcstart\_724,1}.p1, 177).rem)
heap_{funcstart_{724,1}}, heap_{funcstart_{724,1}}, p_{funcstart_{724,1}}, p_{funcstart_{724,1}}, p_{funcstart_{724,1}}
heap_{funcstart_{724,1}}, heap_{funcstart_{724,1}}, p2, 176).rem)
div(\mathbf{heapIs} \ \$heap_{funcstart\_724,1}, \ \$heap_{funcstart\_724,1}.p1, \ 177).quot) + (171 *
\operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724,1}, \$ \operatorname{heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow ((-35 * div(heapIs $heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1.p2}, 176).\text{quot} + (172 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
\theta_{funcstart\_724,1.p2, 176).rem}))._replace(p3 \rightarrow asType<short
```

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int>((div(heapIs \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p3, 178).rem *
asType < int > (\$heap_{funcstart\_724,1}.\_replace(p1 \rightarrow ((-2 * div(heapIs))))))
\$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1, 177).quot) + (171 * div(\textbf{heapIs}) + (171 * div(\textbf{heapIs})) + (171
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.\text{p1}, 177).\text{rem}))._replace(p2 \rightarrow ((-35)
* div(\mathbf{heapIs} \ \$ heap_{funcstart\_724,1}, \ \$ heap_{funcstart\_724,1}.p2, \ 176).quot) + (172 \ *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.\operatorname{p2}, \ 176).\operatorname{rem}))).\operatorname{r3})) \ -
(asType<int>(asType<short int>(div3.quot)) *
asType<int>($heap<sub>724.1:742.8</sub>.b3))))
\rightarrow [const member of object with modified fields]
[61.7] $heap<sub>724,1:744,8</sub> == $heap<sub>funcstart_724,1</sub>._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 *
\label{eq:div_heap} \text{div}(\textbf{heapIs} \ \$ \text{heap}_{funcstart\_724,1}, \ \$ \text{heap}_{funcstart\_724,1}.\text{p1},
177).rem)))._replace(p2 \rightarrow ((-35 * div(heapIs $heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1}.\text{p2}, 176).\text{quot} + (172 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
\rho_{uncstart\_724,1.p2, 176).rem}))._replace(p3 \rightarrow asType<short
int>((div(heapIs \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p3, 178).rem *
asType < int > (\$heap_{funcstart\_724,1}.r3)) - (asType < int > (asType < short)
int>(div3.quot)) * asType< int>($heap_{724.1:742.8}.b3))))
\rightarrow [const static or extern object]
[61.8] heap_{724,1;744,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).quot) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow ((-35 * div(heapIs $heap_{funcstart_724.1},
\text{Sheap}_{funcstart\_724,1}.\text{p2}, 176).\text{quot} + (172 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
\theta_{1} = \theta_{1} - \theta_{2} - \theta_{3} - \theta_{4} - \theta_{5} - \theta_{6} - \theta_{6
int>((div(heapIs \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p3, 178).rem *
asType < int > (\$heap_{init}.r3)) - (asType < int > (asType < short)
int>(div3.quot)) * asType< int>($heap_{724.1:742.8}.b3))))
\rightarrow [expand definition of constant 'r3' at prang.c (25.20)]
[61.9] $heap<sub>724,1:744,8</sub> == $heap<sub>funcstart_724,1</sub>._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 \ *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow ((-35 * div(heapIs $heap_{funcstart_724.1},
\text{Sheap}_{funcstart\_724,1}.\text{p2}, 176).\text{quot} + (172 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
\frac{\text{sheap}_{funcstart\_724,1.p2, 176}.rem)}{\text{sheap}_{funcstart\_724,1.p2, 176}.rem)}._replace(p3 \rightarrow asType<short
int > ((div(heapIs \$heap_{funcstart\_724.1}, \$heap_{funcstart\_724.1}, p3, 178).rem *
asType<int>(asType<short int>((int)170))) -
(asType<int>(asType<short int>(div3.quot)) *
asType < int > (\$heap_{724,1;742,8}.b3))))
\rightarrow [simplify]
[61.12] $heap<sub>724,1;744,8</sub> == $heap<sub>funcstart_724,1</sub>._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 *
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\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow ((-35 * div(heapIs $heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1.p2}, 176).\text{quot} + (172 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
\theta_{funcstart\_724,1}.p2, 176).rem))._replace(p3 \rightarrow asType<short
int>((div(heapIs \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p3, 178).rem * 170)
- (asType<int>(asType<short int>(div3.quot)) *
asType<int>($heap<sub>724.1:742.8</sub>.b3))))
\rightarrow [from term 39.6, div3 is equal to div(heapIs $heap_{funcstart\_724.1},
heap_{funcstart_{-724,1}}.p3, 178
[61.13] heap_{724,1;744,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 *
\label{eq:div_heap} \text{div}(\textbf{heapIs} \ \$ \text{heap}_{funcstart\_724,1}, \ \$ \text{heap}_{funcstart\_724,1}.\text{p1},
177).rem)))._replace(p2 \rightarrow ((-35 * div(heapIs $heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1}.\text{p2}, 176).\text{quot} + (172 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
\rho_{uncstart\_724,1.p2, 176).rem}))._replace(p3 \rightarrow asType<short int>((170
* div(heapIs heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p3, 178).rem) –
(asType<int>(asType<short int>(div(heapIs $heap_{funcstart\_724,1},))
\text{sheap}_{funcstart_724,1.p3}, 178).\text{quot}) * asType<int>(\text{sheap}_{724,1:742.8.b3}))))
\rightarrow [simplify]
[61.15] $\text{heap}_{724,1;744,8} == \text{$heap}_{funcstart_724,1}._\text{$\bf replace}(p1 \to ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).quot) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow ((-35 * div(heapIs $heap_{tuncstart_724.1},
\text{Sheap}_{funcstart\_724,1}.\text{p2}, 176).\text{quot} + (172 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
\frac{\text{sheap}_{funcstart\_724,1.p2, 176}.rem)}{\text{.replace}(p3 \rightarrow asType < short int} > ((170))
* div(heapIs heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p3, 178).rem) –
(\text{div}(\mathbf{heapIs} \$ \text{heap}_{funcstart\_724,1}, \$ \text{heap}_{funcstart\_724,1}.\text{p3}, 178).\text{quot} *
asType<int>($heap<sub>724.1:742.8</sub>.b3))))
\rightarrow [from term 57.24, $heap<sub>724,1;742,8</sub> is equal to
heap_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 * div(heapIs $heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1}.p1, 177).quot) + (171 * div(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
heap_{funcstart\_724,1}.p1, 177).rem))._replace(p2 \rightarrow (-35 * div(heapIs)))._
heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p2, 176).quot) + (172 * div(heapIs)
heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p2, 176).rem))]
[61.16] $\text{heap}_{724,1;744,8} == $\text{heap}_{funcstart\_724,1}._\text{replace}(p1 \to ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 *
\operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724,1}, \$ \operatorname{heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow ((-35 * div(heap
Is \rho_{tart\_724,1}
\rho_{funcstart_{-724,1},p2, 176} = 176, quot) + (172 * div(heapIs \rho_{funcstart_{-724,1},p2} = 176).
\rho_{tuncstart\_724,1.p2, 176}.rem))._replace(p3 \rightarrow asType<short int>((170
* div(heapIs heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p3, 178).rem) –
(\text{div}(\mathbf{heapIs} \$ \text{heap}_{funcstart\_724,1}, \$ \text{heap}_{funcstart\_724,1}.\text{p3}, 178).\text{quot} *
\mathbf{asType}{<}\mathbf{int}{>}(\$\text{heap}_{funcstart\_724,1}.\mathbf{\_replace}(\text{p1} \rightarrow ((\text{-2} * \text{div}(\mathbf{heapIs}
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\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.\text{p1}, 177).\text{quot}) + (171 * \text{div}(\text{heapIs})
\$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1, 177).rem))).\_\mathbf{replace}(p2 \rightarrow ((-35), -20)))
* div(\mathbf{heapIs} \ \$ heap_{funcstart\_724,1}, \ \$ heap_{funcstart\_724,1}.p2, \ 176).quot) + (172 \ *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.\operatorname{p2}, \ 176).\operatorname{rem}))).\operatorname{b3}))))
→ [const member of object with modified fields]
[61.18] $heap<sub>724,1;744,8</sub> == $heap<sub>funcstart_724,1</sub>._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).quot) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow ((-35 * div(heapIs $heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\ 724,1}.\text{p2},\ 176).\text{quot}) + (172 * \text{div}(\text{heapIs} \text{Sheap}_{funcstart\ 724,1},
\rho_{tuncstart\_724,1.p2, 176, rem})._replace(p3 \rightarrow asType<short int>((170
* \operatorname{div}(\mathbf{heapIs} \ \text{$heap}_{funcstart\_724,1}, \ \text{$heap}_{funcstart\_724,1}.p3, \ 178).rem) -
(\text{div}(\mathbf{heapIs} \$ \text{heap}_{funcstart\_724,1}, \$ \text{heap}_{funcstart\_724,1}.\text{p3}, 178).\text{quot} *
asType < int > (\$heap_{funcstart\_724,1}.b3)))
\rightarrow [const static or extern object]
[61.19] $heap<sub>724,1;744,8</sub> == $heap<sub>funcstart_724,1</sub>._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow ((-35 * div(heapIs $heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1.p2}, 176).\text{quot} + (172 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
\frac{\text{sheap}_{funcstart\_724,1.p2, 176}.rem)}{\text{.replace}(p3 \rightarrow asType < short int} > ((170))
* div(heapIs heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p3, 178).rem) –
(\text{div}(\mathbf{heapIs} \$ \text{heap}_{funcstart\_724.1}, \$ \text{heap}_{funcstart\_724.1}. \text{p3}, 178).\text{quot} *
asType < int > (\$heap_{init}.b3)))
\rightarrow [expand definition of constant 'b3' at prang.c (27,20)]
[61.20] $heap<sub>724,1;744,8</sub> == $heap<sub>funcstart_724,1</sub>._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 \ \text{*}
\operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724,1}, \$ \operatorname{heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow ((-35 * div(heapIs $heap_{funcstart_724.1},
\text{Sheap}_{funcstart\_724,1}.\text{p2}, 176).\text{quot} + (172 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
\rho_{tuncstart\_724.1.p2, 176).rem})._replace(p3 \rightarrow asType<short int>((170
* div(heapIs heap_{funcstart\_724.1}, heap_{funcstart\_724.1}, n_{funcstart\_724.1}, n_{funcstart\_724.1}
(\text{div}(\mathbf{heapIs} \ \$ \text{heap}_{funcstart\_724.1}, \ \$ \text{heap}_{funcstart\_724.1}. \text{p3}, \ 178). \text{quot} \ *
asType<int>(asType<short int>((int)63))))
\rightarrow [simplify]
[61.26] $heap<sub>724,1;744,8</sub> == $heap<sub>funcstart_724,1</sub>._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 *
\operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724.1}, \$ \operatorname{heap}_{funcstart\_724.1}.p1,
177).rem)))._replace(p2 \rightarrow ((-35 * div(heapIs $heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1}.\text{p2}, 176).\text{quot} + (172 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
\theta_{uncstart\_724,1}.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)))))._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))))))))))))
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.p3, 178).quot) + (170 * div(heapIs)
```

```
heap_{funcstart_{-724,1}}, heap_{funcstart_{-724,1}}, 178).rem)))
[Take goal term]
[1.0] $heap<sub>724.1:744.8</sub>.p1 \leq maxof(int)
\rightarrow [from term 61.26, $heap<sub>724,1;744,8</sub> is equal to
heap_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 * div(heapIs $heap_{funcstart\_724,1},
heap_{funcstart\_724,1}.p1, 177).quot + (171 * div(heapIs p_{funcstart\_724,1})
\rho_{funcstart\_724,1.p1, 177}.rem))._replace\rho_{funcstart\_724,1.p1, 177}.rem))._replace
heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p2, 176).quot) + (172 * div(heapIs)
heap_{funcstart_{724,1}}, heap_{funcstart_{724,1}}, p_{funcstart_{724,1}}, p_{funcstart_{724,1}}
div(\mathbf{heapIs} \ \$heap_{funcstart\_724,1}, \ \$heap_{funcstart\_724,1}.p3, \ 178).quot) + (170 *
div(\mathbf{heapIs} \ \$heap_{funcstart\_724,1}, \ \$heap_{funcstart\_724,1}.p3, \ 178).rem))]
[1.1] \text{sheap}_{funcstart\_724.1}._replace(p1 \rightarrow ((-2 * div(heapIs
\$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1, 177).quot) + (171 * div(\textbf{heapIs}) + (171 * div(\textbf{heapIs})) + (171
* div(\mathbf{heapIs} \ \$ heap_{funcstart\_724,1}, \ \$ heap_{funcstart\_724,1}.p2, \ 176).quot) + (172 \ *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.p2,
176).rem)))._replace(p3 \rightarrow ((-63 * div(heapIs $heap_{funcstart\_724,1},
heap_{funcstart\_724,1}.p3, 178).quot + (170 * div(heapIs $heap_{funcstart\_724,1},
\theta_{funcstart\_724,1.p3}, 178).rem).p1 \leq \max_{funcstart\_724,1.p3}
\rightarrow [simplify]
[1.18] -32768 < ((-171 * div(heapIs $heap_{tuncstart}, 724.1))
\text{Sheap}_{funcstart\_724,1}.\text{p1}, 177).\text{rem} + (2 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
heap_{funcstart_{-724,1}}.p1, 177).quot)
\rightarrow [from term 56.17, literala < ((-171 * div(heapIs $heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1}.p1, 177).rem + (2 * div(heapIs \text{Sheap}_{funcstart\_724,1},
heap_{funcstart_{-724,1}}.p1, 177).quot) is true whenever (-1 + literala) < -30269
        Proof of rule precondition:
        [1.18.0] (-32768 + -1) < -30269
        \rightarrow [simplify]
        [1.18.2] true
[1.19] true
Proof of verification condition: Type constraint satisfied in implicit
conversion from 'int' to 'short int'
Condition generated at: C:\Escher\Customers\prang\prang.c (63.8)
Condition defined at:
```

To prove: minof(short int)  $\leq$  ((asType<int>(\$heap<sub>724,1;744,8</sub>.M1) \* asType<int>(static\_cast<integer>(asType<int>(\$heap<sub>724,1:744,8</sub>.p1) <

 $(int)(0) + asType < int > (sheap_{724.1:744.8}.p1)$ 

## Given:

```
heap_{init}.LIMIT == (int)80
\theta sheap<sub>init</sub>.M1 == asType<short int>((int)30269)
\theta_{init}.r1 == asType < short int > ((int)171)
heap_{init}.a1 == asType < short int > ((int)177)
\theta = asType < short int > ((int)2)
\theta sheap<sub>init</sub>.M2 == asType<short int>((int)30307)
\theta_{init}.r2 == asType < short int > ((int)172)
heap_{init}.a2 == asType < short int > ((int)176)
\theta = asType < short int > ((int)35)
\theta sheap<sub>init</sub>.M3 == asType<short int>((int)30323)
\theta_{init}.r3 == asType<short int>((int)170)
heap_{init}.a3 == asType<short int>((int)178)
\theta = asType < short int > ((int)63)
\theta = asType < short int > ((int)1)
\theta
\theta = asType < short int > ((int)3)
invariant
1(heapIs heap_{funcstart_{-724,1}})
\operatorname{div1} == \operatorname{div}(\mathbf{heapIs} \ \operatorname{\$heap}_{funcstart\_724,1},
asType < int > (\$heap_{funcstart\_724,1}.p1),
asType < int > (\$heap_{funcstart\_724,1}.a1))
(asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.p1)) /
\mathbf{asType}{<}\mathbf{integer}{>}(\mathbf{asType}{<}\mathbf{int}{>}(\$\mathbf{heap}_{funcstart\_724,1}.\mathbf{a1}))) = =
asType<integer>(div1.quot)
(asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.p1)) \%
\mathbf{asType}{<}\mathbf{integer}{>}(\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{a1}))) = =
asType<integer>(div1.rem)
!(0 == asType < integer > (div1.rem)) || !(0 ==
asType<integer>(div1.quot))
div2 == div(\mathbf{heapIs} \$heap_{funcstart\_724,1},
asType < int > (\$heap_{funcstart\_724,1}.p2),
asType < int > (\$heap_{funcstart\_724,1}.a2))
(asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.p2)) /
asType<integer>(asType<int>($heap_{tuncstart\_724.1}.a2))) ==
asType<integer>(div2.quot)
(asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.p2)) \%
```

```
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a2))) = =
asType<integer>(div2.rem)
!(0 == asType < integer > (div2.rem)) || !(0 ==
asType<integer>(div2.quot))
div3 == div(\mathbf{heapIs} \$heap_{funcstart\_724,1},
asType < int > (\$heap_{funcstart\_724,1}.p3),
asType < int > (\$heap_{funcstart\_724,1}.a3))
(\mathbf{asType}{<}\mathbf{integer}{>}(\mathbf{asType}{<}\mathbf{int}{>}(\$\mathbf{heap}_{funcstart\_724,1}.\mathbf{p3})) \ / \\
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a3))) = =
asType<integer>(div3.quot)
(asType<integer>(asType<int>($heap_{tuncstart\_724.1}.p3)) %
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a3))) = =
asType<integer>(div3.rem)
!(0 == asType < integer > (div3.rem)) || !(0 ==
asType<integer>(div3.quot))
heap_{724,1;740,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow asType<short
int>((asType<int>(asType<short int>(div1.rem)) *
asType < int > (\$heap_{funcstart\_724,1}.r1)) - (asType < int > (asType < short)
\mathbf{int}{>}(\mathbf{div1.quot})) * \mathbf{asType}{<} \mathbf{int}{>} (\$\mathbf{heap}_{funcstart\_724,1}.\mathbf{b1}))))
-asType<integer const>($heap<sub>724,1:740,8</sub>.M1) <
asType<integer>($heap<sub>724.1:740.8</sub>.p1)
!(0 == asType < integer > (\$heap_{724,1:740,8}.p1))
asType<integer>($heap<sub>724,1:740,8</sub>.p1) <
asType<integer>($heap<sub>724.1:740.8</sub>.M1)
\text{heap}_{724.1:742.8} == \text{heap}_{724.1:740.8}._replace(p2 \rightarrow asType<short)
int>((asType<int>(asType<short int>(div2.rem)) *
asType < int > (\$heap_{724.1:740.8}.r2)) - (asType < int > (asType < short)
int>(div2.quot)) * asType< int>($heap_{724.1:740.8}.b2))))
-asType < integer const > (\$heap_{724,1:742.8}.M2) < 
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathrm{heap}_{724,1;742,8}.\mathrm{p2})
!(0 == asType < integer > (\$heap_{724,1;742,8}.p2))
asType<integer>($heap<sub>724.1:742.8</sub>.p2) <
asType<integer>($heap<sub>724,1;742,8</sub>.M2)
\text{$heap}_{724,1;744,8} == \text{$heap}_{724,1;742,8}.\_\textbf{replace}(p3 \to \textbf{asType} < \textbf{short}
int>((asType<int>(asType<short int>(div3.rem)) *
asType < int > (\$heap_{724,1.742,8.}r3)) - (asType < int > (asType < short)
int>(div3.quot)) * asType< int>($heap_{724,1:742,8}.b3))))
-{\bf asType}{<}{\bf integer~const}{>}(\${\rm heap}_{724,1;744,8}.{\rm M3}) <
asType<integer>($heap<sub>724,1:744,8</sub>.p3)
```

```
!(0 == asType < integer > (\$heap_{724,1;744,8}.p3))
asType<integer>($heap<sub>724.1:744.8</sub>.p3) <
asType<integer>($heap<sub>724,1:744,8</sub>.M3)
Proof:
[Take given term]
[11.0] div1 == div(heapIs heap_{funcstart\_724,1},
asType < int > (\$heap_{funcstart\_724,1}.p1),
asType < int > (\$heap_{funcstart\_724,1}.a1))
\rightarrow [simplify]
[11.1] \operatorname{div1} == \operatorname{div}(\mathbf{heapIs} \operatorname{\$heap}_{funcstart\_724,1}, \operatorname{\$heap}_{funcstart\_724,1}.p1,
asType < int > (\$heap_{funcstart\_724,1}.a1))
\rightarrow [const static or extern object]
[11.2] \ \mathrm{div1} == \mathrm{div}(\mathbf{heapIs} \ \$ \mathrm{heap}_{funcstart\_724,1}, \ \$ \mathrm{heap}_{funcstart\_724,1}.\mathrm{p1},
\mathbf{asType}{<}\mathbf{int}{>}(\$\text{heap}_{init}.\text{a1}))
\rightarrow [expand definition of constant 'a1' at prang.c (16,20)]
[11.3] \operatorname{div1} == \operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724,1}, \$ \operatorname{heap}_{funcstart\_724,1}.p1,
asType<int>(asType<short int>((int)177)))
\rightarrow [simplify]
[11.6] div1 == div(heapIs \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}.p1, 177)
[Take given term]
[25.0] \operatorname{div2} == \operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724,1},
asType < int > ($heap_{funcstart\_724,1}.p2),
asType < int > (\$heap_{funcstart\_724,1}.a2))
\rightarrow [simplify]
[25.1] div2 == div(heapIs $heap_{tuncstart\_724.1}, $heap_{tuncstart\_724.1}.p2,
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{a2}))
\rightarrow [const static or extern object]
\label{eq:continuous} \mbox{\sc [25.2] div2} == \mbox{\sc div}(\mathbf{heapIs} \ \$\mbox{\sc heap}_{funcstart\_724,1}, \ \$\mbox{\sc heap}_{funcstart\_724,1}.\mbox{\sc p2},
asType < int > ($heap_{init}.a2))
\rightarrow [expand definition of constant 'a2' at prang.c (21,20)]
[25.3]~{\rm div2} == {\rm div}(\mathbf{heapIs}~\$ \mathrm{heap}_{funcstart\_724,1},\,\$ \mathrm{heap}_{funcstart\_724,1}.\mathrm{p2},
asType<int>(asType<short int>((int)176)))
\rightarrow [simplify]
[25.6] div2 == div(heapIs $heap_{funcstart\_724,1}$, $heap_{funcstart\_724,1}.p2, 176)
[Take given term]
[39.0] \operatorname{div3} == \operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724,1},
```

```
\mathbf{asType} < \mathbf{int} > (\$ heap_{funcstart\_724,1}.p3),
asType < int > (\$heap_{funcstart\_724,1}.a3))
\rightarrow [simplify]
[39.1] \ \mathrm{div3} == \mathrm{div}(\mathbf{heapIs} \ \$ \mathrm{heap}_{funcstart\_724,1}, \ \$ \mathrm{heap}_{funcstart\_724,1}.\mathrm{p3},
asType < int > (\$heap_{funcstart\_724,1}.a3))
\rightarrow [const static or extern object]
[39.2] div3 == div(heapIs heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p3,
asType < int > (\$heap_{init}.a3))
\rightarrow [expand definition of constant 'a3' at prang.c (26,20)]
[39.3] \operatorname{div3} == \operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724,1}, \$ \operatorname{heap}_{funcstart\_724,1}.p3,
asType<int>(asType<short int>((int)178)))
\rightarrow [simplify]
[39.6] \ \mathrm{div3} == \mathrm{div}(\mathbf{heapIs} \ \$ \mathrm{heap}_{funcstart\_724,1}, \ \$ \mathrm{heap}_{funcstart\_724,1}.\mathrm{p3}, \ 178)
[Take given term]
[53.0] \rho_{1740,8} == \rho_{1740
int>((asType<int>(asType<short\ int>(div1.rem))*
asType < int > (\$heap_{funcstart\_724,1}.r1)) - (asType < int > (asType < short)
int>(div1.quot)) * asType< int>($heap_{funcstart\_724,1}.b1))))
\rightarrow [from term 11.6, div1 is equal to div(heapIs $heap_{tuncstart_724.1},
heap_{funcstart_{-724,1}.p1, 177}
[53.1] \theta == 
int>((asType<int>(asType<short int>(div(heapIs $heap_{funcstart\_724,1},
\theta_{funcstart\_724,1.p1, 177}.rem) * asType < int > (\theta_{funcstart\_724,1.r1}) - (\theta_{funcstart\_724,1.r1}
(asType<int>(asType<short int>(div1.quot)) *
asType < int > (\$heap_{funcstart\_724,1}.b1))))
\rightarrow [simplify]
[53.3] heap_{724,1:740,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow asType<short
int>((div(heapIs \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1, 177).rem *
asType < int > (\$heap_{funcstart\_724,1}.r1)) - (asType < int > (asType < short)
int>(div1.quot)) * asType< int>($heap_{funcstart\_724,1}.b1))))
\rightarrow [const static or extern object]
[53.4] heap_{724,1;740,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow asType<short
int>((div(heapIs \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1, 177).rem *
asType < int > (\$heap_{init}.r1)) - (asType < int > (asType < short)
int>(div1.quot)) * asType< int>($heap_{funcstart\_724,1}.b1))))
\rightarrow [expand definition of constant 'r1' at prang.c (15,20)]
\text{[53.5] \$heap}_{724,1;740,8} == \$heap_{funcstart\_724,1}.\_\textbf{replace}(p1 \rightarrow \textbf{asType} < \textbf{short}
int>((div(heapIs \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1, 177).rem *
```

```
asType<int>(asType<short int>((int)171))) -
(asType<int>(asType<short int>(div1.quot)) *
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{b1}))))
\rightarrow [simplify]
[53.8] heap_{724,1;740,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow asType<short
int>((div(heapIs \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1, 177).rem * 171)
- (asType<int>(asType<short int>(div1.quot))
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{b1}))))
\rightarrow [from term 11.6, div1 is equal to div(heapIs $heap_{funcstart_{724,1}},
heap_{funcstart_{724,1}}.p1, 177
[53.9] heap_{724,1:740.8} == heap_{funcstart\_724,1}-replace(p1 \rightarrow asType<short
int>((171 * div(heapIs \$heap_{funcstart\_724.1}, \$heap_{funcstart\_724.1}, p1, 177).rem)
- (asType<int>(asType<short int>(div(heapIs $heap_{funcstart\_724,1},))
heap_{funcstart_{724,1},p1,177}, quot)) *
asType < int > (\$heap_{funcstart\_724,1}.b1)))
\rightarrow [simplify]
[53.11] \theta_{13} = \theta_
int>((171 * div(heapIs $heap_{funcstart\_724,1}, $heap_{funcstart\_724,1}.p1, 177).rem)
- (\text{div}(\mathbf{heapIs} \$ \text{heap}_{funcstart\_724,1}, \$ \text{heap}_{funcstart\_724,1}.\text{p1}, 177).\text{quot} *
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{b1}))))
\rightarrow [const static or extern object]
[53.12] $\text{heap}_{724.1:740.8} == $\text{heap}_{funcstart\_724.1}._\text{replace}(p1 \rightarrow \text{asType} < \text{short}
int>((171 * div(heapIs \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1, 177).rem)
- (\text{div}(\mathbf{heapIs} \$ \text{heap}_{funcstart\_724,1}, \$ \text{heap}_{funcstart\_724,1}.\text{p1}, 177).\text{quot} *
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{init}.\mathrm{b1}))))
\rightarrow [expand definition of constant 'b1' at prang.c (17,20)]
[53.13] heap_{724,1;740,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow asType<short
int>((171 * div(heapIs $heap_{funcstart\_724,1}, $heap_{funcstart\_724,1}.p1, 177).rem)
- (\text{div}(\textbf{heapIs} \$ \text{heap}_{funcstart\_724,1}, \$ \text{heap}_{funcstart\_724,1}.\text{p1}, 177).\text{quot} *
asType<int>(asType<short int>((int)2))))
\rightarrow [simplify]
[53.19] heap_{724,1;740,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, 177).rem)))
[Take given term]
[54.0] -asType<integer const>($heap<sub>724 1.740 8</sub>.M1) <
asType<integer>($heap<sub>724,1;740,8</sub>.p1)
\rightarrow [from term 53.19, $heap<sub>724,1;740,8</sub> is equal to
heap_{funcstart\_724,1}._replace(p1 \rightarrow (-2 * div(heapIs heap_{funcstart\_724,1}),
```

```
heap_{funcstart\_724,1}.p1, 177).quot + (171 * div(heapIs $heap_{funcstart\_724,1},
heap_{funcstart_{724,1}.p1, 177).rem}
[54.1] -asType<integer const>($heap_{funcstart\_724,1}.\_replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 *
div(heapIs \$heap_{funcstart\_724.1}, \$heap_{funcstart\_724.1.pl}, 177).rem))).M1) <
asType<integer>($heap<sub>724,1;740,8</sub>.p1)
\rightarrow [const member of object with modified fields]
[54.2] -asType<integer const>($heap_{tuncstart\_724.1}.M1) <
asType<integer>($heap<sub>724,1;740,8</sub>.p1)
\rightarrow [const static or extern object]
[54.3] -asType<integer const>($heap_{init}.M1) <
asType<integer>($heap<sub>724,1;740,8</sub>.p1)
\rightarrow [expand definition of constant 'M1' at prang.c (14,20)]
[54.4] - \mathbf{asType} < \mathbf{integer\ const} > (\mathbf{asType} < \mathbf{short\ int} > ((\mathbf{int})30269)) < \mathbf{asType} < \mathbf{onst} > (\mathbf{asType} < \mathbf{onst} > (\mathbf{onst}) > (\mathbf{onst}) < \mathbf{onst} > (\mathbf{onst}) > (\mathbf{onst}) < \mathbf{onst} > (\mathbf{onst}) > (\mathbf{onst}) > (\mathbf{onst}) < \mathbf{onst} > (\mathbf{onst}) > (\mathbf{onst}
asType<integer>($heap<sub>724,1:740,8</sub>.p1)
\rightarrow [simplify]
[54.8] -30269 < asType < integer > ($heap_{724.1:740.8}.p1)
\rightarrow [from term 53.19, $heap<sub>724,1:740.8</sub> is equal to
heap_{funcstart\_724,1}._replace(p1 \rightarrow (-2 * div(heapIs heap_{funcstart\_724,1}),
\text{Sheap}_{funcstart\_724,1}.\text{p1}, 177).\text{quot} + (171 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
heap_{funcstart_{-724,1}.p1, 177).rem}
[54.9] -30269 < asType<integer>($heap_funcstart_724.1._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).quot) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.p1, \ 177).rem))).p1)
\rightarrow [simplify]
 \label{eq:funcstart_724,1} \text{-}30269 < ((-2 * \text{div}(\textbf{heapIs} \$ \text{heap}_{funcstart\_724,1}, \$ \text{heap}_{funcstart\_724,1}.\text{p1},
177).quot) + (171 * div(heapIs heap_{funcstart_{-724,1}}, heap_{funcstart_{-724,1}}, p_1,
177).rem))
[Take given term]
[55.0]!(0 == asType < integer > (\$heap_{724,1;740,8}.p1))
\rightarrow [from term 53.19, \rho_{724,1;740,8} is equal to
heap_{funcstart\_724,1}._replace(p1 \rightarrow (-2 * div(heapIs heap_{funcstart\_724,1}),
\text{Sheap}_{funcstart\_724,1}.p1, 177).quot) + (171 * div(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
heap_{funcstart_{-724,1},p1, 177,rem}
[55.1] !(0 == asType<integer>($heap_{funcstart\_724,1}.replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).quot) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \text{$heap}_{funcstart\_724,1}, \ \text{$heap}_{funcstart\_724,1}.p1, \ 177).rem))).p1))
\rightarrow [simplify]
```

```
[55.3] !(0 == ((-2 * div(heapIs $heap_{funcstart_{-724,1}}, $heap_{funcstart_{-724,1}}.p1,
177).quot) + (171 * div(heapIs heapI_{funcstart_{724,1}}, heap_{funcstart_{724,1}}, p_1,
177).rem)))
[Take given term]
[57.0] $\text{heap}_{724,1:742,8} == $\text{heap}_{724,1:740,8}._\text{replace}(p2 \rightarrow \text{asType} < \text{short}
int>((asType<int>(asType<short int>(div2.rem)) *
asType < int > (\$heap_{724,1:740,8}.r2)) - (asType < int > (asType < short)
int>(div2.quot)) * asType< int>($heap_{724,1:740.8}.b2))))
\rightarrow [from term 53.19, $heap<sub>724,1;740,8</sub> is equal to
heap_{funcstart\_724,1}._replace(p1 \rightarrow (-2 * div(heapIs heap_{funcstart\_724,1}),
heap_{funcstart\_724,1}.p1, 177).quot + (171 * div(heapIs $heap_{funcstart\_724,1},
heap_{funcstart_{-724,1}}.p1, 177).rem)
[57.1] heap_{724,1;742,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 *
\operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724,1}, \$ \operatorname{heap}_{funcstart\_724,1}.p1,
(177).rem))._replace(p2 \rightarrow asType < short)
int>((asType<int>(asType<short\ int>(div2.rem))*
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{724,1;740,8}.\mathrm{r2})) - (\mathbf{asType}{<}\mathbf{int}{>}(\mathbf{asType}{<}\mathbf{short}
int>(div2.quot)) * asType< int>($heap_{724.1:740.8}.b2))))
\rightarrow [from term 25.6, div2 is equal to div(heapIs $heap_{funcstart\_724,1},
heap_{funcstart_{-724,1}}.p2, 176
[57.2] heap_{724,1;742,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).quot) + (171 *
\operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724,1}, \$ \operatorname{heap}_{funcstart\_724,1}.p1,
(177).rem))._replace(p2 \rightarrow asType<short
int>((asType<int>(asType<short int>(div(heapIs $heap_{funcstart\_724.1},
\text{sheap}_{funcstart\_724,1.p2, 176}.\text{rem}) * asType < int > (\text{sheap}_{724,1;740,8.r2})) -
(asType<int>(asType<short int>(div2.quot)) *
asType<int>($heap<sub>724.1:740.8</sub>.b2))))
\rightarrow [simplify]
[57.4] heap_{724,1;742,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).quot) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow asType<short int>((div(heapIs
\theta_{funcstart_{724,1}}, \theta_{funcstart_{724,1}}, \theta_{funcstart_{724,1}}, \theta_{funcstart_{724,1}}
\mathbf{asType} \small{<} \mathbf{int} \small{>} (\$ \mathrm{heap}_{724,1;740,8}.\mathrm{r2})) \\ - (\mathbf{asType} \small{<} \mathbf{int} \small{>} (\mathbf{asType} \small{<} \mathbf{short} \\
int>(div2.quot)) * asType<int>($heap<sub>724.1:740.8</sub>.b2))))
\rightarrow [from term 53.19, $heap<sub>724,1:740,8</sub> is equal to
heap_{funcstart\ 724.1}._replace(p1 \rightarrow (-2 * div(heapIs \$heap_{funcstart\ 724.1},
heap_{funcstart\_724,1}.p1, 177).quot + (171 * div(heapIs $heap_{funcstart\_724,1}, 177).quot) + (171 * div(heapIs $heap_{funcstart\_724,1}, 17
heap_{funcstart_{-724,1}.p1, 177).rem}
```

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[57.5] heap_{724,1;742,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 \ *
\label{eq:div_heap} \text{div}(\textbf{heapIs} \ \$ \text{heap}_{funcstart\_724,1}, \ \$ \text{heap}_{funcstart\_724,1}.\text{p1},
(177).rem))._replace(p2 \rightarrow asType<short int>((div(heapIs)))._replace(p2)
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.\text{p2}, 176).\text{rem} *
asType < int > (\$heap_{funcstart\_724,1}.\_replace(p1 \rightarrow ((-2 * div(heapIs))))))
\theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}
heap_{funcstart_{724,1}}, heap_{funcstart_{724,1},p1, 177}.rem)).r2)) -
(asType<int>(asType<short int>(div2.quot)) *
\mathbf{asType}{<}\mathbf{int}{>}(\${\rm heap}_{724,1;740,8}.{\rm b2}))))
→ [const member of object with modified fields]
[57.6] \rho_{7.6}=0 $heap_{724,1;742,8} == $heap_{funcstart_724,1}._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 *
\operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724,1}, \$ \operatorname{heap}_{funcstart\_724,1}.p1,
177).rem)))._{\mathbf{replace}}(p2 \rightarrow \mathbf{asType} < \mathbf{short\ int} > ((\operatorname{div}(\mathbf{heapIs}))))
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.p2, 176).rem *
asType < int > (\$heap_{funcstart\_724,1}.r2)) - (asType < int > (asType < short)
int>(div2.quot)) * asType< int>($heap_{724.1:740.8}.b2))))
\rightarrow [const static or extern object]
[57.7] heap_{724,1;742,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 \ *
\operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724,1}, \$ \operatorname{heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow asType<short int>((div(heapIs
heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p2, 176).rem *
asType < int > (\$heap_{init}.r2)) - (asType < int > (asType < short)
int>(div2.quot)) * asType<int>($heap<sub>724.1:740.8</sub>.b2))))
\rightarrow [expand definition of constant 'r2' at prang.c (20,20)]
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1,
177).rem)))._{\mathbf{replace}}(p2 \rightarrow \mathbf{asType} < \mathbf{short\ int} > ((\operatorname{div}(\mathbf{heapIs}))))
heap_{funcstart_{724,1}}, heap_{funcstart_{724,1}}, p_{176}.rem *
asType<int>(asType<short int>((int)172))) -
(asType<int>(asType<short int>(div2.quot)) *
asType<int>($heap<sub>724.1:740.8</sub>.b2))))
\rightarrow [simplify]
[57.11] $\text{heap}_{724,1;742,8} == \text{$heap}_{funcstart\_724,1}._\text{$replace}(p1 \to ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1,
177).rem)))._{\mathbf{replace}}(p2 \rightarrow \mathbf{asType} < \mathbf{short\ int} > ((\operatorname{div}(\mathbf{heapIs}))))
heap_{funcstart_{-724,1}}, heap_{funcstart_{-724,1}}.p2, 176).rem * 172) -
(asType<int>(asType<short int>(div2.quot)) *
```

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asType<int>($heap<sub>724.1:740.8</sub>.b2))))
\rightarrow [from term 25.6, div2 is equal to div(heapIs $heap_{funcstart\_724,1},
heap_{funcstart_{-724,1}}.p2, 176
[57.12] heap_{724,1;742,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).quot) + (171 *
\operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724.1}, \$ \operatorname{heap}_{funcstart\_724.1}.p1,
177).rem)))._replace(p2 \rightarrow asType<short int>((172 * div(heapIs
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.p2, 176).rem) -
(asType < int > (asType < short int > (div(heapIs $heap_{funcstart\_724,1}, 
\text{Sheap}_{funcstart\ 724,1}.p2,\ 176).quot) * asType<int>(\text{Sheap}_{724,1:740.8}.b2))))
\rightarrow [simplify]
[57.14] $\text{heap}_{724,1;742,8} == \text{$heap}_{funcstart\_724,1}._\text{$replace}(p1 \to ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow asType<short int>((172 * div(heapIs
heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p2, 176).rem) - (div(heapIs
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.p2, 176).quot *
asType < int > (\$heap_{724,1;740,8}.b2))))
\rightarrow [from term 53.19, $heap<sub>724,1;740,8</sub> is equal to
heap_{funcstart\_724.1}._replace(p1 \rightarrow (-2 * div(heapIs heap_{funcstart\_724.1},
\text{Sheap}_{funcstart\_724,1}.\text{p1}, 177).\text{quot} + (171 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
heap_{funcstart_{-724,1}}.p1, 177).rem)
[57.15] $heap<sub>724,1;742,8</sub> == $heap<sub>funcstart_724,1</sub>._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 \ *
\operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724,1}, \$ \operatorname{heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow asType<short int>((172 * div(heapIs
heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p2, 176).rem) - (div(heapIs)
\theta_{funcstart_{724,1}}, \theta_{funcstart_{724,1},p2, 176}.quot *
asType < int > (\$heap_{funcstart\_724,1}.\_replace(p1 \rightarrow ((-2 * div(heapIs)))))))
\theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}.pl, 177).quot) + (171 * div(heapIs
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.p1, 177).rem))).b2))))
\rightarrow [const member of object with modified fields]
[57.16] $heap<sub>724,1;742,8</sub> == $heap<sub>funcstart_724,1</sub>._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow asType<short int>((172 * div(heapIs
\theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}.p2, 176).rem) - (div(heapIs
heap_{funcstart_{724,1}}, heap_{funcstart_{724,1}}.p2, 176).quot *
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{b2}))))
\rightarrow [const static or extern object]
[57.17] $\text{heap}_{724,1;742,8} == \text{$heap}_{funcstart\_724,1}._\text{$replace}(p1 \to ((-2 *
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\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).quot) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow asType<short int>((172 * div(heapIs
heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p2, 176).rem) - (div(heapIs
p_{funcstart_{-724,1}}, p_{funcstart_{-724,1},p_{2,176}}.quot *
asType < int > (\$heap_{init}.b2))))
\rightarrow [expand definition of constant 'b2' at prang.c (22,20)]
[57.18] \rho_{724,1;742,8} == \rho_{11,742,8} == \rho_{12,11,124,1} ._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).quot) + (171 *
\operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724,1}, \$ \operatorname{heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow asType<short int>((172 * div(heapIs
\theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}
heap_{funcstart_{724,1}}, heap_{funcstart_{724,1}}, 2, 176).quot *
asType<int>(asType<short int>((int)35)))))
\rightarrow [simplify]
[57.24] $heap<sub>724,1;742,8</sub> == $heap<sub>funcstart_724,1</sub>._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow ((-35 * div(heapIs $heap_{tuncstart_724.1},
\text{Sheap}_{funcstart\_724,1.p2}, 176).\text{quot} + (172 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
heap_{funcstart_{-724,1}}.p2, 176).rem))
[Take given term]
[61.0] $\text{heap}_{724,1:744,8} == $\text{heap}_{724,1:742,8}._\text{replace}(p3 \to \text{asType} < \text{short}
int>((asType<int>(asType<short int>(div3.rem)) *
asType < int > (\$heap_{724.1:742.8}.r3)) - (asType < int > (asType < short)
int > (div3.quot)) * asType < int > (\$heap_{724,1;742,8}.b3))))
\rightarrow [from term 57.24, $heap<sub>724,1;742,8</sub> is equal to
heap_{funcstart\_724.1}._replace(p1 \rightarrow ((-2 * div(heapIs $heap_{funcstart\_724.1},
\text{Sheap}_{funcstart_{-724,1},p1, 177}.\text{quot}) + (171 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart_{-724,1}})
\rho_{funcstart\_724,1}.p1, 177).rem))._replace(p2 \rightarrow (-35 * div(heapIs))
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.p2, 176).quot) + (172 * div(\textbf{heapIs})
heap_{funcstart_{-724,1}}, heap_{funcstart_{-724,1}}, p2, 176).rem)
[61.1] heap_{724,1;744,8} == heap_{funcstart\_724,1}.\_replace(p1 \to ((-2 * 
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow ((-35 * div(heapIs $heap_{funcstart\_724,1},
\theta_{funcstart\_724,1}.p2, 176.quot) + (172 * div(heapIs \theta_{funcstart\_724,1},
\theta_{tuncstart\_724,1}, p2, 176).rem)))._replace(p3 \rightarrow asType<short
int>((asType<int>(asType<short int>(div3.rem)) *
asType < int > (\$heap_{724,1;742,8}.r3)) - (asType < int > (asType < short)
int > (div3.quot)) * asType < int > (\$heap_{724,1;742,8}.b3))))
\rightarrow [from term 39.6, div3 is equal to div(heapIs $heap_{funcstart_{724,1}},
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heap_{funcstart_{-724,1}}.p3, 178
[61.2] heap_{724,1;744,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).quot) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow ((-35 * div(heapIs $heap_{tuncstart_724.1},
\text{Sheap}_{funcstart\_724.1.p2}, 176).\text{quot} + (172 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724.1},
\theta_{funcstart\_724,1}.p2, 176).rem))._replace(p3 \rightarrow asType<short
int>((asType<int>(asType<short int>(div(heapIs $heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1.p3}, 178).\text{rem}) * \mathbf{asType} < \mathbf{int} > (\text{Sheap}_{724,1:742.8}.\text{r3})) -
(asType<int>(asType<short int>(div3.quot)) *
asType < int > (\$heap_{724,1;742,8}.b3))))
\rightarrow [simplify]
[61.4] heap_{724,1;744,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 *
div(\mathbf{heapIs} \ \$heap_{funcstart\_724.1}, \ \$heap_{funcstart\_724.1}.p1, \ 177).quot) + (171 *
\operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724.1}, \$ \operatorname{heap}_{funcstart\_724.1}.p1,
177).rem)))._replace(p2 \rightarrow ((-35 * div(heapIs $heap_{funcstart\_724,1},
\text{Sheap}_{funcstart_{724,1},p2, 176}.quot) + (172 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart_{724,1}},
\theta_{uncstart_{724.1},p2,176}.rem)._replace(p3 \rightarrow asType<short
int>((div(heapIs \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p3, 178).rem *
asType < int > (\$heap_{724,1:742,8}.r3)) - (asType < int > (asType < short)
int>(div3.quot)) * asType<int>($heap<sub>724,1:742,8</sub>.b3))))
\rightarrow [from term 57.24, $heap<sub>724,1;742,8</sub> is equal to
\text{Sheap}_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 * div(heapIs $heap_{funcstart\_724,1}), the sheap funcstart\_724,1).
\text{Sheap}_{funcstart\_724,1}.\text{p1}, 177).\text{quot} + (171 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
\rho_{funcstart\_724,1}.p1, 177).rem))._replace\rho_{funcstart\_724,1}.p1, 177).rem))._replace
heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p2, 176).quot) + (172 * div(heapIs)
heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p2, 176).rem)
[61.5] heap_{724,1;744,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow ((-35 * div(heapIs $heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1}.\text{p2}, 176).\text{quot} + (172 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
\theta_{funcstart\_724,1}.p2, 176).rem))._replace(p3 \rightarrow asType<short
int>((div(heapIs \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p3, 178).rem *
\mathbf{asType}{<}\mathbf{int}{>}(\$\text{heap}_{funcstart\_724,1}.\_\mathbf{replace}(\text{p1} \rightarrow ((\text{-2} * \text{div}(\mathbf{heapIs}
\text{Sheap}_{funcstart_{724,1}}, \text{Sheap}_{funcstart_{724,1}}, \text{p1}, 177).\text{quot}) + (171 * \text{div}(\text{heapIs}))
\$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1, 177).rem))).\_\mathbf{replace}(p2 \rightarrow ((-35), -20)))
* div(heapIs heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p2, 176).quot) + (172 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724.1}, \ \text{\$heap}_{funcstart\_724.1}.p2, 176).rem))).r3)) -
(asType<int>(asType<short int>(div3.quot))
asType<int>($heap<sub>724,1;742,8</sub>.b3))))
→ [const member of object with modified fields]
[61.7] \rho_{1.7} = \rho_{1.744,8} = \rho_{1.744,8} = \rho_{1.744,8} = \rho_{1.744,1} ._replace(p1 \rightarrow ((-2 *
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\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).quot) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow ((-35 * div(heapIs $heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1.p2}, 176).\text{quot}) + (172 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
\theta_{funcstart\_724,1}.p2, 176).rem))._replace(p3 \rightarrow asType<short
int>((div(heapIs \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p3, 178).rem *
asType < int > (\$heap_{funcstart\_724,1}.r3)) - (asType < int > (asType < short)
int>(div3.quot)) * asType<int>($heap<sub>724.1:742.8</sub>.b3))))
\rightarrow [const static or extern object]
[61.8] heap_{724,1;744,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 *
\label{eq:div_heap} \text{div}(\textbf{heapIs} \ \$ \text{heap}_{funcstart\_724,1}, \ \$ \text{heap}_{funcstart\_724,1}.\text{p1},
177).rem)))._replace(p2 \rightarrow ((-35 * div(heapIs $heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1}.\text{p2}, 176).\text{quot} + (172 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
\rho_{uncstart\_724,1.p2, 176).rem}))._replace(p3 \rightarrow asType<short
int>((div(heapIs \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p3, 178).rem *
\mathbf{asType} {<} \mathbf{int} {>} (\$ \mathbf{heap}_{init}.\mathbf{r3})) - (\mathbf{asType} {<} \mathbf{int} {>} (\mathbf{asType} {<} \mathbf{short}
int>(div3.quot)) * asType<int>($heap<sub>724.1:742.8</sub>.b3))))
\rightarrow [expand definition of constant 'r3' at prang.c (25,20)]
[61.9] heap_{724,1;744,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).quot) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow ((-35 * div(heapIs $heap_{tuncstart_724.1},
\text{Sheap}_{funcstart\_724,1}.\text{p2}, 176).\text{quot} + (172 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
\theta_{1} = \theta_{1} - \theta_{2} - \theta_{3} - \theta_{4} - \theta_{5} - \theta_{6} - \theta_{6
int>((div(heapIs \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p3, 178).rem *
asType<int>(asType<short int>((int)170))) -
(asType<int>(asType<short int>(div3.quot)) *
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{724,1;742,8}.\mathrm{b3}))))
\rightarrow [simplify]
[61.12] heap_{724,1;744,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 \ *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow ((-35 * div(heapIs \rho_{tart\_724,1},
\text{Sheap}_{funcstart\_724.1.p2}, 176).\text{quot}) + (172 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724.1},
\theta_{uncstart_{724.1},p2,176,rem})._replace(p3 \rightarrow asType<short
int>((div(heapIs \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p3, 178).rem * 170)
- (asType < int > (asType < short int > (div3.quot))
asType < int > (\$heap_{724,1;742,8}.b3))))
\rightarrow [from term 39.6, div3 is equal to div(heapIs $heap_{funcstart\_724.1},
heap_{funcstart_{-724,1}}.p3, 178
[61.13] heap_{724,1;744,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 *
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\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).quot) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow ((-35 * div(heapIs $heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1}.\text{p2}, 176).\text{quot} + (172 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
\rho_{tuncstart\_724,1.p2, 176, rem})._replace(p3 \rightarrow asType<short int>((170
* div(heapIs heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p3, 178).rem) –
(asType<int>(asType<short int>(div(heapIs $heap_{funcstart\_724.1},
\text{Sheap}_{funcstart_{724,1},p3, 178}, \text{quot}) * \mathbf{asType} < \mathbf{int} > (\text{Sheap}_{724,1;742,8}, \text{b3}))))
\rightarrow [simplify]
[61.15] $\text{heap}_{724,1:744,8} == \text{$heap}_{funcstart\_724,1}._\text{$replace}(p1 \to ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow ((-35 * div(heapIs $heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1}.\text{p2}, 176).\text{quot} + (172 * \text{div}(\text{heapIs} \text{Sheap}_{funcstart\_724,1},
\rho_{uncstart_{-724,1},p2, 176,rem})._replace(p3 \rightarrow asType<short int>((170
* div(heapIs heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p3, 178).rem) –
(\text{div}(\mathbf{heapIs} \$ \text{heap}_{funcstart\_724,1}, \$ \text{heap}_{funcstart\_724,1}.\text{p3}, 178).\text{quot} *
asType<int>($heap<sub>724.1:742.8</sub>.b3))))
\rightarrow [from term 57.24, $heap<sub>724,1:742,8</sub> is equal to
\text{Sheap}_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 * div(\textbf{heapIs } \$heap_{funcstart\_724,1},
heap_{funcstart\_724,1}.p1, 177).quot + (171 * div(heapIs $heap_{funcstart\_724,1}, 177).quot) + (171 * div(heapIs $heap_{funcstart\_724,1}, 17
heap_{funcstart\_724,1}.p1, 177).rem)._replace(p2 \rightarrow (-35 * div(heapIs)))._
heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p2, 176).quot) + (172 * div(heapIs)
heap_{funcstart_{724,1}}, heap_{funcstart_{724,1}}, p2, 176).rem)
[61.16] $\text{heap}_{724,1;744,8} == \text{$heap}_{funcstart\_724,1}._\text{$replace}(p1 \to ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 *
\operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724,1}, \$ \operatorname{heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow ((-35 * div(heapIs $heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1}.\text{p2}, 176).\text{quot} + (172 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
\rho_{tuncstart=724.1}.p2, 176).rem))._replace(p3 \rightarrow asType<short int>((170
* div(heapIs heap_{funcstart\_724,1}, heap_{funcstart\_724,1}, n_{funcstart\_724,1}, n_{funcstart\_724,1}, n_{funcstart\_724,1}
(div(heapIs heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p3, 178).quot *
asType < int > (\$heap_{funcstart\_724,1}.\_replace(p1 \rightarrow ((-2 * div(heapIs)))))))
\theta_{funcstart_{724,1}}, \theta_{funcstart_{724,1},p1, 177}.quot) + (171 * div(heapIs)
\rho_{funcstart\_724,1}, \rho_{func
* div(\mathbf{heapIs} \ \$ heap_{funcstart\_724,1}, \ \$ heap_{funcstart\_724,1}.p2, \ 176).quot) + (172 \ *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p2, \ 176).rem))).b3))))
→ [const member of object with modified fields]
[61.18] $\text{heap}_{724,1;744,8} == \text{$heap}_{funcstart\_724,1}._\text{$_{-}}\text{replace}(p1 \to ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 *
\operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724,1}, \$ \operatorname{heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow ((-35 * div(heapIs $heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1.p2}, 176).\text{quot} + (172 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
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\rho_{tuncstart=724.1.p2, 176}.rem)._replace(p3 \rightarrow asType<short int>((170
* div(heapIs heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p3, 178).rem) –
(\text{div}(\mathbf{heapIs} \$ \text{heap}_{funcstart\_724,1}, \$ \text{heap}_{funcstart\_724,1}.\text{p3}, 178).\text{quot} *
asType < int > (\$heap_{funcstart\_724,1}.b3))))
\rightarrow [const static or extern object]
[61.19] $\text{heap}_{724,1;744,8} == \text{$heap}_{funcstart\_724,1}._\text{$replace}(p1 \to ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).quot) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow ((-35 * div(heapIs $heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\ 724.1.p2}, 176).\text{quot} + (172 * \text{div}(\text{heapIs} \text{Sheap}_{funcstart\ 724.1},
\rho_{funcstart\_724,1.p2, 176).rem})).\_replace(p3 \rightarrow asType < short int > ((170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 - 170 
* div(heapIs heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p3, 178).rem) –
(\text{div}(\mathbf{heapIs} \$ \text{heap}_{funcstart\_724,1}, \$ \text{heap}_{funcstart\_724,1}.\text{p3}, 178).\text{quot} *
asType < int > (\$heap_{init}.b3))))
\rightarrow [expand definition of constant 'b3' at prang.c (27,20)]
[61.20] heap_{724,1;744,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow ((-35 * div(heapIs $heap_{tuncstart_724.1},
\text{Sheap}_{funcstart\_724,1.p2}, 176).\text{quot} + (172 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
\rho_{tuncstart\_724,1.p2, 176}.rem)._replace(p3 \rightarrow asType<short int>((170
* div(heapIs heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p3, 178).rem) –
(\text{div}(\mathbf{heapIs} \$ \text{heap}_{funcstart\_724.1}, \$ \text{heap}_{funcstart\_724.1}. \text{p3}, 178).\text{quot} *
asType<int>(asType<short int>((int)63)))))
\rightarrow [simplify]
[61.26] $heap<sub>724,1;744,8</sub> == $heap<sub>funcstart_724,1</sub>._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{$heap}_{funcstart\_724,1}, \ \text{$heap}_{funcstart\_724,1}.p1, \ 177).quot) + (171 *
\operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724,1}, \$ \operatorname{heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow ((-35 * div(heapIs $heap_{funcstart_724.1},
\text{Sheap}_{funcstart\_724,1}.\text{p2}, 176).\text{quot} + (172 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
\rho_{funcstart\_724,1}.p2, 176).rem))._replace(p3 \rightarrow ((-63 * div(heapIs
\text{Sheap}_{funcstart\_724.1}, \text{Sheap}_{funcstart\_724.1}.p3, 178).quot) + (170 * div(heapIs)
heap_{funcstart_{724,1}}, heap_{funcstart_{724,1}}, 178).rem)
[Take goal term]
[1.0]  minof(short int) \leq ((asType < int > (\$heap_{724.1:744.8}.M1) *
asType<int>(static_cast<integer>(asType<int>($heap_{724.1:744.8}.p1) <
(int)(0) + asType<int>($heap<sub>724.1:744.8</sub>.p1))
\rightarrow [simplify]
[1.1] -32768 \leq ((asType<int>($heap<sub>724,1;744,8</sub>.M1) *
asType<int>(static_cast<integer>(asType<int>($heap<sub>724.1:744.8</sub>.p1) <
(int)(0)) + asType < int > ($heap_{724,1;744,8}.p1))
```

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\rightarrow [from term 61.26, $heap<sub>724,1;744,8</sub> is equal to
heap_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 * div(heapIs p_{funcstart\_724,1}),
heap_{funcstart\_724,1}.p1, 177).quot + (171 * div(heapIs $heap_{funcstart\_724,1},
heap_{funcstart\_724,1}.p1, 177).rem))._replace(p2 \rightarrow ((-35 * div(heapIs)))._
heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p2, 176).quot) + (172 * div(heapIs)
\theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}
div(\mathbf{heapIs} \ \$heap_{funcstart\_724,1}, \ \$heap_{funcstart\_724,1}.p3, \ 178).quot) + (170 *
\operatorname{div}(\mathbf{heapIs} \ \$ heap_{funcstart\_724,1}, \ \$ heap_{funcstart\_724,1}.p3, \ 178).rem))]
[1.2] -32768 \leq ((asType<int>($heap<sub>funcstart_724,1</sub>._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow ((-35 * div(heapIs $heap_{tuncstart_724.1},
\text{Sheap}_{funcstart_{-724,1},p2, 176}.quot) + (172 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart_{-724,1}},
\rho_{funcstart\_724,1.p2, 176}.rem)._replace(p3 \rightarrow ((-63 * div(heapIs
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.p3, 178).quot) + (170 * div(heapIs)
\rho_{funcstart_{724,1}}, \rho_{funcstart_{724,1},1}, \gamma_{178,178}.
asType<int>(static_cast<integer>(asType<int>($heap_{724,1:744,8}.p1) <
(int)(0) + asType<int>($heap<sub>724,1:744,8</sub>.p1))
→ [const member of object with modified fields]
[1.5] -32768 \le ((asType < int > (\$heap_{funcstart\_724,1}.M1) *
asType<int>(static_cast<integer>(asType<int>($heap_{724,1:744,8}.p1) <
(int)(0) + asType<int>($heap<sub>724,1:744,8</sub>.p1))
\rightarrow [const static or extern object]
[1.6] -32768 \le ((asType < int > (\$heap_{init}.M1) *)
asType<int>(static_cast<integer>(asType<int>($heap<sub>724.1:744.8</sub>.p1) <
(int)(0)) + asType < int > ($heap_{724,1;744,8}.p1))
\rightarrow [expand definition of constant 'M1' at prang.c (14,20)]
[1.7] -32768 \leq ((asType\leqint>(asType\leqshort int>((int)30269)) *
asType<int>(static_cast<integer>(asType<int>($heap<sub>724.1:744.8</sub>.p1) <
(int)(0)) + asType<int>($heap<sub>724,1:744,8</sub>.p1))
\rightarrow [simplify]
[1.10] -32768 < ((30269 *
asType<int>(static_cast<integer>(asType<int>($heap<sub>724.1:744.8</sub>.p1) <
(int)(0)) + asType < int > (\$heap_{724,1;744,8}.p1))
\rightarrow [from term 61.26, $heap<sub>724,1;744,8</sub> is equal to
heap_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 * div(heapIs $heap_{funcstart\_724,1},
heap_{funcstart_{724,1},p1, 177}, quot) + (171 * div(heapIs p_{funcstart_{724,1},p1, 177}).
\rho_{funcstart\_724,1}.p1, 177).rem))).\_replace(p2 \rightarrow ((-35 * div(heapIs))).\_replace(p2 \rightarrow ((-35 * div(heapIs)))).\_replace(p2 \rightarrow ((-35 * div(heapIs)))))
heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p2, 176).quot) + (172 * div(heapIs)
heap_{funcstart\_724.1}, heap_{funcstart\_724.1}, p2, p2, p3, p4, p3, p4, p3, p4, p3, p4, 
div(\mathbf{heapIs} \ \$heap_{funcstart\_724,1}, \ \$heap_{funcstart\_724,1}.p3, \ 178).quot) + (170 *
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div(\mathbf{heapIs} \ \$heap_{funcstart\_724,1}, \ \$heap_{funcstart\_724,1}.p3, \ 178).rem))]
[1.11] -32768 \le ((30269 *
asType < int > (static\_cast < integer > (asType < int > (sheap_{funcstart\_724.1}..replace(p1))
\rightarrow ((-2 * div(heapIs $heap_{funcstart\_724,1}, $heap_{funcstart\_724,1}.p1, 177).quot) +
(171 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_724.1}, \text{\$heap}_{funcstart\_724.1}.p1,
177).rem)))._replace(p2 \rightarrow ((-35 * div(heapIs $heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1}.\text{p2}, 176).\text{quot} + (172 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
\rho_{funcstart\_724,1.p2, 176}.rem))._replace(p3 \rightarrow ((-63 * div(heapIs
\text{Sheap}_{funcstart\_724.1}, \text{Sheap}_{funcstart\_724.1}.\text{p3}, 178).\text{quot}) + (170 * \text{div}(\text{heapIs}))
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.\text{p3}, 178).\text{rem})).\text{p1}) < (\text{int})0))) +
asType < int > (\$heap_{724,1;744,8}.p1))
\rightarrow [simplify]
[1.23] -32768 \leq ((30269 * asType<int>(([0 < ((-171 * div(heapIs)))))
\text{Sheap}_{funcstart\_724.1}, \text{Sheap}_{funcstart\_724.1}.\text{p1}, 177).\text{rem}) + (2 * \text{div}(\text{heapIs}))
heap_{funcstart_{724,1}}, heap_{funcstart_{724,1}}, 1, 177).quot): 1, []: 0))) +
asType<int>($heap<sub>724.1:744.8</sub>.p1))
→ [explicitly assert falsehood of skipped guards in subsequent guards]
[1.24] -32768 \leq ((30269 * asType<int>(([0 < ((-171 * div(heapIs)))))
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.\text{p1}, 177).\text{rem}) + (2 * \text{div}(\text{heapIs}))
\theta_{funcstart_{724,1}}, \theta_{funcstart_{724,1},p1, 177}.quot)): 1, [!\theta_{funcstart_{724,1},p1, 177}]: 1, [!\theta_{funcstart_{724,1},p1, 1
div(heapIs \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1, 177).rem) + (2 *
div(\mathbf{heapIs} \ \$heap_{funcstart\_724,1}, \ \$heap_{funcstart\_724,1}.p1, \ 177).quot)))]: 0))) +
asType < int > ($heap_{724,1;744,8}.p1))
\rightarrow [simplify]
[1.29] -32768 \leq ((30269 * asType<int>(([0 < ((-171 * div(heapIs
\text{Sheap}_{funcstart\_724.1}, \text{Sheap}_{funcstart\_724.1}.\text{p1}, 177).\text{rem} + (2 * \text{div}(\text{heapIs}))
\theta_{funcstart_{-724,1}}, \theta_{funcstart_{-724,1}}, 177).quot)): 1, [-1 < ((171 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).rem) + (-2 *
div(\mathbf{heapIs} \ \$heap_{funcstart=724.1}, \ \$heap_{funcstart=724.1}, p1, 177).quot))]: 0))) +
asType < int > ($heap_{724,1;744,8}.p1))
\rightarrow [from term 55.3, -1 < ((-2 * div(heapIs $heap_{funcstart\_724,1},
heap_{funcstart\_724,1}.p1, 177).quot + (171 * div(heapIs $heap_{funcstart\_724,1}, 177).quot) + (171 * div(heapIs $heap_{funcstart\_724,1}, 17
heap_{funcstart\_724.1.p1}, 177).rem) is true if and only if 0 < ((-2 * div(heapIs)))
heap_{funcstart\_724.1}, heap_{funcstart\_724.1}.p1, 177).quot) + (171 * div(heapIs)
heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p1, 177).rem))]
[1.30] -32768 \leq ((30269 * asType<int>(([0 < ((-171 * div(heapIs)))))
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.\text{p1}, 177).\text{rem}) + (2 * \text{div}(\text{heapIs}))
\rho_{funcstart\_724,1}, \rho_{func
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 *
div(\mathbf{heapIs} \ \$heap_{funcstart\_724,1}, \ \$heap_{funcstart\_724,1}.p1, \ 177).rem))]: 0))) +
asType<int>($heap<sub>724,1:744,8</sub>.p1))
```

```
\lceil 1.31 \rceil -32768 \leq ((30269 * (\lceil 0 < ((-171 * div(heapIs $heap_{funcstart\_724,1}, 
\text{Sheap}_{funcstart\_724,1}.\text{p1}, 177).\text{rem} + (2 * \text{div}(\text{heapIs} \text{Sheap}_{funcstart\_724,1},
heap_{funcstart_{-724,1}}.p1, 177).quot): 1, [0 < ((-2 * div(heapIs)))]: 1, [0 < ((-2 * div(heapIs)))]:
\text{Sheap}_{funcstart\_724.1}, \text{Sheap}_{funcstart\_724.1}, \text{p1}, 177).\text{quot}) + (171 * \text{div}(\text{heapIs}))
heap_{funcstart_{724,1}}, heap_{funcstart_{724,1}}, 177).rem) = 0) +
asType<int>($heap<sub>724.1:744.8</sub>.p1))
\rightarrow [move guard outside expression]
[1.32] -32768 \leq (([0 < ((-171 * div(heapIs $heap<sub>funcstart-724,1</sub>,
\text{Sheap}_{funcstart\_724,1}.\text{p1}, 177).\text{rem} + (2 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
\{\text{heap}_{funcstart\_724.1.p1}, 177\}.quot))]: 1 * 30269, [0 < ((-2 * \text{div}(\text{heapIs})))]
\theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}
\frac{\text{sheap}_{funcstart\_724.1}, \text{sheap}_{funcstart\_724.1}, \text{p1}, 177).\text{rem}}{1}: 0 * 30269} +
asType<int>($heap<sub>724,1:744,8</sub>.p1))
\rightarrow [simplify]
[1.34] -32768 \leq (([0 < ((-171 * div(heapIs $heap_{tuncstart_724.1},
\text{Sheap}_{funcstart\_724,1}.\text{p1}, 177).\text{rem} + (2 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
\frac{\text{heap}_{funcstart\_724,1.p1, 177}.quot)}{177}: 30269, [0 < ((-2 * div(\mathbf{heapIs})))]:
\$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1, 177).quot) + (171 * div(\mathbf{heapIs})
\frac{\text{sheap}_{funcstart_{724,1}}, \text{sheap}_{funcstart_{724,1},p1, 177}.rem)}{1}: 0} +
asType<int>($heap<sub>724,1:744,8</sub>.p1))
\rightarrow [from term 61.26, $heap<sub>724,1;744,8</sub> is equal to
heap_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 * div(heapIs $heap_{funcstart\_724,1},
heap_{funcstart\_724,1}.p1, 177).quot + (171 * div(heapIs p_{funcstart\_724,1})
heap_{funcstart\_724,1}.p1, 177).rem))).\_replace(p2 \rightarrow ((-35 * div(heapIs)))._replace(p2 \rightarrow ((-35 * div(heapIs))))._replace(p2 \rightarrow ((-35 * div(heapIs))))._replace(p2 \rightarrow ((-35 * div(heapIs)))))._replace(p2 \rightarrow ((-35 * div(heapIs)))))._replace(p2 \rightarrow ((-35 * div(heapIs)))))._replace(p2 \rightarrow ((-35 * div(heapIs)))))
heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p2, 176).quot) + (172 * div(heapIs)
heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p2, 176).rem)))._replace(p3 \rightarrow (-63 *
div(\mathbf{heapIs} \ \$heap_{funcstart\_724,1}, \ \$heap_{funcstart\_724,1}.p3, \ 178).quot) + (170 *
div(\mathbf{heapIs} \ \$heap_{funcstart\_724,1}, \ \$heap_{funcstart\_724,1}.p3, \ 178).rem))]
[1.35] - 32768 \le (([0 < ((-171 * div(\mathbf{heapIs} \$heap_{funcstart\_724.1},
\text{Sheap}_{funcstart\_724,1}.\text{p1}, 177).\text{rem} + (2 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
\rho_{uncstart_{724,1},p1,177,quot}): 30269, \rho_{uncstart_{724,1},p1,177,quot}: 30269, \rho_{uncstart_{724,1},p1,177,quot}:
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.\text{p1}, 177).\text{quot}) + (171 * \text{div}(\text{heapIs}))
heap_{funcstart_{724,1}}, heap_{funcstart_{724,1}}, 177).rem) +
asType < int > (\$heap_{funcstart\_724,1}.\_replace(p1 \rightarrow ((-2 * div(heapIs)))))))
\rho_{tuncstart_{-724,1}}, \rho_{tuncstart_{-724,1},1}, 177).quot + (171 * div(heapIs))
\theta_{funcstart_{724,1}}, \theta_{funcstart_{724,1},p1, 177}.rem))).replace(p2 \rightarrow ((-35)))
* div(heapIs heap_{funcstart_{724,1}}, heap_{funcstart_{724,1}}, 176).quot) + (172 *
\label{eq:div_heap} \text{div}(\textbf{heapIs} \ \$ \text{heap}_{funcstart\_724,1}, \ \$ \text{heap}_{funcstart\_724,1}.\text{p2},
176).rem)))._replace(p3 \rightarrow ((-63 * div(heapIs $heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724.1.p3}, 178).\text{quot}) + (170 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724.1},
heap_{funcstart_{-724,1}.p3, 178).rem})).p1))
```

 $\rightarrow$  [simplify]

```
\rightarrow [simplify]
 \label{eq:continuous} \mbox{$[1.40]$ -32768} \leq ((-2 * \mbox{div}(\mathbf{heapIs} \ \$ \mbox{$heap}_{funcstart\_724,1}, \ \$ \mbox{$heap}_{funcstart\_724,1}.\mbox{$p1$}, 
177).quot) + (171 * div(heapIs heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p1,
177).rem) + ([0 < ((-171 * div(heapIs $heap_{funcstart\_724.1},
\text{Sheap}_{funcstart_724,1}.\text{p1}, 177).\text{rem} + (2 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart_724,1},
\text{heap}_{funcstart_{724,1},p1, 177}, quot))]: 30269, [0 < ((-2 * \text{div}(\text{heapIs})))]
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.\text{p1}, 177).\text{quot}) + (171 * \text{div}(\text{heapIs}))
\label{eq:heap_funcstart_724,1} $\operatorname{heap_{funcstart\_724,1}.p1,\ 177).rem})]:\ 0))
\rightarrow [move guard outside expression]
[1.41] -32768 \leq ([0 < ((-171 * div(heapIs $heap<sub>funcstart_724,1</sub>,
\text{Sheap}_{funcstart\_724,1}.\text{p1}, 177).\text{rem} + (2 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
heap_{funcstart_{724,1},p1, 177,quot)}: 30269 + (-2 * div(heapIs
\text{Sheap}_{funcstart\_724.1}, \text{Sheap}_{funcstart\_724.1}, \text{p1}, 177).\text{quot}) + (171 * \text{div}(\text{heapIs}))
\theta_{funcstart_{-724,1}}, \theta_{funcstart_{-724,1}}, \theta_{funcstart_{-724,1}}, \theta_{funcstart_{-724,1}}, \theta_{funcstart_{-724,1}}, \theta_{funcstart_{-724,1}}
\theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}
\theta_{funcstart_{-724,1}}, \theta_{funcstart_{-724,1},p1, 177}.rem): 0 + (-2 * div(heapIs
\theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}.p1, 177).quot) + (171 * div(heapIs
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.p1, 177).rem)
\rightarrow [simplify]
[1.44] -32769 < ([0 < ((-171 * div(heapIs $heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1}.\text{p1}, 177).\text{rem} + (2 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
heap_{funcstart_{-724,1}}.p1, 177).quot): 30269 + (-2 * div(heapIs
\theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.\text{p1}, 177).\text{rem}, [0 < ((-2 * \text{div}(\mathbf{heapIs})))]
\$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1, 177).quot) + (171 * div(\mathbf{heapIs})
\theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}.p1, 177).rem))]: (-2 * div(heapIs)
\theta_{funcstart_{724,1}}, \theta_{funcstart_{724,1},p1, 177}.quot + (171 * div(heapIs))
heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p1, 177).rem
\rightarrow [move guard outside expression]
[1.45] ([0 < ((-171 * div(heapIs $heap_{funcstart\_724,1}, $heap_{funcstart\_724,1}.p1,
177).rem) + (2 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_724,1}, \text{\$heap}_{funcstart\_724,1}.p1,
(30269 + (-2 * div(\mathbf{heapIs} \$heap_{funcstart\_724,1}, + (-2 * div(\mathbf{heapIs} \$heap_funcstart)))]
\rho_{funcstart\_724,1.p1, 177}.quot) + (171 * div(heapIs \rho_{funcstart\_724,1})
\text{Sheap}_{funcstart\_724,1}.\text{p1}, 177).\text{rem}, [0 < ((-2 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1}.\text{p1}, 177).\text{quot} + (171 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1}.\text{p1}, 177).\text{rem})): -32769 < ((-2 * div(heapIs
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.p1, 177).quot) + (171 * div(heapIs)
heap_{funcstart_{724,1}}, heap_{funcstart_{724,1}}, 177).rem)
\rightarrow [simplify]
\label{eq:continuous} \textit{[1.47]} \; ([0 < ((-171 \; * \; \mathrm{div}(\mathbf{heapIs} \; \$ \mathrm{heap}_{funcstart\_724,1}, \; \$ \mathrm{heap}_{funcstart\_724,1}.\mathrm{p1},
177).rem) + (2 * \text{div}(\mathbf{heapIs} \$ \text{heap}_{funcstart\_724,1}, \$ \text{heap}_{funcstart\_724,1}.p1,
177).quot))]: -63038 < ((-2 * div(heapIs $heap_{funcstart\_724,1},
```

```
\theta_{funcstart_{-724,1},p1,177}.quot) + (171 * div(heapIs \theta_{funcstart_{-724,1},p1,177}).
\text{Sheap}_{funcstart\_724,1}.\text{p1}, 177).\text{rem}, [0 < ((-2 * \text{div}(\textbf{heapIs} \$ \text{heap}_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1}.\text{p1}, 177).\text{quot} + (171 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
[-32769 < ((-2 * div(heapIs))]: -32769 < ((-2 * div(heapIs))]: -32769 < ((-2 * div(heapIs)))]: -32769 < ((-2 * div(heapIs)))]
\theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}
heap_{funcstart_{724,1}}, heap_{funcstart_{724,1},p1, 177).rem))
\rightarrow [from term 54.11, literala < ((-2 * div(heapIs $heap_{funcstart\_724,1},
heap_{funcstart\_724,1}.p1, 177).quot + (171 * div(heapIs $heap_{funcstart\_724,1},
heap_{funcstart_{724,1}.p1, 177).rem} is true whenever (-1 + literala) < -30269
       Proof of rule precondition:
       [1.47.0] (-63038 + -1) < -30269
       \rightarrow [simplify]
       [1.47.2] true
\label{eq:continuous} \mbox{$[1.48]$ ([0 < ((-171 * div(\mathbf{heapIs} \ \$heap_{funcstart\_724,1}, \ \$heap_{funcstart\_724,1}.p1, \ ]) $$}
177).rem) + (2 * \text{div}(\mathbf{heapIs} \$ \text{heap}_{funcstart\_724,1}, \$ \text{heap}_{funcstart\_724,1}.\text{p1},
177).quot))]: true, [0 < ((-2 * div(\mathbf{heapIs} \$heap_{funcstart\_724,1}, 
\text{Sheap}_{funcstart\_724,1}.\text{p1}, 177).\text{quot} + (171 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
\frac{\text{sheap}_{funcstart\_724,1.p1, 177).rem}}{\text{cm}}: -32769 < ((-2 * div(\mathbf{heapIs})))
\theta_{funcstart_{724,1}}, \theta_{funcstart_{724,1},p1, 177}.quot + (171 * div(heapIs))
heap_{funcstart_{724,1}}, heap_{funcstart_{724,1}}, 177).rem))
\rightarrow [from term 54.11, literala < ((-2 * div(heapIs $heap_{funcstart\_724,1},
heap_{funcstart\_724,1}.p1, 177).quot + (171 * div(heapIs $heap_{funcstart\_724,1},
\rho_{funcstart\_724,1}.p1,\ 177).rem)) is true whenever (-1 + literala) < -30269]
       Proof of rule precondition:
       [1.48.0] (-32769 + -1) < -30269
       \rightarrow [simplify]
       [1.48.2] true
[1.49] ([0 < ((-171 * div(heapIs \theta_{funcstart_{724,1}}, \theta_{funcstart_{724,1}}, \theta_{funcstart_{724,1}})]
177).rem) + (2 * \text{div}(\mathbf{heapIs} \$ \text{heap}_{funcstart\_724,1}, \$ \text{heap}_{funcstart\_724,1}.\text{p1},
177).quot))]: true, [0 < ((-2 * div(\mathbf{heapIs} \$heap_{funcstart\_724,1}, 
\text{Sheap}_{funcstart\_724,1}.\text{p1}, 177).\text{quot} + (171 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
heap_{funcstart_{-724,1}.p1, 177}.rem): true
\rightarrow [all guards have equal guarded terms]
[1.50] true
```

**Proof of verification condition:** Type constraint satisfied in implicit conversion from 'int' to 'short int'

Condition generated at: C:\Escher\Customers\prang\prang.c (63,8)

```
Condition defined at:
```

```
To prove: ((asType<int>($heap<sub>724.1:744.8</sub>.M1) *
\mathbf{asType} < \mathbf{int} > (\mathbf{static\_cast} < \mathbf{integer} > (\mathbf{asType} < \mathbf{int} > (\$ \mathrm{heap}_{724,1;744,8}.\mathrm{p1}) < \mathsf{nt}) < \mathsf{nt} > \mathsf{nt} >
(int)(0) + asType<int>($heap<sub>724.1:744.8</sub>.p1)) \leq maxof(short int)
Given:
heap_{init}.LIMIT == (int)80
heap_{init}.M1 == asType < short int > ((int)30269)
\theta_{init}.r1 == asType < short int > ((int)171)
heap_{init}.a1 == asType < short int > ((int)177)
\theta
heap_{init}.M2 == asType < short int > ((int)30307)
\theta_{init}.r2 == asType < short int > ((int)172)
heap_{init}.a2 == asType < short int > ((int)176)
\theta = asType < short int > ((int)35)
heap_{init}.M3 == asType < short int > ((int)30323)
\theta_{init}.r3 == asType < short int > ((int)170)
heap_{init}.a3 == asType < short int > ((int)178)
\theta = asType < short int > ((int)63)
\theta = asType < short int > ((int)1)
\theta
heap_{init}.p3 == asType < short int > ((int)3)
invariant
1(heap<br/>Is heap_{funcstart\_724,1})
\mathrm{div1} == \mathrm{div}(\mathbf{heapIs} \ \$ \mathrm{heap}_{funcstart\_724,1},
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p1}),
asType < int > (\$heap_{funcstart\_724,1}.a1))
(asType<integer>(asType<int>($heap_{tuncstart\_724.1}.p1)) /
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a1))) = =
asType<integer>(div1.quot)
(\mathbf{asType} < \mathbf{integer} > (\mathbf{asType} < \mathbf{int} > (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p1})) \ \%
\mathbf{asType}{<}\mathbf{integer}{>}(\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{a1}))) = =
asType<integer>(div1.rem)
!(0 == asType < integer > (div1.rem)) || !(0 ==
asType<integer>(div1.quot))
\mathrm{div2} == \mathrm{div}(\mathbf{heapIs} \ \$ \mathrm{heap}_{funcstart\_724,1},
\mathbf{asType} < \mathbf{int} > (\$ \mathrm{heap}_{funcstart\_724,1}.\mathrm{p2}),
asType < int > (\$heap_{funcstart\_724,1}.a2))
```

```
(asType < int > (asType < int > (\$heap_{funcstart\_724,1}.p2)) /
\mathbf{asType} < \mathbf{integer} > (\mathbf{asType} < \mathbf{int} > (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{a2}))) = =
asType<integer>(div2.quot)
(asType<int>(asType<int>($heap_{funcstart\_724,1}.p2)) %
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a2))) = =
asType<integer>(div2.rem)
!(0 == asType < integer > (div2.rem)) || !(0 ==
asType<integer>(div2.quot))
div3 == div(\mathbf{heapIs} \$ heap_{funcstart\_724,1},
asType < int > (\$heap_{funcstart\_724,1}.p3),
asType < int > (\$heap_{funcstart_{-724,1}}.a3))
(asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.p3)) /
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a3))) = =
asType<integer>(div3.quot)
(asType<int>(sheap<sub>funcstart_724,1.</sub>p3)) %
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a3))) = =
asType<integer>(div3.rem)
!(0 == asType < integer > (div3.rem)) || !(0 ==
asType<integer>(div3.quot))
\$heap_{724,1;740,8} == \$heap_{funcstart\_724,1}.\_\textbf{replace}(p1 \rightarrow \textbf{asType} < \textbf{short}
int>((asType<int>(asType<short int>(div1.rem)) *
asType < int > (\$heap_{tuncstart\_724.1}.r1)) - (asType < int > (asType < short)
int>(div1.quot)) * asType<int>($heap_{funcstart\_724,1}.b1)))
-\mathbf{asType}{<}\mathbf{integer\ const}{>}(\$\mathrm{heap}_{724,1;740,8}.\mathrm{M1}) <
asType<integer>($heap<sub>724,1:740.8</sub>.p1)
!(0 == asType < integer > (\$heap_{724,1:740.8}.p1))
{\bf asType}{<} {\bf integer}{>} (\${\rm heap}_{724,1;740,8}.{\rm p1}) <
asType<integer>($heap<sub>724.1:740.8</sub>.M1)
\text{heap}_{724.1:742.8} == \text{heap}_{724.1:740.8}._replace(p2 \rightarrow asType<short)
int>((asType<int>(asType<short int>(div2.rem)) *
asType < int > (\$heap_{724,1:740,8}.r2)) - (asType < int > (asType < short)
int>(div2.quot)) * asType<int>($heap<sub>724.1:740.8</sub>.b2))))
-asType < integer\ const > (\$heap_{724,1;742,8}.M2) < 
asType<integer>($heap<sub>724.1:742.8</sub>.p2)
!(0 == asType < integer > (\$heap_{724,1:742.8}.p2))
asType<integer>($heap<sub>724,1.742,8.</sub>p2) <
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathrm{heap}_{724,1;742,8}.\mathrm{M2})
$heap_{724,1;744,8} == $heap_{724,1;742,8}.replace(p3 \rightarrow asType<short
int>((asType<int>(asType<short int>(div3.rem)) *
```

```
asType < int > (\$heap_{724.1:742.8}.r3)) - (asType < int > (asType < short)
int>(div3.quot)) * asType< int>($heap_{724,1;742,8}.b3))))
-asType<integer const>($heap_{724,1:744,8}.M3) <
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathrm{heap}_{724,1;744,8}.\mathrm{p3})
!(0 == asType < integer > (\$heap_{724,1;744,8}.p3))
asType<integer>($heap<sub>724,1:744,8</sub>.p3) <
asType<integer>($heap<sub>724,1:744,8</sub>.M3)
Proof:
[Take given term]
[11.0] \operatorname{div1} == \operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724,1},
asType < int > (\$heap_{funcstart\_724,1}.p1),
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{a1}))
\rightarrow [simplify]
[11.1] div1 == div(heapIs heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p1,
asType < int > (\$heap_{funcstart\_724.1}.a1))
\rightarrow [const static or extern object]
[11.2] \ \mathrm{div1} == \mathrm{div}(\mathbf{heapIs} \ \$ \mathrm{heap}_{funcstart\_724,1}, \ \$ \mathrm{heap}_{funcstart\_724,1}.\mathrm{p1},
asType < int > (\$heap_{init}.a1))
\rightarrow [expand definition of constant 'a1' at prang.c (16,20)]
\textit{[11.3]} \ \text{div1} == \text{div}(\mathbf{heapIs} \ \$ \text{heap}_{funcstart\_724,1}, \ \$ \text{heap}_{funcstart\_724,1}.\text{p1},
asType<int>(asType<short int>((int)177)))
\rightarrow [simplify]
[11.6] div1 == div(heapIs \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}.p1, 177)
[Take given term]
[25.0] div2 == div(heapIs $heap_{tuncstart\_724.1},
asType < int > (\$heap_{funcstart\_724,1}.p2),
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{a2}))
\rightarrow [simplify]
[25.1]~{\rm div2} == {\rm div}(\mathbf{heapIs}~\$ \mathrm{heap}_{funcstart\_724,1},\,\$ \mathrm{heap}_{funcstart\_724,1}.\mathrm{p2},
asType < int > (\$heap_{funcstart\_724,1}.a2))
\rightarrow [const static or extern object]
[25.2]~{\rm div2} == {\rm div}(\mathbf{heapIs}~\$ \mathrm{heap}_{funcstart\_724,1},\,\$ \mathrm{heap}_{funcstart\_724,1}.\mathrm{p2},
asType < int > (\$heap_{init}.a2))
\rightarrow [expand definition of constant 'a2' at prang.c (21,20)]
[25.3] \operatorname{div2} == \operatorname{div}(\mathbf{heapIs} \operatorname{\$heap}_{funcstart\_724,1}, \operatorname{\$heap}_{funcstart\_724,1}.p2,
asType<int>(asType<short int>((int)176)))
```

```
\rightarrow [simplify]
[25.6] \ \mathrm{div2} == \mathrm{div}(\mathbf{heapIs} \ \$ \mathrm{heap}_{funcstart\_724,1}, \ \$ \mathrm{heap}_{funcstart\_724,1}.\mathrm{p2}, \ 176)
[Take given term]
[39.0] \operatorname{div3} == \operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1},
asType < int > (\$heap_{funcstart\_724,1}.p3),
asType < int > (\$heap_{funcstart\_724,1}.a3))
\rightarrow [simplify]
[39.1] \operatorname{div3} == \operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p3,
asType < int > (\$heap_{funcstart\_724,1}.a3))
\rightarrow [const static or extern object]
[39.2] \ \mathrm{div3} == \mathrm{div}(\mathbf{heapIs} \ \$ \mathrm{heap}_{funcstart\_724,1}, \ \$ \mathrm{heap}_{funcstart\_724,1}.\mathrm{p3},
asType < int > (\$heap_{init}.a3))
\rightarrow [expand definition of constant 'a3' at prang.c (26,20)]
[39.3] \operatorname{div3} == \operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724,1}, \$ \operatorname{heap}_{funcstart\_724,1}.p3,
asType < int > (asType < short int > ((int)178)))
\rightarrow [simplify]
[39.6] div3 == div(heapIs heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p3, 178)
[Take given term]
[53.0] heap_{724,1:740.8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow asType<short
int>((asType<int>(asType<short int>(div1.rem)) *
asType < int > (\$heap_{funcstart\_724,1}.r1)) - (asType < int > (asType < short)
\mathbf{int}{>}(\mathbf{div1.quot})) \ * \ \mathbf{asType}{<} \mathbf{int}{>} (\$\mathbf{heap}_{funcstart\_724,1}.\mathbf{b1}))))
\rightarrow [from term 11.6, div1 is equal to div(heapIs $heap_{funcstart\_724,1},
heap_{funcstart_{-724,1}}.p1, 177
[53.1] \theta == 
int>((asType<int>(asType<short int>(div(heapIs $heap_{funcstart\_724,1},))
\rho_{funcstart\_724,1.p1, 177}.rem) * asType < int > (\rho_{funcstart\_724,1.r1}) - (\rho_{funcstart\_724,1.r1}
(asType<int>(asType<short int>(div1.quot)) *
asType < int > (\$heap_{funcstart\_724,1}.b1))))
\rightarrow [simplify]
[53.3] \text{sheap}_{724,1;740,8} == \text{sheap}_{funcstart\_724,1}.\_\text{replace}(\text{p1} \rightarrow \text{asType} < \text{short})
int>((div(heapIs \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1, 177).rem *
\mathbf{asType} \hspace{-0.1em}<\hspace{-0.1em} \mathbf{int} \hspace{-0.1em}> \hspace{-0.1em} (\$ \mathrm{heap}_{funcstart\_724,1}.\mathrm{r1})) - (\mathbf{asType} \hspace{-0.1em}<\hspace{-0.1em} \mathbf{int} \hspace{-0.1em}> \hspace{-0.1em} (\mathbf{asType} \hspace{-0.1em}<\hspace{-0.1em} \mathbf{short})
int>(div1.quot)) * asType<int>($heap_{funcstart\_724,1}.b1)))
\rightarrow [const static or extern object]
[53.4] heap_{724,1;740,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow asType<short
\mathbf{int}{>}((\mathrm{div}(\mathbf{heapIs}\ \$\mathrm{heap}_{funcstart\_724,1},\ \$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p1},\ 177).\mathrm{rem}\ *
asType < int > (\$heap_{init}.r1)) - (asType < int > (asType < short)
```

```
\mathbf{int}{>}(\mathbf{div1.quot})) \ * \ \mathbf{asType}{<} \mathbf{int}{>} (\$\mathbf{heap}_{funcstart\_724,1}.\mathbf{b1}))))
\rightarrow [expand definition of constant 'r1' at prang.c (15,20)]
[53.5] \rho_{13,1;740,8} == \rho_{13,1;740,8} == \rho_{13,1;740,8} =- \rho_{
int>((div(heapIs \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1, 177).rem *
asType<int>(asType<short int>((int)171))) -
(asType<int>(asType<short int>(div1.quot)) *
asType < int > (\$heap_{funcstart\_724,1}.b1))))
\rightarrow [simplify]
[53.8] heap_{724,1;740,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow asType<short
\mathbf{int} > ((\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.\operatorname{p1}, \ 177).\operatorname{rem} \ * \ 171)
- (asType<int>(asType<short int>(div1.quot)) *
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{b1}))))
\rightarrow [from term 11.6, div1 is equal to div(heapIs $heap_{funcstart\_724,1},
heap_{funcstart_{-724,1}}.p1, 177
[53.9] \rho_{724,1;740,8} == \rho_{funcstart\_724,1}.\_replace(p1 \rightarrow asType < short)
int>((171 * div(heapIs \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1, 177).rem)
- (asType<int>(asType<short int>(div(heapIs $heap_{funcstart\_724,1},))
heap_{funcstart_{-724,1}}.p1, 177).quot)
asType < int > (\$heap_{funcstart\_724,1}.b1))))
\rightarrow [simplify]
[53.11] \theta == 
int>((171 * div(heapIs \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1, 177).rem)
- (\text{div}(\mathbf{heapIs} \$ \text{heap}_{funcstart\_724,1}, \$ \text{heap}_{funcstart\_724,1}.\text{p1}, 177).\text{quot} *
asType < int > (\$heap_{funcstart\_724,1}.b1)))
\rightarrow [const static or extern object]
[53.12] heap_{724,1;740,8} == heap_{funcstart\_724,1}. replace(p1 \rightarrow asType<short
int>((171 * div(heapIs \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1, 177).rem)
- (div(heapIs heap_{funcstart_{-724,1}}, heap_{funcstart_{-724,1}}, 177).quot *
asType < int > (\$heap_{init}.b1)))
\rightarrow [expand definition of constant 'b1' at prang.c (17,20)]
[53.13] heap_{724,1;740,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow asType<short
int > ((171 * div(heapIs \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1, 177).rem)
- (div(heapIs heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p1, 177).quot *
asType<int>(asType<short int>((int)2))))
\rightarrow [simplify]
[53.19] $\text{heap}_{724,1;740,8} == \text{$heap}_{funcstart\_724,1}._\text{$replace}(p1 \to ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).quot) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.p1, \ 177).rem)))
[Take given term]
```

```
[55.0]!(0 == asType < integer > (\$heap_{724.1:740.8}.p1))
\rightarrow [from term 53.19, $heap<sub>724.1:740.8</sub> is equal to
heap_{funcstart\_724,1}._replace(p1 \rightarrow (-2 * div(heapIs $heap_{funcstart\_724,1},
heap_{funcstart\_724,1}.p1, 177).quot) + (171 * div(heapIs $heap_{funcstart\_724,1}, 1
heap_{funcstart_{724,1},p1,177,rem})
[55.1] !(0 == asType<integer>(p1 \rightarrow ((-2 * p1) + p1) = (-2 * p1))
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).quot) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.\operatorname{p1}, \ 177).\operatorname{rem}))).\operatorname{p1}))
\rightarrow [simplify]
 [55.3] ! (0 == ((-2 * \operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724,1}, \$ \operatorname{heap}_{funcstart\_724,1}.p1,
177).quot) + (171 * div(heapIs heap_{funcstart_{-724,1}}, heap_{funcstart_{-724,1}}, p_1,
[Take given term]
[56.0] asType<integer>($heap<sub>724.1:740.8</sub>.p1) <
asType<integer>($heap<sub>724.1:740.8</sub>.M1)
\rightarrow [from term 53.19, $heap<sub>724,1;740.8</sub> is equal to
heap_{funcstart\_724,1}._replace(p1 \rightarrow (-2 * div(heapIs heap_{funcstart\_724,1}),
heap_{funcstart\_724.1}.p1, 177).quot + (171 * div(heapIs p_{funcstart\_724.1})
heap_{funcstart_{-724,1}}.p1, 177).rem)
\operatorname{div}(\mathbf{heapIs} \ \operatorname{heap}_{funcstart\_724,1}, \ \operatorname{heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 \ *
div(\mathbf{heapIs} \ \$heap_{funcstart\_724.1}, \ \$heap_{funcstart\_724.1}.p1, \ 177).rem))).p1) <
asType<integer>($heap<sub>724,1:740,8</sub>.M1)
\rightarrow [simplify]
[56.3] ((-2 * div(heapIs heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p1,
177).quot) + (171 * div(heapIs heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p1,
177).rem)) < asType<integer>($heap<sub>724.1:740.8</sub>.M1)
\rightarrow [from term 53.19, $heap<sub>724,1;740,8</sub> is equal to
heap_{funcstart\_724,1}._replace(p1 \rightarrow (-2 * div(heapIs heap_{funcstart\_724,1}),
heap_{funcstart_{724,1},p1, 177}, quot) + (171 * div(heapIs p_{funcstart_{724,1},p1, 177}).
heap_{funcstart_{-724,1}}.p1, 177).rem)
\label{eq:constart_724,1} \textit{[(-2*div(\textbf{heapIs}\ \$heap_{funcstart\_724,1},\ \$heap_{funcstart\_724,1}.p1,}
177).quot) + (171 * div(heapIs heap_{funcstart_{-724,1}}, heap_{funcstart_{-724,1}}, p_1,
177).rem)) < asType<integer>($heap<sub>funcstart_724,1</sub>._replace(p1 \rightarrow ((-2 *
div(\mathbf{heapIs} \ \text{$heap}_{funcstart\_724,1}, \ \text{$heap}_{funcstart\_724,1}.p1, \ 177).quot) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.\operatorname{p1}, \ 177).\operatorname{rem}))).\operatorname{M1})
\rightarrow [const member of object with modified fields]
[56.5] ((-2 * div(heapIs heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p1,
177).quot) + (171 * div(heapIs heap_{funcstart_{-724,1}}, heap_{funcstart_{-724,1}}, 1,
(177).rem) < asType < integer > (\$heap_{funcstart\_724,1}.M1)
```

```
\rightarrow [const static or extern object]
[56.6] ((-2 * div(heapIs heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p1,
177).quot) + (171 * div(heapIs heap_{funcstart}, heap_{funcstart}, heap_{funcstart}, p_1,
(177).rem) < asType < integer > (\$heap_{init}.M1)
\rightarrow [expand definition of constant 'M1' at prang.c (14,20)]
[56.7] ((-2 * div(heapIs heap_{funcstart_{-724,1}}, heap_{funcstart_{-724,1}}, ]
177).quot) + (171 * div(heapIs $heap_{funcstart\_724,1}, $heap_{funcstart\_724,1}.p1,
177).rem)) < \mathbf{asType} < \mathbf{integer} > (\mathbf{asType} < \mathbf{short\ int} > ((\mathbf{int})30269))
\rightarrow [simplify]
[56.17] -30269 < ((-171 * div(heapIs $heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1}.\text{p1}, 177).\text{rem} + (2 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
heap_{funcstart_{-724,1}}.p1, 177).quot)
[Take given term]
[57.0] $\text{heap}_{724,1:742,8} == $\text{heap}_{724,1:740.8}._\text{replace}(p2 \to \text{asType} < \text{short}
int>((asType<int>(asType<short int>(div2.rem)) *
asType < int > (\$heap_{724,1:740,8}.r2)) - (asType < int > (asType < short)
int>(div2.quot)) * asType<int>($heap<sub>724.1:740.8</sub>.b2))))
\rightarrow [from term 53.19, $heap<sub>724,1;740,8</sub> is equal to
heap_{funcstart\_724,1}._replace(p1 \rightarrow (-2 * div(heapIs heap_{funcstart\_724,1}),
heap_{funcstart\_724,1}.p1, 177).quot + (171 * div(heapIs $heap_{funcstart\_724,1},
heap_{funcstart_{-724,1},p1,177,rem})
[57.1] \rho_{17.42,8} == \rho_{17.42,1}.\_replace = \rho_{17.42,1}.\_replace
div(\mathbf{heapIs} \ \$heap_{funcstart\_724,1}, \ \$heap_{funcstart\_724,1}.p1, \ 177).quot) + (171 *
\operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724,1}, \$ \operatorname{heap}_{funcstart\_724,1}.p1,
177).rem))).\_replace(p2 \rightarrow asType < short
int>((asType<int>(asType<short\ int>(div2.rem))*
\mathbf{asType} < \mathbf{int} > (\$ heap_{724,1;740,8}.r2)) - (\mathbf{asType} < \mathbf{int} > (\mathbf{asType} < \mathbf{short})
int > (div2.quot)) * asType < int > ($heap_{724,1;740,8}.b2))))
\rightarrow [from term 25.6, div2 is equal to div(heapIs $heap_{funcstart_724,1},
heap_{funcstart_{724,1}}.p2, 176
[57.2] heap_{724,1;742,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 *
\operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724.1}, \$ \operatorname{heap}_{funcstart\_724.1}.p1,
177).rem)))._replace(p2 \rightarrow asType<short
int>((asType<int>(asType<short int>(div(heapIs $heap_{funcstart\_724,1},))
\text{sheap}_{funcstart\_724,1.p2, 176}.\text{rem}) * asType < int > (\text{sheap}_{724,1;740,8.r2})) -
(asType<int>(asType<short int>(div2.quot)) *
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{724,1;740,8}.\mathrm{b2}))))
\rightarrow [simplify]
[57.4] $heap<sub>724.1:742.8</sub> == $heap<sub>funcstart_724.1</sub>._replace(p1 \rightarrow ((-2 *
```

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\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).quot) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow asType<short int>((div(heapIs
\text{Sheap}_{funcstart_{-724,1}}, \text{Sheap}_{funcstart_{-724,1}}.p2, 176).rem *
asType < int > (\$heap_{724,1:740,8}.r2)) - (asType < int > (asType < short)
int > (div2.quot)) * asType < int > (\$heap_{724,1;740,8}.b2))))
\rightarrow [from term 53.19, $heap<sub>724,1;740,8</sub> is equal to
heap_{funcstart\_724,1}._replace(p1 \rightarrow (-2 * div(heapIs *heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1}.p1, 177).quot) + (171 * div(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
heap_{funcstart_{-724,1}}.p1, 177).rem)
[57.5] heap_{724,1;742,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 \ *
\operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724,1}, \$ \operatorname{heap}_{funcstart\_724,1}.p1,
(177).rem))._replace(p2 \rightarrow asType<short int>((div(heapIs)))._replace(p2 \rightarrow asType
heap_{funcstart_{-724,1}}, heap_{funcstart_{-724,1}}, 176).rem *
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathbf{\_replace}(\mathrm{p1} \rightarrow ((-2 * \mathrm{div}(\mathbf{heapIs}
\theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}
heap_{funcstart_{724.1}}, heap_{funcstart_{724.1}}, 177).rem)).r2)) -
(asType<int>(asType<short int>(div2.quot)) *
asType<int>($heap<sub>724.1:740.8</sub>.b2))))
\rightarrow [const member of object with modified fields]
[57.6] heap_{724,1;742,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 \ *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1,
177).rem)))._{\mathbf{replace}}(p2 \rightarrow \mathbf{asType} < \mathbf{short\ int} > ((\operatorname{div}(\mathbf{heapIs}))))
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.p2, 176).rem *
asType < int > (\$heap_{tuncstart\_724.1}.r2)) - (asType < int > (asType < short)
int>(div2.quot)) * asType< int>($heap_{724.1:740.8}.b2))))
\rightarrow [const static or extern object]
[57.7] heap_{724,1;742,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 \ *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724.1}, \ \$ \operatorname{heap}_{funcstart\_724.1}.p1,
177).rem)))._{\mathbf{replace}}(p2 \rightarrow \mathbf{asType} < \mathbf{short\ int} > ((\operatorname{div}(\mathbf{heapIs}))))
heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p2, 176).rem *
asType < int > (\$heap_{init}.r2)) - (asType < int > (asType < short)
int>(div2.quot)) * asType<int>($heap<sub>724.1:740.8</sub>.b2))))
\rightarrow [expand definition of constant 'r2' at prang.c (20,20)]
[57.8] heap_{724,1;742,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1,
177).rem)))._{\mathbf{replace}}(p2 \rightarrow \mathbf{asType} < \mathbf{short\ int} > ((\operatorname{div}(\mathbf{heapIs}))))
\text{Sheap}_{funcstart_{724,1}}, \text{Sheap}_{funcstart_{724,1}}.p2, 176).rem *
```

```
asType<int>(asType<short int>((int)172))) -
(asType<int>(asType<short int>(div2.quot)) *
asType < int > (\$heap_{724,1;740,8}.b2))))
\rightarrow [simplify]
[57.11] $\text{heap}_{724,1;742,8} == \text{$heap}_{funcstart\_724,1}._\text{replace}(p1 \to ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow asType<short int>((div(heapIs
heap_{funcstart_{724,1}}, heap_{funcstart_{724,1}}, p2, 176).rem * 172) -
(asType<int>(asType<short int>(div2.quot)) *
asType<int>($heap<sub>724,1:740,8</sub>.b2))))
\rightarrow [from term 25.6, div2 is equal to div(heapIs $heap_{funcstart\_724,1},
heap_{funcstart_{-724,1},p2,176}
[57.12] $heap<sub>724,1;742,8</sub> == $heap<sub>funcstart_724,1</sub>._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).quot) + (171 *
\operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724,1}, \$ \operatorname{heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow asType<short int>((172 * div(heapIs
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.p2, 176).rem) -
(asType<int>(asType<short int>(div(heapIs $heap_{tuncstart_724.1},
\text{sheap}_{funcstart\_724,1}.\text{p2}, 176).\text{quot})) * asType < int > (\text{sheap}_{724,1:740.8}.\text{b2}))))
\rightarrow [simplify]
[57.14] $heap<sub>724,1;742,8</sub> == $heap<sub>funcstart_724,1</sub>._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).quot) + (171 *
\operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724,1}, \$ \operatorname{heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow asType<short int>((172 * div(heapIs
heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p2, 176).rem) - (div(heapIs
\theta_{funcstart_{724,1}}, \theta_{funcstart_{724,1},p2,176}.quot *
asType < int > ($heap_{724,1;740,8}.b2))))
\rightarrow [from term 53.19, $heap<sub>724.1:740.8</sub> is equal to
heap_{funcstart\_724,1}._replace(p1 \rightarrow (-2 * div(heapIs heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1.p1}, 177).\text{quot} + (171 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
heap_{funcstart_{-724,1}}.p1, 177).rem)
[57.15] $heap<sub>724,1;742,8</sub> == $heap<sub>funcstart_724,1</sub>._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.p1,
177).rem)))._{\mathbf{replace}}(p2 \rightarrow \mathbf{asType} < \mathbf{short\ int} > ((172 * div(\mathbf{heapIs}))))
\theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}.p2, 176).rem) - (div(heapIs
heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p2, 176).quot *
asType < int > (\$heap_{funcstart\_724,1}.\_replace(p1 \rightarrow ((-2 * div(heapIs)))))))
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.\text{p1}, 177).\text{quot}) + (171 * \text{div}(\text{heapIs}))
\text{Sheap}_{funcstart_{-724,1}}, \text{Sheap}_{funcstart_{-724,1}}.p1, 177).rem))).b2))))
\rightarrow [const member of object with modified fields]
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[57.16] $heap<sub>724,1;742,8</sub> == $heap<sub>funcstart_724,1</sub>._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 \ *
\label{eq:div_heap} \text{div}(\textbf{heapIs} \ \$ \text{heap}_{funcstart\_724,1}, \ \$ \text{heap}_{funcstart\_724,1}.\text{p1},
177).rem)))._replace(p2 \rightarrow asType<short int>((172 * div(heapIs
\theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}.p2, 176).rem) - \theta_{funcstart\_724,1}.p2, 176).rem) - \theta_{funcstart\_724,1}
\theta_{funcstart_{724,1}}, \theta_{funcstart_{724,1}}, \theta_{funcstart_{724,1}}, \theta_{funcstart_{724,1}}
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{b2}))))
\rightarrow [const static or extern object]
[57.17] $heap<sub>724,1;742,8</sub> == $heap<sub>funcstart_724,1</sub>._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 *
\label{eq:div_heap} \text{div}(\textbf{heapIs} \ \$ \text{heap}_{funcstart\_724,1}, \ \$ \text{heap}_{funcstart\_724,1}.\text{p1},
177).rem)))._replace(p2 \rightarrow asType<short int>((172 * div(heapIs
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.\text{p2}, 176).\text{rem}) - (\text{div}(\text{heapIs})
heap_{funcstart_{724,1}}, heap_{funcstart_{724,1}}, 2, 176, quot
\mathbf{asType} < \mathbf{int} > (\$ \mathrm{heap}_{init}.\mathrm{b2}))))
\rightarrow [expand definition of constant 'b2' at prang.c (22,20)]
[57.18] \rho_{724,1;742,8} == \rho_{134,1;742,8} == \rho_{134,1;742,8} = 
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 \ *
\operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724.1}, \$ \operatorname{heap}_{funcstart\_724.1}.p1,
177).rem)))._replace(p2 \rightarrow asType<short int>((172 * div(heapIs
\$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p2, 176).rem) - (div(\textbf{heapIs}
heap_{funcstart_{724,1}}, heap_{funcstart_{724,1}}.p2, 176).quot *
asType<int>(asType<short int>((int)35)))))
\rightarrow [simplify]
[57.24] heap_{724,1;742,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 \ *
\operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724,1}, \$ \operatorname{heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow ((-35 * div(heapIs $heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1}.\text{p2}, 176).\text{quot} + (172 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
heap_{funcstart_{-724,1}}.p2, 176).rem))
[Take given term]
[61.0] $\text{heap}_{724,1:744,8} == $\text{heap}_{724,1:742,8}.$\text{-replace}(p3 \to asType < short)
int>((asType<int>(asType<short int>(div3.rem)) *
asType < int > (\$heap_{724.1:742.8}.r3)) - (asType < int > (asType < short)
int>(div3.quot)) * asType< int>($heap_{724.1:742.8}.b3))))
\rightarrow [from term 57.24, $heap<sub>724,1;742,8</sub> is equal to
heap_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 * div(heapIs $heap_{funcstart\_724,1},
heap_{funcstart\_724,1}.p1, 177).quot + (171 * div(heapIs $heap_{funcstart\_724,1}, 177).quot) + (171 * div(heapIs $heap_{funcstart\_724,1}, 17
\rho_{uncstart\_724,1}.p1, 177).rem))).\_replace(p2 \rightarrow (-35 * div(heapIs))).
heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p2, 176).quot) + (172 * div(heapIs)
heap_{funcstart_{724,1}}, heap_{funcstart_{724,1}}, p2, 176).rem)
```

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[61.1] heap_{724,1;744,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).quot) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow ((-35 * div(heapIs $heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1}.\text{p2}, 176).\text{quot} + (172 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
\rho_{funcstart\_724,1.p2, 176}.rem))._replace(p3 \rightarrow asType<short
int>((asType<int>(asType<short int>(div3.rem)) *
asType < int > (\$heap_{724,1:742.8}.r3)) - (asType < int > (asType < short)
int>(div3.quot)) * asType<int>($heap<sub>724.1:742.8</sub>.b3))))
\rightarrow [from term 39.6, div3 is equal to div(heapIs $heap_{funcstart\_724,1},
heap_{funcstart_{-724,1}}.p3, 178
[61.2] heap_{724,1;744,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 \ *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow ((-35 * div(heapIs $heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1}.\text{p2}, 176).\text{quot}) + (172 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
\rho_{funcstart\_724,1.p2, 176}.rem))._replace(p3 \rightarrow asType<short
int>((asType<int>(asType<short int>(div(heapIs $heap_{funcstart\_724,1},))
\rho_{tuncstart_{724,1},p3,178,rem} ** asType<int>($\phi_{tuncstart_{724,1},742,8}.r3)) -
(asType<int>(asType<short int>(div3.quot)) *
asType<int>($heap<sub>724.1:742.8</sub>.b3))))
\rightarrow [simplify]
[61.4] heap_{724,1;744,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).quot) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow ((-35 * div(heapIs $heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1}.\text{p2}, 176).\text{quot} + (172 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
\theta_{funcstart\_724,1.p2, 176}.rem))._replace(p3 \rightarrow asType<short
int>((div(heapIs \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p3, 178).rem *
asType < int > (\$heap_{724.1:742.8}.r3)) - (asType < int > (asType < short)
int>(div3.quot)) * asType<int>($heap<sub>724,1:742,8</sub>.b3))))
\rightarrow [from term 57.24, $\$heap_{724,1:742,8}$ is equal to
heap_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 * div(heapIs $heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1}.\text{p1}, 177).\text{quot} + (171 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
\rho_{funcstart\_724,1}.p1, 177).rem))._replace(\rho_{funcstart\_724,1}.p1, 177).rem))
heap_{funcstart_{724,1}}, heap_{funcstart_{724,1}}, p_{funcstart_{724,1}}, p_{funcstart_{724,1}}, p_{funcstart_{724,1}}
heap_{funcstart_{724,1}}, heap_{funcstart_{724,1}}, p2, 176).rem)
div(\mathbf{heapIs} \ \$heap_{funcstart\_724,1}, \ \$heap_{funcstart\_724,1}.p1, \ 177).quot) + (171 *
\operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724,1}, \$ \operatorname{heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow ((-35 * div(heapIs $heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1.p2}, 176).\text{quot} + (172 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
\theta_{funcstart\_724,1.p2, 176).rem}))._replace(p3 \rightarrow asType<short
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int>((div(heapIs \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p3, 178).rem *
asType < int > (\$heap_{funcstart\_724,1}.\_replace(p1 \rightarrow ((-2 * div(heapIs))))))
\$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1, 177).quot) + (171 * div(\textbf{heapIs}) + (171 * div(\textbf{heapIs})) + (171
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.\text{p1}, 177).\text{rem}))._replace(p2 \rightarrow ((-35)
* div(\mathbf{heapIs} \ \$ heap_{funcstart\_724,1}, \ \$ heap_{funcstart\_724,1}.p2, \ 176).quot) + (172 \ *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.\operatorname{p2}, \ 176).\operatorname{rem}))).\operatorname{r3})) \ -
(asType<int>(asType<short int>(div3.quot)) *
asType<int>($heap<sub>724.1:742.8</sub>.b3))))
\rightarrow [const member of object with modified fields]
[61.7] $heap<sub>724,1:744,8</sub> == $heap<sub>funcstart_724,1</sub>._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 *
\label{eq:div_heap} \text{div}(\textbf{heapIs} \ \$ \text{heap}_{funcstart\_724,1}, \ \$ \text{heap}_{funcstart\_724,1}.\text{p1},
177).rem)))._replace(p2 \rightarrow ((-35 * div(heapIs $heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1}.\text{p2}, 176).\text{quot} + (172 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
\rho_{uncstart\_724,1.p2, 176).rem}))._replace(p3 \rightarrow asType<short
int>((div(heapIs \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p3, 178).rem *
asType < int > (\$heap_{funcstart\_724,1}.r3)) - (asType < int > (asType < short)
int>(div3.quot)) * asType< int>($heap_{724.1:742.8}.b3))))
\rightarrow [const static or extern object]
[61.8] heap_{724,1;744,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).quot) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow ((-35 * div(heapIs $heap_{funcstart_724.1},
\text{Sheap}_{funcstart\_724,1}.\text{p2}, 176).\text{quot} + (172 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
\theta_{1} = \theta_{1} - \theta_{2} - \theta_{3} - \theta_{4} - \theta_{5} - \theta_{6} - \theta_{6
int>((div(heapIs \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p3, 178).rem *
asType < int > (\$heap_{init}.r3)) - (asType < int > (asType < short)
int>(div3.quot)) * asType< int>($heap_{724.1:742.8}.b3))))
\rightarrow [expand definition of constant 'r3' at prang.c (25.20)]
[61.9] $heap<sub>724,1:744,8</sub> == $heap<sub>funcstart_724,1</sub>._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 \ *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow ((-35 * div(heapIs $heap_{funcstart_724.1},
\text{Sheap}_{funcstart\_724,1}.\text{p2}, 176).\text{quot} + (172 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
\frac{\text{sheap}_{funcstart\_724,1.p2, 176}.rem)}{\text{sheap}_{funcstart\_724,1.p2, 176}.rem)}._replace(p3 \rightarrow asType<short
int > ((div(heapIs \$heap_{funcstart\_724.1}, \$heap_{funcstart\_724.1}, p3, 178).rem *
asType<int>(asType<short int>((int)170))) -
(asType<int>(asType<short int>(div3.quot)) *
asType < int > (\$heap_{724,1;742,8}.b3))))
\rightarrow [simplify]
[61.12] $heap<sub>724,1;744,8</sub> == $heap<sub>funcstart_724,1</sub>._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 *
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\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow ((-35 * div(heapIs $heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1.p2}, 176).\text{quot} + (172 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
\theta_{funcstart\_724,1}.p2, 176).rem))._replace(p3 \rightarrow asType<short
int>((div(heapIs \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p3, 178).rem * 170)
- (asType<int>(asType<short int>(div3.quot)) *
asType<int>($heap<sub>724.1:742.8</sub>.b3))))
\rightarrow [from term 39.6, div3 is equal to div(heapIs $heap_{funcstart\_724.1},
heap_{funcstart_{-724,1}}.p3, 178
[61.13] heap_{724,1;744,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 *
\label{eq:div_heap} \text{div}(\textbf{heapIs} \ \$ \text{heap}_{funcstart\_724,1}, \ \$ \text{heap}_{funcstart\_724,1}.\text{p1},
177).rem)))._replace(p2 \rightarrow ((-35 * div(heapIs $heap_{funcstart\_724,1},
\text{Sheap}_{funcstart_{-724,1},p2}, 176).quot) + (172 * div(heapIs \text{Sheap}_{funcstart_{-724,1}},
\rho_{uncstart\_724,1.p2, 176).rem}))._replace(p3 \rightarrow asType<short int>((170
* \operatorname{div}(\mathbf{heapIs} \ \text{$heap}_{funcstart\_724,1}, \ \text{$heap}_{funcstart\_724,1}.p3, \ 178).rem) -
(asType<int>(asType<short int>(div(heapIs $heap_{funcstart\_724,1},))
\text{sheap}_{funcstart_724,1.p3}, 178).\text{quot}) * asType<int>(\text{sheap}_{724,1:742.8.b3}))))
\rightarrow [simplify]
[61.15] $heap<sub>724,1;744,8</sub> == $heap<sub>funcstart_724,1</sub>._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).quot) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow ((-35 * div(heapIs $heap_{tuncstart_724.1},
\text{Sheap}_{funcstart\_724,1}.\text{p2}, 176).\text{quot} + (172 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
\rho_{tuncstart\_724,1.p2, 176).rem})._replace(p3 \rightarrow asType<short int>((170
* div(heapIs heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p3, 178).rem) –
(\text{div}(\mathbf{heapIs} \$ \text{heap}_{funcstart\_724,1}, \$ \text{heap}_{funcstart\_724,1}.\text{p3}, 178).\text{quot} *
asType<int>($heap<sub>724.1:742.8</sub>.b3))))
\rightarrow [from term 57.24, $heap<sub>724,1;742,8</sub> is equal to
heap_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 * div(heapIs $heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1}.p1, 177).quot) + (171 * div(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
heap_{funcstart\_724,1}.p1, 177).rem))._replace(p2 \rightarrow (-35 * div(heapIs)))._
heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p2, 176).quot) + (172 * div(heapIs)
heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p2, 176).rem))]
[61.16] $\text{heap}_{724,1;744,8} == $\text{heap}_{funcstart\_724,1}._\text{replace}(p1 \to ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 *
\operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724,1}, \$ \operatorname{heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow ((-35 * div(heap
Is \rho_{tart\_724,1}
\rho_{funcstart_{-724,1},p2, 176} = 176, quot) + (172 * div(heapIs \rho_{funcstart_{-724,1},p2} = 176).
\rho_{tuncstart\_724,1.p2, 176}.rem))._replace(p3 \rightarrow asType<short int>((170
* div(heapIs heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p3, 178).rem) –
(\text{div}(\mathbf{heapIs} \$ \text{heap}_{funcstart\_724,1}, \$ \text{heap}_{funcstart\_724,1}.\text{p3}, 178).\text{quot} *
\mathbf{asType}{<}\mathbf{int}{>}(\$\text{heap}_{funcstart\_724,1}.\mathbf{\_replace}(\text{p1} \rightarrow ((\text{-2} * \text{div}(\mathbf{heapIs}
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\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.\text{p1}, 177).\text{quot}) + (171 * \text{div}(\text{heapIs})
\$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1, 177).rem))).\_\mathbf{replace}(p2 \rightarrow ((-35), -20)))
* div(\mathbf{heapIs} \ \$ heap_{funcstart\_724,1}, \ \$ heap_{funcstart\_724,1}.p2, \ 176).quot) + (172 \ *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.\operatorname{p2}, \ 176).\operatorname{rem}))).\operatorname{b3}))))
→ [const member of object with modified fields]
[61.18] $heap<sub>724,1;744,8</sub> == $heap<sub>funcstart_724,1</sub>._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).quot) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow ((-35 * div(heapIs $heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\ 724,1}.\text{p2},\ 176).\text{quot}) + (172 * \text{div}(\text{heapIs} \text{Sheap}_{funcstart\ 724,1},
\rho_{tuncstart\_724,1.p2, 176, rem})._replace(p3 \rightarrow asType<short int>((170
* div(heapIs heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p3, 178).rem) –
(\text{div}(\mathbf{heapIs} \$ \text{heap}_{funcstart\_724,1}, \$ \text{heap}_{funcstart\_724,1}.\text{p3}, 178).\text{quot} *
asType < int > (\$heap_{funcstart\_724,1}.b3)))
\rightarrow [const static or extern object]
[61.19] $heap<sub>724,1;744,8</sub> == $heap<sub>funcstart_724,1</sub>._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow ((-35 * div(heapIs $heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1.p2}, 176).\text{quot} + (172 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
\frac{\text{sheap}_{funcstart\_724,1.p2, 176}.rem)}{\text{.replace}(p3 \rightarrow asType < short int > ((170)))}
* div(heapIs heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p3, 178).rem) –
(\text{div}(\mathbf{heapIs} \ \$ \text{heap}_{funcstart\_724.1}, \ \$ \text{heap}_{funcstart\_724.1}. \text{p3}, \ 178). \text{quot} \ *
asType < int > (\$heap_{init}.b3)))
\rightarrow [expand definition of constant 'b3' at prang.c (27,20)]
[61.20] $heap<sub>724,1;744,8</sub> == $heap<sub>funcstart_724,1</sub>._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 \ *
\operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724,1}, \$ \operatorname{heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow ((-35 * div(heapIs $heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1}.\text{p2}, 176).\text{quot} + (172 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
\rho_{tuncstart\_724.1.p2, 176).rem})._replace(p3 \rightarrow asType<short int>((170
* div(heapIs heap_{funcstart\_724.1}, heap_{funcstart\_724.1}, n_{funcstart\_724.1}, n_{funcstart\_724.1}
(\text{div}(\mathbf{heapIs} \$ \text{heap}_{funcstart\_724.1}, \$ \text{heap}_{funcstart\_724.1}. \text{p3}, 178).\text{quot} *
asType<int>(asType<short int>((int)63)))))
\rightarrow [simplify]
[61.26] $heap<sub>724,1;744,8</sub> == $heap<sub>funcstart_724,1</sub>._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 *
\operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724.1}, \$ \operatorname{heap}_{funcstart\_724.1}.p1,
177).rem)))._replace(p2 \rightarrow ((-35 * div(heapIs $heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1}.\text{p2}, 176).\text{quot} + (172 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
\theta_{uncstart\_724,1}.p2, 176).rem))).\_replace(p3 \rightarrow ((-63 * div(heapIs)))._replace(p3 \rightarrow ((-63 * div(heapIs))))._replace(p3 \rightarrow ((-63 * div(heapIs))))._replace(p3 \rightarrow ((-63 * div(heapIs))))._replace(p3 \rightarrow ((-63 * div(heapIs))))._replace(p3 \rightarrow ((-63 * div(heapIs)))))._replace(p3 \rightarrow ((-63 * div(heapIs)))))._replace(p3 \rightarrow ((-63 * div(heapIs))))._replace(p3 \rightarrow ((-63 * div(heapIs)))))._replace(p3 \rightarrow ((-63 * div(heapIs)))))))))._replace(p3 \rightarrow ((-63 * div(heapIs)))))._replace(p3 \rightarrow ((-63 * div(heapIs))))))))))))
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.p3, 178).quot) + (170 * div(heapIs)
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heap_{funcstart_{-724,1}}, heap_{funcstart_{-724,1}}, 178).rem))
 [Take goal term]
 [1.0] ((asType<int>($heap<sub>724.1:744.8</sub>.M1) *
\mathbf{asType} < \mathbf{int} > (\mathbf{static\_cast} < \mathbf{integer} > (\mathbf{asType} < \mathbf{int} > (\$ \mathrm{heap}_{724,1;744,8}.\mathrm{p1}) < \mathsf{p1}) < \mathsf{p2} < \mathsf{p2} < \mathsf{p3} < \mathsf{p3} < \mathsf{p4} < \mathsf{p3} < \mathsf{p4} <
 (int)(0)) + asType < int > (\$heap_{724,1;744,8}.p1)) \le maxof(short int)
 \rightarrow [from term 61.26, $heap<sub>724,1;744,8</sub> is equal to
 heap_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 * div(heapIs $heap_{funcstart\_724,1},
 heap_{funcstart\_724,1}.p1, 177).quot + (171 * div(heapIs $heap_{funcstart\_724,1}, 177).quot) + (171 * div(heapIs $heap_{funcstart\_724,1}, 177).quot)
 \rho_{funcstart\_724,1.p1, 177}.rem))._replace\rho_{funcstart\_724,1.p1, 177}.rem))._replace
 heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p2, 176).quot) + (172 * div(heapIs)
 heap_{funcstart\_724.1}, heap_{funcstart\_724.1}, p2, p2, p3, p4, p3, p4, p3, p4, 
 div(\mathbf{heapIs} \ \$heap_{funcstart\_724,1}, \ \$heap_{funcstart\_724,1}.p3, \ 178).quot) + (170 \ *
div(\mathbf{heapIs} \ \$heap_{funcstart\_724,1}, \ \$heap_{funcstart\_724,1}.p3, \ 178).rem))]
 \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1, 177).quot) + (171 * div(\textbf{heapIs})
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.p1, 177).rem))).\_replace(p2 \rightarrow ((-35)))
 * div(\mathbf{heapIs} \ \$ heap_{funcstart\_724,1}, \ \$ heap_{funcstart\_724,1}.p2, \ 176).quot) + (172 \ *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p2,
 176).rem)))._replace(p3 \rightarrow ((-63 * div(heapIs $heap_{tuncstart_724.1},
 \text{Sheap}_{funcstart_{-724,1},p3, 178}.\text{quot}) + (170 * \text{div}(\text{heapIs} \text{Sheap}_{funcstart_{-724,1}},
heap_{funcstart_{-724,1}.p3, 178, rem)}).M1) *
asType<int>(static_cast<integer>(asType<int>($heap_{724.1:744.8}.p1) <
 (int)(0) + asType<int>($heap<sub>724,1:744,8</sub>.p1)) \leq maxof(short int)
 \rightarrow [const member of object with modified fields]
 [1.4] ((asType<int>($heap_{tuncstart_{-724,1}}.M1) *
\mathbf{asType} < \mathbf{int} > (\mathbf{static\_cast} < \mathbf{integer}) < (\mathbf{asType} < \mathbf{int} > (\$ \mathrm{heap}_{724,1:744.8}.\mathrm{p1}) < (\$ \mathrm{heap}_{724,1:744.8}.\mathrm{p2}) < (\$ \mathrm{heap}_{724,1:744.8}.\mathrm{p2})
 (int)(0)) + asType < int > (\$heap_{724,1;744,8}.p1)) \le maxof(short int)
 \rightarrow [const static or extern object]
 [1.5] ((asType<int>($heap<sub>init</sub>.M1) *
asType<int>(static_cast<integer>(asType<int>($heap_{724,1:744,8}.p1) <
 (int)(0)) + asType < int > (\$heap_{724,1:744,8}.p1)) \le maxof(short int)
 \rightarrow [expand definition of constant 'M1' at prang.c (14,20)]
[1.6] ((asType<int>(asType<short int>((int)30269)) *
\mathbf{asType} < \mathbf{int} > (\mathbf{static\_cast} < \mathbf{integer} > (\mathbf{asType} < \mathbf{int} > (\$ \mathrm{heap}_{724,1;744,8}.\mathrm{p1}) < \mathsf{nt}) < \mathsf{nt} > \mathsf{nt} >
 (int)(0)) + asType < int > (\$heap_{724,1:744,8}.p1)) \le maxof(short int)
 \rightarrow [simplify]
 [1.9] ((30269 *
 asType<int>(static_cast<integer>(asType<int>($heap<sub>724.1:744.8</sub>.p1) <
 (\mathbf{int})0))) + \mathbf{asType} < \mathbf{int} > (\$ \mathrm{heap}_{724,1;744,8}.\mathrm{p1})) \leq \mathbf{maxof}(\mathbf{short}\ \mathbf{int})
 \rightarrow [from term 61.26, $heap<sub>724.1:744.8</sub> is equal to
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heap_{funcstart_{-724,1}}-replace(p1 \rightarrow ((-2 * div(heapIs heap_{funcstart_{-724,1}}),
\text{Sheap}_{funcstart\_724,1.p1}, 177).\text{quot} + (171 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
\rho_{funcstart\_724,1}.p1, 177).rem))).\_replace(p2 \rightarrow ((-35 * div(heapIs))).\_replace(p2 \rightarrow ((-35 * div(heapIs)))).\_replace(p2 \rightarrow ((-35 * div(heapIs)))).\_replace(p2 \rightarrow ((-35 * div(heapIs)))))
heap_{funcstart\_724,1}, heap_{funcstart\_724,1}. p2, p2, p3, p3, p4, 
heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p2, 176).rem)))._replace(p3 \rightarrow (-63 *
div(\mathbf{heapIs} \ \$heap_{funcstart\_724,1}, \ \$heap_{funcstart\_724,1}.p3, \ 178).quot) + (170 *
div(\mathbf{heapIs} \ \$heap_{funcstart\_724,1}, \ \$heap_{funcstart\_724,1}.p3, \ 178).rem))]
[1.10] ((30269 *
asType < int > (static\_cast < integer > (asType < int > (\$heap_{funcstart\_724.1}.\_replace(p1))
\rightarrow ((-2 * div(heapIs $heap_{funcstart\_724,1}, $heap_{funcstart\_724,1}.p1, 177).quot) +
(171 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_724,1}, \text{\$heap}_{funcstart\_724,1}.\text{p1},
177).rem)))._replace(p2 \rightarrow ((-35 * div(heapIs $heap_{tuncstart\_724.1},
\text{Sheap}_{funcstart_{-724,1},p2, 176}.quot) + (172 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart_{-724,1}},
\rho_{funcstart\_724,1.p2, 176}.rem)._replace(p3 \rightarrow ((-63 * div(heapIs
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.p3, 178).quot) + (170 * div(heapIs)
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.\text{p3}, 178).\text{rem}))).\text{p1}) < (\text{int})0))) +
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{724,1;744,8}.\mathrm{p1})) \leq \mathbf{maxof}(\mathbf{short}\ \mathbf{int})
\rightarrow [simplify]
[1.22] ((30269 * asType<int>(([0 < ((-171 * div(heapIs $heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1}.\text{p1}, 177).\text{rem} + (2 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
\frac{\text{sheap}_{funcstart_{724,1},p1, 177}.quot)}{1}: 1, []: 0))) +
asType < int > (\$heap_{724,1:744,8}.p1)) \le maxof(short int)
→ [explicitly assert falsehood of skipped guards in subsequent guards]
[1.23] ((30269 * asType<int>(([0 < ((-171 * div(heapIs $heap_{funcstart\_724.1},
\text{Sheap}_{funcstart\_724,1}.\text{p1}, 177).\text{rem} + (2 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
\frac{\text{heap}_{funcstart_724,1.p1, 177}.\text{quot}}{1, [!(0 < ((-171 * \text{div}(\textbf{heapIs})))]}
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.\text{p1}, 177).\text{rem}) + (2 * \text{div}(\text{heapIs}))
\frac{\text{sheap}_{funcstart\ 724.1}, \frac{\text{sheap}_{funcstart\ 724.1}, p1, 177).quot}}{177).quot}}))]: 0))) +
asType < int > (\$heap_{724,1:744,8}.p1)) \le maxof(short int)
\rightarrow [simplify]
[1.28] ((30269 * asType<int>(([0 < ((-171 * div(heapIs $heap_{tuncstart\_724.1},
\text{Sheap}_{funcstart\_724,1}.\text{p1}, 177).\text{rem} + (2 * \text{div}(\text{heapIs} \text{Sheap}_{funcstart\_724,1},
\rho_{funcstart\_724,1.p1, 177}.quot): 1, [-1 < ((171 * div(heapIs))]: 1, [-1 < ((171 * div(heapIs))]: 1, [-1]
\theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}
\theta_{funcstart_{724,1}}, \theta_{funcstart_{724,1},1}, 177).quot))]: 0))) +
asType < int > (\$heap_{724,1:744,8}.p1)) \le maxof(short int)
\rightarrow [from term 55.3, -1 < ((-2 * div(heapIs $heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1}.\text{p1}, 177).\text{quot} + (171 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
heap_{funcstart\_724,1}.p1, 177).rem is true if and only if 0 < ((-2 * div(\mathbf{heapIs})))
heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p1, 177).quot) + (171 * div(heapIs)
heap_{funcstart_{-724,1}}, heap_{funcstart_{-724,1}}, p1, 177).rem)
[1.29] ((30269 * asType<int>(([0 < ((-171 * div(heapIs $heap_{tuncstart\_724.1},
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\$ heap_{funcstart\_724,1}.p1,\ 177).quot))]:\ 1,\ [0<((-2*div(\textbf{heapIs}
\$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1, 177).quot) + (171 * div(\textbf{heapIs}) + (171 * div(\textbf{heapIs})) + (171
\text{Sheap}_{funcstart_{724,1}}, \text{Sheap}_{funcstart_{724,1}}, p1, 177).rem))]: 0))) +
asType < int > (\$heap_{724,1:744,8}.p1)) \le maxof(short int)
\rightarrow [simplify]
[1.30] ((30269 * ([0 < ((-171 * div(heapIs $heap_{funcstart_724,1}, 
\text{Sheap}_{funcstart\_724,1}.\text{p1}, 177).\text{rem} + (2 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1.p1}, 177).\text{quot}): 1, [0 < ((-2 * \text{div}(\textbf{heapIs})))]: 1, [0 < ((-2 * \text{div}(\textbf{heapIs})))]:
\text{Sheap}_{funcstart\ 724.1}, \text{Sheap}_{funcstart\ 724.1}, \text{p1}, 177).\text{quot}) + (171 * \text{div}(\text{heapIs})
heap_{funcstart_{724,1}}, heap_{funcstart_{724,1}}, 177).rem))]: 0)) +
asType < int > (\$heap_{724,1;744,8}.p1)) \le maxof(short int)
\rightarrow [move guard outside expression]
 \label{eq:continuous} \textit{[1.31]} \; (([0 < ((-171 \; * \; \mathrm{div}(\mathbf{heapIs} \; \$ \mathrm{heap}_{funcstart\_724,1}, \; \$ \mathrm{heap}_{funcstart\_724,1}.\mathrm{p1}, \;
177).rem) + (2 * \text{div}(\mathbf{heapIs} \$ \text{heap}_{funcstart\_724,1}, \$ \text{heap}_{funcstart\_724,1}.p1,
177).quot))]: 1 * 30269, [0 < ((-2 * div(heapIs $heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1}.\text{p1}, 177).\text{quot} + (171 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
\frac{\text{sheap}_{funcstart_{724,1},p1, 177}.rem)}{177} = 0 * 30269} +
asType < int > (\$heap_{724,1:744,8}.p1)) \le maxof(short int)
\rightarrow [simplify]
[1.33] (([0 < ((-171 * div(heapIs p_{funcstart\_724,1}, p_{funcstart\_724,1}, p_{funcstart\_724,1})])
177).rem) + (2 * \text{div}(\mathbf{heapIs} \$ \text{heap}_{funcstart\_724,1}, \$ \text{heap}_{funcstart\_724,1}.p1,
177).quot))]: 30269, [0 < ((-2 * div(heapIs $heap_{funcstart\_724,1}, 
\text{Sheap}_{funcstart\_724,1.p1}, 177).\text{quot} + (171 * \text{div}(\text{heapIs} \text{Sheap}_{funcstart\_724,1},
\frac{\text{sheap}_{funcstart}}{(1,0,0)} = \frac{177}{177} = \frac{177}{
\leq \max of(short int)
\rightarrow [from term 61.26, $heap_{724,1;744,8}$ is equal to
heap_{funcstart\_724.1}._replace(p1 \rightarrow ((-2 * div(heapIs heap_{funcstart\_724.1}),
\text{Sheap}_{funcstart_{-724,1},p1, 177}.\text{quot}) + (171 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart_{-724,1}})
\rho_{funcstart\_724,1}.p1, 177).rem))._replace\rho_{funcstart\_724,1}.p1, 177).rem))._replace
heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p2, 176).quot) + (172 * div(heapIs)
\rho_{funcstart\_724,1}, \rho_{funcstart\_724,1}
div(\mathbf{heapIs} \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p3, 178).quot) + (170 *
div(\mathbf{heapIs} \ \$heap_{funcstart\_724,1}, \ \$heap_{funcstart\_724,1}.p3, \ 178).rem))]
 \label{eq:continuous} \textit{[1.34]} \; (([0 < ((-171 \; * \; \mathrm{div}(\mathbf{heapIs} \; \$ \mathrm{heap}_{funcstart\_724,1}, \; \$ \mathrm{heap}_{funcstart\_724,1}.\mathrm{p1}, \;
177).rem) + (2 * \text{div}(\mathbf{heapIs} \$ \text{heap}_{funcstart\_724,1}, \$ \text{heap}_{funcstart\_724,1}.p1,
177).quot))]: 30269, [0 < ((-2 * div(\mathbf{heapIs} \$heap_{funcstart\_724,1}, 
\theta_{funcstart\_724,1}.p1, 177).quot + (171 * div(heapIs $heap_{funcstart\_724,1}, 177).quot) + (171 * div(heapIs $heap_{funcstart\_724,1}, 177).
\frac{\text{heap}_{funcstart_{724,1.p1, 177}.rem}}{177.rem} +
asType < int > (\$heap_{funcstart\_724,1}.\_replace(p1 \rightarrow ((-2 * div(heapIs))))))
\$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1, 177).quot) + (171 * div(\mathbf{heapIs})
\rho_{funcstart\_724,1}, \rho_{funcstart\_724,1}, \rho_{funcstart\_724,1}, \rho_{funcstart\_724,1}, \rho_{funcstart\_724,1}, \rho_{funcstart\_724,1}, \rho_{funcstart\_724,1}
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 $\text{Sheap}_{funcstart\_724.1.p1, 177}.\text{rem}) + (2 * \text{div}(\text{heapIs} \text{Sheap}_{funcstart\_724.1,})$ 

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* div(heapIs heap_{funcstart_{-724,1}}, heap_{funcstart_{-724,1}}, p2, 176).quot) + (172 *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.p2,
176).rem)))._replace(p3 \rightarrow ((-63 * div(heapIs $heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1.p3}, 178).\text{quot} + (170 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1}.p3, 178).rem)).p1)) \leq \maxof(\text{short int})
\rightarrow [simplify]
[1.39] \; ((-2 * {\rm div}(\mathbf{heapIs} \; \$ {\rm heap}_{funcstart\_724,1}, \, \$ {\rm heap}_{funcstart\_724,1}.{\rm p1}, \, 177).{\rm quot})
+ (171 * div(\mathbf{heapIs} \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1, 177).rem) +
([0 < ((-171 * div(heapIs heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p1,
177).rem) + (2 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart 724.1}, \text{\$heap}_{funcstart 724.1}, \text{pl})
177).quot))]: 30269, [0 < ((-2 * div(heapIs $heap_{funcstart\_724,1}, 
\text{Sheap}_{funcstart\_724,1.p1}, 177).\text{quot} + (171 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
\frac{\text{sheap}_{funcstart_{724,1},p1, 177}.rem)}{0} \le \max of(short int)
\rightarrow [move guard outside expression]
[1.40] ([0 < ((-171 * div(heapIs $heap_{tuncstart\_724.1}, $heap_{tuncstart\_724.1}.p1,
(177).rem + (2 * div(heapIs $heap_{funcstart\_724,1}, $heap_{funcstart\_724,1}.p1,
177).quot))]: 30269 + (-2 * div(\mathbf{heapIs} \$heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1}.\text{p1}, 177).\text{quot} + (171 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1}.\text{p1}, 177).\text{rem}, [0 < ((-2 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724.1}.\text{p1}, 177).\text{quot} + (171 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724.1},
\rho_{tuncstart_{-724,1},p1,177,rem}): 0 + (-2 * div(heapIs $heap_{tuncstart_{-724,1},p1,177,rem})
\text{Sheap}_{funcstart\_724.1.pl}, 177).\text{quot} + (171 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724.1},
\text{Sheap}_{funcstart\_724.1}.\text{p1}, 177).\text{rem}) \leq \text{maxof}(\text{short int})
\rightarrow [simplify]
[1.43] (-1 + ([0 < ((-171 * div(heapIs $heap_{tuncstart\_724.1},
\text{Sheap}_{funcstart_{-724,1},p1, 177}.\text{rem}) + (2 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart_{-724,1}})
heap_{funcstart_724,1.p1, 177}.quot): 30269 + (-2 * div(heapIs
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.\text{p1}, 177).\text{quot}) + (171 * \text{div}(\textbf{heapIs}))
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.\text{p1}, 177).\text{rem}, [0 < ((-2 * div(\textbf{heapIs})))]
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.\text{p1}, 177).\text{quot}) + (171 * \text{div}(\textbf{heapIs}))
\theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}.p1, 177).rem))]: (-2 * div(heapIs)
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.\text{p1}, 177).\text{quot}) + (171 * \text{div}(\textbf{heapIs})
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.p1, 177).rem))) < 32767
\rightarrow [move guard outside expression]
[1.44] \; ([0 < ((-171 * \operatorname{div}(\mathbf{heapIs} \; \$ \operatorname{heap}_{funcstart\_724,1}, \, \$ \operatorname{heap}_{funcstart\_724,1}.\operatorname{p1}, \,
177).rem) + (2 * \text{div}(\mathbf{heapIs} \$ \text{heap}_{funcstart\_724,1}, \$ \text{heap}_{funcstart\_724,1}.\text{p1},
(177).quot)]: -1 + (30269 + (-2 * div(heapIs $heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724.1.p1}, 177).\text{quot} + (171 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724.1},
\text{heap}_{funcstart\_724,1}.\text{p1}, 177).\text{rem}, [0 < ((-2 * \text{div}(\text{heapIs } \text{heap}_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1}.\text{p1}, 177).\text{quot} + (171 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
heap_{funcstart_{-724,1}.p1, 177).rem}): -1 + ((-2 * div(heapIs
\theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}
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\text{Sheap}_{funcstart_{-724,1}}, \text{Sheap}_{funcstart_{-724,1}}.\text{p1}, 177).\text{rem}))) < 32767
\rightarrow [simplify]
[1.48] \ 0 < (32767 + -([0 < ((-171 * div(heapIs $heap_{tuncstart\_724.1},
\text{Sheap}_{funcstart\_724,1}.\text{p1}, 177).\text{rem} + (2 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
heap_{funcstart_{724,1}.p1, 177, quot)}: 30268 + (-2 * div(heapIs
heap_{funcstart_{-724,1}}, heap_{funcstart_{-724,1}}.p1, 177).quot) + (171 * div(heapIs)
\$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1, 177).rem), [0 < ((-2 * div(\mathbf{heapIs}) + (-2 * div(\mathbf{heapIs}
\theta_{funcstart_{724,1}}, \theta_{funcstart_{724,1},p1, 177}.quot) + (171 * div(heapIs)
\frac{\text{sheap}_{funcstart\_724,1}, \text{sheap}_{funcstart\_724,1}.p1, 177).rem)}{\text{rem}}: -1 + (-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.\operatorname{p1}, \ 177).\operatorname{rem})))
\rightarrow [move guard outside expression]
[1.49] \ 0 < (32767 + ([0 < ((-171 * div(heapIs $heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1}.\text{p1}, 177).\text{rem} + (2 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
\frac{\text{sheap}_{funcstart\_724,1.p1, 177}.\text{quot}}{\text{loc}} = -(30268 + (-2 * \text{div}(\text{heapIs})))
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.\text{p1}, 177).\text{quot}) + (171 * \text{div}(\text{heapIs}))
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.\text{p1}, 177).\text{rem}), [0 < ((-2 * div(\mathbf{heapIs})))]
\$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1, 177).quot) + (171 * div(\mathbf{heapIs})
\{\text{heap}_{funcstart\_724,1}, \{\text{heap}_{funcstart\_724,1}, \text{p1}, 177\}.\text{rem}\}\}: -(-1 + (-2 * 
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).quot) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \text{$heap}_{funcstart\_724,1}, \ \text{$heap}_{funcstart\_724,1}.p1, \ 177).rem))))
\rightarrow [simplify]
[1.61] 0 < (32767 + ([0 < ((-171 * div(heapIs $heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1}.\text{p1}, 177).\text{rem} + (2 * \text{div}(\text{heapIs} \text{Sheap}_{funcstart\_724,1},
heap_{funcstart_{-724,1}}.p1, 177).quot): -30268 + (-171 * div(heapIs
\theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.\text{p1}, 177).\text{quot}, [0 < ((-2 * \text{div}(\textbf{heapIs})))]
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.\text{p1}, 177).\text{quot}) + (171 * \text{div}(\textbf{heapIs}))
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.\text{p1}, 177).\text{rem}): 1 + (-171 *
\operatorname{div}(\mathbf{heapIs} \ \text{$heap}_{funcstart\_724,1}, \ \text{$heap}_{funcstart\_724,1}.p1, \ 177).rem) + (2 *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot})))
\rightarrow [move guard outside expression]
[1.62] 0 < ([0 < ((-171 * div(heapIs $heap_{tuncstart\_724.1},
\text{Sheap}_{funcstart\_724.1.p1, 177}.\text{rem}) + (2 * \text{div}(\text{heapIs} \text{Sheap}_{funcstart\_724.1,})
\rho_{uncstart_{-724,1},p1, 177, quot)} = 32767 + (-30268 + (-171 * div(heapIs))
\theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.p1, 177).quot), [0 < ((-2 * 
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).quot) + (171 *
div(\mathbf{heapIs} \ \text{$heap}_{funcstart\_724,1}, \ \text{$heap}_{funcstart\_724,1}.p1, \ 177).rem))]: 32767 +
(1 + (-171 * div(\mathbf{heapIs} \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1, 177).rem)
+ (2 * \text{div}(\mathbf{heapIs} \$ \text{heap}_{funcstart\_724,1}, \$ \text{heap}_{funcstart\_724,1}.\text{p1}, 177).\text{quot})))
\rightarrow [simplify]
```

```
[1.66] \ 0 < ([0 < ((-171 * div(heapIs $heap_{tuncstart\_724.1},
\text{Sheap}_{funcstart\_724,1}.\text{p1}, 177).\text{rem} + (2 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
\frac{\text{sheap}_{funcstart_724,1.p1, 177}.\text{quot}}{177}: 2499 + (-171 * div(heapIs
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.\text{p1}, 177).\text{rem}) + (2 * \text{div}(\text{heapIs}))
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.\text{p1}, 177).\text{quot}), [0 < ((-2 * \text{div}(\textbf{heapIs})))]
\$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1, 177).quot) + (171 * div(\textbf{heapIs}) + (171 * div(\textbf{heapIs})) + (171
\frac{177}{177} = 
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).rem) + (2 *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}))
\rightarrow [move guard outside expression]
[1.67] ([0 < ((-171 * div(heapIs heapIs heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p1,
177).rem) + (2 * div(heapIs $heap_{funcstart\_724,1}, $heap_{funcstart\_724,1}.p1,
(177).quot)]: 0 < (2499 + (-171 * div(heapIs $heap_{funcstart\_724,1}, 177))
\text{Sheap}_{funcstart\_724,1}.\text{p1}, 177).\text{rem} + (2 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
\theta_{funcstart\_724,1}.p1,\ 177).quot)),\ [0<((-2*div(\mathbf{heapIs})
\theta_{funcstart_{724,1}}, \theta_{funcstart_{724,1},p1, 177}.quot) + (171 * div(heapIs)
\{\text{heap}_{funcstart\_724,1}, \{\text{heap}_{funcstart\_724,1}.p1, 177\}.rem\}\}: 0 < (32768 + (-171 *
\operatorname{div}(\mathbf{heapIs} \ \text{$heap}_{funcstart\_724.1}, \ \text{$heap}_{funcstart\_724.1}. p1, 177).rem) + (2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724.1}, \ \text{\$heap}_{funcstart\_724.1}, \operatorname{p1}, 177).\operatorname{quot})))
\rightarrow [simplify]
\label{eq:continuous} \textit{[1.69]} \; ([0 < ((-171 \; * \; \mathrm{div}(\mathbf{heapIs} \; \$ \mathrm{heap}_{funcstart\_724,1}, \, \$ \mathrm{heap}_{funcstart\_724,1}.\mathrm{p1},
177).rem) + (2 * \text{div}(\mathbf{heapIs} \$ \text{heap}_{funcstart\_724,1}, \$ \text{heap}_{funcstart\_724,1}.\text{p1},
(-177).quot)): -2499 < ((-171 * div(heapIs $heap_{funcstart})]
\text{Sheap}_{funcstart\_724,1}.\text{p1}, 177).\text{rem} + (2 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1}.\text{p1}, 177).\text{quot}), [0 < ((-2 * \text{div}(\textbf{heapIs})))]
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.\text{p1}, 177).\text{quot}) + (171 * \text{div}(\text{heapIs}))
\rho_{funcstart_{-724,1}}, \rho_{funcstart_{-724,1}}, \rho_{funcstart_{-724,1}}, \rho_{funcstart_{-724,1}}, \rho_{funcstart_{-724,1}}
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.\text{p1}, \ 177).\text{rem}) + (2 *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot})))
\rightarrow [from guard, literala < ((-171 * div(heapIs $heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1}.\text{p1}, 177).\text{rem} + (2 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
heap_{funcstart\_724,1}.p1, 177).quot) is true whenever (-1 + literala) < 0
             Proof of rule precondition:
             [1.69.0](-2499 + -1) < 0
             \rightarrow [simplify]
             [1.69.2] true
\label{eq:continuous} \textit{[1.70]} \; ([0 < ((-171 \; * \; \mathrm{div}(\mathbf{heapIs} \; \$ \mathrm{heap}_{funcstart\_724,1}, \; \$ \mathrm{heap}_{funcstart\_724,1}.\mathrm{p1}, \;
177).rem) + (2 * \text{div}(\mathbf{heapIs} \$ \text{heap}_{funcstart\_724,1}, \$ \text{heap}_{funcstart\_724,1}.p1,
177).quot))]: true, [0 < ((-2 * div(\mathbf{heapIs} \$heap_{funcstart\_724,1}, 
\theta_{funcstart\_724,1}.p1, 177).quot + (171 * div(heapIs $heap_{funcstart\_724,1}, 177).quot) + (171 * div(heapIs $heap_{funcstart\_724,1}, 177).
\{\text{heap}_{funcstart\_724.1}.\text{p1}, 177\}.\text{rem}\}: 0 < (32768 + (-171 * \text{div}(\text{heapIs})))
```

```
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.\text{p1}, 177).\text{rem}) + (2 * \text{div}(\text{heapIs}))
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.p1, 177).quot)))
\rightarrow [simplify]
\label{eq:loss_loss} \mbox{[1.72] ([0 < ((-171 * div(\mathbf{heapIs} \ \$heap_{funcstart\_724,1}, \ \$heap_{funcstart\_724,1}.p1,
177).rem) + (2 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_724,1}, \text{\$heap}_{funcstart\_724,1}.p1,
177).quot))]: true, [0 < ((-2 * div(\mathbf{heapIs} \$heap_{funcstart\_724,1}, 
\text{Sheap}_{funcstart\_724,1}.\text{p1}, 177).\text{quot} + (171 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
\frac{\text{heap}_{funcstart_724,1.p1, 177}.rem)}{\text{cm}}: -32768 < ((-171 * div(heapIs)))
\theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}
heap_{funcstart_{724,1}}, heap_{funcstart_{724,1}}, 177).quot)))
\rightarrow [from term 56.17, literala < ((-171 * div(heapIs $heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1}.p1, 177).rem) + (2 * div(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
heap_{funcstart\_724.1.p1, 177}, quot)) is true whenever (-1 + literala) < -30269
        Proof of rule precondition:
        [1.72.0](-32768 + -1) < -30269
        \rightarrow [simplify]
        [1.72.2] true
 [1.73] \ ([0 < ((-171 * \mathrm{div}(\mathbf{heapIs} \$ \mathrm{heap}_{funcstart\_724,1}, \$ \mathrm{heap}_{funcstart\_724,1}.\mathrm{p1},
177).rem) + (2 * \text{div}(\textbf{heapIs} \$ \text{heap}_{funcstart\_724,1}, \$ \text{heap}_{funcstart\_724,1}.\text{p1},
177).quot))]: true, [0 < ((-2 * div(heapIs \rho_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724.1.p1}, 177).\text{quot} + (171 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724.1},
\frac{\text{sheap}_{funcstart_{724,1},p1, 177}.rem)}{\text{true}}
\rightarrow [all guards have equal guarded terms]
[1.74] true
Proof of verification condition: Type constraint satisfied in implicit
conversion from 'short int const' to 'int'
Condition generated at: C:\Escher\Customers\prang\prang.c (64,27)
Condition defined at:
To prove: minof(int) \le \$heap_{724,1;747,8}.M2
Given:
heap_{init}.LIMIT == (int)80
heap_{init}.M1 == asType < short int > ((int)30269)
\theta_{init}.r1 == asType < short int > ((int)171)
heap_{init}.a1 == asType < short int > ((int)177)
\theta
\theta sheap<sub>init</sub>.M2 == asType<short int>((int)30307)
```

```
\rho_{init}.r2 == asType < short int > ((int)172)
heap_{init}.a2 == asType < short int > ((int)176)
heap_{init}.b2 == asType < short int > ((int)35)
heap_{init}.M3 == asType < short int > ((int)30323)
\theta_{init}.r3 == asType<short int>((int)170)
heap_{init}.a3 == asType < short int > ((int)178)
\theta = asType < short int > ((int)63)
\theta = asType < short int > ((int)1)
\theta
\theta = asType < short int > ((int)3)
invariant1(heapIs heap_{funcstart\_724,1})
div1 == div(\mathbf{heapIs} \$ heap_{funcstart\_724,1},
asType < int > (\$heap_{funcstart\_724,1}.p1),
asType < int > (\$heap_{funcstart\_724,1}.a1))
(asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.p1)) /
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a1))) = =
asType<integer>(div1.quot)
(asType<int>(asType<int>($heap_{funcstart\_724.1}.p1)) %
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a1))) = =
asType<integer>(div1.rem)
!(0 == asType < integer > (div1.rem)) || !(0 ==
asType<integer>(div1.quot))
div2 == div(\mathbf{heapIs} \$ heap_{funcstart\_724,1},
asType < int > (\$heap_{funcstart\_724,1}.p2),
asType < int > (\$heap_{funcstart\_724.1}.a2))
(asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.p2)) /
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a2))) = =
asType<integer>(div2.quot)
(asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.p2)) \%
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a2))) = =
asType<integer>(div2.rem)
!(0 == asType < integer > (div2.rem)) || !(0 ==
asType<integer>(div2.quot))
\label{eq:div3} \text{div3} == \text{div}(\mathbf{heapIs} \ \$ \text{heap}_{funcstart\_724,1},
asType < int > (\$heap_{funcstart\_724,1}.p3),
asType < int > (\$heap_{funcstart\_724,1}.a3))
(asType<integer>(asType<int>($heap_{funcstart\_724.1}.p3)) /
```

```
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a3))) = =
asType<integer>(div3.quot)
(\mathbf{asType}{<}\mathbf{int}{>}(\mathbf{asType}{<}\mathbf{int}{>}(\$\mathbf{heap}_{funcstart\_724,1}.\mathbf{p3}))~\%
\mathbf{asType}{<}\mathbf{integer}{>}(\mathbf{asType}{<}\mathbf{int}{>}(\$\mathbf{heap}_{funcstart\_724,1}.\mathbf{a3}))) = =
asType<integer>(div3.rem)
!(0 == asType < integer > (div3.rem)) || !(0 ==
asType<integer>(div3.quot))
\text{Sheap}_{724,1;740,8} == \text{Sheap}_{funcstart\_724,1}.\_\mathbf{replace}(\text{p1} \to \mathbf{asType} < \mathbf{short})
int>((asType<int>(asType<short int>(div1.rem)) *
asType < int > (\$heap_{funcstart\_724,1}.r1)) - (asType < int > (asType < short)
int>(div1.quot)) * asType< int>(heap_{funcstart\_724,1}.b1)))
-asType < integer const > (\$heap_{724.1:740.8}.M1) < 
asType<integer>($heap<sub>724.1:740.8</sub>.p1)
!(0 == asType < integer > (\$heap_{724,1;740,8}.p1))
asType < integer > ($heap_{724,1;740,8}.p1) < 
asType < integer > (\$heap_{724,1;740,8}.M1)
heap_{724,1:742,8} == heap_{724,1:740,8}.replace(p2 \rightarrow asType<short
int>((asType<int>(asType<short int>(div2.rem)) *
asType < int > (\$heap_{724,1:740,8}.r2)) - (asType < int > (asType < short)
int>(div2.quot)) * asType<int>($heap<sub>724,1:740,8</sub>.b2))))
-asType<integer const>($heap<sub>724.1:742.8</sub>.M2) <
asType < integer > (\$heap_{724,1;742,8}.p2)
!(0 == asType < integer > (\$heap_{724,1:742.8}.p2))
asType<integer>($heap<sub>724.1:742.8</sub>.p2) <
asType<integer>($heap<sub>724.1:742.8</sub>.M2)
heap_{724,1:744,8} == heap_{724,1:742,8}._replace(p3 \rightarrow asType<short
int>((asType<int>(asType<short int>(div3.rem)) *
asType < int > (\$heap_{724,1:742,8}.r3)) - (asType < int > (asType < short)
int>(div3.quot)) * asType< int>($heap_{724.1:742.8}.b3))))
-asType < integer const > (\$heap_{724,1:744.8}.M3) < 
asType < integer > ($heap_{724,1;744,8}.p3)
!(0 == \mathbf{asType} {<} \mathbf{integer} {>} (\$ heap_{724,1;744,8}.p3))
asType < integer > (\$heap_{724,1;744,8}.p3) < 
asType < integer > (\$heap_{724,1;744,8}.M3)
heap_{724,1:747,8} == heap_{724,1:744,8}.replace(p1 \rightarrow asType<short
int>((asType<int>($heap<sub>724,1;744,8</sub>.M1) *
asType<int>(static_cast<integer>(asType<int>($heap_{724,1:744,8}.p1) <
(int)(0)) + asType < int > (\$heap_{724,1;744,8}.p1)))
Proof:
```

```
[Take goal term]
[1.0] minof(int) \leq $heap<sub>724.1:747.8</sub>.M2
\rightarrow [simplify]
[1.1] -32768 \leq $heap<sub>724,1:747,8</sub>.M2
\rightarrow [const static or extern object]
[1.2] -32768 \le \text{$heap}_{init}.M2
\rightarrow [expand definition of constant 'M2' at prang.c (19,20)]
[1.3] -32768 \le asType < short int > ((int)30307)
\rightarrow [simplify]
[1.6] true
Proof of verification condition: Type constraint satisfied in implicit
conversion from 'short int const' to 'int'
Condition generated at: C:\Escher\Customers\prang\prang.c (64,27)
Condition defined at:
To prove: heap_{724,1;747,8}.M2 \le maxof(int)
Given:
heap_{init}.LIMIT == (int)80
\theta
\theta_{init}.r1 == asType < short int > ((int)171)
\theta
\theta
heap_{init}.M2 == asType < short int > ((int)30307)
\rho_{init}.r2 == asType < short int > ((int)172)
heap_{init}.a2 == asType < short int > ((int)176)
\theta == asType<short int>((int)35)
\theta == asType<short int>((int)30323)
\theta_{init}.r3 == asType<short int>((int)170)
\theta == asType<short int>((int)178)
\theta = asType < short int > ((int)63)
\theta = asType < short int > ((int)1)
\theta
\rho = asType < short int > ((int)3)
```

```
invariant1(heapIs heap_{funcstart_{-724.1}})
\operatorname{div1} == \operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1},
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p1}),
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{a1}))
(\mathbf{asType}{<}\mathbf{integer}{>}(\mathbf{asType}{<}\mathbf{int}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{p1})) \ / \\
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a1))) = =
asType<integer>(div1.quot)
(\mathbf{asType} {<} \mathbf{integer} {>} (\mathbf{asType} {<} \mathbf{int} {>} (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p1})) \ \%
\mathbf{asType} < \mathbf{integer} > (\mathbf{asType} < \mathbf{int} > (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{a1}))) = =
asType<integer>(div1.rem)
!(0 == asType < integer > (div1.rem)) || !(0 ==
asType<integer>(div1.quot))
div2 == div(\mathbf{heapIs} \$heap_{funcstart\_724,1},
asType < int > (\$heap_{funcstart\_724,1}.p2),
asType < int > (\$heap_{funcstart\_724,1}.a2))
(asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.p2)) /
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a2))) = =
asType<integer>(div2.quot)
(\mathbf{asType}{<}\mathbf{int}{>}(\mathbf{sheap}_{funcstart\_724,1}.\mathbf{p2}))~\%
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a2))) = =
asType<integer>(div2.rem)
!(0 == asType < integer > (div2.rem)) || !(0 ==
asType<integer>(div2.quot))
div3 == div(\mathbf{heapIs} \$ heap_{funcstart\_724,1},
asType < int > ($heap_{funcstart\_724,1}.p3),
asType < int > (\$heap_{funcstart\_724,1}.a3))
(\mathbf{asType}{<}\mathbf{int}{>}(\mathbf{asType}{<}\mathbf{int}{>}(\mathbf{\$}\mathbf{heap}_{funcstart\_724,1}.\mathbf{p3}))\ /
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a3))) = =
asType<integer>(div3.quot)
(\mathbf{asType} {<} \mathbf{integer} {>} (\mathbf{asType} {<} \mathbf{int} {>} (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p3})) \ \%
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a3))) = =
asType<integer>(div3.rem)
!(0 == asType < integer > (div3.rem)) || !(0 ==
asType<integer>(div3.quot))
\$heap_{724,1;740,8} == \$heap_{funcstart\_724,1}.\_\textbf{replace}(p1 \rightarrow \textbf{asType} < \textbf{short}
int>((asType<int>(asType<short int>(div1.rem)) *
asType < int > (\$heap_{funcstart\_724,1}.r1)) - (asType < int > (asType < short)
int>(div1.quot)) * asType< int>($heap_{funcstart\_724,1}.b1))))
-asType < integer const > (\$heap_{724.1:740.8}.M1) < 
asType<integer>($heap<sub>724.1:740.8</sub>.p1)
```

```
!(0 == asType < integer > (\$heap_{724,1:740.8}.p1))
asType<integer>($heap<sub>724.1:740.8</sub>.p1) <
asType<integer>($heap<sub>724,1:740,8</sub>.M1)
heap_{724,1;742,8} == heap_{724,1;740,8}.replace(p2 \rightarrow asType<short
\mathbf{int}{>}((\mathbf{asType}{<}\mathbf{int}{>}(\mathbf{asType}{<}\mathbf{short}\ \mathbf{int}{>}(\mathbf{div2.rem}))\ ^*
asType < int > (\$heap_{724.1:740.8}.r2)) - (asType < int > (asType < short)
int>(div2.quot)) * asType< int>($heap_{724,1:740,8}.b2))))
-asType<integer const>($heap<sub>724,1:742,8</sub>.M2) <
asType<integer>($heap<sub>724,1:742,8</sub>.p2)
!(0 == asType < integer > (\$heap_{724,1;742,8}.p2))
asType<integer>($heap<sub>724,1:742,8</sub>.p2) <
asType<integer>($heap<sub>724,1:742,8</sub>.M2)
\text{heap}_{724.1:744.8} == \text{heap}_{724.1:742.8}._replace(p3 \rightarrow asType<short)
int>((asType<int>(asType<short int>(div3.rem)) *
asType < int > (\$heap_{724,1;742,8}.r3)) - (asType < int > (asType < short)
int > (div3.quot)) * asType < int > (\$heap_{724,1;742,8}.b3))))
-{\bf asType}{<} {\bf integer~const}{>} (\${\rm heap}_{724,1;744,8}.{\rm M3}) <
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathrm{heap}_{724,1;744,8}.\mathrm{p3})
!(0 == asType < integer > (\$heap_{724,1;744,8}.p3))
asType<integer>($heap<sub>724,1:744,8</sub>.p3) <
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathrm{heap}_{724,1;744,8}.\mathrm{M3})
heap_{724,1:747,8} == heap_{724,1:744,8}._replace(p1 \rightarrow asType<short
\mathbf{int}{>}((\mathbf{asType}{<}\mathbf{int}{>}(\$\text{heap}_{724,1;744,8}.\text{M1}) \ *
asType<int>(static_cast<integer>(asType<int>($heap<sub>724.1:744.8</sub>.p1) <
(int)(0) + asType<int>($heap<sub>724.1:744.8</sub>.p1)))
Proof:
[Take goal term]
[1.0] $heap<sub>724,1:747,8</sub>.M2 \leq maxof(int)
\rightarrow [const static or extern object]
[1.1] $heap<sub>init</sub>.M2 \leq maxof(int)
\rightarrow [expand definition of constant 'M2' at prang.c (19,20)]
[1.2] asType<short int>((int)30307) < maxof(int)
\rightarrow [simplify]
[1.6] true
```

**Proof of verification condition:** Type constraint satisfied in implicit conversion from 'short int' to 'int'

```
Condition generated at: C:\Escher\Customers\prang\prang.c (64,17)
Condition defined at:
To prove: minof(int) \le \$heap_{724,1:747.8}.p2
Given:
heap_{init}.LIMIT == (int)80
\theta
\theta_{init}.r1 == asType < short int > ((int)171)
heap_{init}.a1 == asType < short int > ((int)177)
\theta
heap_{init}.M2 == asType < short int > ((int)30307)
\theta
heap_{init}.a2 == asType < short int > ((int)176)
\theta = asType < short int > ((int)35)
\theta = asType < short int > ((int)30323)
heap_{init}.r3 == asType < short int > ((int)170)
heap_{init}.a3 == asType < short int > ((int)178)
\theta = asType < short int > ((int)63)
\theta
\theta
\theta = asType < short int > ((int)3)
invariant1(heapIs heap_{funcstart\_724,1})
div1 == div(\mathbf{heapIs} \$ heap_{funcstart\_724.1},
asType < int > (\$heap_{funcstart\_724.1}.p1),
asType < int > (\$heap_{funcstart\_724,1}.a1))
(\mathbf{asType}{<}\mathbf{integer}{>}(\mathbf{asType}{<}\mathbf{int}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathtt{p1}))\ /
\mathbf{asType}{<}\mathbf{integer}{>}(\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{a1}))) ==
asType<integer>(div1.quot)
(asType<integer>(asType<int>($heap_{tuncstart\_724.1}.p1)) %
\mathbf{asType}{<}\mathbf{integer}{>}(\mathbf{asType}{<}\mathbf{int}{>}(\$\mathbf{heap}_{funcstart\_724,1}.\mathbf{a1}))) = =
asType<integer>(div1.rem)
!(0 == asType < integer > (div1.rem)) || !(0 ==
asType<integer>(div1.quot))
div2 == div(\mathbf{heapIs} \$ heap_{funcstart\_724,1},
asType < int > (\$heap_{funcstart\_724,1}.p2),
asType < int > (\$heap_{funcstart\_724,1}.a2))
```

```
(asType < int > (asType < int > (\$heap_{funcstart\_724,1}.p2)) /
\mathbf{asType} < \mathbf{integer} > (\mathbf{asType} < \mathbf{int} > (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{a2}))) = =
asType<integer>(div2.quot)
(asType<int>(asType<int>($heap_{funcstart\_724,1}.p2)) %
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a2))) = =
asType<integer>(div2.rem)
!(0 == asType < integer > (div2.rem)) || !(0 ==
asType<integer>(div2.quot))
div3 == div(\mathbf{heapIs} \$ heap_{funcstart\_724,1},
asType < int > (\$heap_{funcstart\_724,1}.p3),
asType < int > (\$heap_{funcstart_{-724,1}}.a3))
(asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.p3)) /
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a3))) = =
asType<integer>(div3.quot)
(asType<int>(asType<int>($heap_{tuncstart\_724.1}.p3)) %
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a3))) = =
asType<integer>(div3.rem)
!(0 == asType < integer > (div3.rem)) || !(0 ==
asType<integer>(div3.quot))
\$heap_{724,1;740,8} == \$heap_{funcstart\_724,1}.\_\textbf{replace}(p1 \rightarrow \textbf{asType} < \textbf{short}
int>((asType<int>(asType<short int>(div1.rem)) *
asType < int > (\$heap_{tuncstart\_724.1}.r1)) - (asType < int > (asType < short)
int>(div1.quot)) * asType<int>($heap_{funcstart\_724,1}.b1)))
-\mathbf{asType}{<}\mathbf{integer\ const}{>}(\$\mathrm{heap}_{724,1;740,8}.\mathrm{M1}) <
asType<integer>($heap<sub>724,1:740.8</sub>.p1)
!(0 == asType < integer > (\$heap_{724,1;740,8}.p1))
{\bf asType}{<} {\bf integer}{>} (\${\rm heap}_{724,1;740,8}.{\rm p1}) <
asType<integer>($heap<sub>724.1:740.8</sub>.M1)
\text{heap}_{724.1:742.8} == \text{heap}_{724.1:740.8}._replace(p2 \rightarrow asType<short)
int>((asType<int>(asType<short int>(div2.rem)) *
asType < int > (\$heap_{724,1:740,8}.r2)) - (asType < int > (asType < short)
int>(div2.quot)) * asType<int>($heap<sub>724.1:740.8</sub>.b2))))
-asType < integer\ const > (\$heap_{724,1;742,8}.M2) < 
asType<integer>($heap<sub>724.1:742.8</sub>.p2)
!(0 == asType < integer > (\$heap_{724,1;742,8}.p2))
asType<integer>($heap<sub>724,1.742,8.</sub>p2) <
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathrm{heap}_{724,1;742,8}.\mathrm{M2})
$heap_{724,1;744,8} == $heap_{724,1;742,8}.replace(p3 \rightarrow asType<short
int>((asType<int>(asType<short int>(div3.rem)) *
```

```
asType < int > (\$heap_{724.1:742.8}.r3)) - (asType < int > (asType < short)
int>(div3.quot)) * asType<int>($heap<sub>724,1:742,8</sub>.b3))))
-asType<integer const>($heap_{724,1:744,8}.M3) <
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathrm{heap}_{724,1;744,8}.\mathrm{p3})
!(0 == asType < integer > (\$heap_{724,1;744,8}.p3))
asType<integer>($heap<sub>724,1:744,8</sub>.p3) <
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathrm{heap}_{724,1;744,8}.\mathrm{M3})
heap_{724,1:747,8} == heap_{724,1:744,8}.replace(p1 \rightarrow asType<short
int>((asType<int>($heap<sub>724.1:744.8</sub>.M1) *
asType<int>(static_cast<integer>(asType<int>($heap_{724.1:744.8}.p1) <
(int)(0) + asType < int > ($heap_{724.1:744.8}.p1))
Proof:
[Take goal term]
[1.0] minof(int) \leq $heap<sub>724,1:747,8</sub>.p2
\rightarrow [simplify]
[1.3] -32769 < \text{$heap}_{724.1:747.8}.p2
\rightarrow [negate goal and search for contradiction]
[1.4]!(-32769 < \text{$heap}_{724.1:747.8}.p2)
\rightarrow [simplify]
[1.6] 32768 < -$heap<sub>724 1.747 8.p2</sub>
[Assume known post-assertion, class invariant or type constraint for term 1.6]
[66.0] minof(short int) \leq $heap<sub>724,1:747,8</sub>.p2
\rightarrow [simplify]
[66.3] -32769 < heap_{724,1:747,8}.p2
\rightarrow [from term 1.6, literala < $heap<sub>724,1;747,8</sub>.p2 is false whenever -2 < (32768)
+ literala)]
   Proof of rule precondition:
   [66.3.0] - 2 < (-32769 + 32768)
   \rightarrow [simplify]
   [66.3.2] true
[66.4] false
Proof of verification condition: Type constraint satisfied in implicit
```

Condition generated at: C:\Escher\Customers\prang\prang.c (64,17)

```
Condition defined at:
To prove: heap_{724,1:747.8}.p2 \le maxof(int)
Given:
heap_{init}.LIMIT == (int)80
\theta
\theta_{init}.r1 == asType < short int > ((int)171)
\theta
\theta
heap_{init}.M2 == asType < short int > ((int)30307)
\rho_{init}.r2 == asType < short int > ((int)172)
\theta sheap<sub>init</sub>.a2 == asType<short int>((int)176)
\theta = asType < short int > ((int)35)
heap_{init}.M3 == asType < short int > ((int)30323)
\theta_{init}.r3 == asType<short int>((int)170)
heap_{init}.a3 == asType < short int > ((int)178)
\theta = asType < short int > ((int)63)
\theta = asType < short int > ((int)1)
\theta
\theta = asType < short int > ((int)3)
invariant1(heapIs heap_{funcstart_{-724,1}})
\operatorname{div1} == \operatorname{div}(\mathbf{heapIs} \ \operatorname{heap}_{funcstart\_724,1},
\mathbf{asType} < \mathbf{int} > (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p1}),
asType < int > (\$heap_{funcstart\_724,1}.a1))
(\mathbf{asType}{<}\mathbf{integer}{>}(\mathbf{asType}{<}\mathbf{int}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathtt{p1}))\ /
\mathbf{asType}{<}\mathbf{integer}{>}(\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{a1}))) ==
asType<integer>(div1.quot)
(asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.p1)) \%
\mathbf{asType}{<}\mathbf{integer}{>}(\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{a1}))) = =
asType<integer>(div1.rem)
!(0 == asType < integer > (div1.rem)) || !(0 ==
asType<integer>(div1.quot))
```

(asType<integer>(asType<int>(\$heap\_{tuncstart\\_724.1}.p2)) /

 $div2 == div(\mathbf{heapIs} \$ heap_{funcstart\_724,1},$   $\mathbf{asType} < \mathbf{int} > (\$ heap_{funcstart\_724,1}.p2),$  $\mathbf{asType} < \mathbf{int} > (\$ heap_{funcstart\_724,1}.a2))$ 

```
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a2))) = =
asType<integer>(div2.quot)
(\mathbf{asType}{<}\mathbf{int}{>}(\mathbf{asType}{<}\mathbf{int}{>}(\$\mathbf{heap}_{funcstart\_724,1}.\mathbf{p2}))~\%
\mathbf{asType}{<}\mathbf{integer}{>}(\mathbf{asType}{<}\mathbf{int}{>}(\$\mathbf{heap}_{funcstart\_724,1}.\mathbf{a2}))) = =
asType<integer>(div2.rem)
!(0 == asType < integer > (div2.rem)) || !(0 ==
asType<integer>(div2.quot))
div3 == div(\mathbf{heapIs} \$ heap_{funcstart\_724,1},
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p3}),
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{a3}))
(asType<int>(asType<int>($heap_{tuncstart\_724.1}.p3)) /
asType < integer > (asType < int > (\$heap_{funcstart\_724.1}.a3))) = =
asType<integer>(div3.quot)
(\mathbf{asType}{<}\mathbf{int}{>}(\mathbf{asType}{<}\mathbf{int}{>}(\$\mathbf{heap}_{funcstart\_724,1}.\mathbf{p3}))~\%
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a3))) = =
asType<integer>(div3.rem)
!(0 == asType < integer > (div3.rem)) || !(0 ==
asType<integer>(div3.quot))
$heap_{724,1;740,8} == $heap_{funcstart\_724,1}.\_replace(p1 \rightarrow asType < short)
int>((asType<int>(asType<short int>(div1.rem)) *
asType < int > (\$heap_{funcstart\_724,1}.r1)) - (asType < int > (asType < short)
int>(div1.quot)) * asType< int>(heap_{funcstart\_724,1}.b1)))
-asType<integer const>($heap<sub>724.1:740.8</sub>.M1) <
asType<integer>($heap<sub>724.1:740.8</sub>.p1)
!(0 == asType < integer > (\$heap_{724,1;740,8}.p1))
asType<integer>($heap<sub>724,1;740,8</sub>.p1) <
asType < integer > (\$heap_{724,1;740,8}.M1)
heap_{724,1:742,8} == heap_{724,1:740,8}.replace(p2 \rightarrow asType<short
int>((asType<int>(asType<short int>(div2.rem)) *
asType < int > (\$heap_{724,1:740,8}.r2)) - (asType < int > (asType < short)
\mathbf{int}{>}(\text{div2.quot})) \ * \ \mathbf{asType}{<} \mathbf{int}{>} (\$\text{heap}_{724,1;740,8}.\text{b2}))))
-asType < integer\ const > (\$heap_{724,1;742,8}.M2) < 
\mathbf{asType} < \mathbf{integer} > (\$ heap_{724,1;742,8}.p2)
!(0 == asType < integer > (\$heap_{724,1;742,8}.p2))
asType<integer>($heap<sub>724.1:742.8</sub>.p2) <
asType<integer>($heap<sub>724,1.742,8</sub>.M2)
\text{sheap}_{724,1;744,8} == \text{sheap}_{724,1;742,8}.\_\text{replace}(p3 \to asType < short)
int>((asType<int>(asType<short int>(div3.rem)) *
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{724,1;742,8}.\mathrm{r3})) - (\mathbf{asType}{<}\mathbf{int}{>}(\mathbf{asType}{<}\mathbf{short}
```

```
int>(div3.quot)) * asType<int>($heap<sub>724.1:742.8</sub>.b3))))
-asType<integer const>($heap<sub>724.1:744.8</sub>.M3) <
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathrm{heap}_{724,1;744,8}.\mathrm{p3})
!(0 == asType < integer > (\$heap_{724,1;744,8}.p3))
asType<integer>($heap<sub>724,1:744,8</sub>.p3) <
asType<integer>($heap<sub>724,1:744,8</sub>.M3)
\text{$heap}_{724,1;747,8} == \text{$heap}_{724,1;744,8}.\_\textbf{replace}(\text{p1} \to \textbf{asType} < \textbf{short}
int>((asType<int>($heap<sub>724.1:744.8</sub>.M1) *
asType<int>(static_cast<integer>(asType<int>($heap_{724.1:744.8}.p1) <
(int)(0) + asType < int > ($heap_{724.1:744.8}.p1))
Proof:
[Take goal term]
[1.0] $heap<sub>724,1;747,8</sub>.p2 \leq maxof(int)
\rightarrow [simplify]
[1.9] -32768 < -\$heap_{724,1;747,8}.p2
\rightarrow [negate goal and search for contradiction]
[1.10]!(-32768 < -\$heap_{724.1:747.8}.p2)
\rightarrow [simplify]
[1.13] 32767 < $heap<sub>724.1:747.8</sub>.p2
[Assume known post-assertion, class invariant or type constraint for term 1.13]
[66.0] $heap<sub>724,1:747,8</sub>.p2 \leq maxof(short int)
\rightarrow [simplify]
[66.9] -32768 < -\$heap_{724,1;747,8}.p2
\rightarrow [from term 1.13, literala < -$heap<sub>724.1:747.8</sub>.p2 is false whenever -2 <
(32767 + literala)
    Proof of rule precondition:
    [66.9.0] - 2 < (-32768 + 32767)
    \rightarrow [simplify]
    [66.9.2] true
[66.10] false
```

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

Condition generated at: C:\Escher\Customers\prang\prang.c (64,11)

Condition defined at:

```
To prove: minof(int) <
static\_cast < integer > (asType < int > (\$heap_{724,1:747,8}.p2) < (int)0)
Given:
heap_{init}.LIMIT == (int)80
\theta
\theta_{init}.r1 == asType < short int > ((int)171)
\theta
\theta = asType < short int > ((int)2)
heap_{init}.M2 == asType < short int > ((int)30307)
\theta
heap_{init}.a2 == asType < short int > ((int)176)
\theta sheap<sub>init</sub>.b2 == asType<short int>((int)35)
heap_{init}.M3 == asType < short int > ((int)30323)
heap_{init}.r3 == asType < short int > ((int)170)
heap_{init}.a3 == asType < short int > ((int)178)
\theta = asType < short int > ((int)63)
\theta = asType < short int > ((int)1)
\theta
\theta = asType < short int > ((int)3)
invariant1(heapIs heap_{funcstart\_724,1})
\operatorname{div1} == \operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724,1},
asType < int > (\$heap_{funcstart\_724,1}.p1),
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{a1}))
(\mathbf{asType}{<}\mathbf{integer}{>}(\mathbf{asType}{<}\mathbf{int}{>}(\$\mathbf{heap}_{funcstart\_724,1}.\mathbf{p1})) \ / \\
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a1))) = =
asType<integer>(div1.quot)
(\mathbf{asType}{<}\mathbf{int}{>}(\mathbf{asType}{<}\mathbf{int}{>}(\$\mathbf{heap}_{funcstart\_724,1}.\mathbf{p1}))~\%
\mathbf{asType}{<}\mathbf{integer}{>}(\mathbf{asType}{<}\mathbf{int}{>}(\$\mathbf{heap}_{funcstart\_724,1}.\mathbf{a1}))) = =
asType<integer>(div1.rem)
!(0 == asType < integer > (div1.rem)) || !(0 ==
asType<integer>(div1.quot))
div2 == div(\mathbf{heapIs} \$ heap_{funcstart\_724,1},
asType < int > (\$heap_{funcstart\_724,1}.p2),
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{a2}))
(asType<integer>(asType<int>($heap_{tuncstart\_724,1}.p2)) /
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a2))) = =
```

```
asType<integer>(div2.quot)
(asType < int > (asType < int > (\$heap_{funcstart\_724,1}.p2)) \%
\mathbf{asType}{<}\mathbf{integer}{>}(\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{a2}))) ==
asType<integer>(div2.rem)
!(0 == asType < integer > (div2.rem)) || !(0 ==
asType<integer>(div2.quot))
div3 == div(\mathbf{heapIs} \$ heap_{funcstart\_724,1},
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p3}),
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{a3}))
(asType<int>(asType<int>($heap_{tuncstart\_724.1}.p3)) /
asType < integer > (asType < int > (\$heap_{funcstart\_724.1}.a3))) = =
asType<integer>(div3.quot)
(asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.p3)) \%
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a3))) = =
asType<integer>(div3.rem)
!(0 == asType < integer > (div3.rem)) || !(0 ==
asType<integer>(div3.quot))
\rho_{174,1740,8} == \rho_{174,174
int>((asType<int>(asType<short int>(div1.rem)) *
asType < int > (\$heap_{funcstart-724,1}.r1)) - (asType < int > (asType < short)
int>(div1.quot)) * asType< int>($heap_{funcstart\_724,1}.b1))))
-asType < integer\ const > (\$heap_{724,1;740,8}.M1) < 
asType<integer>($heap<sub>724.1:740.8</sub>.p1)
!(0 == asType < integer > (\$heap_{724,1:740,8}.p1))
asType<integer>($heap<sub>724.1:740.8</sub>.p1) <
asType<integer>($heap<sub>724,1:740,8</sub>.M1)
heap_{724,1:742,8} == heap_{724,1:740,8}.replace(p2 \rightarrow asType<short
int>((asType<int>(asType<short int>(div2.rem)) *
asType < int > (\$heap_{724,1:740.8}.r2)) - (asType < int > (asType < short)
int > (div2.quot)) * asType < int > ($heap_{724,1:740.8}.b2))))
-asType < integer\ const > (\$heap_{724,1;742,8}.M2) < 
asType<integer>($heap<sub>724.1:742.8</sub>.p2)
!(0 == asType < integer > (\$heap_{724,1:742.8}.p2))
asType < integer > (\$heap_{724,1;742,8}.p2) <
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathrm{heap}_{724,1;742,8}.\mathrm{M2})
\text{sheap}_{724,1;744,8} == \text{sheap}_{724,1;742,8}.\_\text{replace}(p3 \to asType < short)
int>((asType<int>(asType<short int>(div3.rem)) *
asType < int > (\$heap_{724,1:742.8}.r3)) - (asType < int > (asType < short)
int>(div3.quot)) * asType<int>($heap<sub>724,1:742,8</sub>.b3))))
```

```
-{\bf asType}{<}{\bf integer~const}{>}(\${\rm heap}_{724,1;744,8}.{\rm M3}) <
asType<integer>($heap<sub>724,1:744,8</sub>.p3)
!(0 == \mathbf{asType} {<} \mathbf{integer} {>} (\$ \mathrm{heap}_{724,1;744,8}.\mathrm{p3}))
asType<integer>($heap<sub>724,1;744,8</sub>.p3) <
asType<integer>($heap<sub>724,1;744,8</sub>.M3)
heap_{724,1:747,8} == heap_{724,1:744,8}.replace(p1 \rightarrow asType<short
int>((asType<int>($heap<sub>724,1;744,8</sub>.M1) *
asType<int>(static_cast<integer>(asType<int>($heap_{724,1:744,8}.p1) <
(int)(0) + asType < int > ($heap_{724,1:744,8}.p1))
Proof:
[Take goal term]
[1.0] minof(int) \leq static_cast<integer>(asType<int>($heap_{724.1:747.8}.p2)
< (int)0)
\rightarrow [simplify]
[1.6] -32768 \le ([0 < -\$heap_{724.1;747.8}.p2]: 1, []: 0)
\rightarrow [explicitly assert falsehood of skipped guards in subsequent guards]
[1.7] - 32768 \le ([0 < -\$heap_{724,1:747,8}.p2]: 1, [!(0 < -\$heap_{724,1:747,8}.p2)]: 0)
\rightarrow [simplify]
[1.12] -32769 < ([0 < -$heap<sub>724,1:747,8</sub>.p2]: 1, [-1 < $heap<sub>724,1:747,8</sub>.p2]: 0)
\rightarrow [move guard outside expression]
[1.13] ([0 < -$heap<sub>724,1:747,8</sub>.p2]: -32769 < 1, [-1 < $heap<sub>724,1:747,8</sub>.p2]: -32769
< 0)
\rightarrow [simplify]
[1.15] ([0 < -$heap<sub>724,1;747,8</sub>.p2]: true, [-1 < $heap<sub>724,1;747,8</sub>.p2]: true)
\rightarrow [all guards have equal guarded terms]
[1.16] true
Proof of verification condition: Type constraint satisfied in explicit
conversion from 'integer' to 'int'
Condition generated at: C:\Escher\Customers\prang\prang.c (64,11)
Condition defined at:
To prove: static_cast<integer>(asType<int>($heap<sub>724,1:747,8</sub>.p2) <
(int)0) \leq maxof(int)
Given:
heap_{init}.LIMIT == (int)80
```

```
heap_{init}.M1 == asType < short int > ((int)30269)
\theta_{init}.r1 == asType < short int > ((int)171)
heap_{init}.a1 == asType < short int > ((int)177)
\theta = asType < short int > ((int)2)
\theta sheap<sub>init</sub>.M2 == asType<short int>((int)30307)
\theta_{init}.r2 == asType < short int > ((int)172)
heap_{init}.a2 == asType < short int > ((int)176)
\theta = asType < short int > ((int)35)
\theta = asType < short int > ((int)30323)
heap_{init}.r3 == asType < short int > ((int)170)
heap_{init}.a3 == asType < short int > ((int)178)
\theta = asType < short int > ((int)63)
\theta = asType < short int > ((int)1)
\theta
\theta = asType < short int > ((int)3)
invariant1(heapIs heap_{funcstart_{-724,1}})
\operatorname{div1} == \operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724,1},
asType < int > (\$heap_{funcstart\_724.1}.p1),
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{a1}))
(\mathbf{asType}{<}\mathbf{integer}{>}(\mathbf{asType}{<}\mathbf{int}{>}(\$\mathbf{heap}_{funcstart\_724,1}.\mathbf{p1})) \ / \\
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a1))) = =
asType<integer>(div1.quot)
(asType < int > (asType < int > (\$heap_{funcstart\_724,1}.p1)) \%
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a1))) = =
asType<integer>(div1.rem)
!(0 == asType < integer > (div1.rem)) || !(0 ==
\mathbf{asType}{<}\mathbf{integer}{>}(\mathbf{div1}.\mathbf{quot}))
div2 == div(\mathbf{heapIs} \$heap_{funcstart\_724,1},
asType < int > (\$heap_{funcstart\_724.1}.p2),
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{a2}))
(\mathbf{asType} < \mathbf{integer} > (\mathbf{asType} < \mathbf{int} > (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p2})) \ / \\
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a2))) = =
asType<integer>(div2.quot)
(asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.p2)) \%
asType < integer > (asType < int > (\$heap_{funcstart\_724.1}.a2))) = =
asType<integer>(div2.rem)
```

```
!(0 == asType < integer > (div2.rem)) || !(0 ==
asType<integer>(div2.quot))
\label{eq:div3} \text{div3} == \text{div}(\mathbf{heapIs} \ \$ \text{heap}_{funcstart\_724,1},
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p3}),
asType < int > (\$heap_{funcstart\_724.1}.a3))
(asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.p3)) /
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a3))) = =
asType<integer>(div3.quot)
(asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.p3)) \%
\mathbf{asType}{<}\mathbf{integer}{>}(\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{a3}))) ==
asType<integer>(div3.rem)
!(0 == asType < integer > (div3.rem)) || !(0 ==
asType<integer>(div3.quot))
\$heap_{724,1;740,8} == \$heap_{funcstart\_724,1}.\_\mathbf{replace}(p1 \to \mathbf{asType} < \mathbf{short}
int>((asType<int>(asType<short int>(div1.rem)) *
asType < int > (\$heap_{funcstart\_724,1}.r1)) - (asType < int > (asType < short)
int>(div1.quot)) * asType< int>(heap_{funcstart\_724,1}.b1)))
-{\bf asType}{<}{\bf integer~const}{>}(\${\rm heap}_{724,1;740,8}.{\rm M1})<
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathrm{heap}_{724,1;740,8}.\mathrm{p1})
!(0 == asType < integer > (\$heap_{724,1;740,8}.p1))
asType<integer>($heap<sub>724.1:740.8</sub>.p1) <
asType<integer>($heap<sub>724,1:740,8</sub>.M1)
heap_{724,1:742,8} == heap_{724,1:740,8}.replace(p2 \rightarrow asType<short
int>((asType<int>(asType<short int>(div2.rem)) *
asType < int > (\$heap_{724,1:740,8}.r2)) - (asType < int > (asType < short)
int>(div2.quot)) * asType< int>($heap_{724,1;740,8}.b2))))
-asType<integer const>($heap<sub>724.1:742.8</sub>.M2) <
asType<integer>($heap<sub>724.1:742.8</sub>.p2)
!(0 == asType < integer > (\$heap_{724,1:742.8}.p2))
asType<integer>($heap<sub>724.1:742.8</sub>.p2) <
asType<integer>($heap<sub>724.1:742.8</sub>.M2)
heap_{724,1:744,8} == heap_{724,1:742,8}.replace(p3 \rightarrow asType<short
int>((asType<int>(asType<short int>(div3.rem)) *
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{724,1;742,8}.\mathrm{r3})) - (\mathbf{asType}{<}\mathbf{int}{>}(\mathbf{asType}{<}\mathbf{short}
int>(div3.quot)) * asType< int>($heap_{724.1:742.8}.b3))))
-asType<integer const>($heap<sub>724 1.744 8.</sub>M3) <
asType<integer>($heap<sub>724 1.744 8.</sub>p3)
!(0 == asType < integer > (\$heap_{724,1:744.8}.p3))
asType<integer>($heap<sub>724.1:744.8</sub>.p3) <
```

```
asType<integer>($heap<sub>724.1:744.8</sub>.M3)
heap_{724,1:747,8} == heap_{724,1:744,8}.replace(p1 \rightarrow asType<short
int>((asType< int>(\$heap_{724,1;744,8}.M1) *
asType<int>(static_cast<integer>(asType<int>($heap_{724.1:744.8}.p1) <
(int)(0) + asType < int > ($heap_{724.1:744.8}.p1))
Proof:
[Take goal term]
[1.0] static_cast<integer>(asType<int>($heap<sub>724.1:747.8</sub>.p2) < (int)0) \leq
maxof(int)
\rightarrow [simplify]
[1.5] ([0 < -$heap<sub>724,1;747,8</sub>.p2]: 1, []: 0) \leq maxof(int)
→ [explicitly assert falsehood of skipped guards in subsequent guards]
[1.6] ([0 < -$heap<sub>724,1:747,8</sub>.p2]: 1, [!(0 < -$heap<sub>724,1:747,8</sub>.p2)]: 0) \leq
maxof(int)
\rightarrow [simplify]
[1.11] (-1 + ([0 < -$heap<sub>724,1:747,8</sub>.p2]: 1, [-1 < $heap<sub>724,1:747,8</sub>.p2]: 0)) <
\rightarrow [move guard outside expression]
[1.12] ([0 < -$heap<sub>724,1:747,8</sub>.p2]: -1 + 1, [-1 < $heap<sub>724,1:747,8</sub>.p2]: -1 + 0) <
32767
\rightarrow [simplify]
[1.15] 0 < (32767 + -([0 < -\$heap_{724,1:747,8}.p2]): 0, [-1 < \$heap_{724,1:747,8}.p2]:
-1))
\rightarrow [move guard outside expression]
 [1.16] \ 0 < (32767 + ([0 < -\$heap_{724,1;747,8}.p2]: \ -0, \ [-1 < \$heap_{724,1;747,8}.p2]: \ ) 
--1))
\rightarrow [simplify]
[1.18] \ 0 < (32767 + ([0 < -\$heap_{724.1:747.8}.p2]); 0, [-1 < \$heap_{724.1:747.8}.p2];
1))
\rightarrow [move guard outside expression]
[1.19] \ 0 < ([0 < -\$heap_{724,1;747,8}.p2]: 0 + 32767, [-1 < \$heap_{724,1;747,8}.p2]: 1
+32767)
\rightarrow [simplify]
[1.21] 0 < ([0 < -\$heap_{724,1;747,8}.p2]: 32767, [-1 < \$heap_{724,1;747,8}.p2]: 32768)
\rightarrow [move guard outside expression]
[1.22] ([0 < -$heap<sub>724,1:747,8</sub>.p2]: 0 < 32767, [-1 < $heap<sub>724,1:747,8</sub>.p2]: 0 <
```

```
32768)
\rightarrow [simplify]
[1.24] ([0 < -$heap<sub>724.1:747.8</sub>.p2]: true, [-1 < $heap<sub>724.1:747.8</sub>.p2]: true)
\rightarrow [all guards have equal guarded terms]
[1.25] true
Proof of verification condition: Arithmetic result of operator '*' is within
limit of type 'int'
Condition generated at: C:\Escher\Customers\prang\prang.c (64,25)
Condition defined at:
To prove: minof(int) \le (asType < int > (\$heap_{724.1:747.8}.M2) *
\mathbf{asType} < \mathbf{int} > (\mathbf{static\_cast} < \mathbf{integer} > (\mathbf{asType} < \mathbf{int} > (\$ \mathrm{heap}_{724,1;747,8}.\mathrm{p2}) < \mathsf{nt}) < \mathsf{neget} > (\$ \mathrm{heap}_{724,1;747,8}.\mathrm{p2}) < \mathsf{neget} > (\$ \mathrm{heap}_{724,1;747,8}.\mathrm
(int)0)))
Given:
heap_{init}.LIMIT == (int)80
\theta
\theta_{init}.r1 == asType < short int > ((int)171)
heap_{init}.a1 == asType < short int > ((int)177)
\theta sheap<sub>init</sub>.M2 == asType<short int>((int)30307)
\theta_{init}.r2 == asType < short int > ((int)172)
heap_{init}.a2 == asType < short int > ((int)176)
\theta = asType < short int > ((int)35)
\theta sheap<sub>init</sub>.M3 == asType<short int>((int)30323)
\theta_{init}.r3 == asType<short int>((int)170)
\theta == asType<short int>((int)178)
\theta = asType < short int > ((int)63)
\theta
\theta
heap_{init}.p3 == asType < short int > ((int)3)
invariant1(heapIs heap_{funcstart_{-724,1}})
\operatorname{div1} == \operatorname{div}(\mathbf{heapIs} \ \operatorname{\$heap}_{funcstart\_724,1},
asType < int > (\$heap_{funcstart\_724,1}.p1),
asType < int > (\$heap_{funcstart\_724,1}.a1))
```

```
(\mathbf{asType}{<}\mathbf{int}{>}(\mathbf{asType}{<}\mathbf{int}{>}(\$\mathbf{heap}_{funcstart\_724,1}.\mathbf{p1}))\ /
\mathbf{asType} < \mathbf{integer} > (\mathbf{asType} < \mathbf{int} > (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{a1}))) = =
asType < integer > (div1.quot)
(asType<integer>(asType<int>($heap_{tuncstart\_724.1}.p1)) %
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a1))) = =
asType<integer>(div1.rem)
!(0 == asType < integer > (div1.rem)) || !(0 ==
asType<integer>(div1.quot))
div2 == div(\mathbf{heapIs} \$ heap_{funcstart\_724,1},
\mathbf{asType} < \mathbf{int} > (\$ \mathrm{heap}_{funcstart\_724,1}.\mathrm{p2}),
asType < int > (\$heap_{funcstart_{-724,1}}.a2))
(asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.p2)) /
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a2))) = =
asType<integer>(div2.quot)
(asType<int>(asType<int>($heap_{tuncstart\_724.1}.p2)) %
\mathbf{asType}{<}\mathbf{integer}{>}(\mathbf{asType}{<}\mathbf{int}{>}(\$\mathbf{heap}_{funcstart\_724,1}.\mathbf{a2}))) = =
asType<integer>(div2.rem)
!(0 == asType < integer > (div2.rem)) || !(0 ==
asType<integer>(div2.quot))
div3 == div(\mathbf{heapIs} \$ heap_{funcstart\_724,1},
asType < int > (\$heap_{funcstart\_724,1}.p3),
asType < int > (\$heap_{funcstart\_724.1}.a3))
(asType<int>(asType<int>($heap_{tuncstart}, 724.1.p3)) /
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a3))) = =
asType<integer>(div3.quot)
(asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.p3)) \%
asType < integer > (asType < int > (\$heap_{funcstart\_724.1}.a3))) = =
asType<integer>(div3.rem)
!(0 == asType < integer > (div3.rem)) || !(0 ==
asType<integer>(div3.quot))
heap_{724,1;740,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow asType<short
int>((asType<int>(asType<short int>(div1.rem)) *
asType < int > (\$heap_{funcstart\_724,1}.r1)) - (asType < int > (asType < short)
int>(div1.quot)) * asType<int>($heap_{funcstart\_724,1}.b1)))
-asType < integer const > (\$heap_{724,1:740.8}.M1) < 
asType<integer>($heap<sub>724.1:740.8</sub>.p1)
!(0 == asType < integer > (\$heap_{724,1;740,8}.p1))
asType<integer>($heap<sub>724.1:740.8</sub>.p1) <
asType<integer>($heap<sub>724.1:740.8</sub>.M1)
```

```
heap_{724,1;742,8} == heap_{724,1;740,8}.replace(p2 \rightarrow asType<short
int>((asType<int>(asType<short int>(div2.rem)) *
asType < int > (\$heap_{724,1:740,8}.r2)) - (asType < int > (asType < short)
int>(div2.quot)) * asType< int>($heap_{724,1;740.8}.b2))))
-asType<integer const>($heap<sub>724.1:742.8</sub>.M2) <
asType<integer>($heap<sub>724.1:742.8</sub>.p2)
!(0 == asType < integer > (\$heap_{724,1;742,8}.p2))
asType<integer>($heap<sub>724,1:742,8</sub>.p2) <
asType<integer>($heap<sub>724,1:742,8</sub>.M2)
heap_{724,1;744,8} == heap_{724,1;742,8}.replace(p3 \rightarrow asType<short
int>((asType<int>(asType<short int>(div3.rem)) *
asType < int > (\$heap_{724.1:742.8}.r3)) - (asType < int > (asType < short)
int > (div3.quot)) * asType < int > (\$heap_{724,1;742,8}.b3))))
-{\bf asType}{<} {\bf integer~const}{>} (\${\rm heap}_{724,1;744,8}.{\rm M3}) <
asType<integer>($heap<sub>724.1:744.8</sub>.p3)
!(0 == asType < integer > (\$heap_{724,1;744,8}.p3))
\mathbf{asType}{<}\mathbf{integer}{>}(\${heap}_{724,1;744,8}.p3) <
asType<integer>($heap<sub>724.1:744.8</sub>.M3)
\text{heap}_{724.1:747.8} == \text{heap}_{724.1:744.8}._replace(p1 \rightarrow asType<short)
int>((asType<int>($heap<sub>724,1;744,8</sub>.M1) *
asType<int>(static_cast<integer>(asType<int>($heap_{724.1:744.8}.p1) <
(int)(0) + asType<int>($heap<sub>724.1:744.8</sub>.p1)))
Proof:
[Take goal term]
[1.0]  minof(int) \leq (asType < int > (\$heap_{724,1:747,8}.M2) *
asType<int>(static_cast<integer>(asType<int>($heap_{724,1:747,8}.p2) <
(int)0)))
\rightarrow [simplify]
[1.1] -32768 \leq (asType<int>($heap<sub>724,1:747,8</sub>.M2) *
asType<int>(static_cast<integer>(asType<int>($heap_{724.1:747.8}.p2) <
(\mathbf{int})(0)
\rightarrow [const static or extern object]
[1.2] -32768 \le (asType < int > (\$heap_{init}.M2) *
asType<int>(static_cast<integer>(asType<int>($heap<sub>724.1:747.8</sub>.p2) <
(int)0)))
\rightarrow [expand definition of constant 'M2' at prang.c (19,20)]
[1.3] -32768 \leq (asType\leqint>(asType\leqshort int>((int)30307)) *
asType<int>(static_cast<integer>(asType<int>($heap<sub>724,1:747.8</sub>.p2) <
```

```
(\mathbf{int})(0)
\rightarrow [simplify]
[1.11] -32768 \leq (30307 * asType<int>(([0 < -$heap<sub>724,1:747,8</sub>.p2]: 1, []: 0)))
→ [explicitly assert falsehood of skipped guards in subsequent guards]
[1.12] -32768 \leq (30307 * asType<int>(([0 < -$heap<sub>724.1:747.8</sub>.p2]: 1, [!(0 <
-\$ heap_{724,1;747,8}.p2)] \colon \ 0)))
\rightarrow [simplify]
[1.16] -32768 \leq (30307 * ([0 < -$heap<sub>724,1:747,8</sub>.p2]: 1, [-1 <
heap_{724,1;747,8}.p2: 0)
\rightarrow [move guard outside expression]
[1.17] -32768 \leq ([0 < -$heap<sub>724,1;747,8</sub>.p2]: 1 * 30307, [-1 <
heap_{724,1:747,8}.p2: 0 * 30307)
\rightarrow [simplify]
[1.21] -32769 < ([0 < -$heap<sub>724,1:747,8</sub>.p2]: 30307, [-1 < $heap<sub>724,1:747,8</sub>.p2]: 0)
\rightarrow [move guard outside expression]
[1.22] ([0 < -$heap<sub>724,1;747,8</sub>.p2]: -32769 < 30307, [-1 < $heap<sub>724,1;747,8</sub>.p2]:
-32769 < 0
\rightarrow [simplify]
[1.24] ([0 < -$heap<sub>724,1;747,8</sub>.p2]: true, [-1 < $heap<sub>724,1;747,8</sub>.p2]: true)
\rightarrow [all guards have equal guarded terms]
[1.25] true
Proof of verification condition: Arithmetic result of operator '*' is within
limit of type 'int'
Condition generated at: C:\Escher\Customers\prang\prang.c (64,25)
Condition defined at:
To prove: (asType<int>($heap_{724,1;747,8}.M2) *
asType<int>(static_cast<integer>(asType<int>($heap_{724.1:747.8}.p2) <
(int)(0)) \le maxof(int)
Given:
heap_{init}.LIMIT == (int)80
heap_{init}.M1 == asType < short int > ((int)30269)
\theta_{init}.r1 == asType < short int > ((int)171)
heap_{init}.a1 == asType < short int > ((int)177)
\theta = asType < short int > ((int)2)
```

```
heap_{init}.M2 == asType < short int > ((int)30307)
\theta_{init}.r2 == asType < short int > ((int)172)
\theta_{init}.a2 == asType<short int>((int)176)
heap_{init}.b2 == asType<short int>((int)35)
\theta = asType < short int > ((int)30323)
heap_{init}.r3 == asType < short int > ((int)170)
heap_{init}.a3 == asType < short int > ((int)178)
\theta = asType < short int > ((int)63)
\theta = asType < short int > ((int)1)
\theta
\rho = asType < short int > ((int)3)
invariant1(heapIs heap_{funcstart_{-724,1}})
div1 == div(\mathbf{heapIs} \$ heap_{funcstart\_724.1},
asType < int > (\$heap_{funcstart\_724.1}.p1),
asType < int > (\$heap_{funcstart\_724,1}.a1))
(asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.p1)) /
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a1))) ==
asType<integer>(div1.quot)
(asType < int > (asType < int > (\$heap_{funcstart\_724,1}.p1)) \%
asType < integer > (asType < int > (\$heap_{funcstart_{-724.1}}.a1))) = =
asType<integer>(div1.rem)
!(0 == asType < integer > (div1.rem)) || !(0 ==
asType<integer>(div1.quot))
div2 == div(\mathbf{heapIs} \$heap_{funcstart\_724,1},
asType < int > (\$heap_{funcstart\_724.1}.p2),
asType < int > (\$heap_{funcstart\_724,1}.a2))
(asType<integer>(asType<int>($heap_{funcstart\_724.1}.p2)) /
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a2))) = =
asType<integer>(div2.quot)
(\mathbf{asType} < \mathbf{integer} > (\mathbf{asType} < \mathbf{int} > (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p2})) \ \%
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a2))) = =
asType<integer>(div2.rem)
!(0 == asTvpe < integer > (div2.rem)) || !(0 ==
asType<integer>(div2.quot))
div3 == div(\mathbf{heapIs} \$ heap_{funcstart\_724,1},
asType < int > (\$heap_{funcstart\_724,1}.p3),
asType < int > (\$heap_{funcstart\_724,1}.a3))
```

```
(asType < int > (asType < int > (\$heap_{funcstart\_724,1}.p3)) /
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a3))) = =
asType<integer>(div3.quot)
(asType<int>(asType<int>($heap_{funcstart\_724,1}.p3)) %
\mathbf{asType}{<}\mathbf{integer}{>}(\mathbf{asType}{<}\mathbf{int}{>}(\$\mathbf{heap}_{funcstart\_724,1}.\mathbf{a3}))) = =
asType<integer>(div3.rem)
!(0 == asType < integer > (div3.rem)) || !(0 ==
asType<integer>(div3.quot))
\$heap_{724,1;740,8} == \$heap_{funcstart\_724,1}.\_\textbf{replace}(p1 \rightarrow \textbf{asType} < \textbf{short}
int>((asType<int>(asType<short int>(div1.rem)) *
asType < int > (\$heap_{funcstart\_724,1}.r1)) - (asType < int > (asType < short)
int>(div1.quot)) * asType<int>($heap_{funcstart\_724,1}.b1)))
-asType<integer const>($heap<sub>724,1:740,8</sub>.M1) <
asType<integer>($heap<sub>724,1:740,8</sub>.p1)
!(0 == asType < integer > (\$heap_{724,1;740,8}.p1))
asType<integer>($heap<sub>724.1:740.8</sub>.p1) <
asType<integer>($heap<sub>724.1:740.8</sub>.M1)
\text{heap}_{724.1:742.8} == \text{heap}_{724.1:740.8}._replace(p2 \rightarrow asType<short)
int>((asType<int>(asType<short int>(div2.rem))
asType < int > (\$heap_{724,1:740,8}.r2)) - (asType < int > (asType < short)
int>(div2.quot)) * asType<int>($heap<sub>724.1:740.8</sub>.b2))))
-asType < integer\ const > (\$heap_{724,1;742,8}.M2) < 
asType<integer>($heap<sub>724.1:742.8</sub>.p2)
!(0 == asType < integer > (\$heap_{724,1:742.8}.p2))
asType<integer>($heap<sub>724.1:742.8</sub>.p2) <
asType<integer>($heap<sub>724.1:742.8</sub>.M2)
heap_{724,1:744,8} == heap_{724,1:742,8}.replace(p3 \rightarrow asType<short
int>((asType<int>(asType<short int>(div3.rem)) *
asType < int > (\$heap_{724,1:742.8}.r3)) - (asType < int > (asType < short)
int > (div3.quot)) * asType < int > (\$heap_{724,1;742,8}.b3))))
-asType < integer const > (\$heap_{724,1;744,8}.M3) < 1
asType<integer>($heap<sub>724.1:744.8</sub>.p3)
!(0 == asType < integer > (\$heap_{724,1:744.8}.p3))
asType < integer > (\$heap_{724,1;744,8}.p3) < 
\mathbf{asType} < \mathbf{integer} > (\$ \mathrm{heap}_{724,1;744,8}.\mathrm{M3})
heap_{724,1:747,8} == heap_{724,1:744,8}.replace(p1 \rightarrow asType<short
int>((asType<int>($heap<sub>724.1:744.8</sub>.M1) *
asType<int>(static_cast<integer>(asType<int>($heap<sub>724,1:744,8</sub>.p1) <
(int)(0)) + asType < int > (\$heap_{724,1;744,8}.p1)))
```

## **Proof:**

```
[Take goal term]
[1.0] (asType<int>($heap<sub>724.1:747.8</sub>.M2) *
\mathbf{asType} < \mathbf{int} > (\mathbf{static\_cast} < \mathbf{integer} > (\mathbf{asType} < \mathbf{int} > (\$ \mathrm{heap}_{724,1;747,8}.\mathrm{p2}) < \mathsf{nt}) < \mathsf{neger} > (\mathsf{neger} > (\mathsf{neger
(int)(0)) \le maxof(int)
\rightarrow [const static or extern object]
[1.1] (asType<int>($heap_{init}.M2) *
asType<int>(static_cast<integer>(asType<int>($heap_{724.1:747.8}.p2) <
(int)(0)) \le maxof(int)
\rightarrow [expand definition of constant 'M2' at prang.c (19,20)]
[1.2] (asType<int>(asType<short int>((int)30307)) *
asType<int>(static_cast<integer>(asType<int>($heap_{724.1:747.8}.p2) <
(int)(0)) \le maxof(int)
\rightarrow [simplify]
[1.10] (30307 * asType<int>(([0 < -$heap<sub>724.1:747.8</sub>.p2]: 1, []: 0))) \leq
maxof(int)
\rightarrow [explicitly assert falsehood of skipped guards in subsequent guards]
[1.11] (30307 * asType<int>(([0 < -$heap<sub>724,1:747,8</sub>.p2]: 1, [!(0 <
-\$heap_{724,1;747,8}.p2): 0))) \le maxof(int)
\rightarrow [simplify]
[1.15] (30307 * ([0 < -$heap<sub>724,1;747,8</sub>.p2]: 1, [-1 < $heap<sub>724,1;747,8</sub>.p2]: 0)) \leq
maxof(int)
\rightarrow [move guard outside expression]
[1.16] \; ([0 < -\$heap_{724,1;747,8}.p2]: \; 1 \; * \; 30307, \; [-1 < \$heap_{724,1;747,8}.p2]: \; 0 \; * \; 1.16] \; ([0 < -\$heap_{724,1;747,8}.p2]: \; 0 \; * \; 1.16] \; ([0 < -\$heap_{724,1;747,8}.p2]: \; 0 \; * \; 1.16] \; ([0 < -\$heap_{724,1;747,8}.p2]: \; 0 \; * \; 1.16] \; ([0 < -\$heap_{724,1;747,8}.p2]: \; 0 \; * \; 1.16] \; ([0 < -\$heap_{724,1;747,8}.p2]: \; 0 \; * \; 1.16] \; ([0 < -\$heap_{724,1;747,8}.p2]: \; 0 \; * \; 1.16] \; ([0 < -\$heap_{724,1;747,8}.p2]: \; 0 \; * \; 1.16] \; ([0 < -\$heap_{724,1;747,8}.p2]: \; 0 \; * \; 1.16] \; ([0 < -\$heap_{724,1;747,8}.p2]: \; 0 \; * \; 1.16] \; ([0 < -\$heap_{724,1;747,8}.p2]: \; 0 \; * \; 1.16] \; ([0 < -\$heap_{724,1;747,8}.p2]: \; 0 \; * \; 1.16] \; ([0 < -\$heap_{724,1;747,8}.p2]: \; 0 \; * \; 1.16] \; ([0 < -\$heap_{724,1;747,8}.p2]: \; 0 \; * \; 1.16] \; ([0 < -\$heap_{724,1;747,8}.p2]: \; 0 \; * \; 1.16] \; ([0 < -\$heap_{724,1;747,8}.p2]: \; 0 \; * \; 1.16] \; ([0 < -\$heap_{724,1;747,8}.p2]: \; 0 \; * \; 1.16] \; ([0 < -\$heap_{724,1;747,8}.p2]: \; 0 \; * \; 1.16] \; ([0 < -\$heap_{724,1;747,8}.p2]: \; 0 \; * \; 1.16] \; ([0 < -\$heap_{724,1;747,8}.p2]: \; 0 \; * \; 1.16] \; ([0 < -\$heap_{724,1;747,8}.p2]: \; 0 \; * \; 1.16] \; ([0 < -\$heap_{724,1;747,8}.p2]: \; 0 \; 1.16] \; ([0 < -\$heap_{7
30307) \leq maxof(int)
\rightarrow [simplify]
[1.20] (-1 + ([0 < -$heap<sub>724,1:747,8</sub>.p2]: 30307, [-1 < $heap<sub>724,1:747,8</sub>.p2]: 0)) <
32767
\rightarrow [move guard outside expression]
[1.21] ([0 < -$heap<sub>724,1;747,8</sub>.p2]: -1 + 30307, [-1 < $heap<sub>724,1;747,8</sub>.p2]: -1 +
0) < 32767
\rightarrow [simplify]
[1.24] 0 < (32767 + -([0 < -\$heap_{724,1;747,8}.p2]: 30306, [-1 < -\$heap_{724,1;747,8}.p2])
heap_{724,1;747,8}.p2: -1)
\rightarrow [move guard outside expression]
```

```
heap_{724,1;747,8}.p2: --1)
\rightarrow [simplify]
[1.27] 0 < (32767 + ([0 < -\$heap_{724,1:747,8}.p2]: -30306, [-1 <
heap_{724,1;747,8}.p2: 1)
\rightarrow [move guard outside expression]
[1.28] 0 < ([0 < -\$heap_{724,1;747,8}.p2]: -30306 + 32767, [-1 < -1.28])
heap_{724,1;747,8}.p2: 1 + 32767)
\rightarrow [simplify]
[1.30] \ 0 < ([0 < -\$heap_{724,1;747,8}.p2]: 2461, [-1 < \$heap_{724,1;747,8}.p2]: 32768)
\rightarrow [move guard outside expression]
[1.31] ([0 < -$heap<sub>724,1:747,8</sub>.p2]: 0 < 2461, [-1 < $heap<sub>724,1:747,8</sub>.p2]: 0 <
32768)
\rightarrow [simplify]
[1.33] ([0 < -$heap<sub>724,1:747,8</sub>.p2]: true, [-1 < $heap<sub>724,1:747,8</sub>.p2]: true)
\rightarrow [all guards have equal guarded terms]
[1.34] true
Proof of verification condition: Type constraint satisfied in implicit
conversion from 'short int' to 'int'
Condition generated at: C:\Escher\Customers\prang\prang.c (64,5)
Condition defined at:
To prove: minof(int) \le \$heap_{724,1:747.8}.p2
Given:
heap_{init}.LIMIT == (int)80
\theta sheap<sub>init</sub>.M1 == asType<short int>((int)30269)
\theta_{init}.r1 == asType < short int > ((int)171)
heap_{init}.a1 == asType < short int > ((int)177)
\theta = asType < short int > ((int)2)
heap_{init}.M2 == asType < short int > ((int)30307)
\theta_{init}.r2 == asType < short int > ((int)172)
heap_{init}.a2 == asType < short int > ((int)176)
\theta = asType < short int > ((int)35)
heap_{init}.M3 == asType < short int > ((int)30323)
heap_{init}.r3 == asType < short int > ((int)170)
```

```
heap_{init}.a3 == asType < short int > ((int)178)
heap_{init}.b3 == asType<short int>((int)63)
\theta_{init}.p1 == asType < short int > ((int)1)
\theta
\theta = asType < short int > ((int)3)
invariant1(heapIs heap_{funcstart\_724,1})
\mathrm{div1} == \mathrm{div}(\mathbf{heapIs} \ \$ \mathrm{heap}_{funcstart\_724,1},
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p1}),
asType < int > (\$heap_{funcstart\_724,1}.a1))
(asType<int>(asType<int>($heap_{tuncstart\_724.1}.p1)) /
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a1))) = =
asType<integer>(div1.quot)
(asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.p1)) \%
\mathbf{asType}{<}\mathbf{integer}{>}(\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{a1}))) ==
asType<integer>(div1.rem)
!(0 == asType < integer > (div1.rem)) || !(0 ==
asType<integer>(div1.quot))
div2 == div(\mathbf{heapIs} \$heap_{funcstart\_724,1},
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p2}),
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{a2}))
(asType<integer>(asType<int>($heap_{tuncstart\_724.1}.p2)) /
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a2))) = =
asType<integer>(div2.quot)
(\mathbf{asType} {<} \mathbf{integer} {>} (\mathbf{asType} {<} \mathbf{int} {>} (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p2})) \ \%
\mathbf{asType}{<}\mathbf{integer}{>}(\mathbf{asType}{<}\mathbf{int}{>}(\$\mathbf{heap}_{funcstart\_724,1}.\mathbf{a2}))) = =
asType<integer>(div2.rem)
!(0 == asType < integer > (div2.rem)) || !(0 ==
asType<integer>(div2.quot))
div3 == div(\mathbf{heapIs} \$ heap_{funcstart\_724,1},
\mathbf{asType} < \mathbf{int} > (\$ \mathrm{heap}_{funcstart\_724,1}.\mathrm{p3}),
asType < int > (\$heap_{funcstart\_724,1}.a3))
(asType<int>(asType<int>($heap_{tuncstart\_724.1}.p3)) /
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a3))) = =
asType<integer>(div3.quot)
(\mathbf{asType} {<} \mathbf{integer} {>} (\mathbf{asType} {<} \mathbf{int} {>} (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p3})) \ \%
\mathbf{asType} < \mathbf{integer} > (\mathbf{asType} < \mathbf{int} > (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{a3}))) = =
asType<integer>(div3.rem)
!(0 == asType < integer > (div3.rem)) || !(0 ==
```

```
asType<integer>(div3.quot))
heap_{724,1;740,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow asType<short
int>((asType<int>(asType<short int>(div1.rem)) *
asType < int > (\$heap_{funcstart\_724,1}.r1)) - (asType < int > (asType < short)
int>(div1.quot)) * asType<int>($heap_{funcstart\_724,1}.b1)))
-asType < integer\ const > (\$heap_{724,1;740,8}.M1) < 
asType<integer>($heap<sub>724,1:740.8</sub>.p1)
!(0 == asType < integer > (\$heap_{724,1;740,8}.p1))
asType<integer>($heap<sub>724.1:740.8</sub>.p1) <
asType<integer>($heap<sub>724.1:740.8</sub>.M1)
\$heap_{724,1;742,8} == \$heap_{724,1;740,8}.\mathbf{\_replace}(p2 \rightarrow \mathbf{asType} {<} \mathbf{short}
int>((asType<int>(asType<short int>(div2.rem)) *
asType < int > (\$heap_{724,1:740,8}.r2)) - (asType < int > (asType < short)
\mathbf{int}{>}(\text{div2.quot})) \ * \ \mathbf{asType}{<} \mathbf{int}{>} (\$\text{heap}_{724,1;740,8}.\text{b2}))))
-asType < integer\ const > (\$heap_{724,1;742,8}.M2) < 
asType<integer>($heap<sub>724.1:742.8</sub>.p2)
!(0 == \mathbf{asType} {<} \mathbf{integer} {>} (\$ \mathrm{heap}_{724,1;742,8}.\mathrm{p2}))
asType<integer>($heap<sub>724,1;742,8</sub>.p2) <
asType<integer>($heap<sub>724.1:742.8</sub>.M2)
\$heap_{724,1;744,8} == \$heap_{724,1;742,8}.\mathbf{\_replace}(p3 \rightarrow \mathbf{asType} {<} \mathbf{short}
int>((asType<int>(asType<short int>(div3.rem))
asType < int > (\$heap_{724,1:742,8}.r3)) - (asType < int > (asType < short)
int>(div3.quot)) * asType<int>($heap<sub>724,1:742,8</sub>.b3))))
-asType<integer const>($heap<sub>724.1:744.8</sub>.M3) <
asType<integer>($heap<sub>724.1:744.8</sub>.p3)
!(0 == asType < integer > (\$heap_{724,1:744.8}.p3))
asType<integer>($heap<sub>724.1:744.8</sub>.p3) <
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathrm{heap}_{724,1;744,8}.\mathrm{M3})
heap_{724,1:747,8} == heap_{724,1:744,8}.replace(p1 \rightarrow asType<short
int>((asType< int>(\$heap_{724,1;744,8}.M1) *
asType<int>(static_cast<integer>(asType<int>($heap<sub>724.1:744.8</sub>.p1) <
(int)(0)) + asType < int > (\$heap_{724,1;744,8}.p1)))
Proof:
[Take goal term]
[1.0] minof(int) \leq $heap<sub>724,1:747,8</sub>.p2
\rightarrow [simplify]
[1.3] -32769 < \text{$heap}_{724.1:747.8}.p2
\rightarrow [negate goal and search for contradiction]
```

```
[1.4]!(-32769 < \text{$heap}_{724.1:747.8}.p2)
\rightarrow [simplify]
[1.6] 32768 < -$heap<sub>724.1:747.8</sub>.p2
[Assume known post-assertion, class invariant or type constraint for term 1.6]
[66.0] minof(short int) \leq $heap<sub>724,1;747,8</sub>.p2
\rightarrow [simplify]
[66.3] -32769 < $heap<sub>724,1:747,8</sub>.p2
\rightarrow [from term 1.6, literala < $heap<sub>724.1:747.8</sub>.p2 is false whenever -2 < (32768)
+ literala)]
   Proof of rule precondition:
   [66.3.0] - 2 < (-32769 + 32768)
   \rightarrow [simplify]
   [66.3.2] true
[66.4] false
Proof of verification condition: Type constraint satisfied in implicit
conversion from 'short int' to 'int'
Condition generated at: C:\Escher\Customers\prang\prang.c (64,5)
Condition defined at:
To prove: heap_{724,1;747,8}.p2 \le maxof(int)
Given:
heap_{init}.LIMIT == (int)80
heap_{init}.M1 == asType < short int > ((int)30269)
\theta_{init}.r1 == asType < short int > ((int)171)
heap_{init}.a1 == asType < short int > ((int)177)
\theta
heap_{init}.M2 == asType < short int > ((int)30307)
\rho_{init}.r2 == asType < short int > ((int)172)
heap_{init}.a2 == asType < short int > ((int)176)
\theta = asType < short int > ((int)35)
\theta = asType < short int > ((int)30323)
heap_{init}.r3 == asType < short int > ((int)170)
heap_{init}.a3 == asType < short int > ((int)178)
```

```
\theta = asType < short int > ((int)63)
\theta = asType < short int > ((int)1)
\theta
heap_{init}.p3 == asType < short int > ((int)3)
invariant1(heapIs heap_{funcstart\_724,1})
\operatorname{div1} == \operatorname{div}(\mathbf{heapIs} \ \operatorname{\$heap}_{funcstart\_724,1},
asType < int > (\$heap_{funcstart\_724,1}.p1),
asType < int > (\$heap_{funcstart\_724,1}.a1))
(asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.p1)) /
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a1))) = =
asType<integer>(div1.quot)
(\mathbf{asType}{<}\mathbf{int}{>}(\mathbf{asType}{<}\mathbf{int}{>}(\$\mathbf{heap}_{funcstart\_724,1}.\mathbf{p1}))~\%
\mathbf{asType}{<}\mathbf{integer}{>}(\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{a1}))) = =
asType<integer>(div1.rem)
!(0 == asType < integer > (div1.rem)) || !(0 ==
asType<integer>(div1.quot))
div2 == div(\mathbf{heapIs} \$heap_{funcstart\_724,1},
asType < int > (\$heap_{funcstart\_724,1}.p2),
asType < int > (\$heap_{funcstart\_724,1}.a2))
(asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.p2)) /
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a2))) = =
asType<integer>(div2.quot)
(asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.p2)) \%
\mathbf{asType}{<}\mathbf{integer}{>}(\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{a2}))) ==
asType<integer>(div2.rem)
!(0 == asType < integer > (div2.rem)) || !(0 ==
asType<integer>(div2.quot))
div3 == div(\mathbf{heapIs} \$ heap_{funcstart\_724,1},
asType < int > (\$heap_{funcstart\_724,1}.p3),
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{a3}))
(\mathbf{asType}{<}\mathbf{integer}{>}(\mathbf{asType}{<}\mathbf{int}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{p3})) \ / \\
asType < integer > (asType < int > (\$heap_{funcstart\_724.1}.a3))) = =
asType<integer>(div3.quot)
(\mathbf{asType} < \mathbf{int} > (\mathbf{asType} < \mathbf{int} > (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p3})) \ \%
\mathbf{asType} < \mathbf{integer} > (\mathbf{asType} < \mathbf{int} > (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{a3}))) = =
asType<integer>(div3.rem)
!(0 == asType < integer > (div3.rem)) || !(0 ==
asType<integer>(div3.quot))
```

```
$heap_{724,1;740,8} == $heap_{funcstart\_724,1}.\_replace(p1 \rightarrow asType < short)
int>((asType<int>(asType<short int>(div1.rem)) *
asType < int > (\$heap_{funcstart\_724,1}.r1)) - (asType < int > (asType < short)
int>(div1.quot)) * asType< int>($heap_{funcstart\_724,1}.b1))))
-asType < integer const > (\$heap_{724.1:740.8}.M1) < 
asType<integer>($heap<sub>724,1:740,8</sub>.p1)
!(0 == asType < integer > (\$heap_{724,1;740,8}.p1))
asType<integer>($heap<sub>724,1:740,8</sub>.p1) <
asType<integer>($heap<sub>724,1:740,8</sub>.M1)
heap_{724,1:742.8} == heap_{724,1:740.8}.replace(p2 \rightarrow asType<short
int>((asType<int>(asType<short int>(div2.rem)) *
asType < int > (\$heap_{724.1:740.8}.r2)) - (asType < int > (asType < short)
int > (div2.quot)) * asType < int > (\$heap_{724,1;740,8}.b2))))
-\mathbf{asType}{<}\mathbf{integer\ const}{>}(\$\mathrm{heap}_{724,1;742,8}.\mathrm{M2}) <
asType<integer>($heap<sub>724.1:742.8</sub>.p2)
!(0 == \mathbf{asType} {<} \mathbf{integer} {>} (\$ \mathrm{heap}_{724,1;742,8}.\mathrm{p2}))
asType<integer>($heap<sub>724,1:742,8</sub>.p2) <
asType<integer>($heap<sub>724.1:742.8</sub>.M2)
\text{heap}_{724.1:744.8} == \text{heap}_{724.1:742.8}._replace(p3 \rightarrow asType<short)
int>((asType<int>(asType<short int>(div3.rem)) *
asType < int > (\$heap_{724.1:742.8}.r3)) - (asType < int > (asType < short)
int>(div3.quot)) * asType< int>($heap_{724.1:742.8}.b3))))
-asType<integer const>($heap<sub>724,1:744,8</sub>.M3) <
asType<integer>($heap<sub>724.1:744.8</sub>.p3)
!(0 == asType < integer > (\$heap_{724.1:744.8}.p3))
asType<integer>($heap<sub>724,1:744,8</sub>.p3) <
asType<integer>($heap<sub>724,1:744,8</sub>.M3)
heap_{724,1;747,8} == heap_{724,1;744,8}.replace(p1 \rightarrow asType<short
int>((asType<int>($heap<sub>724.1:744.8</sub>.M1) *
asType<int>(static_cast<integer>(asType<int>($heap<sub>724.1:744.8</sub>.p1) <
(int)(0) + asType < int > (\$heap_{724,1:744.8}.p1))
Proof:
[Take goal term]
[1.0] $heap<sub>724,1:747,8</sub>.p2 \leq maxof(int)
\rightarrow [simplify]
[1.9] -32768 < -$heap<sub>724,1;747,8</sub>.p2
→ [negate goal and search for contradiction]
[1.10]!(-32768 < -\$heap_{724.1:747.8}.p2)
```

```
\rightarrow [simplify]
[1.13] 32767 < $\text{heap}_{724,1:747.8}.p2
[Assume known post-assertion, class invariant or type constraint for term 1.13]
[66.0] $heap<sub>724.1:747.8</sub>.p2 \leq maxof(short int)
\rightarrow [simplify]
[66.9] -32768 < -\$heap_{724,1;747,8}.p2
\rightarrow [from term 1.13, literala < -$heap<sub>724,1:747,8</sub>.p2 is false whenever -2 <
(32767 + literala)
         Proof of rule precondition:
         [66.9.0] - 2 < (-32768 + 32767)
         \rightarrow [simplify]
         [66.9.2] true
[66.10] false
Proof of verification condition: Type constraint satisfied in implicit
conversion from 'int' to 'short int'
Condition generated at: C:\Escher\Customers\prang\prang.c (64,8)
Condition defined at:
To prove: minof(short\ int) \le ((asType < int > (\$heap_{724,1;747,8}.M2) *
\mathbf{asType} < \mathbf{int} > (\mathbf{static\_cast} < \mathbf{integer} > (\mathbf{asType} < \mathbf{int} > (\$ \mathrm{heap}_{724,1;747,8}.\mathrm{p2}) < \mathsf{nt}) < \mathsf{neget} > (\$ \mathrm{heap}_{724,1;747,8}.\mathrm{p2}) < \mathsf{neget} > (\$ \mathrm{heap}_{724,1;747,8}.\mathrm
(int)(0)) + asType<int>($heap<sub>724,1:747,8</sub>.p2))
Given:
heap_{init}.LIMIT == (int)80
\theta sheap<sub>init</sub>.M1 == asType<short int>((int)30269)
\theta_{init}.r1 == asType < short int > ((int)171)
\theta
heap_{init}.M2 == asType < short int > ((int)30307)
\theta_{init}.r2 == asType<short int>((int)172)
heap_{init}.a2 == asType < short int > ((int)176)
\theta = asType < short int > ((int)35)
heap_{init}.M3 == asType < short int > ((int)30323)
\theta_{init}.r3 == asType<short int>((int)170)
heap_{init}.a3 == asType<short int>((int)178)
```

```
\theta = asType < short int > ((int)63)
\theta = asType < short int > ((int)1)
\theta
heap_{init}.p3 == asType < short int > ((int)3)
invariant1(heapIs heap_{funcstart\_724,1})
\operatorname{div1} == \operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1},
asType < int > (\$heap_{funcstart\_724,1}.p1),
asType < int > (\$heap_{funcstart\_724,1}.a1))
(asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.p1)) /
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a1))) = =
asType<integer>(div1.quot)
(\mathbf{asType}{<}\mathbf{int}{>}(\mathbf{asType}{<}\mathbf{int}{>}(\$\mathbf{heap}_{funcstart\_724,1}.\mathbf{p1}))~\%
\mathbf{asType}{<}\mathbf{integer}{>}(\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{a1}))) = =
asType<integer>(div1.rem)
!(0 == asType < integer > (div1.rem)) || !(0 ==
asType<integer>(div1.quot))
div2 == div(\mathbf{heapIs} \$heap_{funcstart\_724,1},
asType < int > (\$heap_{funcstart\_724,1}.p2),
asType < int > (\$heap_{funcstart\_724,1}.a2))
(asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.p2)) /
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a2))) = =
asType<integer>(div2.quot)
(asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.p2)) \%
\mathbf{asType}{<}\mathbf{integer}{>}(\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{a2}))) ==
asType<integer>(div2.rem)
!(0 == asType < integer > (div2.rem)) || !(0 ==
asType<integer>(div2.quot))
div3 == div(\mathbf{heapIs} \$ heap_{funcstart\_724,1},
asType < int > (\$heap_{funcstart\_724,1}.p3),
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{a3}))
(\mathbf{asType}{<}\mathbf{integer}{>}(\mathbf{asType}{<}\mathbf{int}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{p3})) \ / \\
asType < integer > (asType < int > (\$heap_{funcstart\_724.1}.a3))) = =
asType<integer>(div3.quot)
(\mathbf{asType} < \mathbf{int} > (\mathbf{asType} < \mathbf{int} > (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p3})) \ \%
\mathbf{asType} < \mathbf{integer} > (\mathbf{asType} < \mathbf{int} > (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{a3}))) = =
asType<integer>(div3.rem)
!(0 == asType < integer > (div3.rem)) || !(0 ==
asType<integer>(div3.quot))
```

```
heap_{724,1;740,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow asType<short
int>((asType<int>(asType<short int>(div1.rem)) *
asType < int > (\$heap_{funcstart\_724,1}.r1)) - (asType < int > (asType < short)
int>(div1.quot)) * asType< int>($heap_{funcstart\_724,1}.b1))))
-asType < integer const > (\$heap_{724.1:740.8}.M1) < 
asType<integer>($heap<sub>724,1:740,8</sub>.p1)
!(0 == asType < integer > (\$heap_{724,1;740,8}.p1))
asType < integer > (\$heap_{724,1:740,8}.p1) <
asType<integer>($heap<sub>724,1:740,8</sub>.M1)
\text{$heap}_{724,1;742,8} == \text{$heap}_{724,1;740,8}. replace(p2 \rightarrow asType < short
int>((asType<int>(asType<short int>(div2.rem)) *
asType < int > (\$heap_{724.1:740.8}.r2)) - (asType < int > (asType < short)
int > (div2.quot)) * asType < int > (\$heap_{724,1;740,8}.b2))))
-\mathbf{asType}{<}\mathbf{integer\ const}{>}(\$\mathrm{heap}_{724,1;742,8}.\mathrm{M2}) <
asType<integer>($heap<sub>724.1:742.8</sub>.p2)
!(0 == \mathbf{asType} {<} \mathbf{integer} {>} (\$ \mathrm{heap}_{724,1;742,8}.\mathrm{p2}))
asType<integer>($heap<sub>724,1:742,8</sub>.p2) <
asType<integer>($heap<sub>724.1:742.8</sub>.M2)
\text{heap}_{724.1:744.8} == \text{heap}_{724.1:742.8}._replace(p3 \rightarrow asType<short)
int>((asType<int>(asType<short int>(div3.rem)) *
asType < int > (\$heap_{724.1:742.8}.r3)) - (asType < int > (asType < short)
int>(div3.quot)) * asType< int>($heap_{724.1:742.8}.b3))))
-asType<integer const>($heap<sub>724,1:744,8</sub>.M3) <
asType<integer>($heap<sub>724.1:744.8</sub>.p3)
!(0 == asType < integer > (\$heap_{724 \ 1.744 \ 8.p3}))
asType<integer>($heap<sub>724,1:744,8</sub>.p3) <
asType<integer>($heap<sub>724,1;744,8</sub>.M3)
heap_{724,1;747,8} == heap_{724,1;744,8}.replace(p1 \rightarrow asType<short
int>((asType<int>($heap<sub>724.1:744.8</sub>.M1) *
asType<int>(static_cast<integer>(asType<int>($heap<sub>724.1:744.8</sub>.p1) <
(int)(0) + asType < int > (\$heap_{724,1:744.8}.p1))
Proof:
[Take goal term]
[1.0]  minof(short int) \leq ((asType < int > (\$heap_{724,1:747,8}.M2) *
asType<int>(static_cast<integer>(asType<int>($heap_{724,1:747,8}.p2) <
(int)(0) + asType<int>($heap<sub>724,1:747,8</sub>.p2))
\rightarrow [simplify]
[1.1] -32768 \leq ((asType<int>($heap<sub>724.1:747.8</sub>.M2) *
```

```
asType<int>(static_cast<integer>(asType<int>($heap<sub>724.1:747.8</sub>.p2) <
(int)(0)) + asType < int > ($heap_{724,1;747,8}.p2))
\rightarrow [const static or extern object]
[1.2] -32768 \leq ((asType<int>($heap<sub>init</sub>.M2) *
\mathbf{asType} < \mathbf{int} > (\mathbf{static\_cast} < \mathbf{integer} > (\mathbf{asType} < \mathbf{int} > (\$ \mathrm{heap}_{724,1;747,8}.\mathrm{p2}) < \mathsf{nt} > (\$ \mathrm{heap}_{724,1;747,8}.\mathrm{p2}) < \mathsf{nt
(int)(0)) + asType < int > ($heap_{724,1;747,8}.p2))
\rightarrow [expand definition of constant 'M2' at prang.c (19,20)]
[1.3] -32768 \leq ((asType\leqint>(asType\leqshort int>((int)30307)) *
asType<int>(static_cast<integer>(asType<int>($heap_{724.1:747.8}.p2) <
(int)(0) + asType<int>($heap<sub>724.1:747.8</sub>.p2))
\rightarrow [simplify]
[1.11] -32768 \leq ((30307 * asType<int>(([0 < -$heap<sub>724.1:747.8</sub>.p2]: 1, []: 0)))
+ \ \mathbf{asType} {<} \mathbf{int} {>} (\$ heap_{724,1;747,8}.p2))
\rightarrow [explicitly assert falsehood of skipped guards in subsequent guards]
[1.12] -32768 \leq ((30307 * asType<int>(([0 < -$heap<sub>724.1:747.8</sub>.p2]: 1, [!(0 <
-\$heap_{724,1;747,8}.p2)]{:}\ 0))) + \mathbf{asType}{<}\mathbf{int}{>}(\$heap_{724,1;747,8}.p2))
\rightarrow [simplify]
[1.16] -32768 \leq ((30307 * ([0 < -$heap_{724,1;747,8}.p2]: 1, [-1 <
\text{sheap}_{724,1;747,8}.\text{p2}: 0) + \mathbf{asType} < \mathbf{int} > (\text{sheap}_{724,1;747,8}.\text{p2}))
\rightarrow [move guard outside expression]
[1.17] -32768 \leq (([0 < -$heap<sub>724,1;747,8</sub>.p2]: 1 * 30307, [-1 <
[\text{sheap}_{724,1:747,8}.\text{p2}]: 0 * 30307) + asType < int > (\text{sheap}_{724,1:747,8}.\text{p2}))
\rightarrow [simplify]
[1.20] -32768 \leq (([0 < -$heap<sub>724.1:747.8</sub>.p2]: 30307, [-1 < $heap<sub>724.1:747.8</sub>.p2]:
0) + \text{$heap}_{724,1;747,8}.p2)
\rightarrow [move guard outside expression]
[1.21] -32768 \leq ([0 < -$heap<sub>724,1:747,8</sub>.p2]: 30307 + $heap<sub>724,1:747,8</sub>.p2, [-1 <
heap_{724,1;747,8}.p2: 0 + p_{724,1;747,8}.p2
\rightarrow [simplify]
$heap<sub>724,1;747,8</sub>.p2]: $heap<sub>724,1;747,8</sub>.p2)
\rightarrow [move guard outside expression]
[1.25] ([0 < -$heap<sub>724,1;747,8</sub>.p2]: -32769 < (30307 + $heap<sub>724,1;747,8</sub>.p2), [-1 <
heap_{724,1;747,8}.p2: -32769 < heap_{724,1;747,8}.p2
\rightarrow [simplify]
[1.27] ([0 < -$heap<sub>724,1;747,8</sub>.p2]: -63076 < $heap<sub>724,1;747,8</sub>.p2, [-1 <
```

```
\rho_{24,1:747.8}[-32769 < \rho_{24,1:747.8}[-32769]
\rightarrow [from guard, literala < $heap<sub>724,1:747.8</sub>.p2 is true whenever (-1 + literala) <
-1]
          Proof of rule precondition:
          [1.27.0](-32769 + -1) < -1
          \rightarrow [simplify]
          [1.27.2] true
[1.28] ([0 < -\$heap_{724,1;747,8}.p2]: -63076 < \$heap_{724,1;747,8}.p2, [-1 < -63076] 
$heap<sub>724,1;747,8</sub>.p2]: true)
→ [negate goal and search for contradiction]
 [1.29] \ !([0 < -\$heap_{724,1;747,8}.p2] \colon -63076 < \$heap_{724,1;747,8}.p2, \ [-1 < -4] 
$heap<sub>724,1;747,8</sub>.p2]: true)
\rightarrow [move guard outside expression]
[1.30] \; ([0 < -\$heap_{724,1;747,8}.p2] \colon !(-63076 < \$heap_{724,1;747,8}.p2), \; [-1 < -\$heap_{724,1;747,8}.p2] \cdot !(-63076 < \$heap_{724,1;747,8}.p2) \cdot |(-63076 < \$heap_{724,1;747,8}.p2) \cdot |(-6307
heap_{724,1;747,8}.p2: !true
\rightarrow [simplify]
[1.35] (0 < -$heap<sub>724,1:747,8</sub>.p2) \wedge (63075 < -$heap<sub>724,1:747,8</sub>.p2)
[Work on sub-term 2 of conjunction in term 1.35]
[66.0] \ 63075 < -\$ heap_{724,1;747,8}.p2
[Assume known post-assertion, class invariant or type constraint for term 1.35]
[67.0] minof(short int) \leq $heap<sub>724,1;747,8</sub>.p2
\rightarrow [simplify]
\textit{[67.3] -32769} < \$ heap_{724,1;747,8}.p2
\rightarrow [from term 66.0, literala < $heap<sub>724.1:747.8</sub>.p2 is false whenever -2 < (63075)
+ literala)
          Proof of rule precondition:
          [67.3.0] - 2 < (-32769 + 63075)
          \rightarrow [simplify]
          [67.3.2] true
[67.4] false
```

**Proof of verification condition:** Type constraint satisfied in implicit conversion from 'int' to 'short int'

Condition generated at: C:\Escher\Customers\prang\prang.c (64,8)

## Condition defined at:

```
To prove: ((asType<int>($heap<sub>724.1:747.8</sub>.M2) *
asType<int>(static_cast<integer>(asType<int>($heap<sub>724.1:747.8</sub>.p2) <
(int)(0) + asType<int>(heap_{724,1:747.8}.p2)) \leq maxof(short int)
Given:
heap_{init}.LIMIT == (int)80
heap_{init}.M1 == asType < short int > ((int)30269)
\theta_{init}.r1 == asType < short int > ((int)171)
heap_{init}.a1 == asType < short int > ((int)177)
\theta
heap_{init}.M2 == asType < short int > ((int)30307)
\rho_{init}.r2 == asType < short int > ((int)172)
heap_{init}.a2 == asType < short int > ((int)176)
\theta = asType < short int > ((int)35)
heap_{init}.M3 == asType < short int > ((int)30323)
\theta_{init}.r3 == asType < short int > ((int)170)
heap_{init}.a3 == asType < short int > ((int)178)
\theta = asType < short int > ((int)63)
\theta = asType < short int > ((int)1)
\theta
heap_{init}.p3 == asType < short int > ((int)3)
invariant
1(heap<br/>Is heap_{funcstart\_724,1})
\mathrm{div1} == \mathrm{div}(\mathbf{heapIs} \ \$ \mathrm{heap}_{funcstart\_724,1},
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p1}),
asType < int > (\$heap_{funcstart\_724,1}.a1))
(asType<integer>(asType<int>($heap_{tuncstart\_724.1}.p1)) /
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a1))) = =
asType<integer>(div1.quot)
(\mathbf{asType} < \mathbf{integer} > (\mathbf{asType} < \mathbf{int} > (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p1})) \ \%
\mathbf{asType}{<}\mathbf{integer}{>}(\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{a1}))) = =
asType<integer>(div1.rem)
!(0 == asType < integer > (div1.rem)) || !(0 ==
asType<integer>(div1.quot))
\mathrm{div2} == \mathrm{div}(\mathbf{heapIs} \ \$ \mathrm{heap}_{funcstart\_724,1},
\mathbf{asType} < \mathbf{int} > (\$ \mathrm{heap}_{funcstart\_724,1}.\mathrm{p2}),
asType < int > (\$heap_{funcstart\_724,1}.a2))
```

```
(asType < int > (asType < int > (\$heap_{funcstart\_724,1}.p2)) /
\mathbf{asType} < \mathbf{integer} > (\mathbf{asType} < \mathbf{int} > (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{a2}))) = =
asType<integer>(div2.quot)
(asType<int>(asType<int>($heap_{funcstart\_724,1}.p2)) %
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a2))) = =
asType<integer>(div2.rem)
!(0 == asType < integer > (div2.rem)) || !(0 ==
asType<integer>(div2.quot))
div3 == div(\mathbf{heapIs} \$ heap_{funcstart\_724,1},
asType < int > (\$heap_{funcstart\_724,1}.p3),
asType < int > (\$heap_{funcstart_{-724,1}}.a3))
(asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.p3)) /
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a3))) = =
asType<integer>(div3.quot)
(asType<int>(sheap<sub>funcstart_724,1.</sub>p3)) %
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a3))) = =
asType<integer>(div3.rem)
!(0 == asType < integer > (div3.rem)) || !(0 ==
asType<integer>(div3.quot))
\$heap_{724,1;740,8} == \$heap_{funcstart\_724,1}.\_\textbf{replace}(p1 \rightarrow \textbf{asType} < \textbf{short}
int>((asType<int>(asType<short int>(div1.rem)) *
asType < int > (\$heap_{tuncstart\_724.1}.r1)) - (asType < int > (asType < short)
int>(div1.quot)) * asType<int>($heap_{funcstart\_724,1}.b1)))
-{\bf asType}{<} {\bf integer~const}{>} (\${\rm heap}_{724,1;740,8}.{\rm M1}) <
asType<integer>($heap<sub>724,1:740.8</sub>.p1)
!(0 == asType < integer > (\$heap_{724,1;740,8}.p1))
{\bf asType}{<} {\bf integer}{>} (\${\rm heap}_{724,1;740,8}.{\rm p1}) <
asType<integer>($heap<sub>724.1:740.8</sub>.M1)
\text{heap}_{724.1:742.8} == \text{heap}_{724.1:740.8}._replace(p2 \rightarrow asType<short)
int>((asType<int>(asType<short int>(div2.rem)) *
asType < int > (\$heap_{724,1:740,8}.r2)) - (asType < int > (asType < short)
int>(div2.quot)) * asType<int>($heap<sub>724.1:740.8</sub>.b2))))
-asType < integer\ const > (\$heap_{724,1;742,8}.M2) < 
asType<integer>($heap<sub>724.1:742.8</sub>.p2)
!(0 == asType < integer > (\$heap_{724,1;742,8}.p2))
asType<integer>($heap<sub>724,1.742,8.</sub>p2) <
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathrm{heap}_{724,1;742,8}.\mathrm{M2})
$heap_{724,1;744,8} == $heap_{724,1;742,8}.replace(p3 \rightarrow asType<short
int>((asType<int>(asType<short int>(div3.rem)) *
```

```
asType < int > (\$heap_{724.1:742.8}.r3)) - (asType < int > (asType < short)
int>(div3.quot)) * asType<int>($heap<sub>724.1:742.8</sub>.b3))))
-asType<integer const>($heap<sub>724.1:744.8</sub>.M3) <
asType<integer>($heap<sub>724.1:744.8</sub>.p3)
!(0 == asType < integer > (\$heap_{724,1:744.8}.p3))
asType<integer>($heap<sub>724,1:744,8</sub>.p3) <
asType<integer>($heap<sub>724.1:744.8</sub>.M3)
heap_{724,1:747,8} == heap_{724,1:744,8}.replace(p1 \rightarrow asType<short
int>((asType<int>($heap<sub>724 1.744 8</sub>.M1) *
asType<int>(static_cast<integer>(asType<int>($heap_{724.1:744.8}.p1) <
(int)(0) + asType<int>($heap<sub>724.1:744.8</sub>.p1)))
Proof:
[Take goal term]
[1.0] ((asType<int>($heap<sub>724,1:747,8</sub>.M2) *
asType<int>(static_cast<integer>(asType<int>($heap_{724,1:747,8}.p2) <
(int)(0)) + asType<int>($heap_{724,1:747.8}.p2)) \leq maxof(short int)
\rightarrow [const static or extern object]
[1.1] ((asType<int>($heap_{init}.M2) *
\mathbf{asType} < \mathbf{int} > (\mathbf{static\_cast} < \mathbf{integer}) < (\mathbf{asType} < \mathbf{int} > (\$ \mathrm{heap}_{724,1;747,8}.\mathrm{p2}) < (\$ \mathrm{heap}_{724,1;747,8}.\mathrm{p2})
(int)(0) + asType<int>($heap<sub>724.1:747.8</sub>.p2)) \leq maxof(short int)
\rightarrow [expand definition of constant 'M2' at prang.c (19,20)]
[1.2] ((asType<int>(asType<short int>((int)30307)) *
\mathbf{asType} < \mathbf{int} > (\mathbf{static\_cast} < \mathbf{integer} > (\mathbf{asType} < \mathbf{int} > (\$ \mathrm{heap}_{724,1:747.8}.\mathrm{p2}) < \mathsf{nt}) < \mathsf{neget} > (\mathsf{neget} > (\mathsf{neget}) < \mathsf{neget} > (\mathsf{neget
(int)(0)) + asType<int>($heap_{724,1:747,8}.p2)) \leq maxof(short int)
\rightarrow [simplify]
 [1.10] \ ((30307 * \mathbf{asType} < \mathbf{int} > (([0 < -\$ \text{heap}_{724,1;747,8}.\text{p2}]: \ 1, \ []: \ 0))) \ + \\
asType < int > (\$heap_{724,1;747,8}.p2)) \le maxof(short int)
→ [explicitly assert falsehood of skipped guards in subsequent guards]
[1.11] ((30307 * asType<int>(([0 < -$heap_{724.1:747.8}.p2]: 1, [!(0 < -$heap_{724.1:747.8}.p2]: 1)
-\text{$heap}_{724,1:747.8}.\text{p2}): 0))) + asType<int>($heap}_{724,1:747.8}.\text{p2})) \le \text{9}
maxof(short int)
\rightarrow [simplify]
[1.15] ((30307 * ([0 < -$heap<sub>724,1;747,8</sub>.p2]: 1, [-1 < $heap<sub>724,1;747,8</sub>.p2]: 0)) +
asType < int > (\$heap_{724,1:747,8}.p2)) \le maxof(short int)
\rightarrow [move guard outside expression]
[1.16] (([0 < -$heap<sub>724.1:747.8</sub>.p2]: 1 * 30307, [-1 < $heap<sub>724.1:747.8</sub>.p2]: 0 *
30307) + asType<int>($heap<sub>724.1:747.8</sub>.p2)) \leq maxof(short int)
```

```
\rightarrow [simplify]
[1.19] (([0 < -$heap<sub>724,1:747,8</sub>.p2]: 30307, [-1 < $heap<sub>724,1:747,8</sub>.p2]: 0) +
\text{$heap}_{724,1:747,8}.p2) \leq \max(\text{short int})
\rightarrow [move guard outside expression]
[1.20] ([0 < -$heap<sub>724,1:747,8</sub>.p2]: 30307 + $heap<sub>724,1:747,8</sub>.p2, [-1 <
\text{sheap}_{724,1:747,8}.p2: 0 + \text{sheap}_{724,1:747,8}.p2) \leq \max of(short int)
\rightarrow [simplify]
[1.23] (-1 + ([0 < -$heap<sub>724,1;747,8</sub>.p2]: 30307 + $heap<sub>724,1;747,8</sub>.p2, [-1 <
\text{Sheap}_{724,1;747,8}.\text{p2}: \text{Sheap}_{724,1;747,8}.\text{p2}) < 32767
\rightarrow [move guard outside expression]
[1.24] ([0 < -$heap<sub>724,1:747,8</sub>.p2]: -1 + (30307 + $heap<sub>724,1:747,8</sub>.p2), [-1 <
\text{sheap}_{724,1;747,8}.\text{p2}: -1 + \text{sheap}_{724,1;747,8}.\text{p2}) < 32767
\rightarrow [simplify]
 [1.27] \ 0 < (32767 + -([0 < -\$heap_{724,1;747,8}.p2]: \ 30306 + \$heap_{724,1;747,8}.p2], 
[-1 < \text{$heap}_{724,1;747,8}.p2]: -1 + \text{$heap}_{724,1;747,8}.p2))
\rightarrow [move guard outside expression]
[1.28] 0 < (32767 + ([0 < -\$heap_{724,1;747,8}.p2]: -(30306 + )]
\$ heap_{724,1;747,8}.p2), \ [-1 < \$ heap_{724,1;747,8}.p2] \colon -(-1 + \$ heap_{724,1;747,8}.p2)))
\rightarrow [simplify]
[1.32]\ 0 < (32767 + ([0 < -\$heap_{724,1;747,8}.p2]: -30306 + -\$heap_{724,1;747,8}.p2]
[-1 < \text{$heap}_{724,1;747,8}.p2]: 1 + -\text{$heap}_{724,1;747,8}.p2))
\rightarrow [move guard outside expression]
[1.33] \ 0 < ([0 < -\$heap_{724,1;747,8}.p2]: 32767 + (-30306 + -\$heap_{724,1;747,8}.p2),
[-1 < \text{$heap}_{724,1;747,8}.p2]: 32767 + (1 + -\text{$heap}_{724,1;747,8}.p2))
\rightarrow [simplify]
[1.37] 0 < ([0 < -\$heap_{724,1;747,8}.p2]: 2461 + -\$heap_{724,1;747,8}.p2, [-1 < -\$heap_{724,1;747,8}.p2])
heap_{724,1;747,8}.p2: 32768 + -heap_{724,1;747,8}.p2
\rightarrow [move guard outside expression]
\text{heap}_{724,1;747,8}.\text{p2}: 0 < (32768 + -\text{heap}_{724,1;747,8}.\text{p2})
\rightarrow [simplify]
[1.40] ([0 < -$heap<sub>724,1:747,8</sub>.p2]: -2461 < -$heap<sub>724,1:747,8</sub>.p2, [-1 <
\rho_{724,1;747,8}[p2]: 0 < (32768 + -\rho_{724,1;747,8}[p2])
\rightarrow [from guard, literala < -$heap<sub>724,1;747,8</sub>.p2 is true whenever (-1 + literala)
< 0
```

## Proof of rule precondition:

```
[1.40.0](-2461 + -1) < 0
   \rightarrow [simplify]
   [1.40.2] true
[1.41] ([0 < -$heap<sub>724,1:747,8</sub>.p2]: true, [-1 < $heap<sub>724,1:747,8</sub>.p2]: 0 < (32768)
+ - \text{$heap}_{724,1;747,8}.p2))
\rightarrow [simplify]
[1.43] ([0 < -$heap<sub>724,1:747,8</sub>.p2]: true, [-1 < $heap<sub>724,1:747,8</sub>.p2]: -32768 <
-\$heap_{724,1;747,8}.p2)
\rightarrow [negate goal and search for contradiction]
-\$heap_{724,1;747,8}.p2)
\rightarrow [move guard outside expression]
[1.45] ([0 < -\$heap_{724,1;747,8}.p2]: !true, [-1 < \$heap_{724,1;747,8}.p2]: !(-32768 <
-\$heap_{724,1;747,8}.p2))
\rightarrow [simplify]
[1.51] (-1 < \text{heap}_{724,1;747,8}.\text{p2}) \land (32767 < \text{heap}_{724,1;747,8}.\text{p2})
[Work on sub-term 2 of conjunction in term 1.51]
\textit{[66.0]}\ 32767 < \$ heap_{724,1;747,8}.p2
[Assume known post-assertion, class invariant or type constraint for term 1.51]
[67.0] $heap<sub>724,1:747,8</sub>.p2 \leq maxof(short int)
\rightarrow [simplify]
\textit{[67.9] -32768} < -\$ \text{heap}_{724,1;747,8}.\text{p2}
\rightarrow [from term 66.0, literala < -$heap<sub>724,1;747,8</sub>.p2 is false whenever -2 <
(32767 + literala)
   Proof of rule precondition:
   [67.9.0] - 2 < (-32768 + 32767)
   \rightarrow [simplify]
   [67.9.2] true
[67.10] false
```

**Proof of verification condition:** Type constraint satisfied in implicit conversion from 'short int const' to 'int'

Condition generated at: C:\Escher\Customers\prang\prang.c (65,27)

Condition defined at:

```
To prove: minof(int) \le \$heap_{724,1:748.8}.M3
Given:
heap_{init}.LIMIT == (int)80
heap_{init}.M1 == asType < short int > ((int)30269)
\theta_{init}.r1 == asType < short int > ((int)171)
heap_{init}.a1 == asType < short int > ((int)177)
\theta
heap_{init}.M2 == asType < short int > ((int)30307)
\theta_{init}.r2 == asType < short int > ((int)172)
heap_{init}.a2 == asType < short int > ((int)176)
\theta == asType<short int>((int)35)
\theta = asType < short int > ((int)30323)
heap_{init}.r3 == asType < short int > ((int)170)
heap_{init}.a3 == asType < short int > ((int)178)
\theta = asType < short int > ((int)63)
\theta = asType < short int > ((int)1)
\theta
\theta = asType < short int > ((int)3)
invariant1(heapIs heap_{funcstart\_724,1})
\operatorname{div1} == \operatorname{div}(\mathbf{heapIs} \ \operatorname{\$heap}_{funcstart\_724,1},
asType < int > (\$heap_{funcstart\_724,1}.p1),
asType < int > (\$heap_{funcstart\_724,1}.a1))
(\mathbf{asType}{<}\mathbf{integer}{>}(\mathbf{asType}{<}\mathbf{int}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{p1})) \ / \\
\mathbf{asType}{<}\mathbf{integer}{>}(\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{a1}))) = =
asType<integer>(div1.quot)
(asType<integer>(asType<int>($heap_{tuncstart\_724.1}.p1)) %
\mathbf{asType}{<}\mathbf{integer}{>}(\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{a1}))) ==
asType<integer>(div1.rem)
!(0 == asType < integer > (div1.rem)) || !(0 ==
asType<integer>(div1.quot))
div2 == div(\mathbf{heapIs} \$ heap_{funcstart\_724,1},
asType < int > (\$heap_{funcstart\_724,1}.p2),
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{a2}))
(\mathbf{asType} < \mathbf{integer} > (\mathbf{asType} < \mathbf{int} > (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p2})) \ / \\
\mathbf{asType}{<}\mathbf{integer}{>}(\mathbf{asType}{<}\mathbf{int}{>}(\$\mathbf{heap}_{funcstart\_724,1}.\mathbf{a2}))) = =
asType<integer>(div2.quot)
```

```
(asType < int > (asType < int > (\$heap_{funcstart\_724,1}.p2)) \%
\mathbf{asType} < \mathbf{integer} > (\mathbf{asType} < \mathbf{int} > (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{a2}))) = =
asType<integer>(div2.rem)
!(0 == asType < integer > (div2.rem)) || !(0 ==
asType<integer>(div2.quot))
div3 == div(\mathbf{heapIs} \$ heap_{funcstart\_724,1},
\mathbf{asType} < \mathbf{int} > (\$ \mathrm{heap}_{funcstart\_724,1}.\mathrm{p3}),
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{a3}))
(\mathbf{asType} < \mathbf{integer} > (\mathbf{asType} < \mathbf{int} > (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p3})) \ / \\
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a3))) = =
asType<integer>(div3.quot)
(asType<integer>(asType<int>($heap_{tuncstart\_724.1}.p3)) %
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a3))) = =
asType<integer>(div3.rem)
!(0 == asType < integer > (div3.rem)) || !(0 ==
asType<integer>(div3.quot))
\$heap_{724,1;740,8} == \$heap_{funcstart\_724,1}.\_\textbf{replace}(p1 \rightarrow \textbf{asType} < \textbf{short}
int>((asType<int>(asType<short int>(div1.rem)) *
asType < int > (\$heap_{funcstart\_724,1}.r1)) - (asType < int > (asType < short)
\mathbf{int}{>}(\mathbf{div1.quot})) * \mathbf{asType}{<} \mathbf{int}{>} (\$\mathbf{heap}_{funcstart\_724,1}.\mathbf{b1}))))
-asType<integer const>($heap<sub>724.1:740.8</sub>.M1) <
asType<integer>($heap<sub>724,1:740,8</sub>.p1)
!(0 == asType < integer > (\$heap_{724,1:740.8}.p1))
asType<integer>($heap<sub>724,1:740,8</sub>.p1) <
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathrm{heap}_{724,1;740,8}.\mathrm{M1})
heap_{724,1;742,8} == heap_{724,1;740,8}.replace(p2 \rightarrow asType<short
int>((asType<int>(asType<short int>(div2.rem)) *
asType < int > (\$heap_{724.1:740.8}.r2)) - (asType < int > (asType < short)
int>(div2.quot)) * asType< int>($heap_{724,1;740,8}.b2))))
-asType < integer const > (\$heap_{724,1:742.8}.M2) < 
asType<integer>($heap<sub>724,1;742,8</sub>.p2)
!(0 == \mathbf{asType} {<} \mathbf{integer} {>} (\$ heap_{724,1;742,8}.p2))
asType<integer>($heap<sub>724,1:742,8</sub>.p2) <
asType<integer>($heap<sub>724,1;742,8</sub>.M2)
\text{heap}_{724.1:744.8} == \text{heap}_{724.1:742.8}._replace(p3 \rightarrow asType<short)
int>((asType<int>(asType<short int>(div3.rem))
\mathbf{asType} < \mathbf{int} > (\$ \mathrm{heap}_{724,1;742,8}.\mathrm{r3})) - (\mathbf{asType} < \mathbf{int} > (\mathbf{asType} < \mathbf{short}))
int>(div3.quot)) * asType<int>($heap<sub>724.1:742.8</sub>.b3))))
-asType<integer const>($heap<sub>724,1:744,8</sub>.M3) <
```

```
asType<integer>($heap<sub>724.1:744.8</sub>.p3)
!(0 == \mathbf{asType} {<} \mathbf{integer} {>} (\$ \mathrm{heap}_{724,1;744,8}.\mathrm{p3}))
asType<integer>($heap<sub>724,1;744,8</sub>.p3) <
asType<integer>($heap<sub>724,1;744,8</sub>.M3)
\text{$heap}_{724,1;747,8} == \text{$heap}_{724,1;744,8}.\textbf{replace}(\text{p1} \to \mathbf{asType} < \mathbf{short})
int>((asType<int>($heap<sub>724,1:744,8</sub>.M1) *
asType<int>(static_cast<integer>(asType<int>($heap_{724,1:744,8}.p1) <
(int)(0)) + asType < int > (\$heap_{724,1;744,8}.p1)))
\text{$heap}_{724,1;748,8} == \text{$heap}_{724,1;747,8}.\mathbf{replace}(p2 \to \mathbf{asType} < \mathbf{short})
int>((asType<int>($heap<sub>724.1:747.8</sub>.M2) *
asType<int>(static_cast<integer>(asType<int>($heap<sub>724.1:747.8</sub>.p2) <
(int)(0)) + asType<int>($heap<sub>724.1:747.8</sub>.p2)))
Proof:
[Take goal term]
[1.0] minof(int) \leq $heap<sub>724,1:748,8</sub>.M3
\rightarrow [simplify]
[1.1] -32768 \leq $heap<sub>724.1:748.8</sub>.M3
\rightarrow [const static or extern object]
[1.2] -32768 \le \text{$heap}_{init}.M3
\rightarrow [expand definition of constant 'M3' at prang.c (24,20)]
[1.3] -32768 \le asType < short int > ((int)30323)
\rightarrow [simplify]
[1.6] true
Proof of verification condition: Type constraint satisfied in implicit
conversion from 'short int const' to 'int'
Condition generated at: C:\Escher\Customers\prang\prang.c (65,27)
Condition defined at:
To prove: heap_{724,1;748,8}.M3 \le maxof(int)
Given:
heap_{init}.LIMIT == (int)80
heap_{init}.M1 == asType < short int > ((int)30269)
\theta_{init}.r1 == asType < short int > ((int)171)
\theta
\theta
```

```
heap_{init}.M2 == asType < short int > ((int)30307)
\theta_{init}.r2 == asType < short int > ((int)172)
\theta_{init}.a2 == asType<short int>((int)176)
heap_{init}.b2 == asType<short int>((int)35)
\theta = asType < short int > ((int)30323)
heap_{init}.r3 == asType < short int > ((int)170)
heap_{init}.a3 == asType < short int > ((int)178)
\theta = asType < short int > ((int)63)
\theta = asType < short int > ((int)1)
\theta
\rho = asType < short int > ((int)3)
invariant1(heapIs heap_{funcstart_{-724,1}})
div1 == div(\mathbf{heapIs} \$ heap_{funcstart\_724.1},
asType < int > (\$heap_{funcstart\_724.1}.p1),
asType < int > (\$heap_{funcstart\_724,1}.a1))
(asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.p1)) /
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a1))) ==
asType<integer>(div1.quot)
(asType < int > (asType < int > (\$heap_{funcstart\_724,1}.p1)) \%
asType < integer > (asType < int > (\$heap_{funcstart_{-724.1}}.a1))) = =
asType<integer>(div1.rem)
!(0 == asType < integer > (div1.rem)) || !(0 ==
asType<integer>(div1.quot))
div2 == div(\mathbf{heapIs} \$heap_{funcstart\_724,1},
asType < int > (\$heap_{funcstart\_724.1}.p2),
asType < int > (\$heap_{funcstart\_724,1}.a2))
(asType<integer>(asType<int>($heap_{funcstart\_724.1}.p2)) /
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a2))) = =
asType<integer>(div2.quot)
(\mathbf{asType} < \mathbf{integer} > (\mathbf{asType} < \mathbf{int} > (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p2})) \ \%
asType < integer > (asType < int > (\$heap_{funcstart_{-724,1}}.a2))) = =
asType<integer>(div2.rem)
!(0 == asTvpe < integer > (div2.rem)) || !(0 ==
asType<integer>(div2.quot))
div3 == div(\mathbf{heapIs} \$ heap_{funcstart\_724,1},
asType < int > (\$heap_{funcstart\_724,1}.p3),
asType < int > (\$heap_{funcstart\_724,1}.a3))
```

```
(asType < int > (asType < int > (\$heap_{funcstart\_724,1}.p3)) /
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a3))) = =
asType<integer>(div3.quot)
(asType<int>(asType<int>($heap_{funcstart\_724,1}.p3)) %
\mathbf{asType}{<}\mathbf{integer}{>}(\mathbf{asType}{<}\mathbf{int}{>}(\$\mathbf{heap}_{funcstart\_724,1}.\mathbf{a3}))) = =
asType<integer>(div3.rem)
!(0 == asType < integer > (div3.rem)) || !(0 ==
asType<integer>(div3.quot))
\$heap_{724,1;740,8} == \$heap_{funcstart\_724,1}.\_\textbf{replace}(p1 \rightarrow \textbf{asType} < \textbf{short}
int>((asType<int>(asType<short int>(div1.rem)) *
asType < int > (\$heap_{funcstart\_724,1}.r1)) - (asType < int > (asType < short)
int>(div1.quot)) * asType<int>($heap_{funcstart\_724,1}.b1)))
-asType<integer const>($heap<sub>724,1:740,8</sub>.M1) <
asType<integer>($heap<sub>724,1:740,8</sub>.p1)
!(0 == asType < integer > (\$heap_{724,1;740,8}.p1))
asType<integer>($heap<sub>724.1:740.8</sub>.p1) <
asType<integer>($heap<sub>724.1:740.8</sub>.M1)
\text{heap}_{724.1:742.8} == \text{heap}_{724.1:740.8}._replace(p2 \rightarrow asType<short)
int>((asType<int>(asType<short int>(div2.rem))
asType < int > (\$heap_{724,1:740,8}.r2)) - (asType < int > (asType < short)
int>(div2.quot)) * asType<int>($heap<sub>724.1:740.8</sub>.b2))))
-asType < integer\ const > (\$heap_{724,1;742,8}.M2) < 
asType<integer>($heap<sub>724.1:742.8</sub>.p2)
!(0 == asType < integer > (\$heap_{724,1:742.8}.p2))
asType<integer>($heap<sub>724.1:742.8</sub>.p2) <
asType<integer>($heap<sub>724.1:742.8</sub>.M2)
heap_{724,1:744,8} == heap_{724,1:742,8}.replace(p3 \rightarrow asType<short
int>((asType<int>(asType<short int>(div3.rem)) *
asType < int > (\$heap_{724,1:742.8}.r3)) - (asType < int > (asType < short)
int > (div3.quot)) * asType < int > (\$heap_{724,1;742,8}.b3))))
-asType < integer const > (\$heap_{724,1;744,8}.M3) < 1
asType<integer>($heap<sub>724.1:744.8</sub>.p3)
!(0 == asType < integer > (\$heap_{724,1:744.8}.p3))
asType < integer > (\$heap_{724,1;744,8}.p3) < 
\mathbf{asType} < \mathbf{integer} > (\$ \mathrm{heap}_{724,1;744,8}.\mathrm{M3})
heap_{724,1:747,8} == heap_{724,1:744,8}.replace(p1 \rightarrow asType<short
int>((asType<int>($heap<sub>724.1:744.8</sub>.M1) *
asType<int>(static_cast<integer>(asType<int>($heap<sub>724,1:744,8</sub>.p1) <
(int)(0)) + asType < int > (\$heap_{724,1;744,8}.p1)))
```

```
heap_{724,1;748,8} == heap_{724,1;747,8}._replace(p2 \rightarrow asType<short
int>((asType<int>($heap<sub>724,1:747,8</sub>.M2) *
asType<int>(static_cast<integer>(asType<int>($heap_{724,1:747,8}.p2) <
(int)(0) + asType<int>($heap<sub>724,1:747,8</sub>.p2)))
Proof:
[Take goal term]
[1.0] $heap<sub>724,1:748,8</sub>.M3 \leq maxof(int)
\rightarrow [const static or extern object]
[1.1] $heap<sub>init</sub>.M3 \leq maxof(int)
\rightarrow [expand definition of constant 'M3' at prang.c (24,20)]
[1.2] asType<short int>((int)30323) \le maxof(int)
\rightarrow [simplify]
[1.6] true
Proof of verification condition: Type constraint satisfied in implicit
conversion from 'short int' to 'int'
Condition generated at: C:\Escher\Customers\prang\prang.c (65,17)
Condition defined at:
To prove: minof(int) \le \$heap_{724,1:748.8}.p3
Given:
heap_{init}.LIMIT == (int)80
\theta sheap<sub>init</sub>.M1 == asType<short int>((int)30269)
\theta_{init}.r1 == asType < short int > ((int)171)
heap_{init}.a1 == asType < short int > ((int)177)
\theta = asType < short int > ((int)2)
\theta sheap<sub>init</sub>.M2 == asType<short int>((int)30307)
\theta_{init}.r2 == asType<short int>((int)172)
heap_{init}.a2 == asType < short int > ((int)176)
heap_{init}.b2 == asType<short int>((int)35)
heap_{init}.M3 == asType < short int > ((int)30323)
\theta_{init}.r3 == asType<short int>((int)170)
heap_{init}.a3 == asType < short int > ((int)178)
\theta = asType < short int > ((int)63)
\theta = asType < short int > ((int)1)
```

```
\rho_{init}.p2 == asType < short int > ((int)2)
\theta = asType < short int > ((int)3)
invariant1(heapIs heap_{funcstart\_724.1})
div1 == div(\mathbf{heapIs} \$heap_{funcstart\_724,1},
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p1}),
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{a1}))
(asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.p1)) /
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a1))) = =
asType<integer>(div1.quot)
(asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.p1)) \%
\mathbf{asType} < \mathbf{integer} > (\mathbf{asType} < \mathbf{int} > (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{a1}))) = =
asType<integer>(div1.rem)
!(0 == asType < integer > (div1.rem)) || !(0 ==
asType<integer>(div1.quot))
div2 == div(\mathbf{heapIs} \$heap_{funcstart\_724,1},
asType < int > (\$heap_{funcstart\_724,1}.p2),
asType < int > (\$heap_{funcstart\_724,1}.a2))
(asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.p2)) /
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a2))) = =
asType<integer>(div2.quot)
(\mathbf{asType}{<}\mathbf{int}{>}(\mathbf{asType}{<}\mathbf{int}{>}(\$\mathbf{heap}_{funcstart\_724,1}.\mathbf{p2}))~\%
\mathbf{asType}{<}\mathbf{integer}{>}(\mathbf{asType}{<}\mathbf{int}{>}(\$\mathbf{heap}_{funcstart\_724,1}.\mathbf{a2}))) = =
asType<integer>(div2.rem)
!(0 == asType < integer > (div2.rem)) || !(0 ==
asType<integer>(div2.quot))
div3 == div(\mathbf{heapIs} \$ heap_{funcstart\_724,1},
asType < int > (\$heap_{funcstart\_724,1}.p3),
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{a3}))
(asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.p3)) /
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a3))) = =
asType<integer>(div3.quot)
(\mathbf{asType}{<}\mathbf{int}{>}(\mathbf{sheap}_{funcstart\_724,1}.\mathrm{p3}))~\%
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a3))) = =
asType<integer>(div3.rem)
!(0 == asType < integer > (div3.rem)) || !(0 ==
asType<integer>(div3.quot))
\text{Sheap}_{724,1;740,8} == \text{Sheap}_{funcstart\_724,1}.\_\mathbf{replace}(\text{p1} \to \mathbf{asType} < \mathbf{short})
int>((asType<int>(asType<short int>(div1.rem)) *
asType < int > (\$heap_{funcstart\_724,1}.r1)) - (asType < int > (asType < short)
```

```
\mathbf{int}{>}(\mathbf{div1.quot})) \ * \ \mathbf{asType}{<} \mathbf{int}{>} (\$\mathbf{heap}_{funcstart\_724,1}.\mathbf{b1}))))
-asType < integer const > (\$heap_{724,1:740.8}.M1) < 
asType<integer>($heap<sub>724.1:740.8</sub>.p1)
!(0 == asType < integer > (\$heap_{724,1:740.8}.p1))
asType<integer>($heap<sub>724,1:740,8</sub>.p1) <
asType<integer>($heap<sub>724,1:740,8</sub>.M1)
heap_{724,1;742,8} == heap_{724,1;740,8}.replace(p2 \rightarrow asType<short
int>((asType<int>(asType<short int>(div2.rem)) *
asType < int > (\$heap_{724.1:740.8}.r2)) - (asType < int > (asType < short)
int>(div2.quot)) * asType<int>($heap<sub>724.1:740.8</sub>.b2))))
-asType<integer const>($heap<sub>724,1:742,8</sub>.M2) <
asType<integer>($heap<sub>724,1;742,8</sub>.p2)
!(0 == asType < integer > (\$heap_{724,1:742.8}.p2))
asType<integer>($heap<sub>724,1:742,8</sub>.p2) <
asType<integer>($heap<sub>724,1:742,8</sub>.M2)
\text{heap}_{724.1:744.8} == \text{heap}_{724.1:742.8}._replace(p3 \rightarrow asType<short)
int>((asType<int>(asType<short int>(div3.rem)) *
asType < int > (\$heap_{724,1;742,8}.r3)) - (asType < int > (asType < short)
int>(div3.quot)) * asType<int>($heap_{724,1;742,8}.b3))))
-{\bf asType}{<}{\bf integer~const}{>}(\${\rm heap}_{724,1;744,8}.{\rm M3})<
asType<integer>($heap<sub>724,1:744,8</sub>.p3)
!(0 == asType < integer > (\$heap_{724,1;744,8}.p3))
asType<integer>($heap<sub>724,1:744,8</sub>.p3) <
asType<integer>($heap<sub>724,1:744,8</sub>.M3)
\rho_{724,1:747.8} == \rho_{724,1:744.8}._replace(p1 \rightarrow asType<short
int>((asType<int>($heap<sub>724.1:744.8</sub>.M1) *
asType<int>(static_cast<integer>(asType<int>($heap<sub>724.1:744.8</sub>.p1) <
(\mathbf{int})0))) + \mathbf{asType} < \mathbf{int} > (\$ \mathrm{heap}_{724,1;744,8}.\mathrm{p1})))
\$ heap_{724,1;748,8} == \$ heap_{724,1;747,8}. \textbf{\_replace} (p2 \rightarrow \textbf{asType} < \textbf{short}
int>((asType< int>(\$heap_{724,1;747,8}.M2) *
asType<int>(static_cast<integer>(asType<int>($heap<sub>724.1:747.8</sub>.p2) <
(int)(0)) + asType < int > ($heap_{724,1;747,8}.p2)))
Proof:
[Take goal term]
[1.0] minof(int) \leq $heap<sub>724,1;748,8</sub>.p3
\rightarrow [simplify]
[1.3] -32769 < \text{$heap}_{724.1:748.8}.p3
\rightarrow [negate goal and search for contradiction]
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[1.4]!(-32769 < \text{$heap}_{724.1:748.8}.p3)
\rightarrow [simplify]
[1.6] 32768 < -$heap<sub>724.1:748.8</sub>.p3
[Assume known post-assertion, class invariant or type constraint for term 1.6]
[69.0] minof(short int) \leq $heap<sub>724,1;748,8</sub>.p3
\rightarrow [simplify]
[69.3] -32769 < \text{$heap}_{724,1;748,8}.p3
\rightarrow [from term 1.6, literala < $heap<sub>724.1:748.8</sub>.p3 is false whenever -2 < (32768)
+ literala)]
   Proof of rule precondition:
   [69.3.0] - 2 < (-32769 + 32768)
   \rightarrow [simplify]
   [69.3.2] true
[69.4] false
Proof of verification condition: Type constraint satisfied in implicit
conversion from 'short int' to 'int'
Condition generated at: C:\Escher\Customers\prang\prang.c (65,17)
Condition defined at:
To prove: heap_{724,1;748,8}.p3 \le maxof(int)
Given:
heap_{init}.LIMIT == (int)80
heap_{init}.M1 == asType < short int > ((int)30269)
\theta_{init}.r1 == asType < short int > ((int)171)
heap_{init}.a1 == asType < short int > ((int)177)
\theta
heap_{init}.M2 == asType < short int > ((int)30307)
\theta_{init}.r2 == asType < short int > ((int)172)
heap_{init}.a2 == asType < short int > ((int)176)
\theta = asType < short int > ((int)35)
\theta = asType < short int > ((int)30323)
heap_{init}.r3 == asType < short int > ((int)170)
heap_{init}.a3 == asType < short int > ((int)178)
```

```
\theta = asType < short int > ((int)63)
\theta = asType < short int > ((int)1)
\theta_{init}.p2 == asType < short int > ((int)2)
\theta = asType < short int > ((int)3)
invariant1(heapIs heap_{funcstart\_724,1})
\operatorname{div1} == \operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1},
asType < int > (\$heap_{funcstart\_724,1}.p1),
asType < int > (\$heap_{funcstart\_724,1}.a1))
(asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.p1)) /
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a1))) = =
asType<integer>(div1.quot)
(\mathbf{asType}{<}\mathbf{int}{>}(\mathbf{asType}{<}\mathbf{int}{>}(\$\mathbf{heap}_{funcstart\_724,1}.\mathbf{p1}))~\%
\mathbf{asType}{<}\mathbf{integer}{>}(\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{a1}))) = =
asType<integer>(div1.rem)
!(0 == asType < integer > (div1.rem)) || !(0 ==
asType<integer>(div1.quot))
div2 == div(\mathbf{heapIs} \$heap_{funcstart\_724,1},
asType < int > (\$heap_{funcstart\_724,1}.p2),
asType < int > (\$heap_{funcstart\_724,1}.a2))
(asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.p2)) /
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a2))) = =
asType<integer>(div2.quot)
(\mathbf{asType}{<}\mathbf{integer}{>}(\mathbf{asType}{<}\mathbf{int}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{p2}))~\%
\mathbf{asType}{<}\mathbf{integer}{>}(\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{a2}))) ==
asType<integer>(div2.rem)
!(0 == asType < integer > (div2.rem)) || !(0 ==
asType<integer>(div2.quot))
div3 == div(\mathbf{heapIs} \$ heap_{funcstart\_724,1},
asType < int > (\$heap_{funcstart\_724,1}.p3),
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{a3}))
(\mathbf{asType}{<}\mathbf{integer}{>}(\mathbf{asType}{<}\mathbf{int}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{p3})) \ / \\
asType < integer > (asType < int > (\$heap_{funcstart\_724.1}.a3))) = =
asType<integer>(div3.quot)
(\mathbf{asType} < \mathbf{int} > (\mathbf{asType} < \mathbf{int} > (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p3})) \ \%
\mathbf{asType} < \mathbf{integer} > (\mathbf{asType} < \mathbf{int} > (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{a3}))) = =
asType<integer>(div3.rem)
!(0 == asType < integer > (div3.rem)) || !(0 ==
asType<integer>(div3.quot))
```

```
\$heap_{724,1;740,8} == \$heap_{funcstart\_724,1}.\_\textbf{replace}(p1 \rightarrow \textbf{asType} < \textbf{short}
int>((asType<int>(asType<short int>(div1.rem)) *
asType < int > (\$heap_{funcstart\_724,1}.r1)) - (asType < int > (asType < short)
int>(div1.quot)) * asType< int>($heap_{funcstart\_724,1}.b1))))
-asType < integer const > (\$heap_{724.1:740.8}.M1) < 
asType<integer>($heap<sub>724,1:740,8</sub>.p1)
!(0 == asType < integer > (\$heap_{724,1:740.8}.p1))
asType<integer>($heap<sub>724,1:740,8</sub>.p1) <
asType<integer>($heap<sub>724,1:740,8</sub>.M1)
\rho_{724,1:742.8} == \rho_{724,1:740.8}._replace(p2 \rightarrow asType<short
int>((asType<int>(asType<short int>(div2.rem)) *
asType < int > (\$heap_{724.1:740.8}.r2)) - (asType < int > (asType < short)
int > (div2.quot)) * asType < int > (\$heap_{724,1;740,8}.b2))))
-\mathbf{asType}{<}\mathbf{integer\ const}{>}(\$\mathrm{heap}_{724,1;742,8}.\mathrm{M2}) <
asType<integer>($heap<sub>724.1:742.8</sub>.p2)
!(0 == \mathbf{asType} {<} \mathbf{integer} {>} (\$ \mathrm{heap}_{724,1;742,8}.\mathrm{p2}))
\mathbf{asType}{<}\mathbf{integer}{>}(\${heap}_{724,1;742,8}.p2) <
asType<integer>($heap<sub>724.1:742.8</sub>.M2)
\text{heap}_{724.1:744.8} == \text{heap}_{724.1:742.8}._replace(p3 \rightarrow asType<short)
int>((asType<int>(asType<short int>(div3.rem)) *
asType < int > (\$heap_{724.1:742.8}.r3)) - (asType < int > (asType < short)
int>(div3.quot)) * asType< int>($heap_{724.1:742.8}.b3))))
-asType<integer const>($heap<sub>724,1:744,8</sub>.M3) <
asType<integer>($heap<sub>724.1:744.8</sub>.p3)
!(0 == asType < integer > (\$heap_{724\ 1.744\ 8.p3}))
asType<integer>($heap<sub>724,1:744,8</sub>.p3) <
asType<integer>($heap<sub>724,1:744,8</sub>.M3)
heap_{724,1;747,8} == heap_{724,1;744,8}.replace(p1 \rightarrow asType<short
int>((asType<int>($heap<sub>724,1;744,8</sub>.M1) *
asType<int>(static_cast<integer>(asType<int>($heap<sub>724.1:744.8</sub>.p1) <
(int)(0) + asType<int>($heap<sub>724.1:744.8</sub>.p1)))
heap_{724,1:748,8} == heap_{724,1:747,8}.replace(p2 \rightarrow asType<short
int>((asType<int>($heap<sub>724,1:747,8</sub>.M2) *
asType<int>(static_cast<integer>(asType<int>($heap<sub>724,1:747,8</sub>.p2) <
(int)(0) + asType<int>($heap<sub>724,1:747,8</sub>.p2)))
Proof:
[Take goal term]
[1.0] $heap<sub>724.1:748.8</sub>.p3 \leq maxof(int)
```

```
\rightarrow [simplify]
[1.9] -32768 < -\$heap_{724,1;748,8}.p3
→ [negate goal and search for contradiction]
[1.10]!(-32768 < -\$heap_{724,1;748,8}.p3)
\rightarrow [simplify]
[1.13] 32767 < $heap<sub>724,1;748,8</sub>.p3
[Assume known post-assertion, class invariant or type constraint for term 1.13]
[69.0] $heap<sub>724,1;748,8</sub>.p3 \leq maxof(short int)
\rightarrow [simplify]
[69.9] \ \hbox{--}32768 < -\$ heap_{724,1;748,8}.p3
\rightarrow [from term 1.13, literala < –$heap_{724,1;748,8}.p3 is false whenever -2 <
(32767 + literala)
   Proof of rule precondition:
   [69.9.0] - 2 < (-32768 + 32767)
   \rightarrow [simplify]
   [69.9.2] true
[69.10] false
Proof of verification condition: Type constraint satisfied in explicit
conversion from 'integer' to 'int'
Condition generated at: C:\Escher\Customers\prang\prang.c (65,11)
Condition defined at:
To prove: minof(int) <
static\_cast < integer > (asType < int > (\$heap_{724,1:748,8}.p3) < (int)0)
Given:
heap_{init}.LIMIT == (int)80
\theta sheap<sub>init</sub>.M1 == asType<short int>((int)30269)
\theta_{init}.r1 == asType < short int > ((int)171)
heap_{init}.a1 == asType < short int > ((int)177)
\theta
heap_{init}.M2 == asType < short int > ((int)30307)
\theta_{init}.r2 == asType<short int>((int)172)
heap_{init}.a2 == asType < short int > ((int)176)
```

```
\theta sheap<sub>init</sub>.b2 == asType<short int>((int)35)
heap_{init}.M3 == asType < short int > ((int)30323)
\theta_{init}.r3 == asType<short int>((int)170)
heap_{init}.a3 == asType < short int > ((int)178)
heap_{init}.b3 == asType < short int > ((int)63)
\theta
\theta
\theta = asType < short int > ((int)3)
invariant
1(heap<br/>Is \theta_{funcstart\_724,1}
div1 == div(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1},
asType < int > (\$heap_{funcstart\_724,1}.p1),
asType < int > (\$heap_{funcstart\_724,1}.a1))
(\mathbf{asType}{<}\mathbf{integer}{>}(\mathbf{asType}{<}\mathbf{int}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{p1})) \ / \\
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a1))) = =
asType<integer>(div1.quot)
(\mathbf{asType} < \mathbf{integer} > (\mathbf{asType} < \mathbf{int} > (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p1})) \%
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a1))) = =
asType<integer>(div1.rem)
!(0 == asType < integer > (div1.rem)) || !(0 ==
asType<integer>(div1.quot))
div2 == div(\mathbf{heapIs} \$heap_{funcstart\_724,1},
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p2}),
asType < int > (\$heap_{funcstart\_724,1}.a2))
(asType<int>(sheap<sub>funcstart 724.1</sub>.p2)) /
\mathbf{asType}{<}\mathbf{integer}{>}(\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{a2}))) ==
asType<integer>(div2.quot)
(asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.p2)) \%
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a2))) = =
asType<integer>(div2.rem)
!(0 == asType < integer > (div2.rem)) || !(0 ==
asType<integer>(div2.quot))
div3 == div(\mathbf{heapIs} \$heap_{funcstart\_724,1},
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p3}),
asType < int > (\$heap_{funcstart\_724,1}.a3))
(asType<integer>(asType<int>($heap_{tuncstart\_724.1}.p3)) /
\mathbf{asType}{<}\mathbf{integer}{>}(\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{a3}))) ==
asType<integer>(div3.quot)
(\mathbf{asType} < \mathbf{integer} > (\mathbf{asType} < \mathbf{int} > (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p3})) \%
```

```
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a3))) = =
asType<integer>(div3.rem)
!(0 == asType < integer > (div3.rem)) || !(0 ==
asType<integer>(div3.quot))
heap_{724,1;740,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow asType<short
int>((asType<int>(asType<short int>(div1.rem)) *
asType < int > (\$heap_{funcstart\_724.1}.r1)) - (asType < int > (asType < short)
int>(div1.quot)) * asType< int>($heap_{funcstart\_724,1}.b1))))
-asType<integer const>($heap<sub>724,1:740,8</sub>.M1) <
asType<integer>($heap<sub>724.1:740.8</sub>.p1)
!(0 == asType < integer > (\$heap_{724,1;740,8}.p1))
asType<integer>($heap<sub>724,1;740,8</sub>.p1) <
asType<integer>($heap<sub>724,1:740,8</sub>.M1)
\text{heap}_{724.1:742.8} == \text{heap}_{724.1:740.8}._replace(p2 \rightarrow asType<short)
int>((asType<int>(asType<short int>(div2.rem)) *
asType < int > (\$heap_{724,1;740,8}.r2)) - (asType < int > (asType < short)
int > (div2.quot)) * asType < int > ($heap_{724,1;740,8}.b2))))
-asType < integer const > (\$heap_{724,1:742.8}.M2) < 
asType<integer>($heap<sub>724.1:742.8</sub>.p2)
!(0 == asType < integer > (\$heap_{724,1;742,8}.p2))
{\bf asType}{<} {\bf integer}{>} (\$ {\rm heap}_{724,1;742,8}.{\rm p2}) <
asType<integer>($heap<sub>724,1;742,8</sub>.M2)
heap_{724,1:744.8} == heap_{724,1:742.8}._replace(p3 \rightarrow asType<short
int>((asType<int>(asType<short int>(div3.rem)) *
asType < int > (\$heap_{724.1:742.8}.r3)) - (asType < int > (asType < short)
int>(div3.quot)) * asType< int>($heap_{724,1;742,8}.b3))))
-{\bf asType}{<}{\bf integer~const}{>}(\${\rm heap}_{724,1;744,8}.{\rm M3}) <
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathrm{heap}_{724,1;744,8}.\mathrm{p3})
!(0 == asType < integer > (\$heap_{724,1:744.8}.p3))
asType<integer>($heap<sub>724,1:744,8</sub>.p3) <
asType<integer>($heap<sub>724.1:744.8</sub>.M3)
\text{sheap}_{724,1:747.8} == \text{sheap}_{724,1:744.8}._replace(p1 \rightarrow asType<short
int>((asType<int>($heap<sub>724.1:744.8</sub>.M1) *
\mathbf{asType} < \mathbf{int} > (\mathbf{static\_cast} < \mathbf{integer} > (\mathbf{asType} < \mathbf{int} > (\$ \mathrm{heap}_{724,1;744,8}.\mathrm{p1}) < \mathsf{full}_{1}) < \mathsf{full}_{2} < \mathsf{full}_{2} < \mathsf{full}_{3} < \mathsf{full}_{4} < \mathsf{f
(int)(0) + asType < int > ($heap_{724.1:744.8}.p1))
heap_{724,1:748,8} == heap_{724,1:747,8}.replace(p2 \rightarrow asType<short
int>((asType<int>($heap<sub>724,1:747,8</sub>.M2) *
asType<int>(static_cast<integer>(asType<int>($heap<sub>724,1:747,8</sub>.p2) <
(int)(0)) + asType < int > ($heap_{724,1;747,8}.p2)))
```

```
Proof:
```

```
[Take goal term]
[1.0]  minof(int) \leq static_cast<integer>(asType<int>($heap<sub>724.1:748.8</sub>.p3)
< (int)0)
\rightarrow [simplify]
[1.6] -32768 \le ([0 < -\$heap_{724,1;748,8}.p3]: 1, []: 0)
\rightarrow [explicitly assert falsehood of skipped guards in subsequent guards]
[1.7] -32768 \le ([0 < -\$heap_{724,1;748,8}.p3]: 1, [!(0 < -\$heap_{724,1;748,8}.p3)]: 0)
\rightarrow [simplify]
[1.12] -32769 < ([0 < -$heap<sub>724,1:748,8</sub>.p3]: 1, [-1 < $heap<sub>724,1:748,8</sub>.p3]: 0)
\rightarrow [move guard outside expression]
[1.13] ([0 < -$heap<sub>724,1:748,8</sub>.p3]: -32769 < 1, [-1 < $heap<sub>724,1:748,8</sub>.p3]: -32769
< 0)
\rightarrow [simplify]
[1.15] ([0 < -$heap<sub>724,1;748,8</sub>.p3]: true, [-1 < $heap<sub>724,1;748,8</sub>.p3]: true)
\rightarrow [all guards have equal guarded terms]
[1.16] true
Proof of verification condition: Type constraint satisfied in explicit
conversion from 'integer' to 'int'
Condition generated at: C:\Escher\Customers\prang\prang.c (65,11)
Condition defined at:
To prove: static_cast<integer>(asType<int>($heap_{724.1:748.8}.p3) <
(int)0) \le maxof(int)
Given:
heap_{init}.LIMIT == (int)80
\theta sheap<sub>init</sub>.M1 == asType<short int>((int)30269)
\theta_{init}.r1 == asType < short int > ((int)171)
heap_{init}.a1 == asType < short int > ((int)177)
\theta = asType < short int > ((int)2)
\theta sheap<sub>init</sub>.M2 == asType<short int>((int)30307)
\rho_{init}.r2 == asType < short int > ((int)172)
heap_{init}.a2 == asType < short int > ((int)176)
\theta = asType < short int > ((int)35)
```

```
heap_{init}.M3 == asType < short int > ((int)30323)
\theta_{init}.r3 == asType < short int > ((int)170)
heap_{init}.a3 == asType < short int > ((int)178)
heap_{init}.b3 == asType<short int>((int)63)
\theta = asType < short int > ((int)1)
\theta
\theta = asType < short int > ((int)3)
invariant1(heapIs $heap_{tuncstart_724.1})
div1 == div(\mathbf{heapIs} \$heap_{funcstart\_724,1},
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p1}),
asType < int > (\$heap_{funcstart_{-724,1}}.a1))
(asType<int>(asType<int>($heap_{tuncstart\_724.1}.p1)) /
\mathbf{asType}{<}\mathbf{integer}{>}(\mathbf{asType}{<}\mathbf{int}{>}(\$\mathbf{heap}_{funcstart\_724,1}.\mathbf{a1}))) = =
asType<integer>(div1.quot)
(asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.p1)) \%
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a1))) = =
asType<integer>(div1.rem)
!(0 == asType < integer > (div1.rem)) || !(0 ==
asType<integer>(div1.quot))
\label{eq:div2} \text{div2} == \text{div}(\mathbf{heapIs} \ \$ \text{heap}_{funcstart\_724,1},
\mathbf{asType} < \mathbf{int} > (\$ \mathrm{heap}_{funcstart\_724,1}.\mathrm{p2}),
asType < int > (\$heap_{funcstart\_724,1}.a2))
(asType<integer>(asType<int>($heap_{tuncstart\_724.1}.p2)) /
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a2))) = =
asType<integer>(div2.quot)
(asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.p2)) \%
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a2))) = =
asType<integer>(div2.rem)
!(0 == asType < integer > (div2.rem)) || !(0 ==
asType<integer>(div2.quot))
\mathrm{div3} == \mathrm{div}(\mathbf{heapIs} \ \$ \mathrm{heap}_{funcstart\_724,1},
\mathbf{asType} < \mathbf{int} > (\$ \mathrm{heap}_{funcstart\_724,1}.\mathrm{p3}),
asType < int > (\$heap_{funcstart\_724,1}.a3))
(asType<int>(asType<int>($heap_{tuncstart\_724.1}.p3)) /
\mathbf{asType}{<}\mathbf{integer}{>}(\mathbf{asType}{<}\mathbf{int}{>}(\$\mathbf{heap}_{funcstart\_724,1}.\mathbf{a3}))) = =
asType<integer>(div3.quot)
(\mathbf{asType}{<}\mathbf{int}{>}(\mathbf{asType}{<}\mathbf{int}{>}(\$\mathbf{heap}_{funcstart\_724,1}.\mathbf{p3}))~\%
\mathbf{asType}{<}\mathbf{integer}{>}(\mathbf{asType}{<}\mathbf{int}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathtt{a3}))) ==
```

```
asType<integer>(div3.rem)
!(0 == asType < integer > (div3.rem)) || !(0 ==
asType<integer>(div3.quot))
$heap_{724,1;740,8} == $heap_{funcstart\_724,1}.\_replace(p1 \rightarrow asType < short)
int>((asType<int>(asType<short int>(div1.rem)) *
asType < int > (\$heap_{funcstart\_724.1}.r1)) - (asType < int > (asType < short)
int>(div1.quot)) * asType< int>($heap_{funcstart\_724,1}.b1))))
-asType<integer const>($heap<sub>724,1:740,8</sub>.M1) <
asType<integer>($heap<sub>724,1:740,8</sub>.p1)
!(0 == asType < integer > (\$heap_{724,1;740,8}.p1))
asType<integer>($heap<sub>724,1:740,8</sub>.p1) <
asType<integer>($heap<sub>724,1;740,8</sub>.M1)
\text{heap}_{724.1:742.8} == \text{heap}_{724.1:740.8}._replace(p2 \rightarrow asType<short)
int>((asType<int>(asType<short int>(div2.rem)) *
asType < int > (\$heap_{724,1;740,8}.r2)) - (asType < int > (asType < short)
int>(div2.quot)) * asType< int>($heap_{724,1;740,8}.b2))))
-\mathbf{asType}{<}\mathbf{integer\ const}{>}(\$\mathrm{heap}_{724,1;742,8}.\mathrm{M2}) <
asType<integer>($heap<sub>724.1:742.8</sub>.p2)
!(0 == asType < integer > (\$heap_{724,1;742,8}.p2))
asType<integer>($heap<sub>724.1:742.8</sub>.p2) <
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathrm{heap}_{724,1;742,8}.\mathrm{M2})
\$heap_{724,1;744,8} == \$heap_{724,1;742,8}.\_\mathbf{replace}(p3 \rightarrow \mathbf{asType} {<} \mathbf{short}
int>((asType<int>(asType<short int>(div3.rem)) *
\mathbf{asType} < \mathbf{int} > (\$ \mathrm{heap}_{724,1;742,8}.\mathrm{r3})) - (\mathbf{asType} < \mathbf{int} > (\mathbf{asType} < \mathbf{short}))
int>(div3.quot)) * asType< int>($heap_{724.1:742.8}.b3))))
-asType<integer const>($heap<sub>724,1:744,8</sub>.M3) <
asType<integer>($heap<sub>724,1;744,8</sub>.p3)
!(0 == asType < integer > (\$heap_{724,1;744,8}.p3))
asType<integer>($heap<sub>724,1:744,8</sub>.p3) <
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathrm{heap}_{724,1;744,8}.\mathrm{M3})
heap_{724,1;747,8} == heap_{724,1;744,8}._replace(p1 \rightarrow asType<short
int>((asType<int>($heap<sub>724.1:744.8</sub>.M1) *
asType<int>(static_cast<integer>(asType<int>($heap_{724.1:744.8}.p1) <
(int)(0)) + asType < int > (\$heap_{724,1;744,8}.p1)))
heap_{724,1:748,8} == heap_{724,1:747,8}.replace(p2 \rightarrow asType<short
int>((asType<int>($heap<sub>724,1:747,8</sub>.M2) *
asType<int>(static_cast<integer>(asType<int>($heap<sub>724,1:747.8</sub>.p2) <
(int)(0) + asType<int>($heap<sub>724,1:747,8</sub>.p2)))
Proof:
```

```
[Take goal term]
[1.0] static_cast<integer>(asType<int>($heap_{724,1:748,8}.p3) < (int)0) \leq
maxof(int)
\rightarrow [simplify]
[1.5] ([0 < -$heap<sub>724,1;748,8</sub>.p3]: 1, []: 0) \leq maxof(int)
\rightarrow [explicitly assert falsehood of skipped guards in subsequent guards]
[1.6] ([0 < -$heap<sub>724,1:748,8</sub>.p3]: 1, [!(0 < -$heap<sub>724,1:748,8</sub>.p3)]: 0) \leq
maxof(int)
\rightarrow [simplify]
[1.11] (-1 + ([0 < -\$heap_{724,1;748,8}.p3]: 1, [-1 < \$heap_{724,1;748,8}.p3]: 0)) < [1.11]
32767
\rightarrow [move guard outside expression]
[1.12] ([0 < -$heap<sub>724,1;748,8</sub>.p3]: -1 + 1, [-1 < $heap<sub>724,1;748,8</sub>.p3]: -1 + 0) <
32767
\rightarrow [simplify]
[1.15] 0 < (32767 + -([0 < -\$heap_{724,1;748,8}.p3]); 0, [-1 < \$heap_{724,1;748,8}.p3];
-1))
\rightarrow [move guard outside expression]
[1.16] 0 < (32767 + ([0 < -\$heap_{724.1:748.8}.p3]: -0, [-1 < \$heap_{724.1:748.8}.p3]:
--1))
\rightarrow [simplify]
[1.18] \ 0 < (32767 + ([0 < -\$heap_{724,1;748,8}.p3]); 0, [-1 < \$heap_{724,1;748,8}.p3];
1))
\rightarrow [move guard outside expression]
[1.19] \ 0 < ([0 < -\$heap_{724,1;748,8}.p3]: 0 + 32767, [-1 < \$heap_{724,1;748,8}.p3]: 1
+32767
\rightarrow [simplify]
[1.21] \ 0 < ([0 < -\$heap_{724,1;748,8}.p3]: \ 32767, \ [-1 < \$heap_{724,1;748,8}.p3]: \ 32768)
\rightarrow [move guard outside expression]
[1.22] ([0 < -$heap<sub>724,1;748,8</sub>.p3]: 0 < 32767, [-1 < $heap<sub>724,1;748,8</sub>.p3]: 0 <
32768)
\rightarrow [simplify]
[1.24] ([0 < -$heap<sub>724,1;748,8</sub>.p3]: true, [-1 < $heap<sub>724,1;748,8</sub>.p3]: true)
\rightarrow [all guards have equal guarded terms]
[1.25] true
```

```
limit of type 'int'
Condition generated at: C:\Escher\Customers\prang\prang.c (65,25)
Condition defined at:
To prove: minof(int) \le (asType < int > (\$heap_{724,1;748,8}.M3) *
\mathbf{asType} < \mathbf{int} > (\mathbf{static\_cast} < \mathbf{integer} > (\mathbf{asType} < \mathbf{int} > (\$ \mathrm{heap}_{724,1:748.8}.\mathrm{p3}) < \mathsf{nt})
(\mathbf{int})(0)
Given:
heap_{init}.LIMIT == (int)80
heap_{init}.M1 == asType < short int > ((int)30269)
\theta_{init}.r1 == asType < short int > ((int)171)
\theta_{init}.a1 == asType<short int>((int)177)
\theta = asType < short int > ((int)2)
heap_{init}.M2 == asType < short int > ((int)30307)
\theta_{init}.r2 == asType < short int > ((int)172)
\theta_{init}.a2 == asType<short int>((int)176)
\theta == asType<short int>((int)35)
heap_{init}.M3 == asType < short int > ((int)30323)
heap_{init}.r3 == asType < short int > ((int)170)
heap_{init}.a3 == asType < short int > ((int)178)
\theta = asType < short int > ((int)63)
\theta
\theta
\theta = asType < short int > ((int)3)
invariant1(heapIs $heap_{tuncstart_724.1})
\operatorname{div1} == \operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1},
asType < int > (\$heap_{funcstart\_724,1}.p1),
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{a1}))
(\mathbf{asType}{<}\mathbf{int}{>}(\mathbf{asType}{<}\mathbf{int}{>}(\$\mathbf{heap}_{funcstart\_724,1}.\mathbf{p1})) \ / \\
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a1))) = =
asType<integer>(div1.quot)
(\mathbf{asType} {<} \mathbf{int} {>} (\mathbf{asType} {<} \mathbf{int} {>} (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p1})) \ \%
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a1))) = =
asType<integer>(div1.rem)
```

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

!(0 == asType < integer > (div1.rem)) || !(0 ==

```
asType<integer>(div1.quot))
div2 == div(\mathbf{heapIs} \$heap_{funcstart\_724,1},
asType < int > (\$heap_{funcstart\_724,1}.p2),
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{a2}))
(asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.p2)) /
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a2))) = =
asType<integer>(div2.quot)
(\mathbf{asType} {<} \mathbf{integer} {>} (\mathbf{asType} {<} \mathbf{int} {>} (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p2})) \ \%
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a2))) = =
asType<integer>(div2.rem)
!(0 == asType < integer > (div2.rem)) || !(0 ==
asType<integer>(div2.quot))
div3 == div(\mathbf{heapIs} \$ heap_{funcstart\_724,1},
asType < int > (\$heap_{funcstart\_724,1}.p3),
asType < int > (\$heap_{funcstart\_724,1}.a3))
(asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.p3)) /
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a3))) = =
asType<integer>(div3.quot)
(\mathbf{asType} < \mathbf{integer} > (\mathbf{asType} < \mathbf{int} > (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p3})) \ \%
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a3))) = =
asType<integer>(div3.rem)
!(0 == asType < integer > (div3.rem)) || !(0 ==
asType<integer>(div3.quot))
\text{Sheap}_{724,1;740,8} == \text{Sheap}_{funcstart\_724,1}.\_\mathbf{replace}(\text{p1} \to \mathbf{asType} < \mathbf{short})
int>((asType<int>(asType<short int>(div1.rem)) *
asType < int > (\$heap_{funcstart\_724,1}.r1)) - (asType < int > (asType < short)
int>(div1.quot)) * asType<int>($heap_{funcstart\_724,1}.b1)))
-asType < integer const > (\$heap_{724.1:740.8}.M1) < 
asType < integer > ($heap_{724,1:740,8}.p1)
!(0 == \mathbf{asType} {<} \mathbf{integer} {>} (\$ \mathrm{heap}_{724,1;740,8}.\mathrm{p1}))
asType<integer>($heap<sub>724.1:740.8</sub>.p1) <
\mathbf{asType} < \mathbf{integer} > (\$ \mathrm{heap}_{724,1;740,8}.\mathrm{M1})
heap_{724,1:742,8} == heap_{724,1:740,8}.replace(p2 \rightarrow asType<short
int>((asType<int>(asType<short int>(div2.rem)) *
asType < int > (\$heap_{724.1:740.8}.r2)) - (asType < int > (asType < short)
int > (div2.quot)) * asType < int > ($heap_{724,1:740.8}.b2))))
-asType<integer const>($heap<sub>724.1:742.8</sub>.M2) <
asType<integer>($heap<sub>724.1:742.8</sub>.p2)
!(0 == asType < integer > (\$heap_{724,1:742,8}.p2))
```

```
asType<integer>($heap<sub>724.1:742.8</sub>.p2) <
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathrm{heap}_{724,1;742,8}.\mathrm{M2})
heap_{724,1:744,8} == heap_{724,1:742,8}.replace(p3 \rightarrow asType<short
int>((asType<int>(asType<short int>(div3.rem)) *
asType < int > (\$heap_{724.1:742.8}.r3)) - (asType < int > (asType < short)
int>(div3.quot)) * asType< int>($heap_{724,1;742,8}.b3))))
  -asType < integer const > (\$heap_{724,1:744,8}.M3) < 
asType<integer>($heap<sub>724.1:744.8</sub>.p3)
!(0 == asType < integer > (\$heap_{724,1:744,8}.p3))
asType<integer>($heap<sub>724.1:744.8</sub>.p3) <
\mathbf{asType} < \mathbf{integer} > (\$ \mathrm{heap}_{724,1;744,8}.\mathrm{M3})
\text{Sheap}_{724,1;747,8} == \text{Sheap}_{724,1;744,8}. \text{replace}(\text{p1} \to \text{asType} < \text{short})
int>((asType<int>($heap<sub>724,1:744,8</sub>.M1) *
\mathbf{asType}{<}\mathbf{int}{>}(\mathbf{static\_cast}{<}\mathbf{integer}{>}(\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{724,1;744,8}.\mathrm{p1})<
 (int)(0) + asType<int>($heap<sub>724.1:744.8</sub>.p1)))
heap_{724,1;748,8} == heap_{724,1;747,8}.replace(p2 \rightarrow asType<short
int>((asType<int>($heap<sub>724.1:747.8</sub>.M2) *
asType<int>(static_cast<integer>(asType<int>($heap<sub>724,1:747,8</sub>.p2) <
 (int)(0) + asType < int > (\$heap_{724,1:747,8}.p2))
Proof:
[Take goal term]
 [1.0]  minof(int) \leq (asType < int > (\$heap_{724,1:748,8}.M3) *
\mathbf{asType} < \mathbf{int} > (\mathbf{static\_cast} < \mathbf{integer} > (\mathbf{asType} < \mathbf{int} > (\$ \mathrm{heap}_{724,1;748,8}.\mathrm{p3}) < \mathsf{nt}) < \mathsf{nt} > \mathsf{nt} >
 (\mathbf{int})(0)
 \rightarrow [simplify]
 [1.1] -32768 \leq (asType<int>($heap<sub>724,1:748,8</sub>.M3) *
\mathbf{asType} < \mathbf{int} > (\mathbf{static\_cast} < \mathbf{integer} > (\mathbf{asType} < \mathbf{int} > (\$ \mathrm{heap}_{724,1:748.8}.\mathrm{p3}) < \mathsf{nt}) < \mathsf{nt} > \mathsf{nt} >
 (int)0)))
 \rightarrow [const static or extern object]
 [1.2] -32768 \le (asType < int > (\$heap_{init}.M3) *
asType<int>(static_cast<integer>(asType<int>($heap<sub>724.1:748.8</sub>.p3) <
 (int)0)))
 \rightarrow [expand definition of constant 'M3' at prang.c (24,20)]
 [1.3] -32768 \leq (asType\leqint>(asType\leqshort int>((int)30323)) *
\mathbf{asType} < \mathbf{int} > (\mathbf{static\_cast} < \mathbf{integer} > (\mathbf{asType} < \mathbf{int} > (\$ \mathrm{heap}_{724,1:748.8}.\mathrm{p3}) < \mathsf{nt}) < \mathsf{nt} > \mathsf{nt} >
(\mathbf{int})(0)
 \rightarrow [simplify]
[1.11] -32768 \leq (30323 * asType<int>(([0 < -$heap<sub>724,1:748,8</sub>.p3]: 1, []: 0)))
```

```
[1.12] -32768 \leq (30323 * asType<int>(([0 < -$heap<sub>724.1:748.8</sub>.p3]: 1, [!(0 <
-\$heap_{724,1:748,8}.p3)]: 0)))
\rightarrow [simplify]
[1.16] -32768 \leq (30323 * ([0 < -$heap<sub>724,1:748,8</sub>.p3]: 1, [-1 <
heap_{724,1;748,8}.p3: 0)
\rightarrow [move guard outside expression]
\lceil 1.17 \rceil-32768 \leq ([0 < -$heap_{724,1;748,8}.p3]: 1 * 30323, [-1 <
heap_{724,1;748,8}.p3: 0 * 30323)
\rightarrow [simplify]
[1.21] \ -32769 < ([0 < -\$heap_{724,1;748,8}.p3] \ : \ 30323, \ [-1 < \$heap_{724,1;748,8}.p3] \ : \ 0)
\rightarrow [move guard outside expression]
[1.22] ([0 < -$heap<sub>724,1;748,8</sub>.p3]: -32769 < 30323, [-1 < $heap<sub>724,1;748,8</sub>.p3]:
-32769 < 0
\rightarrow [simplify]
[1.24] ([0 < -$heap<sub>724,1;748,8</sub>.p3]: true, [-1 < $heap<sub>724,1;748,8</sub>.p3]: true)
\rightarrow [all guards have equal guarded terms]
[1.25] true
Proof of verification condition: Arithmetic result of operator '*' is within
limit of type 'int'
Condition generated at: C:\Escher\Customers\prang\prang.c (65,25)
Condition defined at:
To prove: (asType<int>($heap_{724,1;748,8}.M3) *
asType<int>(static_cast<integer>(asType<int>($heap_{724,1:748,8}.p3) <
(int)(0)) \le maxof(int)
Given:
heap_{init}.LIMIT == (int)80
\theta
\theta_{init}.r1 == asType < short int > ((int)171)
heap_{init}.a1 == asType < short int > ((int)177)
\theta
heap_{init}.M2 == asType < short int > ((int)30307)
\theta_{init}.r2 == asType < short int > ((int)172)
\theta_{init}.a2 == asType<short int>((int)176)
```

→ [explicitly assert falsehood of skipped guards in subsequent guards]

```
\theta sheap<sub>init</sub>.b2 == asType<short int>((int)35)
heap_{init}.M3 == asType < short int > ((int)30323)
\theta_{init}.r3 == asType<short int>((int)170)
heap_{init}.a3 == asType < short int > ((int)178)
heap_{init}.b3 == asType < short int > ((int)63)
\theta
\theta
\theta = asType < short int > ((int)3)
invariant
1(heap<br/>Is \theta_{funcstart\_724,1}
div1 == div(\mathbf{heapIs} \$heap_{funcstart\_724,1},
asType < int > (\$heap_{funcstart\_724,1}.p1),
asType < int > (\$heap_{funcstart\_724,1}.a1))
(\mathbf{asType}{<}\mathbf{integer}{>}(\mathbf{asType}{<}\mathbf{int}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{p1})) \ / \\
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a1))) = =
asType<integer>(div1.quot)
(\mathbf{asType} < \mathbf{integer} > (\mathbf{asType} < \mathbf{int} > (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p1})) \%
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a1))) = =
asType<integer>(div1.rem)
!(0 == asType < integer > (div1.rem)) || !(0 ==
asType<integer>(div1.quot))
div2 == div(\mathbf{heapIs} \$heap_{funcstart\_724,1},
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p2}),
asType < int > (\$heap_{funcstart\_724,1}.a2))
(asType<int>(sheap<sub>funcstart 724.1</sub>.p2)) /
\mathbf{asType}{<}\mathbf{integer}{>}(\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{a2}))) ==
asType<integer>(div2.quot)
(asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.p2)) \%
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a2))) = =
asType<integer>(div2.rem)
!(0 == asType < integer > (div2.rem)) || !(0 ==
asType<integer>(div2.quot))
div3 == div(\mathbf{heapIs} \$heap_{funcstart\_724,1},
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p3}),
asType < int > (\$heap_{funcstart\_724,1}.a3))
(asType<integer>(asType<int>($heap_{tuncstart\_724.1}.p3)) /
\mathbf{asType}{<}\mathbf{integer}{>}(\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{a3}))) ==
asType<integer>(div3.quot)
(\mathbf{asType} < \mathbf{integer} > (\mathbf{asType} < \mathbf{int} > (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p3})) \%
```

```
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a3))) = =
asType<integer>(div3.rem)
!(0 == asType < integer > (div3.rem)) || !(0 ==
asType<integer>(div3.quot))
heap_{724,1;740,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow asType<short
int>((asType<int>(asType<short int>(div1.rem)) *
asType < int > (\$heap_{funcstart\_724.1}.r1)) - (asType < int > (asType < short)
int>(div1.quot)) * asType< int>($heap_{funcstart\_724,1}.b1))))
-asType<integer const>($heap<sub>724,1:740,8</sub>.M1) <
asType<integer>($heap<sub>724.1:740.8</sub>.p1)
!(0 == asType < integer > (\$heap_{724,1;740,8}.p1))
asType<integer>($heap<sub>724,1;740,8</sub>.p1) <
asType<integer>($heap<sub>724,1:740,8</sub>.M1)
\text{heap}_{724.1:742.8} == \text{heap}_{724.1:740.8}._replace(p2 \rightarrow asType<short)
int>((asType<int>(asType<short int>(div2.rem)) *
asType < int > (\$heap_{724,1;740,8}.r2)) - (asType < int > (asType < short)
int > (div2.quot)) * asType < int > ($heap_{724,1;740,8}.b2))))
-asType < integer const > (\$heap_{724,1:742.8}.M2) < 
asType<integer>($heap<sub>724.1:742.8</sub>.p2)
!(0 == asType < integer > (\$heap_{724,1;742,8}.p2))
\mathbf{asType}{<}\mathbf{integer}{>}(\$ heap_{724,1;742,8}.p2) <
asType<integer>($heap<sub>724,1;742,8</sub>.M2)
heap_{724,1:744.8} == heap_{724,1:742.8}._replace(p3 \rightarrow asType<short
int>((asType<int>(asType<short int>(div3.rem)) *
asType < int > (\$heap_{724,1.742,8.}r3)) - (asType < int > (asType < short)
int>(div3.quot)) * asType< int>($heap_{724,1;742,8}.b3))))
-{\bf asType}{<}{\bf integer~const}{>}(\${\rm heap}_{724,1;744,8}.{\rm M3}) <
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathrm{heap}_{724,1;744,8}.\mathrm{p3})
!(0 == asType < integer > (\$heap_{724,1:744.8}.p3))
asType<integer>($heap<sub>724,1:744,8</sub>.p3) <
asType<integer>($heap<sub>724.1:744.8</sub>.M3)
\text{sheap}_{724,1:747.8} == \text{sheap}_{724,1:744.8}._replace(p1 \rightarrow asType<short
int>((asType<int>($heap<sub>724.1:744.8</sub>.M1) *
\mathbf{asType} < \mathbf{int} > (\mathbf{static\_cast} < \mathbf{integer} > (\mathbf{asType} < \mathbf{int} > (\$ \mathrm{heap}_{724,1;744,8}.\mathrm{p1}) < \mathsf{nt}) < \mathsf{nt} > \mathsf{nt} >
(int)(0) + asType < int > ($heap_{724.1:744.8}.p1))
heap_{724,1:748,8} == heap_{724,1:747,8}.replace(p2 \rightarrow asType<short
int>((asType<int>($heap<sub>724,1:747,8</sub>.M2) *
asType<int>(static_cast<integer>(asType<int>($heap<sub>724,1:747,8</sub>.p2) <
(int)(0)) + asType < int > ($heap_{724,1;747,8}.p2)))
```

## **Proof:**

```
[Take goal term]
[1.0] (asType<int>($heap<sub>724.1:748.8</sub>.M3) *
\mathbf{asType} < \mathbf{int} > (\mathbf{static\_cast} < \mathbf{integer} > (\mathbf{asType} < \mathbf{int} > (\$ \mathrm{heap}_{724,1;748,8}.\mathrm{p3}) < \mathsf{nt}) < \mathsf{nt} > \mathsf{nt} >
(int)(0)) \le maxof(int)
\rightarrow [const static or extern object]
[1.1] (asType<int>($heap_{init}.M3) *
asType<int>(static_cast<integer>(asType<int>($heap<sub>724.1:748.8</sub>.p3) <
(int)(0)) \le maxof(int)
\rightarrow [expand definition of constant 'M3' at prang.c (24,20)]
[1.2] (asType<int>(asType<short int>((int)30323)) *
asType<int>(static_cast<integer>(asType<int>($heap_{724.1:748.8}.p3) <
(int)(0)) \le maxof(int)
\rightarrow [simplify]
[1.10] (30323 * asType<int>(([0 < -$heap<sub>724.1:748.8</sub>.p3]: 1, []: 0))) \leq
maxof(int)
\rightarrow [explicitly assert falsehood of skipped guards in subsequent guards]
[1.11] (30323 * asType<int>(([0 < -$heap<sub>724,1:748,8</sub>.p3]: 1, [!(0 <
-\$heap_{724,1;748,8}.p3): 0))) \le maxof(int)
\rightarrow [simplify]
[1.15] (30323 * ([0 < -$heap<sub>724,1;748,8</sub>.p3]: 1, [-1 < $heap<sub>724,1;748,8</sub>.p3]: 0)) \leq
maxof(int)
\rightarrow [move guard outside expression]
30323) \leq \maxof(int)
\rightarrow [simplify]
[1.20] (-1 + ([0 < -\$heap_{724,1:748,8}.p3]: 30323, [-1 < \$heap_{724,1:748,8}.p3]: 0)) < -1.20]
32767
\rightarrow [move guard outside expression]
 [1.21] \; ([0 < -\$ heap_{724,1;748,8}.p3] \colon -1 \; + \; 30323, \; [-1 < \$ heap_{724,1;748,8}.p3] \colon -1 \; + \; 30323, \; [-1 < \$ heap_{724,1;748,8}.p3] \colon -1 \; + \; 30323, \; [-1 < \$ heap_{724,1;748,8}.p3] \colon -1 \; + \; 30323, \; [-1 < \$ heap_{724,1;748,8}.p3] \colon -1 \; + \; 30323, \; [-1 < \$ heap_{724,1;748,8}.p3] \colon -1 \; + \; 30323, \; [-1 < \$ heap_{724,1;748,8}.p3] \colon -1 \; + \; 30323, \; [-1 < \$ heap_{724,1;748,8}.p3] \colon -1 \; + \; 30323, \; [-1 < \$ heap_{724,1;748,8}.p3] \colon -1 \; + \; 30323, \; [-1 < \$ heap_{724,1;748,8}.p3] \colon -1 \; + \; 30323, \; [-1 < \$ heap_{724,1;748,8}.p3] \colon -1 \; + \; 30323, \; [-1 < \$ heap_{724,1;748,8}.p3] \colon -1 \; + \; 30323, \; [-1 < \$ heap_{724,1;748,8}.p3] \colon -1 \; + \; 30323, \; [-1 < \$ heap_{724,1;748,8}.p3] \colon -1 \; + \; 30323, \; [-1 < \$ heap_{724,1;748,8}.p3] \colon -1 \; + \; 30323, \; [-1 < \$ heap_{724,1;748,8}.p3] \colon -1 \; + \; 30323, \; [-1 < \$ heap_{724,1;748,8}.p3] \colon -1 \; + \; 30323, \; [-1 < \$ heap_{724,1;748,8}.p3] \colon -1 \; + \; 30323, \; [-1 < \$ heap_{724,1;748,8}.p3] \colon -1 \; + \; 30323, \; [-1 < \$ heap_{724,1;748,8}.p3] \colon -1 \; + \; 30323, \; [-1 < \$ heap_{724,1;748,8}.p3] \colon -1 \; + \; 30323, \; [-1 < \$ heap_{724,1;748,8}.p3] \colon -1 \; + \; 30323, \; [-1 < \$ heap_{724,1;748,8}.p3] \colon -1 \; + \; 30323, \; [-1 < \$ heap_{724,1;748,8}.p3] \colon -1 \; + \; 30323, \; [-1 < \$ heap_{724,1;748,8}.p3] \colon -1 \; + \; 30323, \; [-1 < \$ heap_{724,1;748,8}.p3] \colon -1 \; + \; 30323, \; [-1 < \$ heap_{724,1;748,8}.p3] \colon -1 \; + \; 30323, \; [-1 < \$ heap_{724,1;748,8}.p3] \colon -1 \; + \; 30323, \; [-1 < \$ heap_{724,1;748,8}.p3] \colon -1 \; + \; 30323, \; [-1 < \$ heap_{724,1;748,8}.p3] \colon -1 \; + \; 30323, \; [-1 < \$ heap_{724,1;748,8}.p3] \colon -1 \; + \; 30323, \; [-1 < \$ heap_{724,1;748,8}.p3] \colon -1 \; + \; 30323, \; [-1 < \$ heap_{724,1;748,8}.p3] \colon -1 \; + \; 30323, \; [-1 < \$ heap_{724,1;748,8}.p3] \colon -1 \; + \; 30323, \; [-1 < \$ heap_{724,1;748,8}.p3] \colon -1 \; + \; 30323, \; [-1 < \$ heap_{724,1;748,8}.p3] \colon -1 \; + \; 30323, \; [-1 < \$ heap_{724,1;748,8}.p3] \colon -1 \; + \; 30323, \; [-1 < \$ heap_{724,1;748,8}.p3] \colon -1 \; + \; 30323, \; [-1 < \$ heap_{724,1;748,8}.p3] \colon -1 \; + \; 30323, \; [-1 < \$ heap_{724,1;748,8}.p3] \colon -1 \; + \; 30
0) < 32767
\rightarrow [simplify]
[1.24] 0 < (32767 + -([0 < -\$heap_{724,1;748,8}.p3]: 30322, [-1 < -\$heap_{724,1;748,8}.p3])
heap_{724,1;748,8}.p3: -1)
\rightarrow [move guard outside expression]
```

```
heap_{724,1;748,8}.p3: --1)
\rightarrow [simplify]
[1.27] 0 < (32767 + ([0 < -\$heap_{724,1:748,8}.p3]: -30322, [-1 <
heap_{724,1;748,8}.p3: 1)
\rightarrow [move guard outside expression]
[1.28] 0 < ([0 < -\$heap_{724,1;748,8}.p3]: -30322 + 32767, [-1 < -1.28])
heap_{724,1;748,8}.p3: 1 + 32767)
\rightarrow [simplify]
[1.30] \ 0 < ([0 < -\$heap_{724,1;748,8}.p3]: 2445, [-1 < \$heap_{724,1;748,8}.p3]: 32768)
\rightarrow [move guard outside expression]
[1.31] ([0 < -$heap<sub>724,1:748,8</sub>.p3]: 0 < 2445, [-1 < $heap<sub>724,1:748,8</sub>.p3]: 0 <
32768)
\rightarrow [simplify]
[1.33] ([0 < -$heap<sub>724,1:748,8</sub>.p3]: true, [-1 < $heap<sub>724,1:748,8</sub>.p3]: true)
\rightarrow [all guards have equal guarded terms]
[1.34] true
Proof of verification condition: Type constraint satisfied in implicit
conversion from 'short int' to 'int'
Condition generated at: C:\Escher\Customers\prang\prang.c (65,5)
Condition defined at:
To prove: minof(int) \le \$heap_{724,1:748.8}.p3
Given:
heap_{init}.LIMIT == (int)80
\theta sheap<sub>init</sub>.M1 == asType<short int>((int)30269)
\theta_{init}.r1 == asType < short int > ((int)171)
heap_{init}.a1 == asType < short int > ((int)177)
\theta = asType < short int > ((int)2)
heap_{init}.M2 == asType < short int > ((int)30307)
\theta_{init}.r2 == asType < short int > ((int)172)
heap_{init}.a2 == asType < short int > ((int)176)
\theta = asType < short int > ((int)35)
heap_{init}.M3 == asType < short int > ((int)30323)
heap_{init}.r3 == asType < short int > ((int)170)
```

```
heap_{init}.a3 == asType < short int > ((int)178)
heap_{init}.b3 == asType<short int>((int)63)
\theta = asType < short int > ((int)1)
\theta
\theta = asType < short int > ((int)3)
invariant1(heapIs heap_{funcstart\_724,1})
\mathrm{div1} == \mathrm{div}(\mathbf{heapIs} \ \$ \mathrm{heap}_{funcstart\_724,1},
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p1}),
asType < int > (\$heap_{funcstart\_724,1}.a1))
(asType<int>(asType<int>($heap_{tuncstart\_724.1}.p1)) /
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a1))) = =
asType<integer>(div1.quot)
(asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.p1)) \%
\mathbf{asType}{<}\mathbf{integer}{>}(\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{a1}))) ==
asType<integer>(div1.rem)
!(0 == asType < integer > (div1.rem)) || !(0 ==
asType<integer>(div1.quot))
div2 == div(\mathbf{heapIs} \$heap_{funcstart\_724,1},
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p2}),
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{a2}))
(asType<integer>(asType<int>($heap_{tuncstart\_724.1}.p2)) /
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a2))) = =
asType<integer>(div2.quot)
(\mathbf{asType} {<} \mathbf{integer} {>} (\mathbf{asType} {<} \mathbf{int} {>} (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p2})) \ \%
\mathbf{asType}{<}\mathbf{integer}{>}(\mathbf{asType}{<}\mathbf{int}{>}(\$\mathbf{heap}_{funcstart\_724,1}.\mathbf{a2}))) = =
asType<integer>(div2.rem)
!(0 == asType < integer > (div2.rem)) || !(0 ==
asType<integer>(div2.quot))
div3 == div(\mathbf{heapIs} \$heap_{funcstart\_724,1},
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p3}),
asType < int > (\$heap_{funcstart\_724,1}.a3))
(asType<int>(asType<int>($heap_{tuncstart\_724.1}.p3)) /
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a3))) = =
asType<integer>(div3.quot)
(\mathbf{asType} {<} \mathbf{integer} {>} (\mathbf{asType} {<} \mathbf{int} {>} (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p3})) \ \%
\mathbf{asType} < \mathbf{integer} > (\mathbf{asType} < \mathbf{int} > (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{a3}))) = =
asType<integer>(div3.rem)
!(0 == asType < integer > (div3.rem)) || !(0 ==
```

```
asType<integer>(div3.quot))
heap_{724,1;740,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow asType<short
int>((asType<int>(asType<short int>(div1.rem)) *
asType < int > (\$heap_{funcstart\_724,1}.r1)) - (asType < int > (asType < short)
int>(div1.quot)) * asType<int>($heap_{funcstart\_724,1}.b1)))
-asType < integer\ const > (\$heap_{724,1;740,8}.M1) < 1
asType<integer>($heap<sub>724,1:740.8</sub>.p1)
!(0 == asType < integer > (\$heap_{724,1;740,8}.p1))
asType<integer>($heap<sub>724.1:740.8</sub>.p1) <
asType<integer>($heap<sub>724.1:740.8</sub>.M1)
$heap_{724,1;742,8} == $heap_{724,1;740,8}.replace(p2 \rightarrow asType<short
int>((asType<int>(asType<short int>(div2.rem)) *
asType < int > (\$heap_{724,1:740,8}.r2)) - (asType < int > (asType < short)
\mathbf{int}{>}(\text{div2.quot})) \ * \ \mathbf{asType}{<} \mathbf{int}{>} (\$\text{heap}_{724,1;740,8}.\text{b2}))))
-asType < integer\ const > (\$heap_{724,1;742,8}.M2) < 
asType<integer>($heap<sub>724.1:742.8</sub>.p2)
!(0 == \mathbf{asType} < \mathbf{integer} > (\$ heap_{724,1;742,8}.p2))
asType<integer>($heap<sub>724,1;742,8</sub>.p2) <
asType<integer>($heap<sub>724.1:742.8</sub>.M2)
\text{sheap}_{724,1;744,8} == \text{sheap}_{724,1;742,8}.\_\text{replace}(p3 \to asType < short)
int>((asType<int>(asType<short int>(div3.rem))
asType < int > (\$heap_{724,1:742,8}.r3)) - (asType < int > (asType < short)
int>(div3.quot)) * asType<int>($heap<sub>724,1:742,8</sub>.b3))))
-asType<integer const>($heap<sub>724.1:744.8</sub>.M3) <
asType<integer>($heap<sub>724.1:744.8</sub>.p3)
!(0 == asType < integer > (\$heap_{724,1:744.8}.p3))
asType<integer>($heap<sub>724.1:744.8</sub>.p3) <
asType<integer>($heap<sub>724,1;744,8</sub>.M3)
heap_{724,1:747,8} == heap_{724,1:744,8}.replace(p1 \rightarrow asType<short
int>((asType< int>(\$heap_{724,1;744,8}.M1) *
asType<int>(static_cast<integer>(asType<int>($heap<sub>724.1:744.8</sub>.p1) <
(int)(0)) + asType < int > (\$heap_{724,1;744,8}.p1)))
\text{$heap}_{724,1;748,8} == \text{$heap}_{724,1;747,8}.\_\textbf{replace}(p2 \to \textbf{asType} < \textbf{short}
int>((asType< int>(\$heap_{724,1;747,8}.M2) *
asType<int>(static_cast<integer>(asType<int>($heap<sub>724.1:747.8</sub>.p2) <
(int)(0)) + asType < int > ($heap_{724,1;747,8}.p2)))
Proof:
[Take goal term]
```

```
\rightarrow [simplify]
[1.3] -32769 < \text{heap}_{724,1:748.8}.p3
\rightarrow [negate goal and search for contradiction]
[1.4]!(-32769 < \text{$heap}_{724,1;748,8}.p3)
\rightarrow [simplify]
\textit{[1.6]}\ 32768 < -\$ heap_{724,1;748,8}.p3
[Assume known post-assertion, class invariant or type constraint for term 1.6]
[69.0] minof(short int) \leq $heap<sub>724,1;748,8</sub>.p3
\rightarrow [simplify]
|69.3| -32769 < heap_{724,1;748,8}.p3
\rightarrow [from term 1.6, literala < $heap<sub>724,1:748,8</sub>.p3 is false whenever -2 < (32768)
+ literala)]
   Proof of rule precondition:
   [69.3.0] - 2 < (-32769 + 32768)
   \rightarrow [simplify]
   [69.3.2] true
[69.4] false
Proof of verification condition: Type constraint satisfied in implicit
conversion from 'short int' to 'int'
Condition generated at: C:\Escher\Customers\prang\prang.c (65,5)
Condition defined at:
To prove: heap_{724,1;748,8}.p3 \le maxof(int)
Given:
heap_{init}.LIMIT == (int)80
heap_{init}.M1 == asType < short int > ((int)30269)
\theta_{init}.r1 == asType < short int > ((int)171)
\theta
\theta
\theta sheap<sub>init</sub>.M2 == asType<short int>((int)30307)
\theta_{init}.r2 == asType < short int > ((int)172)
heap_{init}.a2 == asType < short int > ((int)176)
```

[1.0] minof(int)  $\leq$  \$heap<sub>724,1:748,8</sub>.p3

```
\theta sheap<sub>init</sub>.b2 == asType<short int>((int)35)
heap_{init}.M3 == asType < short int > ((int)30323)
\theta_{init}.r3 == asType<short int>((int)170)
heap_{init}.a3 == asType < short int > ((int)178)
heap_{init}.b3 == asType < short int > ((int)63)
\theta
\theta
\theta = asType < short int > ((int)3)
invariant
1(heap<br/>Is \theta_{funcstart\_724,1}
div1 == div(\mathbf{heapIs} \$heap_{funcstart\_724,1},
asType < int > (\$heap_{funcstart\_724,1}.p1),
asType < int > (\$heap_{funcstart\_724,1}.a1))
(\mathbf{asType}{<}\mathbf{integer}{>}(\mathbf{asType}{<}\mathbf{int}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{p1})) \ / \\
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a1))) = =
asType<integer>(div1.quot)
(\mathbf{asType} < \mathbf{integer} > (\mathbf{asType} < \mathbf{int} > (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p1})) \%
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a1))) = =
asType<integer>(div1.rem)
!(0 == asType < integer > (div1.rem)) || !(0 ==
asType<integer>(div1.quot))
div2 == div(\mathbf{heapIs} \$heap_{funcstart\_724,1},
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p2}),
asType < int > (\$heap_{funcstart\_724,1}.a2))
(asType<int>(sheap<sub>funcstart 724.1</sub>.p2)) /
\mathbf{asType}{<}\mathbf{integer}{>}(\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{a2}))) ==
asType<integer>(div2.quot)
(asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.p2)) \%
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a2))) = =
asType<integer>(div2.rem)
!(0 == asType < integer > (div2.rem)) || !(0 ==
asType<integer>(div2.quot))
div3 == div(\mathbf{heapIs} \$heap_{funcstart\_724,1},
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p3}),
asType < int > (\$heap_{funcstart\_724,1}.a3))
(asType<integer>(asType<int>($heap_{tuncstart\_724.1}.p3)) /
\mathbf{asType}{<}\mathbf{integer}{>}(\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{a3}))) ==
asType<integer>(div3.quot)
(\mathbf{asType} < \mathbf{integer} > (\mathbf{asType} < \mathbf{int} > (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p3})) \%
```

```
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a3))) = =
asType<integer>(div3.rem)
!(0 == asType < integer > (div3.rem)) || !(0 ==
asType<integer>(div3.quot))
heap_{724,1;740,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow asType<short
int>((asType<int>(asType<short int>(div1.rem)) *
asType < int > (\$heap_{funcstart\_724.1}.r1)) - (asType < int > (asType < short)
int>(div1.quot)) * asType< int>($heap_{funcstart\_724,1}.b1))))
-asType<integer const>($heap<sub>724,1:740,8</sub>.M1) <
asType<integer>($heap<sub>724.1:740.8</sub>.p1)
!(0 == asType < integer > (\$heap_{724,1;740,8}.p1))
asType<integer>($heap<sub>724,1;740,8</sub>.p1) <
asType<integer>($heap<sub>724,1:740,8</sub>.M1)
\text{heap}_{724.1:742.8} == \text{heap}_{724.1:740.8}._replace(p2 \rightarrow asType<short)
int>((asType<int>(asType<short int>(div2.rem)) *
asType < int > (\$heap_{724,1;740,8}.r2)) - (asType < int > (asType < short)
int > (div2.quot)) * asType < int > ($heap_{724,1;740,8}.b2))))
-asType < integer const > (\$heap_{724,1:742.8}.M2) < 
asType<integer>($heap<sub>724.1:742.8</sub>.p2)
!(0 == asType < integer > (\$heap_{724,1;742,8}.p2))
\mathbf{asType}{<}\mathbf{integer}{>}(\$ heap_{724,1;742,8}.p2) <
asType<integer>($heap<sub>724,1;742,8</sub>.M2)
heap_{724,1:744.8} == heap_{724,1:742.8}._replace(p3 \rightarrow asType<short
int>((asType<int>(asType<short int>(div3.rem)) *
asType < int > (\$heap_{724,1.742,8.}r3)) - (asType < int > (asType < short)
int>(div3.quot)) * asType< int>($heap_{724,1;742,8}.b3))))
-\mathbf{asType}{<}\mathbf{integer}\ \mathbf{const}{>}(\$\mathrm{heap}_{724,1;744,8}.\mathrm{M3}) <
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathrm{heap}_{724,1;744,8}.\mathrm{p3})
!(0 == asType < integer > (\$heap_{724,1:744.8}.p3))
asType<integer>($heap<sub>724,1:744,8</sub>.p3) <
asType<integer>($heap<sub>724.1:744.8</sub>.M3)
\text{sheap}_{724,1:747.8} == \text{sheap}_{724,1:744.8}._replace(p1 \rightarrow asType<short
int>((asType<int>($heap<sub>724.1:744.8</sub>.M1) *
\mathbf{asType} < \mathbf{int} > (\mathbf{static\_cast} < \mathbf{integer} > (\mathbf{asType} < \mathbf{int} > (\$ \mathrm{heap}_{724,1;744,8}.\mathrm{p1}) < \mathsf{nt}) < \mathsf{nt} > \mathsf{nt} >
(int)(0) + asType < int > ($heap_{724.1:744.8}.p1))
heap_{724,1:748,8} == heap_{724,1:747,8}.replace(p2 \rightarrow asType<short
int>((asType<int>($heap<sub>724,1:747,8</sub>.M2) *
asType<int>(static_cast<integer>(asType<int>($heap<sub>724,1:747,8</sub>.p2) <
(int)(0)) + asType < int > ($heap_{724,1;747,8}.p2)))
```

## **Proof:**

```
[Take goal term]
[1.0] $\text{heap}_{724,1;748,8}.p3 \leq \text{maxof(int)}
\rightarrow [simplify]
[1.9] -32768 < -\$heap_{724,1;748,8}.p3
\rightarrow [negate goal and search for contradiction]
[1.10]!(-32768 < -\$heap_{724,1;748,8}.p3)
\rightarrow [simplify]
[1.13] 32767 < $\text{heap}_{724,1;748,8}.p3
[Assume known post-assertion, class invariant or type constraint for term 1.13]
[69.0] $heap<sub>724,1:748,8</sub>.p3 \leq maxof(short int)
\rightarrow [simplify]
[69.9] -32768 < -\$heap_{724.1:748.8}.p3
\rightarrow [from term 1.13, literala < -$heap<sub>724,1:748,8</sub>.p3 is false whenever -2 <
(32767 + literala)
   Proof of rule precondition:
   [69.9.0] - 2 < (-32768 + 32767)
   \rightarrow [simplify]
   [69.9.2] true
[69.10] false
Proof of verification condition: Type constraint satisfied in implicit
conversion from 'int' to 'short int'
Condition generated at: C:\Escher\Customers\prang\prang.c (65,8)
Condition defined at:
To prove: minof(short\ int) \le ((asType < int > (\$heap_{724,1;748,8}.M3) *
asType<int>(static_cast<integer>(asType<int>($heap_{724,1:748,8}.p3) <
(int)(0) + asType<int>($heap<sub>724.1:748.8</sub>.p3))
Given:
heap_{init}.LIMIT == (int)80
\theta sheap<sub>init</sub>.M1 == asType<short int>((int)30269)
\theta_{init}.r1 == asType < short int > ((int)171)
\theta
\theta
```

```
heap_{init}.M2 == asType < short int > ((int)30307)
\theta_{init}.r2 == asType < short int > ((int)172)
\theta_{init}.a2 == asType<short int>((int)176)
heap_{init}.b2 == asType<short int>((int)35)
heap_{init}.M3 == asType < short int > ((int)30323)
heap_{init}.r3 == asType < short int > ((int)170)
heap_{init}.a3 == asType < short int > ((int)178)
\theta = asType < short int > ((int)63)
\theta = asType < short int > ((int)1)
\theta
\rho = asType < short int > ((int)3)
invariant1(heapIs heap_{funcstart_{-724,1}})
div1 == div(\mathbf{heapIs} \$ heap_{funcstart\_724.1},
asType < int > (\$heap_{funcstart\_724.1}.p1),
asType < int > (\$heap_{funcstart\_724,1}.a1))
(asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.p1)) /
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a1))) ==
asType<integer>(div1.quot)
(asType < int > (asType < int > (\$heap_{funcstart\_724,1}.p1)) \%
asType < integer > (asType < int > (\$heap_{funcstart_{-724.1}}.a1))) = =
asType<integer>(div1.rem)
!(0 == asType < integer > (div1.rem)) || !(0 ==
asType<integer>(div1.quot))
div2 == div(\mathbf{heapIs} \$heap_{funcstart\_724,1},
asType < int > (\$heap_{funcstart\_724.1}.p2),
asType < int > (\$heap_{funcstart\_724,1}.a2))
(asType<integer>(asType<int>($heap_{funcstart\_724.1}.p2)) /
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a2))) = =
asType<integer>(div2.quot)
(\mathbf{asType} < \mathbf{integer} > (\mathbf{asType} < \mathbf{int} > (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p2})) \ \%
asType < integer > (asType < int > (\$heap_{funcstart_{-724,1}}.a2))) = =
asType<integer>(div2.rem)
!(0 == asTvpe < integer > (div2.rem)) || !(0 ==
asType<integer>(div2.quot))
div3 == div(\mathbf{heapIs} \$ heap_{funcstart\_724,1},
asType < int > (\$heap_{funcstart\_724,1}.p3),
asType < int > (\$heap_{funcstart\_724,1}.a3))
```

```
(asType < int > (asType < int > (\$heap_{funcstart\_724,1}.p3)) /
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a3))) = =
asType<integer>(div3.quot)
(asType<int>(asType<int>($heap_{funcstart\_724,1}.p3)) %
\mathbf{asType}{<}\mathbf{integer}{>}(\mathbf{asType}{<}\mathbf{int}{>}(\$\mathbf{heap}_{funcstart\_724,1}.\mathbf{a3}))) = =
asType<integer>(div3.rem)
!(0 == asType < integer > (div3.rem)) || !(0 ==
asType<integer>(div3.quot))
\$heap_{724,1;740,8} == \$heap_{funcstart\_724,1}.\_\textbf{replace}(p1 \rightarrow \textbf{asType} < \textbf{short}
int>((asType<int>(asType<short int>(div1.rem)) *
asType < int > (\$heap_{funcstart\_724,1}.r1)) - (asType < int > (asType < short)
int>(div1.quot)) * asType<int>($heap_{funcstart\_724,1}.b1)))
-asType<integer const>($heap<sub>724,1:740,8</sub>.M1) <
asType<integer>($heap<sub>724,1:740,8</sub>.p1)
!(0 == asType < integer > (\$heap_{724,1;740,8}.p1))
asType<integer>($heap<sub>724.1:740.8</sub>.p1) <
asType<integer>($heap<sub>724.1:740.8</sub>.M1)
\text{heap}_{724.1:742.8} == \text{heap}_{724.1:740.8}._replace(p2 \rightarrow asType<short)
int>((asType<int>(asType<short int>(div2.rem)) *
asType < int > (\$heap_{724,1:740,8}.r2)) - (asType < int > (asType < short)
int>(div2.quot)) * asType<int>($heap<sub>724.1:740.8</sub>.b2))))
-asType < integer\ const > (\$heap_{724,1;742,8}.M2) < 
asType<integer>($heap<sub>724.1:742.8</sub>.p2)
!(0 == asType < integer > (\$heap_{724,1:742,8}.p2))
asType<integer>($heap<sub>724.1:742.8</sub>.p2) <
asType<integer>($heap<sub>724.1:742.8</sub>.M2)
heap_{724,1:744,8} == heap_{724,1:742,8}.replace(p3 \rightarrow asType<short
int>((asType<int>(asType<short int>(div3.rem)) *
asType < int > (\$heap_{724,1:742.8}.r3)) - (asType < int > (asType < short)
int > (div3.quot)) * asType < int > (\$heap_{724,1;742,8}.b3))))
-asType < integer const > (\$heap_{724,1;744,8}.M3) < 1
asType<integer>($heap<sub>724.1:744.8</sub>.p3)
!(0 == asType < integer > (\$heap_{724,1:744.8}.p3))
asType < integer > (\$heap_{724,1;744,8}.p3) < 
\mathbf{asType} < \mathbf{integer} > (\$ \mathrm{heap}_{724,1;744,8}.\mathrm{M3})
heap_{724,1:747,8} == heap_{724,1:744,8}.replace(p1 \rightarrow asType<short
int>((asType<int>($heap<sub>724.1:744.8</sub>.M1) *
asType<int>(static_cast<integer>(asType<int>($heap<sub>724,1:744,8</sub>.p1) <
(int)(0)) + asType < int > (\$heap_{724,1;744,8}.p1)))
```

```
heap_{724,1;748,8} == heap_{724,1;747,8}.replace(p2 \rightarrow asType<short
int>((asType< int>(\$heap_{724,1;747,8}.M2) *
asType<int>(static_cast<integer>(asType<int>($heap_{724,1:747,8}.p2) <
(int)(0) + asType<int>($heap<sub>724,1:747,8</sub>.p2)))
Proof:
[Take goal term]
[1.0]  minof(short int) \leq ((asType < int > (\$heap_{724,1:748,8}.M3) *
\mathbf{asType} < \mathbf{int} > (\mathbf{static\_cast} < \mathbf{integer} > (\mathbf{asType} < \mathbf{int} > (\$ \mathrm{heap}_{724,1:748.8}.\mathrm{p3}) < \mathsf{nt})
(int)(0) + asType<int>($heap<sub>724,1:748,8</sub>.p3))
\rightarrow [simplify]
[1.1] -32768 \leq ((asType<int>($heap<sub>724,1:748,8</sub>.M3) *
asType<int>(static_cast<integer>(asType<int>($heap<sub>724,1:748,8</sub>.p3) <
(int)(0)) + asType < int > ($heap_{724,1;748,8}.p3))
\rightarrow [const static or extern object]
[1.2] -32768 \le ((asType < int > (\$heap_{init}.M3) *)
asType<int>(static_cast<integer>(asType<int>($heap_{724,1:748,8}.p3) <
(int)(0) + asType<int>($heap<sub>724,1:748,8</sub>.p3))
\rightarrow [expand definition of constant 'M3' at prang.c (24,20)]
[1.3] -32768 \leq ((asType<int>(asType<short int>((int)30323)) *
asType<int>(static_cast<integer>(asType<int>($heap<sub>724,1:748,8</sub>.p3) <
(int)(0)) + asType < int > ($heap_{724,1:748,8}.p3))
\rightarrow [simplify]
[1.11] -32768 \leq ((30323 * asType<int>(([0 < -$heap<sub>724,1:748,8</sub>.p3]: 1, []: 0)))
+ asType < int > ($heap_{724,1;748,8}.p3))
→ [explicitly assert falsehood of skipped guards in subsequent guards]
[1.12] -32768 \leq ((30323 * asType<int>(([0 < -$heap_{724,1;748,8}.p3]: 1, [!(0 < -$heap_{724,1;748,8}.p3]: 1)
-\text{sheap}_{724,1;748,8}.\text{p3}): 0))) + asType<int>(\text{sheap}_{724,1;748,8}.\text{p3}))
\rightarrow [simplify]
 \lceil 1.16 \rceil \ \hbox{-32768} \le ((30323 \ \hbox{$^*$} \ ([0 < -\$ \mathrm{heap}_{724,1;748,8}.\mathrm{p3}] \hbox{:}\ 1,\ [\hbox{-}1 <
\rho_{24.1;748.8.p3}: 0)) + asType<int>(\rho_{24.1;748.8.p3})
\rightarrow [move guard outside expression]
[1.17] -32768 \leq (([0 < -$heap<sub>724.1:748.8</sub>.p3]: 1 * 30323, [-1 <
[\text{sheap}_{724,1:748,8},\text{p3}]: 0 * 30323) + asType < int > (\text{sheap}_{724,1:748,8},\text{p3}))
\rightarrow [simplify]
[1.20] -32768 \leq (([0 < -\$heap_{724,1;748,8}.p3]: 30323, [-1 < \$heap_{724,1;748,8}.p3]:
0) + heap_{724,1;748,8}.p3
\rightarrow [move guard outside expression]
```

```
[1.21] -32768 \leq ([0 < -$heap<sub>724,1;748,8</sub>.p3]: 30323 + $heap<sub>724,1;748,8</sub>.p3, [-1 <
heap_{724,1;748,8}.p3: 0 + p_{724,1;748,8}.p3
\rightarrow [simplify]
heap_{724,1;748,8}.p3: p_{724,1;748,8}.p3
\rightarrow [move guard outside expression]
[1.25] ([0 < -$heap<sub>724,1;748,8</sub>.p3]: -32769 < (30323 + $heap<sub>724,1;748,8</sub>.p3), [-1 <
heap_{724,1;748,8}.p3: -32769 < heap_{724,1;748,8}.p3
\rightarrow [simplify]
[1.27] ([0 < -$heap<sub>724,1;748,8</sub>.p3]: -63092 < $heap<sub>724,1;748,8</sub>.p3, [-1 <
\rho_{724,1;748,8.p3}: -32769 < \rho_{724,1;748,8.p3}
\rightarrow [from guard, literala < $heap<sub>724,1:748,8</sub>.p3 is true whenever (-1 + literala) <
-1]
        Proof of rule precondition:
        [1.27.0](-32769 + -1) < -1
        \rightarrow [simplify]
        [1.27.2] true
[1.28] ([0 < -$heap<sub>724,1;748,8</sub>.p3]: -63092 < $heap<sub>724,1;748,8</sub>.p3, [-1 <
$heap<sub>724,1:748,8</sub>.p3]: true)
\rightarrow [negate goal and search for contradiction]
[1.29] ! ([0 < -\$heap_{724,1;748,8}.p3] : -63092 < \$heap_{724,1;748,8}.p3, [-1 < -4]) ! ([0 < -\$heap_{724,1;748,8}.p3] : -63092 < \$heap_{724,1;748,8}.p3, [-1 < -4]) ! ([0 < -\$heap_{724,1;748,8}.p3] : -63092 < \$heap_{724,1;748,8}.p3, [-1 < -4]) ! ([0 < -\$heap_{724,1;748,8}.p3] : -63092 < \$heap_{724,1;748,8}.p3, [-1 < -4]) ! ([0 < -\$heap_{724,1;748,8}.p3] : -63092 < \$heap_{724,1;748,8}.p3, [-1 < -4]) ! ([0 < -\$heap_{724,1;748,8}.p3] : -63092 < \$heap_{724,1;748,8}.p3, [-1 < -4]) ! ([0 < -\$heap_{724,1;748,8}.p3] : -63092 < \$heap_{724,1;748,8}.p3, [-1 < -4]) ! ([0 < -\$heap_{724,1;748,8}.p3] : -63092 < \$heap_{724,1;748,8}.p3, [-1 < -4]) ! ([0 < -\$heap_{724,1;748,8}.p3] : -63092 < \$heap_{724,1;748,8}.p3, [-1 < -4]) ! ([0 < -\$heap_{724,1;748,8}.p3] : -63092 < -4]) ! (
$heap<sub>724,1;748,8</sub>.p3]: true)
\rightarrow [move guard outside expression]
[1.30] ([0 < -$heap<sub>724,1;748,8</sub>.p3]: !(-63092 < $heap<sub>724,1;748,8</sub>.p3), [-1 <
$heap<sub>724.1:748.8</sub>.p3]: !true)
\rightarrow [simplify]
[1.35] (0 < -$heap<sub>724,1;748,8</sub>.p3) \land (63091 < -$heap<sub>724,1;748,8</sub>.p3)
[Work on sub-term 2 of conjunction in term 1.35]
\textit{[69.0]} \ 63091 < -\$ \text{heap}_{724,1;748,8}.\text{p3}
[Assume known post-assertion, class invariant or type constraint for term 1.35]
[70.0] minof(short int) \leq $heap<sub>724,1:748,8</sub>.p3
\rightarrow [simplify]
[70.3] -32769 < page = 32769 < page = 32769
\rightarrow [from term 69.0, literala < $heap<sub>724,1:748,8</sub>.p3 is false whenever -2 < (63091)
+ literala)]
```

```
Proof of rule precondition:
            [70.3.0] - 2 < (-32769 + 63091)
            \rightarrow [simplify]
            [70.3.2] true
[70.4] false
Proof of verification condition: Type constraint satisfied in implicit
conversion from 'int' to 'short int'
Condition generated at: C:\Escher\Customers\prang\prang.c (65,8)
Condition defined at:
To prove: ((asType<int>($heap<sub>724.1:748.8</sub>.M3) *
\mathbf{asType} < \mathbf{int} > (\mathbf{static\_cast} < \mathbf{integer} > (\mathbf{asType} < \mathbf{int} > (\$ \mathrm{heap}_{724,1;748,8}.\mathrm{p3}) < \mathsf{nt}) < \mathsf{nt} > \mathsf{nt} >
(int)(0) + asType<int>(heap_{724,1:748,8}.p3)) \leq maxof(short int)
Given:
heap_{init}.LIMIT == (int)80
\theta
\theta_{init}.r1 == asType < short int > ((int)171)
heap_{init}.a1 == asType < short int > ((int)177)
\theta
heap_{init}.M2 == asType < short int > ((int)30307)
\theta_{init}.r2 == asType < short int > ((int)172)
heap_{init}.a2 == asType < short int > ((int)176)
heap_{init}.b2 == asType < short int > ((int)35)
heap_{init}.M3 == asType < short int > ((int)30323)
\theta_{init}.r3 == asType<short int>((int)170)
\theta = asType < short int > ((int)178)
\theta = asType < short int > ((int)63)
```

 $$ heap_{init}.p1 == asType < short int > ((int)1) $ heap_{init}.p2 == asType < short int > ((int)2) $ heap_{init}.p3 == asType < short int > ((int)3) $ heap_{init}.p3 == asType < short int > ((int)3) $ heap_{init}.p3 == asType < short int > ((int)3) $ heap_{init}.p3 == asType < short int > ((int)3) $ heap_{init}.p3 == asType < short int > ((int)3) $ heap_{init}.p3 == asType < short int > ((int)3) $ heap_{init}.p3 == asType < short int > ((int)3) $ heap_{init}.p3 == asType < short int > ((int)3) $ heap_{init}.p3 == asType < short int > ((int)3) $ heap_{init}.p3 == asType < short int > ((int)3) $ heap_{init}.p3 == asType < short int > ((int)3) $ heap_{init}.p3 == asType < short int > ((int)3) $ heap_{init}.p3 == asType < short int > ((int)3) $ heap_{init}.p3 == asType < short int > ((int)3) $ heap_{init}.p3 == asType < short int > ((int)3) $ heap_{init}.p3 == asType < short int > ((int)3) $ heap_{init}.p3 == asType < short int > ((int)3) $ heap_{init}.p3 == asType < short int > ((int)3) $ heap_{init}.p3 == asType < short int > ((int)3) $ heap_{init}.p3 == asType < short int > ((int)3) $ heap_{init}.p3 == asType < short int > ((int)3) $ heap_{init}.p3 == asType < short int > ((int)3) $ heap_{init}.p3 == asType < short int > ((int)3) $ heap_{init}.p3 == asType < short int > ((int)3) $ heap_{init}.p3 == asType < short int > ((int)3) $ heap_{init}.p3 == asType < short int > ((int)3) $ heap_{init}.p3 == asType < short int > ((int)3) $ heap_{init}.p3 == asType < short int > ((int)3) $ heap_{init}.p3 == asType < short int > ((int)3) $ heap_{init}.p3 == asType < short int > ((int)3) $ heap_{init}.p3 == asType < short int > ((int)3) $ heap_{init}.p3 == asType < short int > ((int)3) $ heap_{init}.p3 == asType < short int > ((int)3) $ heap_{init}.p3 == asType < short int > ((int)3) $ heap_{init}.p3 == asType < short int > ((int)3) $ heap_{init}.p3 == asType < short int > ((int)3) $ heap_{init}.p3 == asType < short int > ((int)3) $ heap_{init}.p3 == asType < short int > ((int)3) $ heap_{init}.p3 == asType < short int > ((i$ 

invariant1(heapIs  $heap_{funcstart_{-724,1}}$ ) div1 == div(heapIs  $heap_{funcstart_{-724,1}}$ , asType<int>( $heap_{funcstart_{-724,1}}$ .p1), asType<int>( $heap_{funcstart_{-724,1}}$ .a1))

```
(\mathbf{asType}{<}\mathbf{int}{>}(\mathbf{asType}{<}\mathbf{int}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{p1})) \ / \\
\mathbf{asType} < \mathbf{integer} > (\mathbf{asType} < \mathbf{int} > (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{a1}))) = =
asType < integer > (div1.quot)
(asType<integer>(asType<int>($heap_{tuncstart\_724.1}.p1)) %
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a1))) = =
asType<integer>(div1.rem)
!(0 == asType < integer > (div1.rem)) || !(0 ==
asType<integer>(div1.quot))
div2 == div(\mathbf{heapIs} \$ heap_{funcstart\_724,1},
\mathbf{asType} < \mathbf{int} > (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p2}),
asType < int > (\$heap_{funcstart_{-724,1}}.a2))
(asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.p2)) /
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a2))) = =
asType<integer>(div2.quot)
(asType<int>(asType<int>($heap_{tuncstart\_724.1}.p2)) %
\mathbf{asType}{<}\mathbf{integer}{>}(\mathbf{asType}{<}\mathbf{int}{>}(\$\mathbf{heap}_{funcstart\_724,1}.\mathbf{a2}))) = =
asType<integer>(div2.rem)
!(0 == asType < integer > (div2.rem)) || !(0 ==
asType<integer>(div2.quot))
div3 == div(\mathbf{heapIs} \$ heap_{funcstart\_724,1},
asType < int > (\$heap_{funcstart\_724,1}.p3),
asType < int > (\$heap_{funcstart\_724.1}.a3))
(asType<int>(asType<int>($heap_{tuncstart}, 724.1.p3)) /
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a3))) = =
asType<integer>(div3.quot)
(asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.p3)) \%
\mathbf{asType}{<}\mathbf{integer}{>}(\mathbf{asType}{<}\mathbf{int}{>}(\$\mathbf{heap}_{funcstart\_724,1}.\mathbf{a3}))) = =
asType<integer>(div3.rem)
!(0 == asType < integer > (div3.rem)) || !(0 ==
asType<integer>(div3.quot))
$heap_{724,1;740,8} == $heap_{funcstart\_724,1}.\_replace(p1 \rightarrow asType < short)
int>((asType<int>(asType<short int>(div1.rem)) *
\mathbf{asType} \small{<} \mathbf{int} \small{>} (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{r1})) - (\mathbf{asType} \small{<} \mathbf{int} \small{>} (\mathbf{asType} \small{<} \mathbf{short}
int>(div1.quot)) * asType<int>($heap_{funcstart\_724,1}.b1)))
-asType < integer const > (\$heap_{724,1:740.8}.M1) < 1
asType<integer>($heap<sub>724.1:740.8</sub>.p1)
!(0 == asType < integer > (\$heap_{724,1;740,8}.p1))
asType<integer>($heap<sub>724.1:740.8</sub>.p1) <
asType<integer>($heap<sub>724.1:740.8</sub>.M1)
```

```
\text{Sheap}_{724,1:742,8} == \text{Sheap}_{724,1:740,8}.\_\text{replace}(p2 \rightarrow \text{asType} < \text{short})
int>((asType<int>(asType<short int>(div2.rem)) *
asType < int > (\$heap_{724,1:740,8}.r2)) - (asType < int > (asType < short)
int>(div2.quot)) * asType< int>($heap_{724,1;740.8}.b2))))
-asType < integer const > (\$heap_{724.1:742.8}.M2) < 
asType<integer>($heap<sub>724.1:742.8</sub>.p2)
!(0 == asType < integer > (\$heap_{724,1;742,8}.p2))
asType<integer>($heap<sub>724,1:742,8</sub>.p2) <
asType<integer>($heap<sub>724,1:742,8</sub>.M2)
\text{heap}_{724.1:744.8} == \text{heap}_{724.1:742.8}._replace(p3 \rightarrow asType<short)
int>((asType<int>(asType<short int>(div3.rem)) *
asType < int > (\$heap_{724.1:742.8}.r3)) - (asType < int > (asType < short)
int > (div3.quot)) * asType < int > (\$heap_{724,1;742,8}.b3))))
-{\bf asType}{<} {\bf integer~const}{>} (\${\rm heap}_{724,1;744,8}.{\rm M3}) <
asType<integer>($heap<sub>724.1:744.8</sub>.p3)
!(0 == \mathbf{asType} {<} \mathbf{integer} {>} (\$ \mathrm{heap}_{724,1;744,8}.\mathrm{p3}))
\mathbf{asType}{<}\mathbf{integer}{>}(\$ heap_{724,1;744,8}.p3) <
asType<integer>($heap<sub>724.1:744.8</sub>.M3)
\text{heap}_{724.1:747.8} == \text{heap}_{724.1:744.8}._replace(p1 \rightarrow asType<short)
int>((asType< int>(\$heap_{724,1;744,8}.M1) *
asType<int>(static_cast<integer>(asType<int>($heap_{724.1:744.8}.p1) <
(int)(0) + asType < int > (\$heap_{724,1:744.8}.p1))
heap_{724,1:748,8} == heap_{724,1:747,8}.replace(p2 \rightarrow asType<short
int>((asType<int>($heap<sub>724.1:747.8</sub>.M2) *
asType<int>(static_cast<integer>(asType<int>($heap_{724,1:747,8}.p2) <
(int)(0)) + asType < int > (\$heap_{724,1;747,8}.p2)))
Proof:
[Take goal term]
[1.0] ((asType<int>($heap<sub>724.1:748.8</sub>.M3) *
asType<int>(static_cast<integer>(asType<int>($heap<sub>724.1:748.8</sub>.p3) <
(\mathbf{int})0))) + \mathbf{asType} < \mathbf{int} > (\$ \mathrm{heap}_{724,1;748,8}.\mathrm{p3})) \leq \mathbf{maxof}(\mathbf{short\ int})
\rightarrow [const static or extern object]
[1.1] ((asType<int>($heap_{init}.M3) *
\mathbf{asType} < \mathbf{int} > (\mathbf{static\_cast} < \mathbf{integer} > (\mathbf{asType} < \mathbf{int} > (\$ \mathrm{heap}_{724,1;748,8}.\mathrm{p3}) < \mathsf{mather})
(int)(0) + asType<int>(heap_{724.1:748.8}.p3)) \leq maxof(short int)
\rightarrow [expand definition of constant 'M3' at prang.c (24,20)]
[1.2] ((asType<int>(asType<short int>((int)30323)) *
asType<int>(static_cast<integer>(asType<int>($heap<sub>724,1.748,8.</sub>p3) <
(int)(0) + asType<int>($heap<sub>724.1:748.8</sub>.p3)) \leq maxof(short int)
```

```
\rightarrow [simplify]
[1.10] ((30323 * asType<int>(([0 < -$heap<sub>724.1:748.8</sub>.p3]: 1, []: 0))) +
asType < int > (\$heap_{724,1:748,8}.p3)) \le maxof(short int)
→ [explicitly assert falsehood of skipped guards in subsequent guards]
[1.11] ((30323 * asType<int>(([0 < -$heap_{724,1:748,8}.p3]: 1, [!(0 < -$heap_{724,1:748,8}.p3]: 1,
-\text{$heap}_{724,1:748,8}.p3)]: 0))) + asType<int>($heap}_{724,1:748,8}.p3)) \le \text{9}
maxof(short int)
\rightarrow [simplify]
[1.15] ((30323 * ([0 < -$heap<sub>724,1:748,8</sub>.p3]: 1, [-1 < $heap<sub>724,1:748,8</sub>.p3]: 0)) +
asType < int > (\$heap_{724,1;748,8}.p3)) \le maxof(short int)
\rightarrow [move guard outside expression]
[1.16] (([0 < -$heap<sub>724,1;748,8</sub>.p3]: 1 * 30323, [-1 < $heap<sub>724,1;748,8</sub>.p3]: 0 *
30323) + asType < int > (\$heap_{724,1;748,8}.p3)) \le maxof(short int)
\rightarrow [simplify]
[1.19] (([0 < -$heap<sub>724,1:748,8</sub>.p3]: 30323, [-1 < $heap<sub>724,1:748,8</sub>.p3]: 0) +
heap_{724,1:748.8}.p3 \le maxof(short int)
\rightarrow [move guard outside expression]
[1.20] ([0 < -$heap<sub>724,1;748,8</sub>.p3]: 30323 + $heap<sub>724,1;748,8</sub>.p3, [-1 <
\text{sheap}_{724,1;748,8}.\text{p3}: 0 + \text{sheap}_{724,1;748,8}.\text{p3}) \leq \text{maxof}(\text{short int})
\rightarrow [simplify]
heap_{724,1;748,8}.p3: p_{724,1;748,8}.p3: p_{724,1;748,8}.p3:
\rightarrow [move guard outside expression]
[1.24] ([0 < -$heap<sub>724,1:748,8</sub>.p3]: -1 + (30323 + $heap<sub>724,1:748,8</sub>.p3), [-1 <
\text{sheap}_{724,1;748,8}.\text{p3}: -1 + \text{sheap}_{724,1;748,8}.\text{p3}) < 32767
[1.27] \ 0 < (32767 + -([0 < -\$heap_{724,1;748,8}.p3]: \ 30322 + \$heap_{724,1;748,8}.p3];
[-1 < \text{$heap}_{724,1;748,8}.p3]: -1 + \text{$heap}_{724,1;748,8}.p3))
\rightarrow [move guard outside expression]
[1.28] 0 < (32767 + ([0 < -\$heap_{724,1;748,8}.p3]): -(30322 + (30322 + (30322 + (30322 + (30322 + (30322 + (30322 + (30322 + (30322 + (30322 + (30322 + (30322 + (30322 + (30322 + (30322 + (30322 + (30322 + (30322 + (30322 + (30322 + (30322 + (30322 + (30322 + (30322 + (30322 + (30322 + (30322 + (30322 + (30322 + (30322 + (30322 + (30322 + (30322 + (30322 + (30322 + (30322 + (30322 + (30322 + (30322 + (30322 + (30322 + (30322 + (30322 + (30322 + (30322 + (30322 + (30322 + (30322 + (30322 + (30322 + (30322 + (30322 + (30322 + (30322 + (30322 + (30322 + (30322 + (30322 + (30322 + (30322 + (30322 + (30322 + (30322 + (30322 + (30322 + (30322 + (30322 + (30322 + (30322 + (30322 + (30322 + (30322 + (30322 + (30322 + (30322 + (30322 + (30322 + (30322 + (30322 + (30322 + (30322 + (30322 + (30322 + (30322 + (30322 + (30322 + (30322 + (30322 + (30322 + (30322 + (30322 + (30322 + (30322 + (30322 + (30322 + (30322 + (30322 + (30322 + (30322 + (30322 + (30322 + (30322 + (30322 + (30322 + (30322 + (30322 + (30322 + (30322 + (30322 + (30322 + (30322 + (30322 + (30322 + (30322 + (30322 + (30322 + (30322 + (30322 + (30322 + (30322 + (30322 + (30322 + (30322 + (30322 + (30322 + (30322 + (30322 + (30322 + (30322 + (30322 + (30322 + (30322 + (30322 + (30322 + (30322 + (30322 + (30322 + (30322 + (30322 + (30322 + (30322 + (30322 + (30322 + (30322 + (30322 + (30322 + (30322 + (30322 + (30322 + (30322 + (30322 + (30322 + (30322 + (30322 + (30322 + (30322 + (30322 + (30322 + (30322 + (30322 + (30322 + (30322 + (30322 + (30322 + (30322 + (30322 + (30322 + (30322 + (30322 + (30322 + (30322 + (30322 + (30322 + (30322 + (30322 + (30322 + (30322 + (30322 + (30322 + (30322 + (30322 + (30322 + (30322 + (30322 + (30322 + (30322 + (30322 + (30322 + (30322 + (30322 + (30322 + (30322 + (30322 + (30322 + (30322 + (30322 + (30322 + (30322 + (30322 + (30322 + (30322 + (30322 + (30322 + (30322 + (30322 + (30322 + (30322 + (30322 + (30322 + (30322 + (30322 + (30322 + (30322 + (30322 + (30322 + (30322 + (30322 + (30322 + (30322 + (30322 + (30322 +
\rho_{724,1:748,8.p3}, [-1 < \rho_{724,1:748,8.p3}]: -(-1 + \rho_{724,1:748,8.p3}))
\rightarrow [simplify]
 \label{eq:continuous} \mbox{$[1.32]$ $0 < (32767 + ([0 < -\$heap_{724,1;748,8}.p3]: -30322 + -\$heap_{724,1;748,8}.p3, $] $} 
[-1 < \text{$heap}_{724,1;748,8}.p3]: 1 + -\text{$heap}_{724,1;748,8}.p3))
\rightarrow [move guard outside expression]
[1.33]\ 0 < ([0 < -\$heap_{724,1:748,8}.p3]:\ 32767 + (-30322 + -\$heap_{724,1:748,8}.p3),
```

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[-1 < \text{$heap}_{724,1;748,8}.p3]: 32767 + (1 + -\text{$heap}_{724,1;748,8}.p3))
\rightarrow [simplify]
[1.37] 0 < ([0 < -\$heap_{724,1;748,8}.p3]: 2445 + -\$heap_{724,1;748,8}.p3, [-1 < -\$heap_{724,1;748,8}.p3])
heap_{724,1;748,8}.p3: 32768 + -heap_{724,1;748,8}.p3
\rightarrow [move guard outside expression]
[1.38] ([0 < -$heap<sub>724,1;748,8</sub>.p3]: 0 < (2445 + -$heap<sub>724,1;748,8</sub>.p3), [-1 <
\text{sheap}_{724,1;748,8}.\text{p3}: 0 < (32768 + -\text{sheap}_{724,1;748,8}.\text{p3}))
\rightarrow [simplify]
[1.40] ([0 < -$heap<sub>724,1;748,8</sub>.p3]: -2445 < -$heap<sub>724,1;748,8</sub>.p3, [-1 <
\text{Sheap}_{724,1;748,8}.\text{p3}: 0 < (32768 + -\text{Sheap}_{724,1;748,8}.\text{p3}))
\rightarrow [from guard, literala < -$heap<sub>724,1:748,8</sub>.p3 is true whenever (-1 + literala)
< 0
    Proof of rule precondition:
    [1.40.0](-2445 + -1) < 0
    \rightarrow [simplify]
    [1.40.2] true
[1.41] ([0 < -$heap<sub>724,1;748,8</sub>.p3]: true, [-1 < $heap<sub>724,1;748,8</sub>.p3]: 0 < (32768)
+ - \text{$heap}_{724,1;748,8}.p3))
\rightarrow [simplify]
[1.43] ([0 < -$heap<sub>724.1:748.8</sub>.p3]: true, [-1 < $heap<sub>724.1:748.8</sub>.p3]: -32768 <
-\$heap_{724,1;748,8}.p3
\rightarrow [negate goal and search for contradiction]
[1.44]!([0 < -\$heap_{724,1;748,8}.p3]: true, [-1 < \$heap_{724,1;748,8}.p3]: -32768 <
-\$heap_{724,1;748,8}.p3)
\rightarrow [move guard outside expression]
[1.45] ([0 < -$heap<sub>724,1;748,8</sub>.p3]: !true, [-1 < $heap<sub>724,1;748,8</sub>.p3]: !(-32768 <
-\$heap_{724.1:748.8}.p3)
\rightarrow [simplify]
[1.51] (-1 < \text{heap}_{724,1;748,8}.\text{p3}) \land (32767 < \text{heap}_{724,1;748,8}.\text{p3})
[Work on sub-term 2 of conjunction in term 1.51]
[69.0] \ 32767 < \$ heap_{724,1;748,8}.p3
[Assume known post-assertion, class invariant or type constraint for term 1.51]
[70.0] $heap<sub>724,1:748,8</sub>.p3 \leq maxof(short int)
\rightarrow [simplify]
[70.9] -32768 < -\$heap_{724,1;748,8}.p3
```

```
\rightarrow [from term 69.0, literala < -$heap<sub>724.1:748.8</sub>.p3 is false whenever -2 <
(32767 + literala)
   Proof of rule precondition:
   [70.9.0] - 2 < (-32768 + 32767)
   \rightarrow [simplify]
   [70.9.2] true
[70.10] false
Proof of verification condition: Assertion valid
Condition generated at: C:\Escher\Customers\prang\prang.c (71,12)
To prove: invariant1(heapIs $heap_{tuncend_724.1})
Given:
heap_{init}.LIMIT == (int)80
heap_{init}.M1 == asType < short int > ((int)30269)
\theta_{init}.r1 == asType < short int > ((int)171)
\theta
\theta = asType < short int > ((int)2)
\theta sheap<sub>init</sub>.M2 == asType<short int>((int)30307)
\theta
heap_{init}.a2 == asType < short int > ((int)176)
\theta = asType < short int > ((int)35)
heap_{init}.M3 == asType < short int > ((int)30323)
\theta_{init}.r3 == asType<short int>((int)170)
heap_{init}.a3 == asType < short int > ((int)178)
\theta = asType < short int > ((int)63)
\theta = asType < short int > ((int)1)
\theta
\theta = asType < short int > ((int)3)
invariant1(heapIs heap_{funcstart_{-724,1}})
\operatorname{div1} == \operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724,1},
asType < int > ($heap_{funcstart\_724,1}.p1),
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{a1}))
(asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.p1)) /
```

 $\mathbf{asType}{<}\mathbf{integer}{>}(\mathbf{asType}{<}\mathbf{int}{>}(\$\mathbf{heap}_{funcstart\_724,1}.\mathbf{a1}))) = =$ 

```
asType<integer>(div1.quot)
(asType<integer>(asType<int>($heap_{tuncstart_724,1}.p1)) %
\mathbf{asType}{<}\mathbf{integer}{>}(\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{a1}))) = =
asType<integer>(div1.rem)
!(0 == asType < integer > (div1.rem)) || !(0 ==
asType<integer>(div1.quot))
div2 == div(\mathbf{heapIs} \$ heap_{funcstart\_724,1},
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p2}),
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{a2}))
(asType<int>(asType<int>($heap_{tuncstart\_724.1}.p2)) /
asType < integer > (asType < int > (\$heap_{funcstart\_724.1}.a2))) = =
asType<integer>(div2.quot)
(asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.p2)) \%
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a2))) = =
asType<integer>(div2.rem)
!(0 == asType < integer > (div2.rem)) || !(0 ==
asType<integer>(div2.quot))
div3 == div(\mathbf{heapIs} \$ heap_{funcstart\_724,1},
asType < int > (\$heap_{funcstart\_724,1}.p3),
asType < int > (\$heap_{funcstart\_724,1}.a3))
(asType<integer>(asType<int>($heap_{tuncstart\_724.1}.p3)) /
asType < integer > (asType < int > (\$heap_{funcstart\_724.1}.a3))) = =
asType<integer>(div3.quot)
(asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.p3)) \%
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a3))) = = 
asType<integer>(div3.rem)
!(0 == asType < integer > (div3.rem)) || !(0 ==
asType<integer>(div3.quot))
\rho_{174,1740,8} == \rho_{174,174
int>((asType<int>(asType<short int>(div1.rem)) *
asType < int > (\$heap_{funcstart-724,1}.r1)) - (asType < int > (asType < short)
\mathbf{int}{>}(\mathbf{div1.quot})) * \mathbf{asType}{<} \mathbf{int}{>}(\$\mathbf{heap}_{funcstart\_724,1}.\mathbf{b1}))))
-asType<integer const>($heap<sub>724.1:740.8</sub>.M1) <
asType<integer>($heap<sub>724.1:740.8</sub>.p1)
!(0 == asType < integer > (\$heap_{724,1:740.8}.p1))
asType<integer>($heap<sub>724,1:740,8:p1</sub>) <
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathrm{heap}_{724,1;740,8}.\mathrm{M1})
$heap_{724,1;742,8} == $heap_{724,1;740,8}.replace(p2 \rightarrow asType<short
int>((asType<int>(asType<short int>(div2.rem)) *
```

```
asType < int > (\$heap_{724.1:740.8}.r2)) - (asType < int > (asType < short)
\mathbf{int}{>}(\text{div2.quot})) * \mathbf{asType}{<} \mathbf{int}{>} (\$\text{heap}_{724,1;740,8}.\text{b2}))))
-asType<integer const>($heap<sub>724.1:742.8</sub>.M2) <
asType<integer>($heap<sub>724.1:742.8</sub>.p2)
!(0 == asType < integer > (\$heap_{724,1;742,8}.p2))
asType<integer>($heap<sub>724,1:742,8</sub>.p2) <
asType<integer>($heap<sub>724.1:742.8</sub>.M2)
\text{heap}_{724.1:744.8} == \text{heap}_{724.1:742.8}._replace(p3 \rightarrow asType<short)
int>((asType<int>(asType<short int>(div3.rem)) *
asType < int > (\$heap_{724.1:742.8}.r3)) - (asType < int > (asType < short)
int>(div3.quot)) * asType<int>($heap<sub>724.1:742.8</sub>.b3))))
-asType<integer const>($heap_{724,1:744,8}.M3) <
asType<integer>($heap<sub>724,1:744,8</sub>.p3)
!(0 == asType < integer > (\$heap_{724,1;744,8}.p3))
asType<integer>($heap<sub>724,1:744,8</sub>.p3) <
asType<integer>($heap<sub>724,1:744,8</sub>.M3)
heap_{724,1;747,8} == heap_{724,1;744,8}.replace(p1 \rightarrow asType<short
int>((asType<int>($heap<sub>724,1;744,8</sub>.M1) *
asType<int>(static_cast<integer>(asType<int>($heap<sub>724.1:744.8</sub>.p1) <
(int)(0)) + asType < int > (\$heap_{724,1;744,8}.p1)))
\$ heap_{724,1;748,8} == \$ heap_{724,1;747,8}. \textbf{\_replace} (p2 \rightarrow \textbf{asType} < \textbf{short}
int>((asType<int>($heap<sub>724,1:747,8</sub>.M2) *
asType<int>(static_cast<integer>(asType<int>($heap<sub>724,1:747,8</sub>.p2) <
(int)(0) + asType<int>($heap<sub>724,1:747,8</sub>.p2)))
\text{Sheap}_{funcend\_724.1} == \text{Sheap}_{724.1:748.8}.\_\text{replace}(p3 \rightarrow asType < short)
int>((asType<int>($heap<sub>724.1:748.8</sub>.M3) *
asType<int>(static_cast<integer>(asType<int>($heap<sub>724.1:748.8</sub>.p3) <
(int)(0) + asType<int>($heap_{724.1:748.8}.p3)))
Proof:
[Take goal term]
[1.0] invariant1(heapIs heap_{funcend\_724,1})
\rightarrow [expand definition of function 'invariant1' at prang.c (34,1)]
[1.1] ((((((0 < asType < integer > ($heap_{funcend\_724,1}.p1)) &&
(asType < integer > (\$heap_{funcend\_724,1}.p1) < 
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathrm{heap}_{funcend\_724,1}.\mathrm{M1})))~\&\&~(0<
asType < integer > (\$heap_{funcend\_724,1}.p2))) \&\&
(asType < integer > (\$heap_{funcend\_724,1}.p2) <
asType < integer > (\$heap_{funcend\_724,1}.M2))) \&\& (0 <
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathtt{heap}_{funcend\_724,1}.\mathtt{p3})))\ \&\&
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(\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathsf{heap}_{funcend\_724,1}.\mathsf{p3}) <
asType < integer > (\$heap_{funcend\_724,1}.M3))
\rightarrow [simplify]
[1.3] (((((0 < $heap_{funcend\_724,1}.p1) && ($heap_{funcend\_724,1}.p1 <
asType < integer > (\$heap_{funcend\_724,1}.M1))) \&\& (0 < 1)
asType < integer > (\$heap_{funcend\_724,1}.p2))) \&\&
(\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathrm{heap}_{funcend\_724,1}.\mathrm{p2}) <
asType < integer > (\$heap_{funcend\_724,1}.M2))) \&\& (0 <
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathtt{heap}_{funcend\_724,1}.\mathtt{p3})))\ \&\&
(asType < integer > (\$heap_{funcend\_724,1}.p3) < 
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathrm{heap}_{funcend\_724,1}.\mathrm{M3}))
\rightarrow [const static or extern object]
[1.4] (((((0 < $heap_{funcend\_724,1}.p1) && ($heap_{funcend\_724,1}.p1 < 
asType<integer>(heap_{init}.M1))) && (0 <
asType < integer > (\$heap_{funcend\_724,1}.p2))) \&\&
(\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathtt{heap}_{funcend\_724,1}.\mathtt{p2}) <
asType < integer > (\$heap_{funcend\_724,1}.M2))) \&\& (0 <
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathtt{heap}_{funcend\_724,1}.\mathtt{p3})))\ \&\&
(asType < integer > (\$heap_{funcend\_724.1}.p3) < 
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathrm{heap}_{funcend\_724,1}.\mathrm{M3}))
\rightarrow [expand definition of constant 'M1' at prang.c (14,20)]
[1.5] (((((0 < \frac{1.5}{1.5}) ((((0 < \frac{1.5}{1.5}) && (\frac{1.5}{1.5}) && (\frac{1.5}{1.5})
asType<integer>(asType<short int>((int)30269)))) && (0 <
asType < integer > (\$heap_{funcend\_724,1}.p2))) \&\&
(asType < integer > (\$heap_{funcend\_724,1}.p2) < 
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathrm{heap}_{funcend\_724,1}.\mathrm{M2})))~\&\&~(0<
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathtt{heap}_{funcend\_724,1}.\mathtt{p3})))\ \&\&
(asType < integer > (\$heap_{funcend\_724,1}.p3) < 
asType < integer > (\$heap_{funcend\_724,1}.M3))
\rightarrow [simplify]
[1.16] ((((-30269 < -$heap_{funcend\_724,1}.p1) \land (0 < $heap_{funcend\_724,1}.p1) \land (0
< $heap<sub>funcend_724,1</sub>.p2)) && ($heap<sub>funcend_724,1</sub>.p2 <
asType < integer > (\$heap_{funcend\_724,1}.M2))) \&\& (0 < 
asType < integer > (\$heap_{funcend\_724.1}.p3))) \&\&
(\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathrm{heap}_{funcend\_724,1}.\mathrm{p3}) <
asType < integer > (\$heap_{funcend\_724,1}.M3))
\rightarrow [const static or extern object]
[1.17] \; ((((-30269 < -\$ heap_{funcend\_724,1}.p1) \; \wedge \; (0 < \$ heap_{funcend\_724,1}.p2) \; \wedge \; (0 < \$ heap_{funcend\_724,1}.p2) \; \wedge \; (0 < \$ heap_
< $heap<sub>funcend_724,1.</sub>p2)) && ($heap<sub>funcend_724,1.</sub>p2 <
asType < integer > (\$heap_{init}.M2))) \&\& (0 <
asType < integer > (\$heap_{funcend\_724,1}.p3))) \&\&
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(asType<integer>($heap_funcend_724.1.p3) <
asType < integer > (\$heap_{funcend\_724,1}.M3))
\rightarrow [expand definition of constant 'M2' at prang.c (19,20)]
[1.18] ((((-30269 < -$heap<sub>funcend_724,1.</sub>p1) \wedge (0 < $heap<sub>funcend_724,1.</sub>p1) \wedge (0
< $heap<sub>funcend_724,1</sub>.p2)) && ($heap<sub>funcend_724,1</sub>.p2 <
asType<integer>(asType<short int>((int)30307)))) && (0 <
asType < integer > (\$heap_{funcend\_724,1}.p3))) \&\&
(asType<integer>($heap_funcend_724,1.p3) <
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathrm{heap}_{funcend\_724,1}.\mathrm{M3}))
\rightarrow [simplify]
[1.30] ((-30307 < -$heap<sub>funcend_724,1.</sub>p2) \land (-30269 < -$heap<sub>funcend_724,1.</sub>p1)
\land (0 < \$heap_{funcend\_724,1}.p1) \land (0 < \$heap_{funcend\_724,1}.p2) \land (0 < \$heap_{funcend\_724,1}.p2) \land (0 < \$heap_{funcend\_724,1}.p2)
\rho_{funcend\_724,1.p3}) && (\rho_{funcend\_724,1.p3}
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathrm{heap}_{funcend\_724,1}.\mathrm{M3}))
\rightarrow [const static or extern object]
[1.31] \; ((-30307 < -\$ heap_{funcend\_724,1}.p2) \; \land \; (-30269 < -\$ heap_{funcend\_724,1}.p1)
\land (0 < \text{\$heap}_{funcend\_724,1}.\text{p1}) \land (0 < \text{\$heap}_{funcend\_724,1}.\text{p2}) \land (0 < \text{\$heap}_{funcend\_724,1}.\text{p2})
\rho_{funcend\_724,1.p3}) && (\rho_{funcend\_724,1.p3}
asType < integer > (\$heap_{init}.M3))
\rightarrow [expand definition of constant 'M3' at prang.c (24,20)]
[1.32] ((-30307 < -$heap_{funcend\_724,1}.p2) \land (-30269 < -$heap_{funcend\_724,1}.p1)
\land (0 < \text{\$heap}_{funcend\_724.1}.\text{p1}) \land (0 < \text{\$heap}_{funcend\_724.1}.\text{p2}) \land (0 < \text{\$heap}_{funcend\_724.1}.\text{p2})
\text{Sheap}_{funcend_{724,1},p3} & (\text{Sheap}_{funcend_{724,1},p3} <
asType<integer>(asType<short int>((int)30323)))
\rightarrow [simplify]
[1.40] (-30323 < -\$heap_{funcend\_724,1}.p3) \land (-30307 < -\$heap_{funcend\_724,1}.p2)
 \land (-30269 < -\$ heap_{funcend\_724,1}.p1) \land (0 < \$ heap_{funcend\_724,1}.p2) \land (0 < \$ heap_{funcend\_724,1}.p
\text{Sheap}_{funcend\_724,1}.\text{p2}) \land (0 < \text{Sheap}_{funcend\_724,1}.\text{p3})
\rightarrow [negate goal and search for contradiction]
[1.41]!(-30323 < -\$heap_{funcend\_724,1}.p3) \lor !(-30307 < -\$heap_{funcend\_724,1}.p2)
\vee !(-30269 < -\$heap_{funcend\_724,1}.p1) \vee !(0 < \$heap_{funcend\_724,1}.p1) \vee !(0 < \$heap_{funcend\_724,1}.p2) \wedge !(0 < \$heap_{funcend\_724,1}.p3) \wedge !(0 < \$heap_{funcend\_724,1}.p3
\text{heap}_{funcend\_724,1}.\text{p2}) \lor !(0 < \text{heap}_{funcend\_724,1}.\text{p3})
\rightarrow [simplify]
[1.56] (30322 < $heap_{funcend\_724,1}.p3) \vee (30306 < $heap_{funcend\_724,1}.p2) \vee
(30268 < \text{$heap}_{funcend\_724,1}.\text{p1}) \lor (-1 < -\text{$heap}_{funcend\_724,1}.\text{p1}) \lor (-1 < -\text{$heap}_{funcend\_724,1}.\text{p1}) \lor (-1 < -\text{$heap}_{funcend\_724,1}.\text{p1})
-\$heap_{funcend\_724,1}.p2) \lor (-1 < -\$heap_{funcend\_724,1}.p3)
[Take given term]
[11.0] \operatorname{div1} == \operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724,1},
asType < int > (\$heap_{funcstart\_724,1}.p1),
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\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{a1}))
\rightarrow [simplify]
[11.1] \operatorname{div1} == \operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724,1}, \$ \operatorname{heap}_{funcstart\_724,1}.p1,
asType < int > (\$heap_{funcstart\_724,1}.a1))
\rightarrow [const static or extern object]
\textit{[11.2]} \ \text{div1} == \text{div}(\mathbf{heapIs} \ \$ \text{heap}_{funcstart\_724,1}, \ \$ \text{heap}_{funcstart\_724,1}.\text{p1},
asType < int > (\$heap_{init}.a1))
\rightarrow [expand definition of constant 'a1' at prang.c (16,20)]
[11.3] \operatorname{div1} == \operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724,1}, \$ \operatorname{heap}_{funcstart\_724,1}.p1,
asType<int>(asType<short int>((int)177)))
\rightarrow [simplify]
[11.6] div1 == div(heapIs $heap_{funcstart\_724,1}, $heap_{funcstart\_724,1}.p1, 177)
[Take given term]
[25.0] \operatorname{div2} == \operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724,1},
asType < int > (\$heap_{funcstart\_724,1}.p2),
asType < int > (\$heap_{funcstart\_724,1}.a2))
\rightarrow [simplify]
[25.1] div2 == div(heapIs $heap_{funcstart\_724.1}, $heap_{funcstart\_724.1}.p2,
asType < int > (\$heap_{funcstart\_724,1}.a2))
\rightarrow [const static or extern object]
[25.2] \operatorname{div2} == \operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.p2,
asType < int > (\$heap_{init}.a2))
\rightarrow [expand definition of constant 'a2' at prang.c (21,20)]
[25.3] div2 == div(heapIs \theta_{funcstart_{-724,1}}, \theta_{funcstart_{-724,1}}, \theta_{funcstart_{-724,1}}
asType<int>(asType<short int>((int)176)))
\rightarrow [simplify]
[25.6] div2 == div(heapIs heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p2, 176)
[Take given term]
[39.0] div3 == div(heapIs $heap_{tuncstart\_724.1},
asType < int > (\$heap_{funcstart\_724,1}.p3),
asType < int > (\$heap_{funcstart\_724,1}.a3))
\rightarrow [simplify]
\label{eq:constant_724,1} \textit{liv3} == \textit{div}(\mathbf{heapIs} \ \$ heap_{funcstart\_724,1}, \ \$ heap_{funcstart\_724,1}.p3,
asType < int > (\$heap_{funcstart\_724,1}.a3))
\rightarrow [const static or extern object]
[39.2] \operatorname{div3} == \operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724,1}, \$ \operatorname{heap}_{funcstart\_724,1}.p3,
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asType < int > (\$heap_{init}.a3))
\rightarrow [expand definition of constant 'a3' at prang.c (26,20)]
[39.3] \operatorname{div3} == \operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724,1}, \$ \operatorname{heap}_{funcstart\_724,1}.p3,
asType<int>(asType<short int>((int)178)))
\rightarrow [simplify]
[39.6] div3 == div(heapIs heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p3, 178)
[Take given term]
[53.0] \rho_{1740,8} == \rho_{1740,8} == \rho_{1740,8} == \rho_{1740,8} - \rho_{1740,8} == \rho_{1740,8} == \rho_{1740,8} - \rho_{1740,8} == \rho_{1740,8} 
int>((asType<int>(asType<short int>(div1.rem)) *
asType < int > (\$heap_{tuncstart\_724.1}.r1)) - (asType < int > (asType < short)
\mathbf{int}{>}(\mathbf{div1.quot})) * \mathbf{asType}{<}\mathbf{int}{>}(\$\mathbf{heap}_{funcstart\_724,1}.\mathbf{b1}))))
\rightarrow [from term 11.6, div1 is equal to div(heapIs $heap_{funcstart\_724,1},
heap_{funcstart_{-724,1}}.p1, 177
[53.1] \theta == 
int>((asType<int>(asType<short int>(div(heapIs $heap_{tuncstart_724.1},
\rho_{funcstart\_724,1.p1, 177).rem} * asType<int>(\rho_{funcstart\_724,1.r1}) -
(asType<int>(asType<short int>(div1.quot)) *
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{b1}))))
\rightarrow [simplify]
[53.3] \text{heap}_{724,1;740,8} == \text{heap}_{funcstart\_724,1}._replace(p1 \rightarrow asType<short
int>((div(heapIs \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1, 177).rem *
\mathbf{asType} \small{<} \mathbf{int} \small{>} (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{r1})) - (\mathbf{asType} \small{<} \mathbf{int} \small{>} (\mathbf{asType} \small{<} \mathbf{short}
int>(div1.quot)) * asType<int>($heap_{funcstart\_724,1}.b1)))
\rightarrow [const static or extern object]
[53.4] heap_{724,1;740,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow asType<short
int>((div(heapIs \$heap_{funcstart\_724.1}, \$heap_{funcstart\_724.1}, p1, 177).rem *
asType < int > (\$heap_{init}.r1)) - (asType < int > (asType < short)
\mathbf{int}{>}(\mathbf{div1.quot})) \ * \ \mathbf{asType}{<} \mathbf{int}{>} (\$\mathbf{heap}_{funcstart\_724,1}.\mathbf{b1}))))
\rightarrow [expand definition of constant 'r1' at prang.c (15,20)]
[53.5] \; \$ heap_{724,1;740,8} == \$ heap_{funcstart\_724,1}.\_\mathbf{replace} (p1 \to \mathbf{asType} < \mathbf{short}
int>((div(heapIs \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1, 177).rem *
asType<int>(asType<short int>((int)171))) -
(asType<int>(asType<short int>(div1.quot)) *
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{b1}))))
\rightarrow [simplify]
[53.8] \text{sheap}_{724,1;740,8} == \text{sheap}_{funcstart\_724,1}.\_\text{replace}(\text{p1} \rightarrow \text{asType} < \text{short})
int>((div(heapIs \$heap_{funcstart\_724.1}, \$heap_{funcstart\_724.1}.p1, 177).rem * 171)
- (asType<int>(asType<short int>(div1.quot)) *
asType < int > (\$heap_{funcstart\_724,1}.b1))))
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\rightarrow [from term 11.6, div1 is equal to div(heapIs $heap_{funcstart\_724,1},
heap_{funcstart_{-724,1}}.p1, 177)
[53.9] heap_{724,1:740,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow asType<short
int > ((171 * div(heapIs \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1, 177).rem)
- (asType<int>(asType<short int>(div(heapIs $heap_{funcstart_724.1},
heap_{funcstart_{724,1}}.p1, 177).quot) *
asType < int > (\$heap_{funcstart\_724,1}.b1))))
\rightarrow [simplify]
[53.11] \$ heap_{724,1;740,8} == \$ heap_{funcstart\_724,1}.\_\mathbf{replace} (p1 \to \mathbf{asType} < \mathbf{short})
int>((171 * div(heapIs \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1, 177).rem)
- (div(heapIs heap_{funcstart_{724,1}}, heap_{funcstart_{724,1}}, 177).quot *
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{b1}))))
\rightarrow [const static or extern object]
[53.12] \theta_{12} = \theta_{124,1;740,8} = \theta_{124,1;74
int > ((171 * div(heapIs \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1, 177).rem)
- (\text{div}(\mathbf{heapIs} \$ \text{heap}_{funcstart\_724.1}, \$ \text{heap}_{funcstart\_724.1}.\text{p1}, 177).\text{quot} *
asType < int > (\$heap_{init}.b1)))
\rightarrow [expand definition of constant 'b1' at prang.c (17,20)]
[53.13] \theta_{13} = \theta_
int>((171 * div(heapIs $heap_{funcstart\_724,1}, $heap_{funcstart\_724,1}.p1, 177).rem)
- (\text{div}(\mathbf{heapIs} \$ \text{heap}_{funcstart\_724,1}, \$ \text{heap}_{funcstart\_724,1}.\text{p1}, 177).\text{quot} *
asType<int>(asType<short int>((int)2))))
\rightarrow [simplify]
[53.19] $\text{heap}_{724,1;740,8} == \text{$heap}_{funcstart\_724,1}$._\text{$-replace}(p1 \to ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.p1, \ 177).rem)))
[Take given term]
[54.0] -asType<integer const>($heap<sub>724.1:740.8</sub>.M1) <
asType<integer>($heap<sub>724.1:740.8</sub>.p1)
\rightarrow [from term 53.19, $heap<sub>724.1:740.8</sub> is equal to
heap_{funcstart\_724,1}._replace(p1 \rightarrow (-2 * div(heapIs heap_{funcstart\_724,1}),
heap_{funcstart\_724,1}.p1, 177).quot + (171 * div(heapIs p_{funcstart\_724,1}),
\$heap_{funcstart\_724,1}.p1,\ 177).rem))]
[54.1] -asType<integer const>($heap_{tuncstart\_724,1}._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).rem))).M1) <
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathrm{heap}_{724,1;740,8}.\mathrm{p1})
\rightarrow [const member of object with modified fields]
[54.2] -asType<integer const>(parton{1}{2}) (parton{1}{2}) (parton
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asType<integer>($heap<sub>724,1:740,8</sub>.p1)
\rightarrow [const static or extern object]
[54.3] -asType<integer const>($heap_{init}.M1) <
asType<integer>($heap<sub>724,1;740,8</sub>.p1)
\rightarrow [expand definition of constant 'M1' at prang.c (14,20)]
[54.4] -asType<integer const>(asType<short int>((int)30269)) <
asType<integer>($heap<sub>724,1;740,8</sub>.p1)
\rightarrow [simplify]
[54.8] -30269 < asType < integer > ($heap_{724,1;740,8}.p1)
\rightarrow [from term 53.19, $heap<sub>724.1:740.8</sub> is equal to
heap_{funcstart\_724,1}._replace(p1 \rightarrow (-2 * div(heapIs \$heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1}.\text{p1}, 177).\text{quot} + (171 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
heap_{funcstart_{-724,1}}.p1, 177).rem)
[54.9] -30269 < asType<integer>($heap_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 *
div(\mathbf{heapIs} \ \$heap_{funcstart\_724.1}, \ \$heap_{funcstart\_724.1}.p1, \ 177).quot) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.p1, \ 177).rem))).p1)
\rightarrow [simplify]
 \label{eq:continuous} \mbox{[54.11] -30269} < ((-2 * \mbox{div}(\mathbf{heapIs} \ \$ \mbox{heap}_{funcstart\_724,1}, \ \$ \mbox{heap}_{funcstart\_724,1}.\mbox{p1}, 
177).quot) + (171 * div(heapIs heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p1,
177).rem))
[Take given term]
[55.0]!(0 == asType < integer > (\$heap_{724,1;740,8}.p1))
\rightarrow [from term 53.19, $heap<sub>724.1:740.8</sub> is equal to
heap_{funcstart\_724,1}._replace(p1 \rightarrow (-2 * div(heapIs heap_{funcstart\_724,1}),
heap_{funcstart\_724,1}.p1, 177).quot + (171 * div(heapIs p_{funcstart\_724,1}),
heap_{funcstart_{-724,1}}.p1, 177).rem)
[55.1] !(0 == asType<integer>($heap_{funcstart\_724,1}.replace(p1 \rightarrow ((-2 *
div(\mathbf{heapIs} \ \$heap_{funcstart\_724,1}, \ \$heap_{funcstart\_724,1}.p1, \ 177).quot) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.\operatorname{p1}, \ 177).\operatorname{rem}))).\operatorname{p1}))
 \label{eq:final_start_724,1} \mbox{$[55.3]$ !(0 == ((-2 * div(\mathbf{heapIs} \$ heap_{funcstart\_724,1}, \$ heap_{funcstart\_724,1}.p1, $]) $] $$
177).quot) + (171 * div(heapIs heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p1,
177).rem)))
[Take given term]
[56.0] asType<integer>($heap_{724,1:740.8}.p1) <
asType<integer>($heap<sub>724,1:740,8</sub>.M1)
\rightarrow [from term 53.19, $heap<sub>724,1;740,8</sub> is equal to
heap_{funcstart\_724,1}._replace(p1 \rightarrow (-2 * div(heapIs $heap_{funcstart\_724,1},
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heap_{funcstart\_724,1}.p1, 177).quot + (171 * div(heapIs p_{funcstart\_724,1}),
heap_{funcstart_{-724,1}}.p1, 177).rem)
[56.1] asType<integer>(\frac{1}{2}) (\frac{1}{2}) asType<integer>(\frac{1}{2}) (\frac{1}{2})
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 *
div(\mathbf{heapIs} \ \$heap_{funcstart\_724.1}, \ \$heap_{funcstart\_724.1}.p1, \ 177).rem))).p1) <
asType<integer>($heap<sub>724.1:740.8</sub>.M1)
\rightarrow [simplify]
\label{eq:continuous} \textit{[56.3]}\ (\text{(-2 * div}(\textbf{heapIs }\$\text{heap}_{funcstart\_724,1},\,\$\text{heap}_{funcstart\_724,1}.\text{p1},\,
177).quot) + (171 * div(heapIs heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p1,
(177).rem) < asType < integer > ($heap_{724,1;740,8}.M1)
\rightarrow [from term 53.19, $heap<sub>724,1;740,8</sub> is equal to
heap_{funcstart_{-724,1}}.-replace(p1 \rightarrow (-2 * div(heapIs heap_{funcstart_{-724,1}})
\text{Sheap}_{funcstart\_724,1.p1}, 177).\text{quot} + (171 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
heap_{funcstart_{724,1}.p1, 177).rem}
[56.4] ((-2 * div(heapIs heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p1,
177).quot) + (171 * div(heapIs heapIs = f_{uncstart_{724,1}}, heap_{funcstart_{724,1}}, p_{t,t}
177).rem)) < asType<integer>($heap<sub>funcstart_724.1</sub>._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).quot) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.\operatorname{p1}, \ 177).\operatorname{rem}))).\operatorname{M1})
\rightarrow [const member of object with modified fields]
[56.5] ((-2 * div(heap
Is \rho_{funcstart\_724,1}, \rho_
177).quot) + (171 * div(heapIs \theta_{funcstart_{724,1}}, \theta_{funcstart_{724,1}}
177).rem)) < asType<integer>(heap_{funcstart\_724,1}.M1)
\rightarrow [const static or extern object]
\label{eq:constart_724,1} \textit{[56.6]} \ (\textit{(-2*div}(\textbf{heapIs}\ \$\text{heap}_{funcstart\_724,1},\ \$\text{heap}_{funcstart\_724,1}.\text{p1},
177).quot) + (171 * div(heapIs heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p1,
(177).rem) < asType < integer > (\$heap_{init}.M1)
\rightarrow [expand definition of constant 'M1' at prang.c (14,20)]
[56.7] ((-2 * div(heapIs heap_{funcstart_{-724,1}}, heap_{funcstart_{-724,1}}, ]
177).quot) + (171 * div(heapIs $heap_{funcstart\_724,1}, $heap_{funcstart\_724,1}.p1,
177).rem)) < asType<integer>(asType<short int>((int)30269))
\rightarrow [simplify]
\label{eq:first-start-724,1} \mbox{-} 56.17 \mbox{-} -30269 < ((-171 * div(\mathbf{heapIs} \mbox{\$heap}_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1}.\text{p1}, 177).\text{rem} + (2 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
heap_{funcstart_{-724,1}}.p1, 177).quot)
[Take given term]
[57.0] $\text{heap}_{724,1;742,8} == \text{$heap}_{724,1;740,8}.$\_\text{replace}(p2 \rightarrow \text{asType} < \text{short}
int>((asType<int>(asType<short int>(div2.rem)) *
asType < int > (\$heap_{724,1:740,8}.r2)) - (asType < int > (asType < short)
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int>(div2.quot)) * asType<int>($heap<sub>724.1:740.8</sub>.b2))))
\rightarrow [from term 53.19, $heap<sub>724.1:740.8</sub> is equal to
heap_{funcstart\_724,1}._replace(p1 \rightarrow (-2 * div(heapIs $heap_{funcstart\_724,1},
heap_{funcstart\_724,1}.p1, 177).quot) + (171 * div(heapIs $heap_{funcstart\_724,1}, 1
heap_{funcstart_{-724,1}}.p1, 177).rem)
[57.1] heap_{724,1:742,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).quot) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow asType<short
int>((asType<int>(asType<short int>(div2.rem)) *
asType < int > (\$heap_{724,1:740.8}.r2)) - (asType < int > (asType < short)
\mathbf{int}{>}(\text{div2.quot})) \ * \ \mathbf{asType}{<} \mathbf{int}{>} (\$\text{heap}_{724,1;740,8}.\text{b2}))))
\rightarrow [from term 25.6, div2 is equal to div(heapIs $heap_{tuncstart_{724.1}},
heap_{funcstart_{724,1}}.p2, 176
[57.2] heap_{724,1;742,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 *
\operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724,1}, \$ \operatorname{heap}_{funcstart\_724,1}.p1,
177).rem))).\_replace(p2 \rightarrow asType < short
int>((asType<int>(asType<short int>(div(heapIs $heap_{tuncstart_724.1},
\text{sheap}_{funcstart_724,1}.\text{p2}, 176).\text{rem}) * asType < int > (\text{sheap}_{724,1:740.8}.\text{r2})) -
(asType<int>(asType<short int>(div2.quot)) *
asType<int>($heap<sub>724.1:740.8</sub>.b2))))
\rightarrow [simplify]
[57.4] $heap<sub>724,1:742,8</sub> == $heap<sub>funcstart_724,1</sub>._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 *
\operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724,1}, \$ \operatorname{heap}_{funcstart\_724,1}.p1,
177).rem)))._{\mathbf{replace}}(p2 \rightarrow \mathbf{asType} < \mathbf{short\ int} > ((\operatorname{div}(\mathbf{heapIs}))))
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.p2, 176).rem *
asType < int > (\$heap_{724.1:740.8}.r2)) - (asType < int > (asType < short)
int>(div2.quot)) * asType< int>($heap_{724,1;740,8}.b2))))
\rightarrow [from term 53.19, $heap<sub>724,1;740,8</sub> is equal to
heap_{funcstart\_724,1}._replace(p1 \rightarrow (-2 * div(heapIs heap_{funcstart\_724,1}),
\text{Sheap}_{funcstart\_724,1}.p1, 177).quot) + (171 * div(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
heap_{funcstart_{-724,1}.p1, 177).rem}
[57.5] heap_{724,1;742,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 \ *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.p1,
177).rem))).\mathbf{replace}(p2 \to \mathbf{asType} < \mathbf{short\ int} > ((\operatorname{div}(\mathbf{heapIs}
heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p2, 176).rem *
asType < int > (\$heap_{funcstart\_724,1}.\_replace(p1 \rightarrow ((-2 * div(heapIs))))))
\theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.p1, 177).rem))).r2)) -
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(asType<int>(asType<short int>(div2.quot)) *
asType < int > (\$heap_{724,1;740,8}.b2))))
→ [const member of object with modified fields]
[57.6] heap_{724,1;742,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).quot) + (171 *
\operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724.1}, \$ \operatorname{heap}_{funcstart\_724.1}.p1,
177).rem)))._replace(p2 \rightarrow asType<short int>((div(heapIs
\rho_{funcstart_{724,1}}, \rho_{funcstart_{724,1}}, \rho_{funcstart_{724,1}}, \rho_{funcstart_{724,1}}, \rho_{funcstart_{724,1}}
\mathbf{asType} < \mathbf{int} > (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{r2})) - (\mathbf{asType} < \mathbf{int} > (\mathbf{asType} < \mathbf{short}))
int>(div2.quot)) * asType<int>($heap<sub>724.1:740.8</sub>.b2))))
\rightarrow [const static or extern object]
[57.7] heap_{724,1;742,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 *
\label{eq:div_heap} \text{div}(\textbf{heapIs} \ \$ \text{heap}_{funcstart\_724,1}, \ \$ \text{heap}_{funcstart\_724,1}.\text{p1},
177).rem)))._replace(p2 \rightarrow asType<short int>((div(heapIs
heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p2, 176).rem *
asType < int > (\$heap_{init}.r2)) - (asType < int > (asType < short)
int > (div2.quot)) * asType < int > (\$heap_{724,1;740,8}.b2))))
\rightarrow [expand definition of constant 'r2' at prang.c (20,20)]
div(\mathbf{heapIs} \ \text{$heap}_{funcstart\_724,1}, \ \text{$heap}_{funcstart\_724,1}.p1, \ 177).quot) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.p1,
177).rem)))._{\mathbf{replace}}(p2 \rightarrow \mathbf{asType} < \mathbf{short\ int} > ((\operatorname{div}(\mathbf{heapIs}))))
\text{Sheap}_{funcstart_{-724,1}}, \text{Sheap}_{funcstart_{-724,1}}.p2, 176).rem *
asType<int>(asType<short int>((int)172))) -
(asType<int>(asType<short int>(div2.quot)) *
asType < int > (\$heap_{724,1;740,8}.b2))))
\rightarrow [simplify]
[57.11] $\text{heap}_{724,1;742,8} == \text{$heap}_{funcstart_724,1}._\text{$-replace}(p1 \to ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).quot) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow asType<short int>((div(heapIs
heap_{funcstart_{724,1}}, heap_{funcstart_{724,1}}.p2, 176).rem * 172) -
(asType<int>(asType<short int>(div2.quot)) *
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{724,1;740,8}.\mathrm{b2}))))
\rightarrow [from term 25.6, div2 is equal to div(heapIs $heap_{funcstart_724,1},
heap_{funcstart_{724,1}}.p2, 176)
[57.12] $heap<sub>724,1;742,8</sub> == $heap<sub>funcstart_724,1</sub>._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).quot) + (171 *
\operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724.1}, \$ \operatorname{heap}_{funcstart\_724.1}.p1,
177).rem)))._replace(p2 \rightarrow asType<short int>((172 * div(heapIs
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\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.p2, 176).rem) -
(asType<int>(asType<short int>(div(heapIs $heap_{funcstart_724,1},))
\text{sheap}_{funcstart\_724,1.p2}, 176).\text{quot}) * asType < int > (\text{sheap}_{724,1;740,8}.b2))))
\rightarrow [simplify]
[57.14] $\text{heap}_{724,1;742,8} == \text{$heap}_{funcstart\_724,1}._\text{replace}(p1 \to ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 *
\operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724,1}, \$ \operatorname{heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow asType<short int>((172 * div(heapIs
\theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}
heap_{funcstart_{724,1}}, heap_{funcstart_{724,1}}, 2, 176).quot *
asType<int>($heap<sub>724.1:740.8</sub>.b2))))
\rightarrow [from term 53.19, $heap<sub>724,1;740,8</sub> is equal to
heap_{funcstart\_724.1}._replace(p1 \rightarrow (-2 * div(heapIs heap_{funcstart\_724.1}),
heap_{funcstart_{724,1},p1,177}, quot) + (171 * div(heapIs $heap_{funcstart_{724,1}})
heap_{funcstart_{724,1}}.p1, 177).rem)
[57.15] \rho_{7.15} = \rho_{7.24,1;742,8} = \rho_{1.24,1.24,1} \rho_{1.24,1.24,1}
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 \ *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow asType<short int>((172 * div(heapIs
\theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}
heap_{funcstart_{724,1}}, heap_{funcstart_{724,1}}, p_{176}.quot *
\mathbf{asType}{<}\mathbf{int}{>}(\$\text{heap}_{funcstart\_724,1}.\_\mathbf{replace}(\text{p1} \rightarrow ((\text{-2} * \text{div}(\mathbf{heapIs}
\theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.p1, 177).rem))).b2))))
\rightarrow [const member of object with modified fields]
[57.16] $heap<sub>724,1;742,8</sub> == $heap<sub>funcstart_724,1</sub>._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{$heap}_{funcstart\_724,1}, \ \text{$heap}_{funcstart\_724,1}.p1, \ 177).quot) + (171 *
\operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724,1}, \$ \operatorname{heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow asType<short int>((172 * div(heapIs
\theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}.p2, 176).rem) - (div(heapIs
\theta_{funcstart_{724,1}}, \theta_{funcstart_{724,1}}, \theta_{funcstart_{724,1}}, \theta_{funcstart_{724,1}}
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{b2}))))
\rightarrow [const static or extern object]
[57.17] $\text{heap}_{724.1:742.8} == \text{$heap}_{funcstart_724.1}._\text{replace}(p1 \to ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 \ *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow asType<short int>((172 * div(heapIs
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.\text{p2}, 176).\text{rem}) - (\text{div}(\text{heapIs})
\rho_{funcstart\_724,1}, \rho_{funcstart\_724,1}.p2, 176).quot *
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{init}.\mathrm{b2}))))
\rightarrow [expand definition of constant 'b2' at prang.c (22,20)]
```

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[57.18] $heap<sub>724,1;742,8</sub> == $heap<sub>funcstart_724,1</sub>._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 *
\label{eq:div_heap} \text{div}(\textbf{heapIs} \ \$ \text{heap}_{funcstart\_724,1}, \ \$ \text{heap}_{funcstart\_724,1}.\text{p1},
177).rem)))._replace(p2 \rightarrow asType<short int>((172 * div(heapIs
\theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}.p2, 176).rem) - (div(heapIs
\theta_{funcstart_{724,1}}, \theta_{funcstart_{724,1}}, \theta_{funcstart_{724,1}}, \theta_{funcstart_{724,1}}
asType<int>(asType<short int>((int)35)))))
\rightarrow [simplify]
[57.24] $heap<sub>724,1;742,8</sub> == $heap<sub>funcstart_724,1</sub>._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 *
\label{eq:div_heap} \text{div}(\textbf{heapIs} \ \$ \text{heap}_{funcstart\_724,1}, \ \$ \text{heap}_{funcstart\_724,1}.\text{p1},
177).rem)))._replace(p2 \rightarrow ((-35 * div(heapIs $heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1.p2}, 176).\text{quot}) + (172 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
\theta_{funcstart_{724,1}.p2, 176).rem}
[Take given term]
[58.0] -asType<integer const>($heap_{724,1:742,8}.M2) <
asType<integer>($heap<sub>724,1;742,8</sub>.p2)
\rightarrow [from term 57.24, $heap<sub>724.1:742.8</sub> is equal to
heap_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 * div(heapIs $heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1}.p1, 177).quot) + (171 * div(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
heap_{funcstart\_724,1}.p1, 177).rem))._replace(p2 \rightarrow (-35 * div(heapIs)).
heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p2, 176).quot) + (172 * div(heapIs)
heap_{funcstart_{724,1}}, heap_{funcstart_{724,1}}, 176).rem)
[58.1] -asType < integer const > (\$heap_{funcstart\_724,1}.\_replace(p1 \rightarrow ((-2 * funcstart\_724,1)))))
div(\mathbf{heapIs} \ \$heap_{funcstart\_724,1}, \ \$heap_{funcstart\_724,1}.p1, \ 177).quot) + (171 *
\operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724,1}, \$ \operatorname{heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow ((-35 * div(heapIs $heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1}.\text{p2}, 176).\text{quot} + (172 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
heap_{funcstart_{724,1},p2, 176,rem})).M2) <
asType < integer > ($heap_{724,1;742,8}.p2)
\rightarrow [const member of object with modified fields]
[58.3] -asType<integer const>($heap_{tuncstart\_724.1}.M2) <
asType<integer>($heap<sub>724,1;742,8</sub>.p2)
\rightarrow [const static or extern object]
[58.4] -asType<integer const>(\text{$heap}_{init}.M2) <
asType<integer>($heap<sub>724,1;742,8</sub>.p2)
\rightarrow [expand definition of constant 'M2' at prang.c (19,20)]
[58.5] -asType<integer const>(asType<short int>((int)30307)) <
asType<integer>($heap<sub>724,1;742,8</sub>.p2)
\rightarrow [simplify]
```

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[58.9] -30307 < asType < integer > ($heap_{724, 1.742, 8}.p2)
\rightarrow [from term 57.24, $heap<sub>724.1:742.8</sub> is equal to
heap_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 * div(heapIs $heap_{funcstart\_724,1},
heap_{funcstart\_724,1}.p1, 177).quot) + (171 * div(heapIs $heap_{funcstart\_724,1}, 1
\rho_{funcstart\_724,1}.p1, 177).rem))._replace\rho_{funcstart\_724,1}.p1, 177).rem)
heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p2, 176).quot) + (172 * div(heapIs)
heap_{funcstart_{724,1}}, heap_{funcstart_{724,1}}, p2, 176).rem)
\texttt{[58.10] -30307} < \mathbf{asType} < \mathbf{integer} > (\$ heap_{funcstart\_724,1}. \_\mathbf{replace} (\texttt{p1} \rightarrow ((-2.4)))) + (-2.4)
* div(heapIs heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p1, 177).quot) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart} \ 724.1, \ \$ \operatorname{heap}_{funcstart} \ 724.1.p1,
177).rem)))._replace(p2 \rightarrow ((-35 * div(heapIs $heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1.p2}, 176).\text{quot} + (172 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
heap_{funcstart_{-724,1}.p2, 176}.rem)).p2
\rightarrow [simplify]
[58.12] -30307 < ((-35 * div(heapIs $heap_{funcstart\_724,1}),
\text{Sheap}_{funcstart\_724,1}.\text{p2}, 176).\text{quot} + (172 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
heap_{funcstart_{-724,1}.p2, 176).rem}
[Take given term]
[59.0]!(0 == asType < integer > ($heap_{724,1:742.8}.p2))
\rightarrow [from term 57.24, $heap<sub>724,1;742,8</sub> is equal to
\text{Sheap}_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 * div(heapIs $heap_{funcstart\_724,1}), the sheap funcstart\_724,1).
\text{Sheap}_{funcstart_{-724,1},p1, 177}.\text{quot}) + (171 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart_{-724,1}})
\rho_{funcstart\_724.1}.p1, 177).rem)._replace\rho_{funcstart\_724.1}.p1, 177).rem)._replace
heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p2, 176).quot) + (172 * div(heapIs)
heap_{funcstart_{724,1}}, heap_{funcstart_{724,1}}, p2, 176).rem)
[59.1] !(0 == asType<integer>(\ensuremath{\text{sheap}}_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 *
\operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724,1}, \$ \operatorname{heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow ((-35 * div(heapIs $heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1.p2}, 176).\text{quot} + (172 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
heap_{funcstart_{-724,1}.p2, 176).rem})).p2)
\rightarrow [simplify]
|59.3|!(0 == ((-35 * div(\mathbf{heapIs} \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p2,
176).quot) + (172 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_724,1}, \text{\$heap}_{funcstart\_724,1}.p2,
176).rem)))
[Take given term]
[60.0] asType<integer>($heap_{724,1;742,8}.p2) <
asType<integer>($heap<sub>724.1:742.8</sub>.M2)
\rightarrow [from term 57.24, $heap<sub>724.1:742.8</sub> is equal to
heap_{funcstart\_724.1}._replace(p1 \rightarrow ((-2 * div(heapIs $heap_{funcstart\_724.1},
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\text{Sheap}_{funcstart_{-724,1},p1, 177}.\text{quot}) + (171 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart_{-724,1}})
\rho_{uncstart_{-724,1}.p1, 177).rem})._replace\rho_{uncstart_{-724,1}.p1, 177).rem}._replace\rho_{uncstart_{-724,1}.p1, 177).rem}
heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p2, 176).quot) + (172 * div(heapIs)
heap_{funcstart_{724,1}}, heap_{funcstart_{724,1}}, 2, 176).rem
[60.1] asType<integer>(p1 \rightarrow ((-2 * p1) + p1))
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).quot) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow ((-35 * div(heapIs $heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1}.\text{p2}, 176).\text{quot} + (172 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
heap_{funcstart_{724,1},p2, 176,rem})).p2) <
\mathbf{asType} < \mathbf{integer} > (\$ \mathrm{heap}_{724,1;742,8}.\mathrm{M2})
\rightarrow [simplify]
\textit{[60.3]} \ (\text{(-35 * div}(\textbf{heapIs} \ \$ heap_{funcstart\_724,1}, \ \$ heap_{funcstart\_724,1}.p2,
176).quot) + (172 * div(heapIs \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}
(176).rem) < asType < integer > ($heap_{724,1;742,8}.M2)
\rightarrow [from term 57.24, $heap<sub>724,1;742,8</sub> is equal to
\text{Sheap}_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 * div(\textbf{heapIs } \$heap_{funcstart\_724,1},
heap_{funcstart\_724,1}.p1, 177).quot + (171 * div(heapIs $heap_{funcstart\_724,1}, 177).quot) + (171 * div(heapIs $heap_{funcstart\_724,1}, 177).quot)
heap_{funcstart\_724.1}.p1, 177).rem)._replace(p2 \rightarrow (-35 * div(heapIs)))._replace
heap_{funcstart\_724,1}, p_{funcstart\_724,1}, p_{funcstart\_724,1}, p_{funcstart\_724,1}, p_{funcstart\_724,1}
heap_{funcstart_{-724,1}}, heap_{funcstart_{-724,1}}, p_2, 176).rem)
\textit{[60.4]} \ (\text{(-35 * div}(\textbf{heapIs} \ \$ heap_{funcstart\_724,1}, \ \$ heap_{funcstart\_724,1}.p2,
176).quot) + (172 * div(heapIs heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p2,
176).rem)) < asType<integer>($heap<sub>funcstart_724,1</sub>._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}. \operatorname{pl},
177).rem)))._replace(p2 \rightarrow ((-35 * div(heapIs $heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1}.\text{p2}, 176).\text{quot} + (172 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
heap_{funcstart_{724,1}.p2, 176}.rem)).M2)
→ [const member of object with modified fields]
[60.6] ((-35 * div(heapIs heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p2,
176).quot) + (172 * div(heapIs \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}.p2,
176).\text{rem})) < \mathbf{asType} < \mathbf{integer} > (\$ \text{heap}_{funcstart\_724,1}.\text{M2})
\rightarrow [const static or extern object]
[60.7] ((-35 * div(heapIs heap_{funcstart_{-724,1}}, heap_{funcstart_{-724,1}}.p2,
176).quot) + (172 * div(heapIs heap_{funcstart_{724,1}}, heap_{funcstart_{724,1}}, p_{funcstart_{724,1}}, p_{funcstart_{724,1}}
(176).rem) < asType < integer > (\$heap_{init}.M2)
\rightarrow [expand definition of constant 'M2' at prang.c (19,20)]
\label{eq:constant_724,1} \textit{[}60.8\textit{]} \; ((-35~*~ \mathrm{div}(\mathbf{heapIs}~\$ \mathrm{heap}_{funcstart\_724,1},\,\$ \mathrm{heap}_{funcstart\_724,1}.\mathrm{p2},
176).quot) + (172 * div(heapIs heapIs = f_{uncstart_{-724,1}}, heap_{funcstart_{-724,1}}.p2,
(176).rem) < asType < integer > (asType < short int > ((int)30307))
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\rightarrow [simplify]
[60.18] -30307 < ((-172 * div(heapIs $heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1}.\text{p2}, 176).\text{rem} + (35 * \text{div}(\text{heapIs} \text{Sheap}_{funcstart\_724,1},
heap_{funcstart_{724,1}.p2, 176}, quot)
[Take given term]
[61.0] $heap<sub>724,1;744,8</sub> == $heap<sub>724,1;742,8</sub>._replace(p3 \rightarrow asType<short
int>((asType<int>(asType<short int>(div3.rem)) *
asType < int > (\$heap_{724,1:742.8}.r3)) - (asType < int > (asType < short)
int>(div3.quot)) * asType<int>($heap<sub>724,1:742,8</sub>.b3))))
\rightarrow [from term 57.24, $heap<sub>724.1:742.8</sub> is equal to
heap_{funcstart\_724.1}._replace(p1 \rightarrow ((-2 * div(heapIs heap_{funcstart\_724.1}),
\text{Sheap}_{funcstart_{-724,1},p1, 177}.\text{quot}) + (171 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart_{-724,1}}),
\rho_{uncstart_{-724,1}.p1, 177).rem})._replace\rho_{uncstart_{-724,1}.p1, 177).rem}._replace\rho_{uncstart_{-724,1}.p1, 177).rem}
heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p2, 176).quot) + (172 * div(heapIs)
heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p2, 176).rem)
[61.1] $\text{heap}_{724.1:744.8} == $\text{heap}_{funcstart_724.1}._\text{replace}(p1 \to ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).quot) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow ((-35 * div(heapIs $heap_{tuncstart_724.1},
\text{Sheap}_{funcstart\_724.1.p2}, 176).\text{quot} + (172 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724.1},
\theta_{uncstart_724.1.p2, 176}.rem)._replace(p3 \rightarrow asType<short
int>((asType<int>(asType<short int>(div3.rem)) *
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{724,1;742,8}.\mathrm{r3})) - (\mathbf{asType}{<}\mathbf{int}{>}(\mathbf{asType}{<}\mathbf{short}
int>(div3.quot)) * asType< int>($heap_{724.1:742.8}.b3))))
\rightarrow [from term 39.6, div3 is equal to div(heapIs $heap_{funcstart_724,1},
heap_{funcstart_{-724,1}}.p3, 178
[61.2] $heap<sub>724,1;744,8</sub> == $heap<sub>funcstart_724,1</sub>._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 \ *
\operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724.1}, \$ \operatorname{heap}_{funcstart\_724.1}.p1,
177).rem)))._replace(p2 \rightarrow ((-35 * div(heapIs $heap_{funcstart\_724,1},
\theta_{funcstart\_724,1.p2}, 176).quot) + (172 * div(heapIs \theta_{funcstart\_724,1},
\theta_{funcstart\_724,1}.p2, 176).rem))._replace(p3 \rightarrow asType<short
int>((asType<int>(asType<short int>(div(heapIs $heap_{funcstart_724,1},))
\text{Sheap}_{funcstart\_724,1.p3}, 178).\text{rem}) * asType < int > (\text{Sheap}_{724,1;742,8.r3})) -
(asType<int>(asType<short int>(div3.quot)) *
asType<int>($heap<sub>724,1;742,8</sub>.b3))))
\rightarrow [simplify]
[61.4] $heap<sub>724,1:744,8</sub> == $heap<sub>funcstart_724,1</sub>._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 *
\operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724,1}, \$ \operatorname{heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow ((-35 * div(heapIs $heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1.p2}, 176).\text{quot}) + (172 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
```

```
\rho_{funcstart=724.1.p2, 176}.rem)._replace(p3 \rightarrow asType<short
int>((div(heapIs \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p3, 178).rem *
asType < int > (\$heap_{724,1:742,8}.r3)) - (asType < int > (asType < short)
int>(div3.quot)) * asType< int>($heap_{724,1;742.8}.b3))))
\rightarrow [from term 57.24, $heap<sub>724.1:742.8</sub> is equal to
heap_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 * div(heapIs *heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1}.\text{p1}, 177).\text{quot} + (171 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
heap_{funcstart\_724,1}.p1, 177).rem)).\_replace(p2 \rightarrow (-35 * div(heapIs))).
\text{Sheap}_{funcstart\_724.1}, \text{Sheap}_{funcstart\_724.1}.p2, 176).quot) + (172 * div(heapIs)
heap_{funcstart_{724,1}}, heap_{funcstart_{724,1}}, 176).rem)
[61.5] heap_{724,1;744,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 \ *
\operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724,1}, \$ \operatorname{heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow ((-35 * div(heapIs $heap_{funcstart_724,1},
\text{Sheap}_{funcstart\_724,1}.\text{p2}, 176).\text{quot} + (172 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
\theta_{funcstart_{-724,1},p2, 176,p2}...replace(p3 \rightarrow asType<short
int>((div(heapIs \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p3, 178).rem *
asType<int>($heap<sub>funcstart_724.1</sub>._replace(p1 \rightarrow ((-2 * div(heapIs
\theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}
\theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}
* div(heapIs heap_{funcstart_{-724,1}}, heap_{funcstart_{-724,1}}, p2, 176).quot) + (172 *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.\operatorname{p2}, \ 176).\operatorname{rem}))).\operatorname{r3})) -
(asType<int>(asType<short int>(div3.quot)) *
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{724,1;742,8}.\mathrm{b3}))))
→ [const member of object with modified fields]
[61.7] $heap<sub>724,1;744,8</sub> == $heap<sub>funcstart_724,1</sub>._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow ((-35 * div(heapIs $heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724.1.p2}, 176).\text{quot} + (172 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724.1},
\theta_{uncstart\ 724,1}, p2, 176).rem)._replace(p3 \rightarrow asType<short
int>((div(heapIs \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p3, 178).rem *
asType < int > (\$heap_{funcstart\_724,1}.r3)) - (asType < int > (asType < short)
\mathbf{int}{>}(\text{div3.quot})) * \mathbf{asType}{<} \mathbf{int}{>} (\$\text{heap}_{724,1;742,8}.\text{b3}))))
\rightarrow [const static or extern object]
[61.8] $heap<sub>724,1;744,8</sub> == $heap<sub>funcstart_724,1</sub>._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 *
\operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724,1}, \$ \operatorname{heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow ((-35 * div(heapIs $heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1}.\text{p2}, 176).\text{quot} + (172 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
\rho_{funcstart\_724,1.p2, 176}.rem))._replace(p3 \rightarrow asType<short
int>((div(heapIs \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p3, 178).rem *
asType < int > (\$heap_{init}.r3)) - (asType < int > (asType < short)
```

```
int>(div3.quot)) * asType<int>($heap<sub>724.1:742.8</sub>.b3))))
\rightarrow [expand definition of constant 'r3' at prang.c (25,20)]
[61.9] heap_{724,1;744,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).quot) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow ((-35 * div(heapIs $heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1}.\text{p2}, 176).\text{quot} + (172 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
\theta_{funcstart\_724,1.p2, 176).rem})). replace(p3 \rightarrow asType < short)
int>((div(heapIs \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p3, 178).rem *
asType<int>(asType<short int>((int)170))) -
(asType<int>(asType<short int>(div3.quot)) *
asType<int>($heap<sub>724,1;742,8</sub>.b3))))
\rightarrow [simplify]
[61.12] $heap<sub>724,1;744,8</sub> == $heap<sub>funcstart_724,1</sub>._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow ((-35 * div(heapIs $heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1}.\text{p2}, 176).\text{quot} + (172 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
\theta_{tuncstart} $\text{p2}, 176\).rem)))._replace(p3 \rightarrow asType < short
int>((div(heapIs \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p3, 178).rem * 170)
- (asType < int > (asType < short int > (div3.quot)) *
asType < int > (\$heap_{724,1;742,8}.b3))))
\rightarrow [from term 39.6, div3 is equal to div(heapIs $heap_{funcstart\_724,1},
heap_{funcstart_{-724,1}}.p3, 178
[61.13] \text{heap}_{724,1;744,8} == \text{heap}_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 \ *
\operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724,1}, \$ \operatorname{heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow ((-35 * div(heapIs $heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1}.\text{p2}, 176).\text{quot} + (172 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
\rho_{uncstart\_724,1.p2, 176).rem}))._replace(p3 \rightarrow asType<short int>((170
* div(heapIs heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p3, 178).rem) –
(asType<int>(asType<short int>(div(heapIs $heap_{tuncstart\_724.1},
\text{Sheap}_{funcstart,724,1.p3}, 178).\text{quot}) * asType < int > (\text{Sheap}_{724,1:742.8.b3})))
\rightarrow [simplify]
[61.15] $heap<sub>724,1;744,8</sub> == $heap<sub>funcstart_724,1</sub>._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).quot) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.p1,
(-35 * div(\mathbf{heapIs} \$heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1.p2}, 176).quot) + (172 * div(heapIs \text{Sheap}_{funcstart\_724,1},
\frac{\text{sheap}_{funcstart\_724,1.p2, 176}.rem)}{\text{.replace}(p3 \rightarrow asType < short int > ((170)))}
* div(heapIs heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p3, 178).rem) –
(\text{div}(\mathbf{heapIs} \$ \text{heap}_{funcstart\_724,1}, \$ \text{heap}_{funcstart\_724,1}.\text{p3}, 178).\text{quot} *
```

```
asType<int>($heap<sub>724.1:742.8</sub>.b3))))
\rightarrow [from term 57.24, $heap<sub>724,1:742.8</sub> is equal to
heap_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 * div(heapIs $heap_{funcstart\_724,1},
heap_{funcstart\_724,1}.p1, 177).quot + (171 * div(heapIs $heap_{funcstart\_724,1}, 177).quot) + (171 * div(heapIs $heap_{funcstart\_724,1}, 17
\rho_{funcstart\_724,1}.p1, 177).rem)._replace\rho_{funcstart\_724,1}.p1, 177).rem)._replace\rho_{funcstart\_724,1}.p1, 177).rem)
heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p2, 176).quot) + (172 * div(heapIs)
heap_{funcstart_{724,1}}, heap_{funcstart_{724,1}}, p2, 176).rem)
[61.16] heap_{724,1;744,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).quot) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart} \ 724.1, \ \$ \operatorname{heap}_{funcstart} \ 724.1.p1,
177).rem)))._replace(p2 \rightarrow ((-35 * div(heapIs $heap_{funcstart_724,1},
\text{Sheap}_{funcstart\_724,1.p2}, 176).\text{quot} + (172 * \text{div}(\text{heapIs} \text{Sheap}_{funcstart\_724,1},
\theta_{funcstart\_724,1.p2, 176}.rem)._replace(p3 \rightarrow asType<short int>((170
* div(heapIs heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p3, 178).rem) –
(\text{div}(\mathbf{heapIs} \$ \text{heap}_{funcstart\_724,1}, \$ \text{heap}_{funcstart\_724,1}.\text{p3}, 178).\text{quot} *
asType < int > (\$heap_{funcstart\_724,1}.\_replace(p1 \rightarrow ((-2 * div(heapIs)))))))
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.\text{p1}, 177).\text{quot}) + (171 * \text{div}(\text{heapIs}))
\rho_{uncstart_{724,1}}, \rho_{uncstart_{724,1},p1, 177}.rem))._replace(p2 \rightarrow ((-35)
* div(heapIs heap_{funcstart_{-724,1}}, heap_{funcstart_{-724,1}}, p2, 176).quot) + (172 *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.\operatorname{p2}, \ 176).\operatorname{rem}))).\operatorname{b3}))))
\rightarrow [const member of object with modified fields]
[61.18] $\text{heap}_{724,1;744,8} == \text{$heap}_{funcstart\_724,1}._\text{$replace}(p1 \to ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 \ *
\operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724.1}, \$ \operatorname{heap}_{funcstart\_724.1}.p1,
177).rem)))._replace(p2 \rightarrow ((-35 * div(heapIs $heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1}.\text{p2}, 176).\text{quot} + (172 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
\theta_{funcstart\_724,1}.p2, 176).rem))._replace(p3 \rightarrow asType<short int>((170
* div(heapIs heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p3, 178).rem) –
(div(heapIs heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p3, 178).quot *
asType < int > (\$heap_{funcstart\_724.1}.b3))))
\rightarrow [const static or extern object]
[61.19] heap_{724,1;744,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow ((-35 * div(heapIs $heap_{funcstart\_724,1},
\text{Sheap}_{funcstart_{-724,1},p2, 176}.quot) + (172 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart_{-724,1}},
\rho_{funcstart\_724,1}.p2, 176).rem))._replace(p3 \rightarrow asType<short int>((170
* div(heapIs heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p3, 178).rem) –
(\text{div}(\mathbf{heapIs} \$ \text{heap}_{funcstart\_724,1}, \$ \text{heap}_{funcstart\_724,1}.\text{p3}, 178).\text{quot} *
asType < int > (\$heap_{init}.b3)))
\rightarrow [expand definition of constant 'b3' at prang.c (27,20)]
[61.20] $\text{heap}_{724,1:744,8} == \text{$heap}_{funcstart\_724,1}.$\text{$_-\text{replace}(p1$}\to ((-2 *
```

```
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).quot) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow ((-35 * div(heapIs $heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1}.\text{p2}, 176).\text{quot} + (172 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
\theta_{funcstart\_724,1.p2, 176}.rem)._replace(p3 \rightarrow asType<short int>((170
* div(heapIs heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p3, 178).rem) –
(\text{div}(\mathbf{heapIs} \$ \text{heap}_{funcstart\_724,1}, \$ \text{heap}_{funcstart\_724,1}.\text{p3}, 178).\text{quot} *
asType<int>(asType<short int>((int)63)))))
\rightarrow [simplify]
[61.26] $\text{heap}_{724,1:744,8} == $\text{heap}_{funcstart\_724,1}._\text{replace}(p1 \to ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 *
\label{eq:div_heap} \text{div}(\textbf{heapIs} \ \$ \text{heap}_{funcstart\_724,1}, \ \$ \text{heap}_{funcstart\_724,1}.\text{p1},
177).rem)))._replace(p2 \rightarrow ((-35 * div(heapIs $heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1}.\text{p2}, 176).\text{quot} + (172 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
heap_{funcstart\_724,1.p2, 176}.rem))._replace(p3 \rightarrow ((-63 * div(heapIs
\$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p3, 178).quot) + (170 * div(\textbf{heapIs}))
heap_{funcstart_{724,1}}, heap_{funcstart_{724,1}}, 178).rem
[Take given term]
[62.0] -asType<integer const>($heap<sub>724.1:744.8</sub>.M3) <
asType<integer>($heap<sub>724.1:744.8</sub>.p3)
\rightarrow [from term 61.26, $heap<sub>724,1;744,8</sub> is equal to
heap_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 * div(heapIs *heap_{funcstart\_724,1},
heap_{funcstart\_724,1}.p1, 177).quot + (171 * div(heapIs $heap_{funcstart\_724,1},
heap_{funcstart\_724,1}.p1, 177).rem))).\_replace(p2 \rightarrow ((-35 * div(heapIs))).\_replace(p2 \rightarrow ((-35 * div(heapIs)))))._replace(p2 \rightarrow ((-35 * div(heapIs)))))
heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p2, 176).quot) + (172 * div(heapIs)
\$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p2, 176).rem))).\_\mathbf{replace}(p3 \rightarrow (-63 * -63 * -63 * -63 * -63 * -63 * -63 * -63 * -63 * -63 * -63 * -63 * -63 * -63 * -63 * -63 * -63 * -63 * -63 * -63 * -63 * -63 * -63 * -63 * -63 * -63 * -63 * -63 * -63 * -63 * -63 * -63 * -63 * -63 * -63 * -63 * -63 * -63 * -63 * -63 * -63 * -63 * -63 * -63 * -63 * -63 * -63 * -63 * -63 * -63 * -63 * -63 * -63 * -63 * -63 * -63 * -63 * -63 * -63 * -63 * -63 * -63 * -63 * -63 * -63 * -63 * -63 * -63 * -63 * -63 * -63 * -63 * -63 * -63 * -63 * -63 * -63 * -63 * -63 * -63 * -63 * -63 * -63 * -63 * -63 * -63 * -63 * -63 * -63 * -63 * -63 * -63 * -63 * -63 * -63 * -63 * -63 * -63 * -63 * -63 * -63 * -63 * -63 * -63 * -63 * -63 * -63 * -63 * -63 * -63 * -63 * -63 * -63 * -63 * -63 * -63 * -63 * -63 * -63 * -63 * -63 * -63 * -63 * -63 * -63 * -63 * -63 * -63 * -63 * -63 * -63 * -63 * -63 * -63 * -63 * -63 * -63 * -63 * -63 * -63 * -63 * -63 * -63 * -63 * -63 * -63 * -63 * -63 * -63 * -63 * -63 * -63 * -63 * -63 * -63 * -63 * -63 * -63 * -63 * -63 * -63 * -63 * -63 * -63 * -63 * -63 * -63 * -63 * -63 * -63 * -63 * -63 * -63 * -63 * -63 * -63 * -63 * -63 * -63 * -63 * -63 * -63 * -63 * -63 * -63 * -63 * -63 * -63 * -63 * -63 * -63 * -63 * -63 * -63 * -63 * -63 * -63 * -63 * -63 * -63 * -63 * -63 * -63 * -63 * -63 * -63 * -63 * -63 * -63 * -63 * -63 * -63 * -63 * -63 * -63 * -63 * -63 * -63 * -63 * -63 * -63 * -63 * -63 * -63 * -63 * -63 * -63 * -63 * -63 * -63 * -63 * -63 * -63 * -63 * -63 * -63 * -63 * -63 * -63 * -63 * -63 * -63 * -63 * -63 * -63 * -63 * -63 * -63 * -63 * -63 * -63 * -63 * -63 * -63 * -63 * -63 * -63 * -63 * -63 * -63 * -63 * -63 * -63 * -63 * -63 * -63 * -63 * -63 * -63 * -63 * -63 * -63 * -63 * -63 * -63 * -63 * -63 * -63 * -63 * -63 * -63 * -63 * -63 * -63 * -63 * -63 * -63 * -63 * -63 * -63 * -63 * -63 * -63 * -63 * -63 * -63 * -63 * -63 * -63 * -63 * -63 * -63 * -63 * -63 * -63 * -63 * -63 * -63 * -63 * -63 * -63 * -63 * -63 * -63 * -63 * -63 * -63 * -63 * -63 * -63 * -63 * -63 * -63 * -63 * -63 * -63 * -63 *
div(\mathbf{heapIs} \ \$heap_{funcstart\_724,1}, \ \$heap_{funcstart\_724,1}.p3, \ 178).quot) + (170 *
\operatorname{div}(\mathbf{heapIs} \ \$ heap_{funcstart\_724,1}, \ \$ heap_{funcstart\_724,1}.p3, \ 178).rem))]
[62.1] -asType < integer const > (\$heap_{funcstart\_724,1}.\_replace(p1 \rightarrow ((-2 * funcstart\_724,1)))))
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 \ *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow ((-35 * div(heapIs $heap_{tuncstart_724.1},
\text{Sheap}_{funcstart\_724.1.p2}, 176).\text{quot} + (172 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724.1},
\theta_{uncstart\_724,1.p2, 176}.rem))._replace(p3 \rightarrow ((-63 * div(heapIs
\text{Sheap}_{funcstart_{-724,1}}, \text{Sheap}_{funcstart_{-724,1}}.\text{p3}, 178).\text{quot}) + (170 * \text{div}(\text{heapIs}))
\text{Sheap}_{funcstart=724.1}, \text{Sheap}_{funcstart=724.1}, \text{p3}, 178).\text{rem})).M3) <
asType<integer>($heap<sub>724,1;744,8</sub>.p3)
\rightarrow [const member of object with modified fields]
{\it [62.4]-asType}{<} integer\ const{>}(\$heap_{funcstart\_724,1}.M3) <
asType<integer>($heap<sub>724,1;744,8</sub>.p3)
\rightarrow [const static or extern object]
```

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[62.5] -asType<integer const>($heap<sub>init</sub>.M3) <
asType<integer>($heap<sub>724,1;744,8</sub>.p3)
\rightarrow [expand definition of constant 'M3' at prang.c (24,20)]
[62.6] -asType<integer const>(asType<short int>((int)30323)) <
asType<integer>($heap<sub>724,1;744,8</sub>.p3)
\rightarrow [simplify]
[62.10] -30323 < asType < integer > (\$heap_{724.1:744.8}.p3)
\rightarrow [from term 61.26, $heap<sub>724,1:744.8</sub> is equal to
heap_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 * div(heapIs $heap_{funcstart\_724,1},
heap_{funcstart\_724,1}.p1, 177).quot + (171 * div(heapIs $heap_{funcstart\_724,1}, 177).quot) + (171 * div(heapIs $heap_{funcstart\_724,1}, 177).quot)
\rho_{funcstart\_724,1.p1, 177}.rem))._replace\rho_{funcstart\_724,1.p1, 177}.rem))._replace
heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p2, 176).quot) + (172 * div(heapIs)
heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p2, 176).rem)))._replace(p3 \rightarrow (-63 *
div(\mathbf{heapIs} \ \$heap_{funcstart\_724,1}, \ \$heap_{funcstart\_724,1}.p3, \ 178).quot) + (170 *
div(\mathbf{heapIs} \ \$heap_{funcstart\_724.1}, \ \$heap_{funcstart\_724.1}.p3, \ 178).rem))]
[62.11] -30323 < asType<integer>($heap_{funcstart\_724,1}._replace(p1 \rightarrow ((-2
* div(heapIs heap_{funcstart_{-724,1}}, heap_{funcstart_{-724,1}}, p_1, p_2, p_3, p_4, p_4, p_4, p_4, p_5, p_6, p_8, 
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow ((-35 * div(heapIs $heap_{funcstart\_724,1},
\rho_{funcstart\_724,1.p2}, 176).quot) + (172 * div(heapIs \rho_{funcstart\_724,1},
\text{heap}_{tuncstart\ 724.1.p2,\ 176}.\text{rem}))._replace(p3 \rightarrow ((-63 * div(heapIs
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.p3, 178).quot) + (170 * div(heapIs)
heap_{funcstart_{724,1}}, heap_{funcstart_{724,1},p3, 178).rem))).p3)
\rightarrow [simplify]
[62.13] -30323 < ((-63 * div(heapIs $heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1.p3}, 178).\text{quot}) + (170 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
heap_{funcstart_{-724,1}.p3, 178.rem}
[Take given term]
[63.0]!(0 == asType < integer > (\$heap_{724.1:744.8}.p3))
\rightarrow [from term 61.26, $heap<sub>724,1:744,8</sub> is equal to
heap_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 * div(heapIs $heap_{funcstart\_724,1},
heap_{funcstart\_724,1}.p1, 177).quot) + (171 * div(heapIs $heap_{funcstart\_724,1}, 1
heap_{funcstart\_724.1}.p1, 177).rem))._replace(p2 \rightarrow ((-35 * div(heapIs)))._
heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p2, 176).quot) + (172 * div(heapIs)
\theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}
div(\mathbf{heapIs} \ \$heap_{funcstart\_724,1}, \ \$heap_{funcstart\_724,1}.p3, \ 178).quot) + (170 *
div(\mathbf{heapIs} \ \$heap_{funcstart\_724,1}, \ \$heap_{funcstart\_724,1}.p3, \ 178).rem))]
[63.1] !(0 == asType<integer>(\ensuremath{$^{\circ}$}) | (1.2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 *
\operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724,1}, \$ \operatorname{heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow ((-35 * div(heapIs $heap_{funcstart_724,1},
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\text{Sheap}_{funcstart_{-724,1},p2, 176}.quot) + (172 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart_{-724,1}},
heap_{funcstart\_724,1.p2, 176}.rem)._replace(p3 \rightarrow ((-63 * div(heapIs)
heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p3, 178).quot) + (170 * div(heapIs
heap_{funcstart_{724,1}}, heap_{funcstart_{724,1}}, 178).rem)).p3)
\rightarrow [simplify]
[63.3]!(0 == ((-63 * div(\mathbf{heapIs} \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p3,
178).quot) + (170 * div(heapIs heapIs = f_{uncstart_{724,1}}, heap_{funcstart_{724,1}}, g_{uncstart_{724,1}}
178).rem)))
[Take given term]
{\it [64.0]}~{\bf asType}{<}{\bf integer}{>}({\rm \$heap}_{724,1;744,8}.p3)<
asType<integer>($heap<sub>724.1:744.8</sub>.M3)
\rightarrow [from term 61.26, $heap<sub>724,1:744,8</sub> is equal to
heap_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 * div(heapIs $heap_{funcstart\_724,1},
heap_{funcstart\_724,1}.p1, 177).quot + (171 * div(heapIs p_{funcstart\_724,1})
\rho_{uncstart_{724,1},p1,177,rem})._replace\rho_{2} \rightarrow ((-35 * div(heapIs)))
heap_{funcstart_{724,1}}, heap_{funcstart_{724,1}}, p_{funcstart_{724,1}}, p_{funcstart_{724,1}}, p_{funcstart_{724,1}}, p_{funcstart_{724,1}}
heap_{funcstart\_724.1}, heap_{funcstart\_724.1}, p2, p2, p3, p4, p3, p4, p3, p4, 
div(\mathbf{heapIs} \ \$heap_{funcstart\_724,1}, \ \$heap_{funcstart\_724,1}.p3, \ 178).quot) + (170 *
div(\mathbf{heapIs} \ \$heap_{funcstart\_724,1}, \ \$heap_{funcstart\_724,1}.p3, \ 178).rem))]
[64.1] asType<integer>(p1 \rightarrow ((-2 * p1.5) + p1.5))
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow ((-35 * div(heapIs $heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1.p2}, 176).\text{quot} + (172 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1}.\text{p2}, 176).\text{rem}))._replace(p3 \rightarrow ((-63 * div(heapIs)
\$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p3, 178).quot) + (170 * div(\textbf{heapIs}))
\$ heap_{funcstart\_724,1}, \$ heap_{funcstart\_724,1}.p3, 178).rem))).p3) <
asType<integer>($heap<sub>724,1;744,8</sub>.M3)
\rightarrow [simplify]
[64.3] ((-63 * div(heapIs heap_{funcstart_{-724,1}}, heap_{funcstart_{-724,1},p3},
178).quot) + (170 * div(heapIs \theta_{funcstart_{-724,1}}, \theta_{funcstart_{-724,1}}, \theta_{funcstart_{-724,1}}, \theta_{funcstart_{-724,1}}
(178).rem) < asType < integer > ($heap_{724,1;744,8}.M3)
\rightarrow [from term 61.26, $heap<sub>724,1;744,8</sub> is equal to
heap_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 * div(heapIs *heap_{funcstart\_724,1},
\text{Sheap}_{funcstart_{-724,1},p1, 177}.\text{quot}) + (171 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart_{-724,1}})
\rho_{1.5}(p2) = \rho_{1.5}(p2) - \rho_{1.5}(p2) $\text{heapIs} \div(\text{heapIs})._\text{replace}
heap_{funcstart\_724,1}, p_{funcstart\_724,1}, p_{funcstart\_724,1}, p_{funcstart\_724,1}, p_{funcstart\_724,1}
heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p2, 176).rem)))._replace(p3 \rightarrow (-63 *
div(\mathbf{heapIs} \ \$heap_{funcstart\_724,1}, \ \$heap_{funcstart\_724,1}.p3, \ 178).quot) + (170 \ *
div(\mathbf{heapIs} \ \$heap_{funcstart\_724,1}, \ \$heap_{funcstart\_724,1}.p3, \ 178).rem))]
[64.4] \; ((-63 * \operatorname{div}(\mathbf{heapIs} \; \$ \operatorname{heap}_{funcstart\_724,1}, \; \$ \operatorname{heap}_{funcstart\_724,1}.\operatorname{p3}, \;
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178).quot) + (170 * div(heapIs \theta_{funcstart_{-724,1}}, \theta_{funcstart_{-724,1}}, \theta_{funcstart_{-724,1}}, \theta_{funcstart_{-724,1}}
178).rem)) < asType<integer>($heap<sub>funcstart_724,1</sub>._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}. p1, \ 177). \operatorname{quot}) + (171 *
\operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724,1}, \$ \operatorname{heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow ((-35 * div(heapIs $heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1.p2}, 176).\text{quot} + (172 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
heap_{funcstart\_724,1.p2, 176).rem})).\_replace(p3 \rightarrow ((-63 * div(heapIs))).\_replace(p3 \rightarrow ((-63 * div(heapIs)))).\_replace(p3 \rightarrow ((-63 * div(heapIs)))))
\text{Sheap}_{funcstart_{724,1}}, \text{Sheap}_{funcstart_{724,1}}, p_3, 178). \text{quot}) + (170 * \text{div}(\text{heapIs}))
\text{Sheap}_{funcstart_{-724,1}}, \text{Sheap}_{funcstart_{-724,1}}.p3, 178).rem))).M3)
→ [const member of object with modified fields]
[64.7] \; ((-63 \; * \; \mathrm{div}(\mathbf{heapIs} \; \$ \mathrm{heap}_{funcstart\_724,1}, \; \$ \mathrm{heap}_{funcstart\_724,1}.\mathrm{p3}, \;
178).quot) + (170 * div(heapIs \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}.p3,
(178).rem) < asType < integer > (\$heap_{funcstart\_724,1}.M3)
\rightarrow [const static or extern object]
[64.8] ((-63 * div(heapIs $heap_{funcstart\_724,1}, $heap_{funcstart\_724,1}.p3,
178).quot) + (170 * div(heapIs heapIs = f_{uncstart\_724,1}, heap_{funcstart\_724,1}.p3,
(178).rem) < asType < integer > (\$heap_{init}.M3)
\rightarrow [expand definition of constant 'M3' at prang.c (24,20)]
\textit{[64.9]} \ (\text{(-63 * div}(\textbf{heapIs} \ \$ \text{heap}_{funcstart\_724,1}, \ \$ \text{heap}_{funcstart\_724,1}.\text{p3},
178).quot) + (170 * div(heapIs \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}.p3,
178).rem)) < asType<integer>(asType<short int>((int)30323))
\rightarrow [simplify]
[64.19] -30323 < ((-170 * div(heapIs $heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1}.\text{p3}, 178).\text{rem} + (63 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
\theta_{funcstart_{724,1}.p3, 178}, quot))
[Take given term]
[65.0] $heap<sub>724,1:747,8</sub> == $heap<sub>724,1:744,8</sub>._replace(p1 \rightarrow asType<short
int>((asType<int>($heap<sub>724.1:744.8</sub>.M1) *
asType<int>(static_cast<integer>(asType<int>($heap<sub>724,1:744,8</sub>.p1) <
(int)(0) + asType < int > ($heap_{724,1;744,8}.p1))
\rightarrow [from term 61.26, $heap<sub>724,1;744,8</sub> is equal to
heap_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 * div(heapIs p_{funcstart\_724,1}),
\text{Sheap}_{funcstart\_724.1.p1}, 177).\text{quot}) + (171 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724.1},
\rho_{tuncstart\_724.1.p1, 177).rem}))._replace\rho_{tuncstart\_724.1.p1, 177).rem})
heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p2, 176).quot) + (172 * div(heapIs)
\theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}
div(\mathbf{heapIs} \ \$heap_{funcstart\_724,1}, \ \$heap_{funcstart\_724,1}.p3, \ 178).quot) + (170 *
div(\mathbf{heapIs} \ \$heap_{funcstart\_724,1}, \ \$heap_{funcstart\_724,1}.p3, \ 178).rem))]
[65.2] heap_{724,1;747,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 \ *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1,
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177).rem)))._replace(p2 \rightarrow ((-35 * div(heapIs $heap_{funcstart\_724,1},
heap_{funcstart\_724,1.p2}, 176).quot) + (172 * div(heapIs heap_{funcstart\_724,1},
\rho_{funcstart\_724,1.p2, 176}.rem)._replace(p3 \rightarrow ((-63 * div(heapIs
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.p3, 178).quot) + (170 * div(heapIs)
\theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}.p3, 178).rem))).\_replace(p1 \rightarrow
asType<short int>((asType<int>($heap<sub>funcstart_724,1</sub>._replace(p1 \rightarrow ((-2
* div(heapIs heap_{funcstart_{724,1}}, heap_{funcstart_{724,1}}, 177).quot) + (171 *
\operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart} 724.1, \$ \operatorname{heap}_{funcstart} 724.1.p1,
177).rem)))._replace(p2 \rightarrow ((-35 * div(heapIs $heap_{funcstart_724,1},
\text{Sheap}_{funcstart\_724,1.p2}, 176).\text{quot} + (172 * \text{div}(\text{heapIs} \text{Sheap}_{funcstart\_724,1},
\theta_{uncstart\_724,1.p2, 176}.rem))._replace(p3 \rightarrow ((-63 * div(heapIs
\theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}. p3, 178).quot) + (170 * div(heapIs
\text{Sheap}_{funcstart_{724,1}}, \text{Sheap}_{funcstart_{724,1}}.p3, 178).rem))).M1) *
\mathbf{asType} < \mathbf{int} > (\mathbf{static\_cast} < \mathbf{integer} > (\mathbf{asType} < \mathbf{int} > (\$ \mathrm{heap}_{724,1;744,8}.\mathrm{p1}) < \mathsf{nt}) < \mathsf{nt} > \mathsf{nt} >
(int)(0)) + asType < int > (\$heap_{724,1;744,8}.p1)))
→ [const member of object with modified fields]
[65.5] heap_{724,1;747,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 *
div(\mathbf{heapIs} \ \$heap_{funcstart\_724.1}, \ \$heap_{funcstart\_724.1}.p1, \ 177).quot) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724.1}, \ \$ \operatorname{heap}_{funcstart\_724.1}.p1,
177).rem)))._replace(p2 \rightarrow ((-35 * div(heapIs $heap_{funcstart\_724.1},
\text{Sheap}_{funcstart\_724.1.p2}, 176).\text{quot} + (172 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724.1},
\rho_{tuncstart\_724.1.p2, 176}.rem)._replace(p3 \rightarrow ((-63 * div(heapIs
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.\text{p3}, 178).\text{quot}) + (170 * \text{div}(\text{heapIs}))
\$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p3, 178).rem))).\_\mathbf{replace}(p1 \rightarrow
asType<short int>((asType<int>($heap_{tuncstart\_724.1}.M1) *
asType<int>(static_cast<integer>(asType<int>($heap<sub>724,1:744,8</sub>.p1) <
(int)(0) + asType < int > (sheap_{724,1:744,8}.p1))
\rightarrow [const static or extern object]
[65.6] $heap<sub>724,1:747,8</sub> == $heap<sub>funcstart_724,1</sub>._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow ((-35 * div(heapIs $heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1.p2}, 176).\text{quot} + (172 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
\rho_{funcstart\_724,1.p2, 176}.rem)._replace(p3 \rightarrow ((-63 * div(heapIs
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.p3, 178).quot) + (170 * div(heapIs)
\$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p3, 178).rem))).\_\mathbf{replace}(p1 \rightarrow
asType < short int > ((asType < int > (\$heap_{init}.M1) *
asType<int>(static_cast<integer>(asType<int>($heap<sub>724,1:744,8</sub>.p1) <
(int)(0)) + asType < int > (\$heap_{724,1:744,8}.p1)))
\rightarrow [expand definition of constant 'M1' at prang.c (14,20)]
[65.7] \rho_{17,1747,8} == \rho_{17,1747,8} 
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).quot) + (171 *
\operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724,1}, \$ \operatorname{heap}_{funcstart\_724,1}.p1,
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177).rem)))._replace(p2 \rightarrow ((-35 * div(heapIs $heap_{funcstart\_724,1},
heap_{funcstart\_724,1.p2}, 176).quot) + (172 * div(heapIs heap_{funcstart\_724,1},
\rho_{funcstart\_724,1.p2, 176}.rem)._replace(p3 \rightarrow ((-63 * div(heapIs
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.p3, 178).quot) + (170 * div(heapIs)
\rho_{funcstart\_724,1}, \rho_{funcstart\_724,1}
asType<short int>((asType<int>(asType<short int>((int)30269)) *
asType<int>(static_cast<integer>(asType<int>($heap<sub>724.1:744.8</sub>.p1) <
(int)(0)) + asType<int>($heap<sub>724.1:744.8</sub>.p1)))
\rightarrow [simplify]
[65.10] $\text{heap}_{724,1:747,8} == $\text{heap}_{funcstart\_724,1}._\text{replace}(p1 \to ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 \ *
\operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724,1}, \$ \operatorname{heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow ((-35 * div(heapIs $heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1}.\text{p2}, 176).\text{quot} + (172 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
\rho_{uncstart\_724,1.p2, 176).rem})._replace(p3 \rightarrow ((-63 * div(heapIs
heap_{funcstart-724,1}, heap_{funcstart-724,1}.p3, 178).quot) + (170 * div(heapIs
\rho_{funcstart\_724,1}, \rho_{funcstart\_724,1}
asType<short int>((30269 *
asType<int>(static_cast<integer>(asType<int>($heap<sub>724.1.744.8.p1</sub>) <
(int)(0) + asType < int > ($heap_{724.1:744.8}.p1))
\rightarrow [from term 61.26, $heap<sub>724,1:744,8</sub> is equal to
heap_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 * div(heapIs $heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1}.p1, 177).quot + (171 * div(\textbf{heapIs } \text{Sheap}_{funcstart\_724,1},
\rho_{funcstart\_724,1.p1, 177}.rem))._replace\rho_{funcstart\_724,1.p1, 177}.rem))._replace
heap_{funcstart\_724,1}, p_{funcstart\_724,1}, p_{funcstart\_724,1}, p_{funcstart\_724,1}, p_{funcstart\_724,1}
heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p2, 176).rem)))._replace(p3 \rightarrow (-63 *
div(\mathbf{heapIs} \ \$heap_{funcstart\_724,1}, \ \$heap_{funcstart\_724,1}.p3, \ 178).quot) + (170 \ *
div(\mathbf{heapIs} \ \$heap_{funcstart\_724,1}, \ \$heap_{funcstart\_724,1}.p3, \ 178).rem))]
[65.11] $\text{heap}_{724,1;747,8} == \text{$heap}_{funcstart\_724,1}._\text{$\bf replace}(p1 \to ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.\operatorname{p1}, \ 177).\operatorname{quot}) + (171 \ *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow ((-35 * div(heapIs $heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1.p2}, 176).\text{quot} + (172 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
\rho_{funcstart\_724,1.p2, 176}.rem)._replace(p3 \rightarrow ((-63 * div(heapIs
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.p3, 178).quot) + (170 * div(heapIs)
\theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}.p3, 178).rem))).\_replace(p1 \rightarrow 0.15)
asType<short int>((30269 *
asType < int > (static\_cast < integer > (asType < int > (\$heap_{funcstart\_724.1}.\_replace(p1))
\rightarrow ((-2 * div(heapIs $heap_{funcstart\_724,1}, $heap_{funcstart\_724,1}.p1, 177).quot) +
(171 * div(\mathbf{heapIs} \$ heap_{funcstart\_724,1}, \$ heap_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow ((-35 * div(heapIs $heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724.1.p2}, 176).\text{quot} + (172 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724.1},
\theta_{uncstart\_724,1}.p2, 176).rem))).\_replace(p3 \rightarrow ((-63 * div(heapIs)))._replace(p3 \rightarrow ((-63 * div(heapIs))))._replace(p3 \rightarrow ((-63 * div(heapIs))))._replace(p3 \rightarrow ((-63 * div(heapIs)))))._replace(p3 \rightarrow ((-63 * div(heapIs)))))._replace(p3 \rightarrow ((-63 * div(heapIs)))))._replace(p3 \rightarrow ((-63 * div(heapIs)))))
\theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}.p3, 178).quot) + (170 * div(heapIs
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\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.\text{p3}, 178).\text{rem})).\text{p1}) < (\text{int})0))) +
asType<int>($heap<sub>724,1:744,8</sub>.p1)))
\rightarrow [simplify]
[65.23] heap_{724,1;747,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 *
\operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724.1}, \$ \operatorname{heap}_{funcstart\_724.1}.p1,
177).rem)))._replace(p2 \rightarrow ((-35 * div(heapIs $heap_{funcstart_724,1},
\text{Sheap}_{funcstart\_724,1.p2}, 176).\text{quot} + (172 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
\rho_{funcstart\_724,1.p2, 176}.rem)._replace(p3 \rightarrow ((-63 * div(heapIs
\text{Sheap}_{funcstart\ 724.1}, \text{Sheap}_{funcstart\ 724.1}.p3, 178).quot) + (170 * div(heapIs)
\theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}.p3, 178).rem)))._replace(p1 \rightarrow
asType<short int>((30269 * asType<int>(([0 < ((-171 * div(heapIs
\theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}.p1, 177).rem) + (2 * div(heapIs
\label{eq:heap-funcstart_724,1} \$ heap_{funcstart\_724,1}.p1,\ 177).quot))]:\ 1,\ []:\ 0)))\ +
asType < int > (\$heap_{724,1;744,8}.p1)))
→ [explicitly assert falsehood of skipped guards in subsequent guards]
[65.24] heap_{724,1;747,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 \ *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart} \ 724.1, \ \$ \operatorname{heap}_{funcstart} \ 724.1, \ p1,
177).rem)))._replace(p2 \rightarrow ((-35 * div(heapIs $heap_{funcstart_724,1},
\text{Sheap}_{funcstart\_724,1.p2}, 176).\text{quot} + (172 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
\rho_{funcstart_724,1}.p2, 176).rem))._replace(p3 \rightarrow ((-63 * div(heapIs
\text{Sheap}_{funcstart\_724.1}, \text{Sheap}_{funcstart\_724.1}.p3, 178).quot) + (170 * div(heapIs)
\rho_{funcstart_{724,1}}, \rho_{funcstart_{724,1},p3, 178}.rem))._replace(p1 \rightarrow
asType<short int>((30269 * asType<int>(([0 < ((-171 * \mathrm{div}(\mathbf{heapIs})
\theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}
\rho_{funcstart_{724,1}}, \rho_{funcstart_{724,1},p1, 177}.quot): 1, [!(0 < ((-171 *
div(heapIs \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}).rem) + (2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot})))]: \ 0))) +
asType<int>($heap<sub>724.1:744.8</sub>.p1)))
\rightarrow [simplify]
[65.29] $heap<sub>724.1:747.8</sub> == $heap<sub>funcstart_724.1</sub>._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 \ *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow ((-35 * div(heapIs $heap_{funcstart\_724,1},
\text{Sheap}_{funcstart_{-724,1},p2, 176}.quot) + (172 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart_{-724,1}},
\text{Sheap}_{funcstart\_724,1}.\text{p2}, 176).\text{rem}))._replace(p3 \rightarrow ((-63 * div(heapIs)
heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p3, 178).quot) + (170 * div(heapIs)
\theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}.p3, 178).rem))).\_replace(p1 \rightarrow
asType<short int>((30269 * asType<int>(([0 < ((-171 * div(heapIs
\theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}
\rho_{tuncstart_{-724,1}}, \rho_{tuncstart_{-724,1}}, \rho_{tuncstart_{-724,1}}, \rho_{tuncstart_{-724,1}}, \rho_{tuncstart_{-724,1}}, \rho_{tuncstart_{-724,1}}
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).rem) + (-2 *
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\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}))]: 0))) +
asType<int>($heap<sub>724,1:744,8</sub>.p1)))
\rightarrow [from term 55.3, -1 < ((-2 * div(heapIs $heap_{funcstart\_724,1},
heap_{funcstart_{724,1},p1, 177}, quot) + (171 * div(heapIs p_{funcstart_{724,1},p1, 177}), quot)
heap_{funcstart_{724,1},p1, 177, rem} is true if and only if 0 < ((-2 * div(heapIs)))
heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p1, 177).quot) + (171 * div(heapIs)
heap_{funcstart_{724,1}}, heap_{funcstart_{724,1}}, 177).rem)
[65.30] heap_{724,1;747,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 \ *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart} \ 724.1, \ \$ \operatorname{heap}_{funcstart} \ 724.1.p1,
177).rem)))._replace(p2 \rightarrow ((-35 * div(heapIs $heap_{funcstart_724,1},
\text{Sheap}_{funcstart\_724,1.p2}, 176).\text{quot} + (172 * \text{div}(\text{heapIs} \text{Sheap}_{funcstart\_724,1},
\rho_{funcstart\_724,1.p2, 176}.rem)._replace(p3 \rightarrow ((-63 * div(heapIs
\theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}
\$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p3, 178).rem))).\_\mathbf{replace}(p1 \rightarrow
\theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}
\{\text{heap}_{funcstart\_724.1}, \text{heap}_{funcstart\_724.1}, \text{p1}, 177\}.\text{quot}\}: 1, [0 < ((-2 * 10.5))]: 1, [0 < ((-2 * 10.5))]: 1, [0 < ((-2 * 10.5))]: 1, [0 < ((-2 * 10.5))]: 1, [0 < ((-2 * 10.5))]: 1, [0 < ((-2 * 10.5))]: 1, [0 < ((-2 * 10.5))]: 1, [0 < ((-2 * 10.5))]: 1, [0 < ((-2 * 10.5))]: 1, [0 < ((-2 * 10.5))]: 1, [0 < ((-2 * 10.5))]: 1, [0 < ((-2 * 10.5))]: 1, [0 < ((-2 * 10.5))]: 1, [0 < ((-2 * 10.5))]: 1, [0 < ((-2 * 10.5))]: 1, [0 < ((-2 * 10.5))]: 1, [0 < ((-2 * 10.5))]: 1, [0 < ((-2 * 10.5))]: 1, [0 < ((-2 * 10.5))]: 1, [0 < ((-2 * 10.5))]: 1, [0 < ((-2 * 10.5))]: 1, [0 < ((-2 * 10.5))]: 1, [0 < ((-2 * 10.5))]: 1, [0 < ((-2 * 10.5))]: 1, [0 < ((-2 * 10.5))]: 1, [0 < ((-2 * 10.5))]: 1, [0 < ((-2 * 10.5))]: 1, [0 < ((-2 * 10.5))]: 1, [0 < ((-2 * 10.5))]: 1, [0 < ((-2 * 10.5))]: 1, [0 < ((-2 * 10.5))]: 1, [0 < ((-2 * 10.5))]: 1, [0 < ((-2 * 10.5))]: 1, [0 < ((-2 * 10.5))]: 1, [0 < ((-2 * 10.5))]: 1, [0 < ((-2 * 10.5))]: 1, [0 < ((-2 * 10.5))]: 1, [0 < ((-2 * 10.5))]: 1, [0 < ((-2 * 10.5))]: 1, [0 < ((-2 * 10.5))]: 1, [0 < ((-2 * 10.5))]: 1, [0 < ((-2 * 10.5))]: 1, [0 < ((-2 * 10.5))]: 1, [0 < ((-2 * 10.5))]: 1, [0 < ((-2 * 10.5))]: 1, [0 < ((-2 * 10.5))]: 1, [0 < ((-2 * 10.5))]: 1, [0 < ((-2 * 10.5))]: 1, [0 < ((-2 * 10.5))]: 1, [0 < ((-2 * 10.5))]: 1, [0 < ((-2 * 10.5))]: 1, [0 < ((-2 * 10.5))]: 1, [0 < ((-2 * 10.5))]: 1, [0 < ((-2 * 10.5))]: 1, [0 < ((-2 * 10.5))]: 1, [0 < ((-2 * 10.5))]: 1, [0 < ((-2 * 10.5))]: 1, [0 < ((-2 * 10.5))]: 1, [0 < ((-2 * 10.5))]: 1, [0 < ((-2 * 10.5))]: 1, [0 < ((-2 * 10.5))]: 1, [0 < ((-2 * 10.5))]: 1, [0 < ((-2 * 10.5))]: 1, [0 < ((-2 * 10.5))]: 1, [0 < ((-2 * 10.5))]: 1, [0 < ((-2 * 10.5))]: 1, [0 < ((-2 * 10.5))]: 1, [0 < ((-2 * 10.5))]: 1, [0 < ((-2 * 10.5))]: 1, [0 < ((-2 * 10.5))]: 1, [0 < ((-2 * 10.5))]: 1, [0 < ((-2 * 10.5))]: 1, [0 < ((-2 * 10.5))]: 1, [0 < ((-2 * 10.5))]: 1, [0 < ((-2 * 10.5))]: 1, [0 < ((-2 * 
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724.1}, \ \text{\$heap}_{funcstart\_724.1}. p1, \ 177). \operatorname{quot}) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).rem))]: 0))) +
asType<int>($heap<sub>724,1;744,8</sub>.p1)))
\rightarrow [simplify]
[65.31] $\text{heap}_{724.1:747.8} == \text{$heap}_{funcstart\_724.1}._\text{$replace}(p1 \to ((-2 *
div(\mathbf{heapIs} \ \$heap_{funcstart\_724.1}, \ \$heap_{funcstart\_724.1}.p1, \ 177).quot) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow ((-35 * div(heapIs $heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724.1.p2}, 176).\text{quot} + (172 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724.1},
\theta_{uncstart\_724,1}.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)))))._replace(p3 \rightarrow ((-63 * div(heapIs))))._replace(p3 \rightarrow ((-63 * div(heapIs)))))._replace(p3 \rightarrow ((-63 * div(heapIs)))))
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.\text{p3}, 178).\text{quot}) + (170 * \text{div}(\text{heapIs}))
\theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}.p3, 178).rem))).\_replace(p1 \rightarrow
asType<short int>((30269 * ([0 < ((-171 * div(heapIs $heap_{tuncstart\_724,1},
\text{Sheap}_{funcstart\_724,1}.\text{p1}, 177).\text{rem} + (2 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1}.\text{p1}, 177).\text{quot}): 1, [0 < ((-2 * \text{div}(\text{heapIs})))]: 1, [0 < ((-2 * \text{div}(\text{heapIs})))]:
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.\text{p1}, 177).\text{quot}) + (171 * \text{div}(\text{heapIs}))
heap_{funcstart_{724,1}}, heap_{funcstart_{724,1},p1, 177).rem): 0)) +
asType < int > (\$heap_{724,1;744,8}.p1)))
\rightarrow [move guard outside expression]
[65.32] $heap<sub>724,1;747,8</sub> == $heap<sub>funcstart_724,1</sub>._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 \ *
\operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724,1}, \$ \operatorname{heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow ((-35 * div(heapIs $heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1.p2}, 176).\text{quot} + (172 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
\rho_{funcstart\_724,1.p2, 176}.rem)._replace(p3 \rightarrow ((-63 * div(heapIs
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\rho_{funcstart\_724,1}, \rho_{funcstart\_724,1}
asType<short int>(([0 < ((-171 * div(heapIs $heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1}.\text{p1}, 177).\text{rem} + (2 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
\theta_{uncstart\_724,1}.p1, 177).quot): 1 * 30269, \theta_{uncstart\_724,1}.p1, 177).quot:
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.p1, 177).quot) + (171 * div(heapIs)
\theta_{funcstart_{724,1}}, \theta_{funcstart_{724,1},1}, 177).rem))]: 0 * 30269) +
asType<int>($heap<sub>724.1:744.8</sub>.p1)))
\rightarrow [simplify]
[65.34] heap_{724,1;747,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 \ *
\label{eq:div_heap} \text{div}(\textbf{heapIs} \ \$ \text{heap}_{funcstart\_724,1}, \ \$ \text{heap}_{funcstart\_724,1}.\text{p1},
177).rem)))._replace(p2 \rightarrow ((-35 * div(heapIs $heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1}.\text{p2}, 176).\text{quot} + (172 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
\rho_{uncstart\_724,1.p2, 176).rem})._replace(p3 \rightarrow ((-63 * div(heapIs
heap_{funcstart-724,1}, heap_{funcstart-724,1}.p3, 178).quot) + (170 * div(heapIs
\rho_{funcstart\_724,1}, \rho_{funcstart\_724,1}
asType<short int>(([0 < ((-171 * div(heapIs $heap_{funcstart\_724,1},
heap_{funcstart\_724,1}.p1, 177).rem + (2 * div(heapIs $heap_{funcstart\_724,1}, 177).rem) + (2 * div(heapIs $heap_{funcstart\_724,1}, 177)
\rho_{tuncstart_{724.1},p1, 177,quot}): 30269, [0 < ((-2 * div(heapIs))]: 30269, [0 < ((-2 * div(heapIs))]
\text{Sheap}_{funcstart\_724.1}, \text{Sheap}_{funcstart\_724.1}.\text{p1}, 177).\text{quot}) + (171 * \text{div}(\text{heapIs})
\frac{\text{sheap}_{funcstart_{724,1}}, \text{sheap}_{funcstart_{724,1},p1, 177}.rem)}{1}: 0} +
asType<int>($heap<sub>724.1:744.8</sub>.p1)))
\rightarrow [from term 61.26, $heap<sub>724,1;744,8</sub> is equal to
heap_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 * div(heapIs $heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724.1}, p1, 177).quot) + (171 * div(\text{heapIs } \text{Sheap}_{funcstart\_724.1}),
heap_{funcstart\_724,1}.p1, 177).rem))).\_replace(p2 \rightarrow ((-35 * div(heapIs))).\_replace(p2 \rightarrow ((-35 * div(heapIs)))))._replace(p2 \rightarrow ((-35 * div(heapIs)))))
heap_{funcstart\_724,1}, p_{funcstart\_724,1}, p_{funcstart\_724,1}, p_{funcstart\_724,1}, p_{funcstart\_724,1}
heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p2, 176).rem)))._replace(p3 \rightarrow (-63 *
div(\mathbf{heapIs} \ \$heap_{funcstart\_724.1}, \ \$heap_{funcstart\_724.1.p3}, \ 178).quot) + (170 *
\operatorname{div}(\mathbf{heapIs} \ \$heap_{funcstart\_724,1}, \ \$heap_{funcstart\_724,1}.p3, \ 178).rem))]
[65.35] $heap<sub>724,1;747,8</sub> == $heap<sub>funcstart_724,1</sub>._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 \ *
\operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724,1}, \$ \operatorname{heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow ((-35 * div(heapIs $heap_{funcstart_724,1},
\text{Sheap}_{funcstart\_724,1}.\text{p2}, 176).\text{quot} + (172 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
\rho_{funcstart\_724,1.p2, 176}.rem)._replace(p3 \rightarrow ((-63 * div(heapIs
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.p3, 178).quot) + (170 * div(heapIs)
\rho_{funcstart_{724,1}}, \rho_{funcstart_{724,1},p3,178}.rem))._replace(p1 \rightarrow
asType<short int>(([0 < ((-171 * div(heapIs $heap_{funcstart\_724,1},
heap_{funcstart\_724,1}.p1, 177).rem + (2 * div(heapIs heap_{funcstart\_724,1}, fixed) + (2 * div(heapIs heap_funcstart\_724,1}, fixed) + (2 
\rho_{tuncstart_{1}, 24.1}, p_{1}, 177, quot): 30269, [0 < ((-2 * div(heapIs))]: 30269, [0 < ((-2 * div(heapIs))]
\text{Sheap}_{funcstart\_724.1}, \text{Sheap}_{funcstart\_724.1}.\text{p1}, 177).\text{quot}) + (171 * \text{div}(\text{heapIs}))
heap_{funcstart_{724,1}}, heap_{funcstart_{724,1}}, 177).rem): 0) +
```

 $heap_{funcstart\_724,1}$ ,  $heap_{funcstart\_724,1}$ .p3, 178).quot) + (170 \* div(heapIs

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asType < int > (\$heap_{funcstart\_724,1}.\_replace(p1 \rightarrow ((-2 * div(heapIs)))))))
heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p1, 177).quot) + (171 * div(heapIs)
* div(heapIs heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p2, 176).quot) + (172 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p2,
176).rem)))._replace(p3 \rightarrow ((-63 * div(heapIs $heap_{funcstart\_724,1},
\rho_{funcstart\_724,1.p3}, 178).quot) + (170 * div(heapIs \rho_{funcstart\_724.1},
heap_{funcstart_{724,1}.p3, 178, rem)}
\rightarrow [simplify]
[65.40] $heap<sub>724,1;747,8</sub> == $heap<sub>funcstart_724,1</sub>._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 \ *
\label{eq:div_heap} \text{div}(\textbf{heapIs} \ \$ \text{heap}_{funcstart\_724,1}, \ \$ \text{heap}_{funcstart\_724,1}.\text{p1},
177).rem)))._replace(p2 \rightarrow ((-35 * div(heapIs $heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1}.\text{p2}, 176).\text{quot} + (172 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
\theta_{uncstart\_724,1.p2, 176}.rem))._replace(p3 \theta_{uncstart\_724,1.p2, 176}.rem))
heap_{funcstart_{-724,1}}, heap_{funcstart_{-724,1}}.p3, 178).quot) + (170 * div(heapIs
\$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p3, 178).rem))).\_\textbf{replace}(p1 \rightarrow
asType<short int>((-2 * div(heapIs $heap_{tuncstart_724.1},
\text{Sheap}_{funcstart\_724,1}.\text{p1}, 177).\text{quot} + (171 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1}.\text{p1}, 177).\text{rem} + ([0 < ((-171 * div(\mathbf{heapIs})))]
\text{Sheap}_{funcstart\_724.1}, \text{Sheap}_{funcstart\_724.1}.\text{p1}, 177).\text{rem}) + (2 * \text{div}(\text{heapIs}))
\rho_{uncstart_{724,1}}, \rho_{uncstart_{724,1},p1, 177}.quot): 30269, \rho_{uncstart_{724,1},p1, 177}.quot):
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 \ *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.p1, \ 177).rem))]: 0)))
\rightarrow [move guard outside expression]
[65.41] $\text{heap}_{724,1;747,8} == \text{$heap}_{funcstart\_724,1}._\text{$replace}(p1 \to ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 \ *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow ((-35 * div(heapIs $heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724.1.p2}, 176).\text{quot} + (172 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724.1},
\text{heap}_{funcstart\_724,1}.p2, 176).rem))).\_replace(p3 \rightarrow ((-63 * div(heapIs))))
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.p3, 178).quot) + (170 * div(heapIs)
\$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p3, \ 178).rem))).\_\mathbf{replace}(p1 \rightarrow
asType<short int>(([0 < ((-171 * div(heapIs $heap_{tuncstart\_724,1},
\text{Sheap}_{funcstart\_724,1}.\text{p1}, 177).\text{rem} + (2 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
heap_{funcstart_{-724,1}}.p1, 177).quot): 30269 + (-2 * div(heapIs
\$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1, 177).quot) + (171 * div(\mathbf{heapIs})
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.p1, 177).rem, [0 < ((-2 * div(\textbf{heapIs})))]
\$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1, 177).quot) + (171 * div(\mathbf{heapIs})
\theta_{funcstart_{-724,1}}, \theta_{funcstart_{-724,1}}.p1, 177).rem))]: 0 + (-2 * div(heapIs)
\theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}.p1, 177).quot) + (171 * div(heapIs
heap_{funcstart_{724,1}}, heap_{funcstart_{724,1}}, 177).rem)))
\rightarrow [simplify]
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[65.43] $heap<sub>724,1;747,8</sub> == $heap<sub>funcstart_724,1</sub>._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 \ *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow ((-35 * div(heapIs $heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1}.\text{p2}, 176).\text{quot} + (172 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
\rho_{funcstart\_724,1.p2, 176}.rem)._replace(p3 \rightarrow ((-63 * div(heapIs
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.p3, 178).quot) + (170 * div(heapIs)
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.p3, 178).rem))).\_replace(p1 \rightarrow ([0 < ]
((-171 * div(\mathbf{heapIs} \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1, 177).rem) +
(2 * \text{div}(\mathbf{heapIs} \$ \text{heap}_{funcstart\_724,1}, \$ \text{heap}_{funcstart\_724,1}.\text{p1}, 177).\text{quot}))]:
30269 + (-2 * div(\textbf{heapIs} \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1,
177).quot) + (171 * div(heapIs \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}.p1,
177).rem), [0 < ((-2 * div(heapIs $heap_{funcstart\_724,1}, $heap_{funcstart\_724,1}.p1,
177).quot) + (171 * div(heapIs heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p1,
177).rem))]: (-2 * div(heapIs \theta_{funcstart_{724,1}}, \theta_{funcstart_{724,1}}, p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_724.1}, \text{\$heap}_{funcstart\_724.1}, \text{p1},
177).rem)))
\rightarrow [move guard outside expression]
\label{eq:fine_start_724,1} [65.45] \ ([0 < ((-171 \ ^* \ \mathrm{div}(\mathbf{heapIs} \ \$ \mathrm{heap}_{funcstart\_724,1}, \ \$ \mathrm{heap}_{funcstart\_724,1}.\mathrm{p1},
177).rem) + (2 * \text{div}(\mathbf{heapIs} \$ \text{heap}_{funcstart\_724,1}, \$ \text{heap}_{funcstart\_724,1}.\text{p1},
177).quot))]: heap_{724,1;747,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 *
div(\mathbf{heapIs} \ \$heap_{funcstart\_724.1}, \ \$heap_{funcstart\_724.1}.p1, \ 177).quot) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow ((-35 * div(heapIs $heap_{funcstart\_724,1},
\text{Sheap}_{funcstart_{724,1},p2, 176}, quot) + (172 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart_{724,1}})
\text{Sheap}_{funcstart\_724,1}.\text{p2}, 176).\text{rem}))._replace(p3 \rightarrow ((-63 * div(heapIs)
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.\text{p3}, 178).\text{quot}) + (170 * \text{div}(\text{heapIs}))
\theta_{uncstart\_724,1}, \theta_{u
+ (-2 * div(\mathbf{heapIs} \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1, 177).quot) +
(171 * div(\mathbf{heapIs} \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1, 177).rem))), [0]
<((-2 * div(\mathbf{heapIs} \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1, 177).quot) +
(171 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_724,1}, \text{\$heap}_{funcstart\_724,1}.\text{p1}, 177).\text{rem}))]:
heap_{724,1;747,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 * div(heapIs)
\theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}.p1, 177).quot) + (171 * div(heapIs
\theta_{1.5} = \theta_{1
* div(\mathbf{heapIs} \ \$ heap_{funcstart\_724,1}, \ \$ heap_{funcstart\_724,1}.p2, \ 176).quot) + (172 \ *
\operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724.1}, \$ \operatorname{heap}_{funcstart\_724.1}.p2,
176).rem)))._replace(p3 \rightarrow ((-63 * div(heapIs $heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1}.\text{p3}, 178).\text{quot} + (170 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
\rho_{tuncstart\_724.1.p3, 178.rem})._replace(p1 \rightarrow ((-2 * div(heapIs
\text{Sheap}_{funcstart\_724.1}, \text{Sheap}_{funcstart\_724.1}.\text{p1}, 177).\text{quot}) + (171 * \text{div}(\text{heapIs}))
heap_{funcstart_{-724,1}}, heap_{funcstart_{-724,1}}, 177).rem))))
[Take given term]
\textit{[66.0]} \$ heap_{724,1;748,8} == \$ heap_{724,1;747,8}.\_\textbf{replace} (p2 \to \textbf{asType} < \textbf{short}
```

```
int>((asType<int>($heap<sub>724.1:747.8</sub>.M2) *
asType<int>(static_cast<integer>(asType<int>($heap_{724,1:747,8}.p2) <
(int)(0) + asType<int>($heap<sub>724,1:747,8</sub>.p2)))
\rightarrow [const static or extern object]
[66.1] $\text{heap}_{724,1:748,8} == $\text{heap}_{724,1:747,8}._\text{replace}(p2 \to \text{asType} < \text{short}
int>((asType<int>(\$heap_{init}.M2))*
asType<int>(static_cast<integer>(asType<int>($heap_{724,1:747,8}.p2) <
(int)(0) + asType < int > (\$heap_{724,1:747,8}.p2))
\rightarrow [expand definition of constant 'M2' at prang.c (19,20)]
[66.2] $\text{heap}_{724,1:748.8} == $\text{heap}_{724,1:747.8}._\text{replace}(p2 \to \text{asType} < \text{short}
int>((asType<int>(asType<short int>((int)30307)) *
asType<int>(static_cast<integer>(asType<int>($heap<sub>724.1:747.8</sub>.p2) <
(int)(0)) + asType < int > ($heap_{724,1;747,8}.p2)))
\rightarrow [simplify]
[66.10] $\text{heap}_{724,1;748,8} == $\text{heap}_{724,1;747,8}._\text{replace}(p2 \rightarrow \text{asType} < \text{short}
int>((30307 * asType< int>(([0 < -\$heap_{724,1;747,8}.p2]: 1, []: 0))) +
asType < int > (\$heap_{724,1;747,8}.p2)))
→ [explicitly assert falsehood of skipped guards in subsequent guards]
[66.11] $\text{heap}_{724.1:748.8} == \text{$heap}_{724.1:747.8}._\text{replace}(p2 \rightarrow \text{asType} < \text{short}
int>((30307 * asType < int>(([0 < -\$heap_{724,1;747,8}.p2]: 1, [!(0 < -\$heap_{724,1;747,8}.p2]: 1, [
-\$heap_{724.1;747.8}.p2): 0))) + asType<int>(\$heap_{724.1;747.8}.p2)))
\rightarrow [simplify]
[66.15] $\text{heap}_{724,1;748,8} == $\text{heap}_{724,1;747,8}.$\text{replace}(p2 \rightarrow asType < short)
int>((30307 * ([0 < -\$heap_{724,1:747,8}.p2]: 1, [-1 < \$heap_{724,1:747,8}.p2]: 0)) +
asType<int>($heap<sub>724.1:747.8</sub>.p2)))
\rightarrow [move guard outside expression]
[66.16] $\text{heap}_{724,1;748,8} == $\text{heap}_{724,1;747,8}._\text{replace}(p2 \rightarrow \text{asType} < \text{short}
\mathbf{int} {>} (([0 < -\$ \mathrm{heap}_{724,1;747,8}.\mathrm{p2}] {:}\ 1\ *\ 30307,\ [\text{-}1 < \$ \mathrm{heap}_{724,1;747,8}.\mathrm{p2}] {:}\ 0\ *
30307) + asType < int > (\$heap_{724,1;747,8}.p2)))
\rightarrow [simplify]
[66.19] $\text{heap}_{724,1;748,8} == $\text{heap}_{724,1;747,8}._\text{replace}(p2 \rightarrow \text{asType} < \text{short}
int>(([0 < -\$heap_{724,1;747,8}.p2]: 30307, [-1 < \$heap_{724,1;747,8}.p2]: 0) +
$heap<sub>724,1;747,8</sub>.p2))
\rightarrow [move guard outside expression]
[66.20] $\text{heap}_{724,1:748.8} == $\text{heap}_{724,1:747.8}.$\text{-replace}(p2 \rightarrow asType < short)
int>(([0 < -\$heap_{724,1:747,8}.p2]: 30307 + \$heap_{724,1:747,8}.p2, [-1 < -\$heap_{724,1:747,8}.p2])
heap_{724,1:747,8}.p2: 0 + p_{724,1:747,8}.p2))
\rightarrow [simplify]
```

```
[66.22] $heap<sub>724.1:748.8</sub> == $heap<sub>724.1:747.8</sub>.-replace(p2 \rightarrow ([0 <
-\$heap_{724,1:747,8}.p2]: 30307 + \$heap_{724,1:747,8}.p2, [-1 < \$heap_{724,1:747,8}.p2]:
$heap<sub>724,1;747,8</sub>.p2))
\rightarrow [move guard outside expression]
[66.24] ([0 < -$heap<sub>724,1;747,8</sub>.p2]: $heap<sub>724,1;748,8</sub> ==
\text{heap}_{724,1:747,8}._replace(p2 \rightarrow (30307 + \text{heap}_{724,1:747,8}.p2)), [-1 <
\rho_{724,1;747,8}: \rho_{724,1;748,8} == \rho_{724,1;747,8}. \rho_{724,1;747,8}
heap_{724,1;747,8}.p2)
[Take given term]
\textit{[69.0]} \$ heap_{funcend\_724,1} == \$ heap_{724,1;748,8}.\_\textbf{replace}(p3 \rightarrow \textbf{asType} < \textbf{short}
int>((asType<int>($heap<sub>724.1:748.8</sub>.M3) *
asType<int>(static_cast<integer>(asType<int>($heap<sub>724.1:748.8</sub>.p3) <
(int)(0)) + asType < int > ($heap_{724,1;748,8}.p3)))
\rightarrow [const static or extern object]
[69.1] \theta == 
int>((asType<int>(\$heap_{init}.M3) *
asType<int>(static_cast<integer>(asType<int>($heap<sub>724.1:748.8</sub>.p3) <
(int)(0)) + asType < int > ($heap_{724,1;748,8}.p3)))
\rightarrow [expand definition of constant 'M3' at prang.c (24,20)]
[69.2] \theta == 
int>((asType<int>(asType<short int>((int)30323)) *
asType<int>(static_cast<integer>(asType<int>($heap<sub>724.1:748.8</sub>.p3) <
(int)(0) + asType < int > (\$heap_{724,1;748,8}.p3))
\rightarrow [simplify]
[69.10] $\text{heap}_{funcend_724,1} == \text{$heap}_{724,1;748,8}._\text{replace}(p3 \rightarrow \text{asType} < \text{short}
int>((30323 * asType < int>(([0 < -\$heap_{724,1;748,8}.p3]: 1, []: 0))) +
\mathbf{asType}{<}\mathbf{int}{>}(\${\rm heap}_{724,1;748,8}.{\rm p3})))
→ [explicitly assert falsehood of skipped guards in subsequent guards]
[69.11] $\text{heap}_{funcend_724,1} == \text{$heap}_{724,1;748,8}._\text{replace}(p3 \rightarrow \text{asType} < \text{short}
int>((30323 * asType < int>)(([0 < -\$heap_{724,1:748,8}.p3]: 1, [!(0 < -\$heap_{724,1:748,8}.p3]: 1)
-\text{$heap}_{724,1;748,8}.p3)]: 0))) + asType<int>($heap}_{724,1;748,8}.p3)))
\rightarrow [simplify]
\textit{[69.15]} \$ heap_{funcend\_724,1} == \$ heap_{724,1;748,8}.\_\textbf{replace} (p3 \rightarrow \textbf{asType} < \textbf{short}
int > ((30323 * ([0 < -\$heap_{724,1;748,8}.p3]: 1, [-1 < \$heap_{724,1;748,8}.p3]: 0)) +
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{724,1;748,8}.\mathrm{p3})))
\rightarrow [move guard outside expression]
[69.16] $heap<sub>funcend_724.1</sub> == $heap<sub>724.1:748.8</sub>._replace(p3 \rightarrow asType<short
int>(([0 < -\$heap_{724,1:748,8}.p3]: 1 * 30323, [-1 < \$heap_{724,1:748,8}.p3]: 0 *
30323) + asType < int > (\$heap_{724.1:748.8}.p3)))
```

```
\rightarrow [simplify]
[69.19] \rho_{100} = \rho_{100
int>(([0 < -\$heap_{724,1;748,8}.p3]: 30323, [-1 < \$heap_{724,1;748,8}.p3]: 0) +
heap_{724,1;748,8}.p3)
\rightarrow [move guard outside expression]
[69.20] heap_{funcend\_724,1} == heap_{724,1:748,8}_replace(p3 \rightarrow asType<short
int>(([0 < -\$heap_{724,1;748,8}.p3]: 30323 + \$heap_{724,1;748,8}.p3, [-1 < -\$heap_{724,1;748,8}.p3])
heap_{724,1;748,8}.p3: 0 + p_{724,1;748,8}.p3))
\rightarrow [simplify]
[69.22] $\text{heap}_{funcend_724,1} == \text{$heap}_{724,1;748,8}.$\text{$replace}(p3 \to ([0 < ]
-\$heap_{724,1;748,8}.p3] : 30323 + \$heap_{724,1;748,8}.p3, [-1 < \$heap_{724,1;748,8}.p3] :
heap_{724,1;748,8}.p3)
\rightarrow [move guard outside expression]
[69.24] ([0 < -$heap<sub>724,1;748,8</sub>.p3]: $heap<sub>funcend_724,1</sub> ==
\text{heap}_{724,1:748,8}._replace(p3 \rightarrow (30323 + \text{heap}_{724,1:748,8}.p3)), [-1 <
\rho_{724,1;748,8}: \rho_{724,1;74
heap_{724,1;748,8}.p3)
[Branch on disjunction or conditional in term 69.24]
heap_{724,1;748,8}.p3)) \lor (heap_{funcend\_724,1} == heap_{724,1;748,8}.replace(p3 \rightarrow partial p
heap_{724,1;748,8}.p3) \lor (-1 < heap_{724,1;748,8}.p3)
[Branch on disjunction or conditional in term 69.24]
[73.0] (0 < -\$heap_{724,1;748,8}.p3) \lor (\$heap_{funcend\_724,1} = -
\text{$heap}_{724,1;748,8}.\mathbf{replace}(p3 \rightarrow \text{$heap}_{724,1;748,8}.p3)) \lor (-1 < \text{$heap}_{724,1;748,8}.p3)
[Copy term 1.56]
[74.0] ((-1 < -\$heap_{funcend\_724,1}.p1) \lor (-1 < -\$heap_{funcend\_724,1}.p2) \lor (-1 < -\$heap_{funcend\_724,1}.p2) \lor (-1 < -\$heap_{funcend\_724,1}.p2)
-\$heap_{funcend\_724,1}.p3) \lor (30268 < \$heap_{funcend\_724,1}.p1) \lor (30306 < \$heap_{funcend\_724,1}.p3)
\text{Sheap}_{funcend\_724,1}.\text{p2}) \lor (30322 < \text{Sheap}_{funcend\_724,1}.\text{p3})) \lor
(\text{\$heap}_{funcend\_724,1} == \text{\$heap}_{724,1;748,8}. \mathbf{replace}(p3 \to \text{\$heap}_{724,1;748,8}.p3)) \lor
(-1 < heap_{724,1;748,8}.p3)
\rightarrow [from term 72.0, $heap_{funcend\_724,1}$ is equal to $heap_{724,1;748,8}._replace(p3)
\rightarrow 30323 + \text{\$heap}_{724,1;748,8}.p3)
[74.1] ((-1 < -$heap<sub>724,1:748,8</sub>._replace(p3 \rightarrow (30323 +
\text{Sheap}_{724,1;748,8}.\text{p3}).\text{p1}) \lor (-1 < -\text{Sheap}_{funcend\_724,1}.\text{p2}) \lor (-1 < -\text{Sheap}_{funcend\_724,1}.\text{p2})
-\$heap_{funcend\_724,1}.p3) \lor (30268 < \$heap_{funcend\_724,1}.p1) \lor (30306 < functions)
\$heap_{funcend\_724,1}.p2) \lor (30322 < \$heap_{funcend\_724,1}.p3)) \lor \dots
\rightarrow [simplify]
[74.2] ((-1 < -$heap<sub>724,1;748,8</sub>.p1) \vee (-1 < -$heap<sub>funcend_724,1</sub>.p2) \vee (-1 <
```

```
-\$heap_{funcend\_724,1}.p3) \lor (30268 < \$heap_{funcend\_724,1}.p1) \lor (30306 < \$heap_{funcend\_724,1}.p3)
\text{Sheap}_{funcend\_724,1}.\text{p2}) \lor (30322 < \text{Sheap}_{funcend\_724,1}.\text{p3})) \lor \dots
\rightarrow [from term 72.0, $heap_{funcend\_724,1}$ is equal to $heap_{724,1;748,8}._replace(p3)
\rightarrow 30323 + \text{\$heap}_{724.1:748.8}.p3)
[74.3] ((-1 < -\$heap_{724,1;748,8}.p1) \lor (-1 < -\$heap_{724,1;748,8}.\_replace(p3 \rightarrow
(30323 + \text{\$heap}_{724,1;748,8}.\text{p3})).\text{p2}) \lor (-1 < -\text{\$heap}_{funcend\_724,1}.\text{p3}) \lor (30268 < -\text{\$heap}_{funcend\_724,1}.\text{p3})
\text{Sheap}_{funcend\_724,1}.\text{p1}) \lor (30306 < \text{Sheap}_{funcend\_724,1}.\text{p2}) \lor (30322 <
heap_{funcend\_724,1.p3}) \vee ...
\rightarrow [simplify]
[74.4] ((-1 < -$heap<sub>724.1:748.8</sub>.p1) \vee (-1 < -$heap<sub>724.1:748.8</sub>.p2) \vee (-1 <
-\$heap_{funcend\_724,1}.p3) \lor (30268 < \$heap_{funcend\_724,1}.p1) \lor (30306 < \$heap_{funcend\_724,1}.p3)
\text{Sheap}_{funcend\_724,1.p2}) \lor (30322 < \text{Sheap}_{funcend\_724,1.p3})) \lor \dots
\rightarrow [from term 72.0, $heap_{funcend\_724,1}$ is equal to $heap_{724,1;748,8}\_replace(p3)]
\rightarrow 30323 + $heap_{724,1;748,8}.p3)]
[74.5] ((-1 < -$heap<sub>724,1;748,8</sub>.p1) \vee (-1 < -$heap<sub>724,1;748,8</sub>.p2) \vee (-1 <
-\$heap_{724,1;748,8}.replace(p3 \rightarrow (30323 + \$heap_{724,1;748,8}.p3)).p3) \lor (30268 <
\text{Sheap}_{funcend\_724,1}.\text{p1}) \lor (30306 < \text{Sheap}_{funcend\_724,1}.\text{p2}) \lor (30322 <
heap_{funcend\_724,1}.p3) \vee ...
\rightarrow [simplify]
[74.10] \; ((-1 < -\$ heap_{724,1;748,8}.p1) \; \lor \; (-1 < -\$ heap_{724,1;748,8}.p2) \; \lor \; (30322 < -\$ heap_{724,1;748,8}
-\$heap_{724,1;748,8}.p3) \lor (30268 < \$heap_{funcend\_724,1}.p1) \lor (30306 < functions)
\$ heap_{funcend\_724,1}.p2) \lor (30322 < \$ heap_{funcend\_724,1}.p3)) \lor \dots
\rightarrow [from term 72.0, $heap_{funcend\_724,1}$ is equal to $heap_{724,1;748,8}._replace(p3)
\rightarrow 30323 + \$heap_{724,1;748,8}.p3)
[74.11] ((-1 < -$heap<sub>724,1;748,8</sub>.p1) \vee (-1 < -$heap<sub>724,1;748,8</sub>.p2) \vee (30322 <
-\$heap_{724,1;748,8}.p3) \lor (30268 < \$heap_{724,1;748,8}.replace(p3 \rightarrow (30323 + 1))
heap_{724,1;748,8.p3}).p1) \lor (30306 < heap_{funcend\_724,1.p2}) \lor (30322 < function for the content of the con
heap_{funcend\_724,1.p3}) \vee ...
\rightarrow [simplify]
[74.12] \; ((-1 < -\$ heap_{724,1;748,8}.p1) \; \lor \; (-1 < -\$ heap_{724,1;748,8}.p2) \; \lor \; (30322 < -\$ heap_{724,1;748,8}
 -\$heap_{724,1;748,8}.p3) \lor (30268 < \$heap_{724,1;748,8}.p1) \lor (30306 < \$heap_{724,1;748,8}.p3)
\$heap_{funcend\_724,1}.p2) \lor (30322 < \$heap_{funcend\_724,1}.p3)) \lor \dots
\rightarrow [from term 72.0, $heap_{funcend\_724,1}$ is equal to $heap_{724,1;748,8}._replace(p3)
\rightarrow 30323 + \$heap_{724,1;748,8}.p3)
[74.13] ((-1 < -$heap<sub>724.1:748.8</sub>.p1) \vee (-1 < -$heap<sub>724.1:748.8</sub>.p2) \vee (30322 <
-\$heap_{724,1:748,8}.p3) \lor (30268 < \$heap_{724,1:748,8}.p1) \lor (30306 < \$heap_{724,1:748,8}.p3)
\text{$heap}_{724,1;748,8}.\text{-replace}(p3 \rightarrow (30323 + \text{$heap}_{724,1;748,8}.p3)).p2) \lor (30322 < \text{$heap}_{724,1;748,8}.p3)
```

 $heap_{funcend\_724,1}.p3)$   $\vee ...$ 

 $\rightarrow$  [simplify]

```
[74.14] ((-1 < -$heap<sub>724,1;748,8</sub>.p1) \vee (-1 < -$heap<sub>724,1;748,8</sub>.p2) \vee (30322 <
-\$heap_{724,1;748,8}.p3) \lor (30268 < \$heap_{724,1;748,8}.p1) \lor (30306 < \$heap_{724,1;748,8}.p3)
\$ heap_{724,1;748,8}.p2) \lor (30322 < \$ heap_{funcend\_724,1}.p3)) \lor \dots
\rightarrow [from term 72.0, $heap_{funcend\_724,1}$ is equal to $heap_{724,1;748,8}._replace(p3)
\rightarrow 30323 + \text{$heap}_{724,1:748,8}.p3)
[74.15] ((-1 < -$heap<sub>724.1:748.8</sub>.p1) \vee (-1 < -$heap<sub>724.1:748.8</sub>.p2) \vee (30322 <
-\$heap_{724,1:748,8}.p3) \lor (30268 < \$heap_{724,1:748,8}.p1) \lor (30306 < \$heap_{724,1:748,8}.p3)
\text{heap}_{724,1:748.8}.\text{p2}) \lor (30322 < \text{heap}_{724,1:748.8}.\text{-replace}(\text{p3} \rightarrow (30323 +
heap_{724,1;748,8}.p_{3}).p_{3}) \vee ...
\rightarrow [simplify]
[74.18] ((-1 < -$heap<sub>724.1:748.8</sub>.p1) \vee (-1 < -$heap<sub>724.1:748.8</sub>.p2) \vee (30322 <
-\$heap_{724,1;748,8}.p3) \lor (30268 < \$heap_{724,1;748,8}.p1) \lor (30306 < \$heap_{724,1;748,8}.p3)
\text{Sheap}_{724,1;748,8}.\text{p2}) \lor (-1 < \text{Sheap}_{724,1;748,8}.\text{p3})) \lor \dots
\rightarrow [from term 73.0, literala < $heap<sub>724,1:748,8</sub>.p3 is false whenever -2 < (0 +
literala)]
        Proof of rule precondition:
        [74.18.0] - 2 < (-1 + 0)
        \rightarrow [simplify]
        [74.18.2] true
[74.19] ((-1 < -$heap<sub>724,1;748,8</sub>.p1) \vee (-1 < -$heap<sub>724,1;748,8</sub>.p2) \vee (30322 <
-\$heap_{724,1;748,8}.p3) \lor (30268 < \$heap_{724,1;748,8}.p1) \lor (30306 < \$heap_{724,1;748,8}.p3)
heap_{724.1:748.8}.p2) \lor false) \lor ...
\rightarrow [simplify]
[74.20] \; ((-1 < -\$heap_{724,1;748,8}.p1) \; \lor \; (-1 < -\$heap_{724,1;748,8}.p2) \; \lor \; (30268 < -\$heap_{724,1;748,8}.p2) \; \lor \;
\text{$heap}_{724,1;748,8}.\text{p1}) \lor (30306 < \text{$heap}_{724,1;748,8}.\text{p2}) \lor (30322 <
-\$heap_{724,1:748,8}.p3)) \lor ...
[Branch on disjunction or conditional in term 66.24]
[75.0] ($heap<sub>724,1:748,8</sub> == $heap<sub>724,1:747,8</sub>._replace(p2 \rightarrow (30307 +
heap_{724,1;747,8}.p2)) \lor (heap_{724,1;748,8} == heap_{724,1;747,8}.replace(p2 \rightarrow
heap_{724,1;747,8}.p2) \lor (-1 < heap_{724,1;747,8}.p2)
[Branch on disjunction or conditional in term 66.24]
[76.0] (0 < -\$heap_{724,1;747,8}.p2) \lor (\$heap_{724,1;748,8} = 
\text{Sheap}_{724,1;747,8}.\text{-replace}(p2 \to \text{Sheap}_{724,1;747,8}.p2)) \lor (-1 < \text{Sheap}_{724,1;747,8}.p2)
[Copy term 74.20]
[83.0] ((-1 < -$heap<sub>724,1;748,8</sub>.p1) \vee (-1 < -$heap<sub>724,1;748,8</sub>.p2) \vee (30268 <
\text{heap}_{724,1:748,8}.\text{p1}) \lor (30306 < \text{heap}_{724,1:748,8}.\text{p2}) \lor (30322 <
-\$heap_{724,1;748,8}.p3)) \lor (\$heap_{funcend\_724,1} == \$heap_{724,1;748,8}.\_\mathbf{replace}(p3)
\rightarrow \text{\$heap}_{724,1:748,8}.\text{p3})) \lor (-1 < \text{\$heap}_{724,1:748,8}.\text{p3}) \lor (\text{\$heap}_{724,1:748,8} ==
```

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\rightarrow [from term 75.0, $heap<sub>724,1:748,8</sub> is equal to $heap<sub>724,1:747,8</sub>._replace(p2 \rightarrow
30307 + \text{$heap}_{724,1;747,8}.p2)
[83.1] ((-1 < -$heap<sub>724,1;747,8</sub>._replace(p2 \rightarrow (30307 +
heap_{724,1;747,8}.p2).p1) \lor (-1 < -heap_{724,1;748,8}.p2) \lor (30268 < -heap_{724,1;747,8}.p2)
\text{$heap}_{724,1;748,8}.\text{p1}) \lor (30306 < \text{$heap}_{724,1;748,8}.\text{p2}) \lor (30322 <
-\$heap_{724,1;748,8}.p3)) \lor ...
\rightarrow [simplify]
[83.2] ((-1 < -$heap_{724,1;747,8}.p1) \vee (-1 < -$heap_{724,1;748,8}.p2) \vee (30268 <
\text{heap}_{724,1:748,8}.\text{p1}) \lor (30306 < \text{heap}_{724,1:748,8}.\text{p2}) \lor (30322 <
-\$heap_{724,1:748,8}.p3)) \lor ...
\rightarrow [from term 75.0, $heap<sub>724,1;748,8</sub> is equal to $heap<sub>724,1;747,8</sub>._replace(p2 \rightarrow
30307 + \$heap_{724,1;747,8}.p2)
[83.3] ((-1 < -\$heap_{724,1;747,8}.p1) \lor (-1 < -\$heap_{724,1;747,8}.\_replace(p2 \rightarrow
(30307 + \text{$heap}_{724,1;747,8}.\text{p2})).\text{p2}) \lor (30268 < \text{$heap}_{724,1;748,8}.\text{p1}) \lor (30306 < \text{$heap}_{724,1;748,8}.\text{p1})
\text{Sheap}_{724,1;748,8}.\text{p2}) \lor (30322 < -\text{Sheap}_{724,1;748,8}.\text{p3})) \lor \dots
\rightarrow [simplify]
[83.8] ((-1 < -$heap<sub>724,1;747,8</sub>.p1) \vee (30306 < -$heap<sub>724,1;747,8</sub>.p2) \vee (30268)
< $heap<sub>724,1;748,8</sub>.p1) \lor (30306 < $heap<sub>724,1;748,8</sub>.p2) \lor (30322 <
-\$heap_{724,1;748,8}.p3)) \lor ...
\rightarrow [from term 75.0, $heap_{724,1;748,8}$ is equal to $heap_{724,1;747,8}._replace(p2 \rightarrow
30307 + \text{$heap}_{724,1;747,8}.p2)
[83.9] ((-1 < -$heap_{724,1;747,8}.p1) \vee (30306 < -$heap_{724,1;747,8}.p2) \vee (30268
< $\text{heap}_{724,1:747,8}.\text{replace}(p2 \rightarrow (30307 + \text{$heap}_{724,1:747,8}.p2)).p1) \lor (30306)
< \text{$heap}_{724,1;748,8}.p2) \lor (30322 < -\text{$heap}_{724,1;748,8}.p3)) \lor \dots
\rightarrow [simplify]
[83.10] ((-1 < -\$heap_{724,1;747,8}.p1) \lor (30306 < -\$heap_{724,1;747,8}.p2) \lor (30268)
< $heap<sub>724,1;747,8</sub>.p1) \lor (30306 < $heap<sub>724,1;748,8</sub>.p2) \lor (30322 <
-\$heap_{724,1;748,8}.p3)) \lor ...
\rightarrow [from term 75.0, $heap<sub>724,1;748,8</sub> is equal to $heap<sub>724,1;747,8</sub>._replace(p2 \rightarrow
30307 + \$heap_{724,1;747,8}.p2)
[83.11] ((-1 < -\$heap_{724,1;747,8}.p1) \lor (30306 < -\$heap_{724,1;747,8}.p2) \lor (30268)
< $heap<sub>724,1;747,8</sub>.p1) \lor (30306 < $heap<sub>724,1;747,8</sub>._replace(p2 \rightarrow (30307 +
\text{heap}_{724,1;747,8}.\text{p2}).\text{p2}) \lor (30322 < -\text{heap}_{724,1;748,8}.\text{p3})) \lor \dots
\rightarrow [simplify]
[83.14] ((-1 < -$heap<sub>724.1:747.8</sub>.p1) \vee (30306 < -$heap<sub>724.1:747.8</sub>.p2) \vee (30268
< $heap<sub>724,1:747,8</sub>.p1) \lor (-1 < $heap<sub>724,1:747,8</sub>.p2) \lor (30322 < 
-\$heap_{724,1:748.8}.p3)) \lor ...
```

 $\text{Sheap}_{724,1;747,8}$ .-replace $(p2 \to \text{Sheap}_{724,1;747,8}.p2)) \lor (-1 < \text{Sheap}_{724,1;747,8}.p2)$ 

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\rightarrow [from term 76.0, literala < $heap<sub>724,1;747,8</sub>.p2 is false whenever -2 < (0 + literala)]
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Proof of rule precondition:
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[83.14.0] - 2 < (-1 + 0)
           \rightarrow [simplify]
           [83.14.2] true
[83.15] ((-1 < -\$heap_{724,1;747,8}.p1) \lor (30306 < -\$heap_{724,1;747,8}.p2) \lor (30268)
< $heap<sub>724,1:747,8</sub>.p1) \lor false \lor (30322 < -$heap<sub>724,1:748,8</sub>.p3)) \lor ...
\rightarrow [from term 75.0, $heap<sub>724,1;748,8</sub> is equal to $heap<sub>724,1;747,8</sub>._replace(p2 \rightarrow
30307 + \frac{\text{sheap}_{724} \cdot 747.8.p2}{1.747.8.p2}
[83.16] \; ((-1 < -\$heap_{724,1:747,8}.p1) \; \lor \; (30306 < -\$heap_{724,1:747,8}.p2) \; \lor \; (30268)
<\$ heap_{724,1;747,8}.p1) \ \lor \ \textbf{false} \ \lor \ (30322 < -\$ heap_{724,1;747,8}.\textbf{\_replace}(p2 \rightarrow
(30307 + \text{\$heap}_{724,1;747,8}.\text{p2})).\text{p3})) \lor \dots
\rightarrow [simplify]
[83.18] \; ((-1 < -\$heap_{724,1;747,8}.p1) \; \lor \; (30268 < \$heap_{724,1;747,8}.p1) \; \lor \; (30306 < -\$heap_{724,1;747,8}.p1) \; \lor
-\$heap_{724,1:747,8}.p2) \lor (30322 < -\$heap_{724,1:747,8}.p3)) \lor ...
[Branch on disjunction or conditional in term 65.45]
[84.0] ($heap<sub>724,1;747,8</sub> == $heap<sub>funcstart_724,1</sub>._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 \ *
\operatorname{div}(\mathbf{heapIs}\ \$ \operatorname{heap}_{funcstart\_724,1},\ \$ \operatorname{heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow ((-35 * div(heapIs $heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1}.\text{p2}, 176).\text{quot} + (172 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
\rho_{funcstart\_724,1.p2, 176}.rem)._replace(p3 \rightarrow ((-63 * div(heapIs
heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p3, 178).quot) + (170 * div(heapIs)
\rho_{funcstart\_724,1}, \rho_{func
(30269 + (-2 * div(\mathbf{heapIs} \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{heap}_{funcstart\_724,1}, \text{heap}_{funcstart\_724,1}.p1,
177).rem)))) \vee ($heap<sub>724,1;747,8</sub> == $heap<sub>funcstart_724,1</sub>._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).quot) + (171 *
\operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724,1}, \$ \operatorname{heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow ((-35 * div(heapIs $heap_{funcstart_724,1},
\text{Sheap}_{funcstart\_724,1}.\text{p2}, 176).\text{quot} + (172 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724.1.p2}, 176).\text{replace}(p3 \rightarrow ((-63 * \text{div}(\text{heapIs}))))
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.\text{p3}, 178).\text{quot}) + (170 * \text{div}(\text{heapIs}))
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.p3, 178).rem))).\_replace(p1 \rightarrow ((-2 * 
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).quot) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).rem)))) \lor (0 <
((-2 * div(\mathbf{heapIs} \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1, 177).quot) +
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 $(171 * \operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724,1}, \$ \operatorname{heap}_{funcstart\_724,1}.\operatorname{p1}, 177).\operatorname{rem})))$ 

```
[85.0] (0 < ((-171 * div(heapIs $heap_{funcstart\_724,1}, $heap_{funcstart\_724,1}.p1,
177).rem) + (2 * \text{div}(\mathbf{heapIs} \$ \text{heap}_{funcstart\_724,1}, \$ \text{heap}_{funcstart\_724,1}.\text{p1},
177).quot))) \vee ($heap<sub>724,1;747,8</sub> == $heap<sub>funcstart_724,1</sub>._replace(p1 \rightarrow ((-2 *
div(\mathbf{heapIs} \ \$heap_{funcstart\_724,1}, \ \$heap_{funcstart\_724,1}.p1, \ 177).quot) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow ((-35 * div(heapIs $heap_{funcstart_724,1},
\text{Sheap}_{funcstart\_724,1.p2}, 176).\text{quot} + (172 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1}.\text{p2}, 176).\text{rem}))._replace(p3 \rightarrow ((-63 * div(heapIs)
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.p3, 178).quot) + (170 * div(heapIs)
\theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}.p3, 178).rem))).\_replace(p1 \rightarrow ((-2 * funcstart\_724,1)))
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).quot) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}. p1, 177).rem)))) \lor (0 <
((-2 * div(\mathbf{heapIs} \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1, 177).quot) +
(171 * \operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724,1}, \$ \operatorname{heap}_{funcstart\_724,1}.\operatorname{p1}, 177).\operatorname{rem})))
[Copy term 75.0]
[86.0] (heap_{724,1;748,8} == heap_{724,1;747,8}._replace(p2 \rightarrow (30307 +
\text{Sheap}_{724,1;747,8}.\text{p2}))) \lor (\text{Sheap}_{724,1;748,8} == \text{Sheap}_{724,1;747,8}.\_\text{replace}(\text{p2} \rightarrow
\text{Sheap}_{724,1;747,8}.\text{p2})) \lor (-1 < \text{Sheap}_{724,1;747,8}.\text{p2}) \lor (\text{Sheap}_{724,1;747,8} = -1)
\text{Sheap}_{funcstart\_724.1}._replace(p1 \rightarrow ((-2 * div(heapIs \text{Sheap}_{funcstart\_724.1}),
\text{Sheap}_{funcstart\_724.1.p1}, 177).\text{quot} + (171 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724.1},
\rho_{tuncstart\_724.1.p1, 177).rem}.-replace(p2 \rightarrow ((-35 * div(heapIs
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.\text{p2}, 176).\text{quot}) + (172 * \text{div}(\text{heapIs}))
\$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p2, \ 176).rem))).\_\mathbf{replace}(p3 \rightarrow ((-63 - 100))))
* div(heapIs heap_{funcstart_{-724,1}}, heap_{funcstart_{-724,1}}, 178).quot) + (170 *
\operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724.1}, \$ \operatorname{heap}_{funcstart\_724.1}.p3,
178).rem)))._replace(p1 \rightarrow ((-2 * div(heapIs $heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1}.\text{p1}, 177).\text{quot} + (171 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
\theta_{funcstart\_724,1}.p1, 177).rem)))) \lor (0 < ((-2 * div(heapIs)))
\theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.p1, 177).rem)))
\rightarrow [from term 84.0, $heap<sub>724,1;747,8</sub> is equal to $heap<sub>funcstart_724,1</sub>._replace(p1
\rightarrow ((-2 * div(\mathbf{heapIs} \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1, 177).quot) +
(171 * div(\mathbf{heapIs} \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow ((-35 * div(\mathbf{heapIs} \$heap_{funcstart\_724,1},
heap_{funcstart_{724,1},p2, 176}, quot) + (172 * div(heapIs p_{funcstart_{724,1},p2}
\rho_{funcstart\_724.1.p2, 176}.rem))._replace\rho_{funcstart\_724.1.p2, 176}.rem))._replace
heap_{funcstart_{-724,1}}, heap_{funcstart_{-724,1}}, p_{3,178}, q_{100}, q_{100}, q_{100}
heap_{funcstart\_724,1}, heap_{funcstart\_724,1}, p_3, p_4, p_5, p_6, p_7, p_8, p_8
+ (-2 * div(\mathbf{heapIs} \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1, 177).quot) +
(171 * div(\mathbf{heapIs} \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1, 177).rem))]
[86.2] (\text{$heap}_{724,1;748,8} == \text{$heap}_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 *
\operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724.1}, \$ \operatorname{heap}_{funcstart\_724.1}.p1,
177).rem)))._replace(p2 \rightarrow ((-35 * div(heapIs $heap_{funcstart\_724,1},
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\text{Sheap}_{funcstart_{-724,1},p2, 176}.quot) + (172 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart_{-724,1}},
\rho_{funcstart\_724,1.p2, 176}.rem)._replace(p3 \rightarrow ((-63 * div(heapIs
\theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}
\rho_{funcstart\_724,1}, \rho_{func
(30269 + (-2 * div(\mathbf{heapIs} \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{heap}_{funcstart\_724,1}, \text{heap}_{funcstart\_724,1}.\text{p1},
177).rem)))._replace(p2 \rightarrow (30307 + $heap_{funcstart\_724,1}._replace(p1 \rightarrow ((-2
* div(heapIs heap_{funcstart_{-724,1}}, heap_{funcstart_{-724,1}}, 177).quot) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724.1}.p1,
177).rem)))._replace(p2 \rightarrow ((-35 * div(heapIs $heap_{funcstart_724,1},
\text{Sheap}_{funcstart\_724,1}.\text{p2}, 176).\text{quot} + (172 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724.1.p2}, 176).\text{replace}(p3 \rightarrow ((-63 * \text{div}(\text{heapIs}))))
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.p3, 178).quot) + (170 * div(heapIs)
\rho_{funcstart\_724,1}, \rho_{func
(30269 + (-2 * div(\mathbf{heapIs} \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_724.1}, \text{\$heap}_{funcstart\_724.1}, \text{p1},
177).rem))).p2))) \vee \dots
\rightarrow [simplify]
[86.6] (heap_{724,1;748,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 \ *
\operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724.1}, \$ \operatorname{heap}_{funcstart\_724.1}.p1,
177).rem)))._replace(p2 \rightarrow ((-35 * div(heapIs $heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1}.\text{p2}, 176).\text{quot} + (172 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
\theta_{uncstart\_724,1.p2, 176}.rem))._replace(p3 \rightarrow ((-63 * div(heapIs
\text{Sheap}_{funcstart_{-724.1}}, \text{Sheap}_{funcstart_{-724.1}}.p3, 178).quot) + (170 * div(heapIs)
heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p3, 178).rem))._replace(p1 \rightarrow
(30269 + (-2 * div(\mathbf{heapIs} \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1,
177).quot) + (171 * div(heapIs heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow (30307 + (-35 * div(heapIs $heap_{funcstart, 724.1},
\text{Sheap}_{funcstart\_724,1.p2}, 176).\text{quot} + (172 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
heap_{funcstart_{724,1},p2, 176,rem}))) \vee ...
[Copy term 76.0]
[88.0] (0 < -$heap<sub>724,1:747,8</sub>.p2) \vee ($heap<sub>724,1:748,8</sub> ==
\text{heap}_{724,1;747,8}.\text{-}\mathbf{replace}(p2 \rightarrow \text{heap}_{724,1;747,8}.p2)) \lor (-1 <
\text{Sheap}_{724,1;747,8}.\text{p2}) \lor (\text{Sheap}_{724,1;747,8} == \text{Sheap}_{funcstart\_724,1}.\_\textbf{replace}(\text{p1} \to \text{p1})
((-2 * div(\mathbf{heapIs} \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1, 177).quot) +
(171 * div(heapIs heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow ((-35 * div(heapIs $heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1}.\text{p2}, 176).\text{quot} + (172 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
\rho_{funcstart\_724,1.p2, 176}.rem)._replace(p3 \rightarrow ((-63 * div(heapIs
heap_{funcstart_{724,1}}, heap_{funcstart_{724,1}}.p3, 178).quot) + (170 * div(heapIs)
\theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}.p3, 178).rem))._replace(p1 \rightarrow ((-2 *
div(\mathbf{heapIs} \ \text{$heap}_{funcstart\_724.1}, \ \text{$heap}_{funcstart\_724.1}.p1, \ 177).quot) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).rem)))) \lor (0 <
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((-2 * div(\mathbf{heapIs} \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1, 177).quot) +
(171 * div(\mathbf{heapIs} \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1, 177).rem)))
\rightarrow [from term 84.0, $heap<sub>724,1:747,8</sub> is equal to $heap<sub>funcstart_724,1</sub>._replace(p1)
\rightarrow ((-2 * div(\mathbf{heapIs} \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1, 177).quot) +
(171 * div(\mathbf{heapIs} \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow ((-35 * div(\mathbf{heapIs} \$heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1}.\text{p2}, 176).\text{quot} + (172 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
heap_{funcstart\_724,1}.p2, 176).rem))).\_replace(p3 \rightarrow ((-63 * div(heapIs))).\_replace(p3 \rightarrow ((-63 * div(heapIs)))))._replace(p3 \rightarrow ((-63 * div(heapIs)))))
\text{Sheap}_{funcstart\_724.1}, \text{Sheap}_{funcstart\_724.1}.p3, 178).quot) + (170 * div(heapIs)
\theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}
+ (-2 * div(heapIs $heap_{funcstart\_724,1}, $heap_{funcstart\_724,1}.p1, 177).quot) +
(171 * div(\mathbf{heapIs} \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1, 177).rem))]
[88.1] (0 < -\$heap_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 * div(heapIs))))
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.\text{p1}, 177).\text{quot}) + (171 * \text{div}(\text{heapIs}))
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.\text{p1}, 177).\text{rem}))._replace(p2 \rightarrow ((-35)
* div(heapIs heap_{funcstart_{-724,1}}, heap_{funcstart_{-724,1}}.p2, 176).quot) + (172 *
\operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724,1}, \$ \operatorname{heap}_{funcstart\_724,1}.p2,
176).rem)))._replace(p3 \rightarrow ((-63 * div(heapIs $heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1}.\text{p3}, 178).\text{quot} + (170 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
\rho_{funcstart\_724,1.p3, 178).rem)._replace(p1 \rightarrow (30269 + (-2 * div(heapIs
\$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1, 177).quot) + (171 * div(\mathbf{heapIs})
\text{Sheap}_{funcstart_{724,1}}, \text{Sheap}_{funcstart_{724,1}.p1, 177).rem})).p2) \lor ...
\rightarrow [simplify]
[88.7] (0 < ((35 * div(heap
Is $heap_{funcstart\_724,1}, $heap_{funcstart\_724,1}.p2,
176).quot) + (-172 * \text{div}(\textbf{heapIs} \$ \text{heap}_{funcstart\_724,1}, \$ \text{heap}_{funcstart\_724,1}.\text{p2},
176).rem))) \vee ...
[Copy term 83.18]
 \lceil 90.0 \rceil \; ((\text{-}1 < -\$ \text{heap}_{724,1;747,8}.\text{p1}) \; \lor \; (30268 < \$ \text{heap}_{724,1;747,8}.\text{p1}) \; \lor \; (30306 < \$ \text{heap}_{724,1;747,8}.\text{p2}) \; \lor \; (30306 < \$ \text{heap}_{724,1;747,8}.\text{p3}) \; \lor \; (30306
-\$heap_{724,1:747.8}.p2) \lor (30322 < -\$heap_{724,1:747.8}.p3)) \lor (\$heap_{funcend_724.1}.p3)
== $heap<sub>724.1:748.8</sub>.replace(p3 \rightarrow $heap<sub>724,1:748,8</sub>.p3)) \lor (-1 <
\text{Sheap}_{724,1:748,8}.\text{p3}) \lor (\text{Sheap}_{724,1:748,8} == \text{Sheap}_{724,1:747,8}.\textbf{replace}(\text{p2} \to \text{p3}))
\text{Sheap}_{724,1:747,8}.\text{p2})) \lor (-1 < \text{Sheap}_{724,1:747,8}.\text{p2}) \lor (\text{Sheap}_{724,1:747,8} = -
\text{Sheap}_{funcstart\_724.1}._replace(p1 \rightarrow ((-2 * div(heapIs \text{Sheap}_{funcstart\_724.1}),
\text{Sheap}_{funcstart\_724,1}.\text{p1}, 177).\text{quot} + (171 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
\rho_{funcstart\_724,1.p1, 177).rem}))._replace(p2 \rightarrow ((-35 * div(heapIs
heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p2, 176).quot) + (172 * div(heapIs)
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.p2, 176).rem))).\_replace(p3 \rightarrow ((-63)))
* div(heapIs heap_{funcstart_{724,1}}, heap_{funcstart_{724,1}}, 178).quot) + (170 *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.p3,
178).rem)))._replace(p1 \rightarrow ((-2 * div(heapIs $heap_{funcstart_724,1},
\text{Sheap}_{funcstart\_724,1}.\text{p1}, 177).\text{quot}) + (171 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1}.\text{p1}, 177).\text{rem})))) \lor (0 < ((-2 * div(\textbf{heapIs}))))) \lor (0 < ((-2 * div(\textbf{heapIs})))))
\theta_{funcstart_{724,1}}, \theta_{funcstart_{724,1},p1, 177}.quot + (171 * div(heapIs))
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\text{Sheap}_{funcstart_{-724,1}}, \text{Sheap}_{funcstart_{-724,1}}.p1, 177).rem)))
\rightarrow [from term 84.0, $heap<sub>724,1;747,8</sub> is equal to $heap<sub>funcstart_724,1</sub>._replace(p1
\rightarrow ((-2 * div(\mathbf{heapIs} \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1, 177).quot) +
(171 * div(heapIs heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow ((-35 * div(\mathbf{heapIs} \$heap_{funcstart\_724.1},
\text{Sheap}_{funcstart\_724,1}.\text{p2}, 176).\text{quot} + (172 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
heap_{funcstart\_724,1}.p2, 176).rem))._replace(p3 \rightarrow ((-63 * div(heapIs)))._replace)
heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p3, 178).quot) + (170 * div(heapIs)
\theta_{uncstart\_724.1}, \theta_{uncstart\_724.1}, \theta_{uncstart\_724.1}, \theta_{uncstart\_724.1}, \theta_{uncstart\_724.1}
+ (-2 * div(\mathbf{heapIs} \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1, 177).quot) +
(171 * div(\mathbf{heapIs} \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1, 177).rem))]
[90.1] ((-1 < -$heap_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 * div(heapIs
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.p1, 177).quot) + (171 * div(heapIs)
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.\text{p1}, 177).\text{rem}))._replace(p2 \rightarrow ((-35)
* div(\mathbf{heapIs} \ \$heap_{funcstart\_724,1}, \ \$heap_{funcstart\_724,1}.p2, \ 176).quot) + (172 \ *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p2,
176).rem)))._replace(p3 \rightarrow ((-63 * div(heapIs $heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724.1.p3}, 178).\text{quot} + (170 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724.1},
\text{heap}_{funcstart\_724.1}.\text{p3}, 178).\text{rem}))._replace(p1 \rightarrow (30269 + (-2 * div(heapIs))
\theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}
\text{Sheap}_{funcstart\_724.1}, \text{Sheap}_{funcstart\_724.1}.\text{p1}, 177).\text{rem})).\text{p1}) \lor (30268 <
\text{heap}_{724.1:747.8.p1} \lor (30306 < -\text{heap}_{724.1:747.8.p2}) \lor (30322 < -\text{heap}_{724.1:747.8.p2})
-\$heap_{724,1;747,8}.p3)) \lor ...
\rightarrow [simplify]
[90.10] ((30268 < ((-171 * div(heapIs $heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1}.\text{p1}, 177).\text{rem} + (2 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1.p1}, 177).\text{quot}))) \lor (30268 < \text{Sheap}_{724,1;747,8.p1}) \lor (30306)
<-$heap<sub>724,1;747,8</sub>.p2) \lor (30322 <-$heap<sub>724,1:747,8</sub>.p3)) \lor ...
\rightarrow [from term 54.11, literala < ((-171 * div(heapIs $heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1}.\text{p1}, 177).\text{rem} + (2 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
heap_{funcstart\_724,1}.p1, 177).quot) is false whenever -2 < (-30269 + literala)
    Proof of rule precondition:
    [90.10.0] - 2 < (-30269 + 30268)
    \rightarrow [simplify]
     [90.10.2] true
[90.11] (\textbf{false} \lor (30268 < \$heap_{724,1;747,8}.p1) \lor (30306 < -\$heap_{724,1;747,8}.p2)
\vee (30322 < -\$heap_{724,1;747,8}.p3)) \vee ...
\rightarrow [from term 84.0, $heap<sub>724,1;747,8</sub> is equal to $heap<sub>funcstart_724,1</sub>._replace(p1)
\rightarrow ((-2 * div(\mathbf{heapIs} \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1, 177).quot) +
(171 * div(\mathbf{heapIs} \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow ((-35 * div(\mathbf{heapIs} \$heap_{funcstart\_724,1},
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\text{Sheap}_{funcstart_{-724,1},p2}, 176).\text{quot}) + (172 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart_{-724,1}},
heap_{funcstart\_724,1}.p2, 176).rem))._replace(p3 \rightarrow ((-63 * div(heapIs)))._
heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p3, 178).quot) + (170 * div(heapIs)
heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p3, 178).rem)))._replace(p1 \rightarrow 30269
+ (-2 * div(heapIs $heap_{funcstart\_724,1}, $heap_{funcstart\_724,1}.p1, 177).quot) +
(171 * div(\mathbf{heapIs} \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1, 177).rem))]
[90.12] (false \vee (30268 < $heap<sub>funcstart_724,1</sub>._replace(p1 \rightarrow ((-2 *
div(\mathbf{heapIs} \ \$heap_{funcstart\_724,1}, \ \$heap_{funcstart\_724,1}.p1, \ 177).quot) + (171 *
\operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724.1}, \$ \operatorname{heap}_{funcstart\_724.1}.p1,
177).rem)))._replace(p2 \rightarrow ((-35 * div(heapIs $heap_{funcstart_724,1},
\text{Sheap}_{funcstart\_724,1}.\text{p2}, 176).\text{quot} + (172 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
\rho_{tuncstart\_724.1.p2, 176}.rem)._replace(p3 \rightarrow ((-63 * div(heapIs
\text{Sheap}_{funcstart_{-724.1}}, \text{Sheap}_{funcstart_{-724.1}}.p3, 178).quot) + (170 * div(heapIs)
\rho_{funcstart\_724,1}, \rho_{funcstart\_724,1}
+ (-2 * div(heapIs $heap_{funcstart\_724,1}, $heap_{funcstart\_724,1}.p1, 177).quot) +
(171 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_724,1}, \text{\$heap}_{funcstart\_724,1}.\text{p1}, 177).\text{rem}))).\text{p1})
\vee (30306 < -\$heap_{724,1;747,8}.p2) \vee (30322 < -\$heap_{724,1;747,8}.p3)) \vee ...
\rightarrow [simplify]
[90.15] (false \vee (-1 < ((-2 * div(heapIs $heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1}.\text{p1}, 177).\text{quot} + (171 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1.p1, 177}.\text{rem}))) \lor (30306 < -\text{Sheap}_{724,1;747,8.p2}) \lor (30322)
< -\$heap_{724,1;747,8}.p3)) \lor ...
\rightarrow [from term 85.0, literala < ((-2 * div(heapIs $heap_{funcstart_724.1},
\text{Sheap}_{funcstart\_724,1}.\text{p1}, 177).\text{quot} + (171 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
heap_{funcstart_{-724,1},p1,177}.rem) is false whenever -2 < (0 + literala)
       Proof of rule precondition:
       [90.15.0] - 2 < (-1 + 0)
       \rightarrow [simplify]
       [90.15.2] true
[90.16] (false \vee false \vee (30306 < -$heap<sub>724.1:747.8</sub>.p2) \vee (30322 <
-\$heap_{724,1:747.8}.p3)) \lor ...
\rightarrow [from term 84.0, $heap<sub>724,1;747,8</sub> is equal to $heap<sub>funcstart_724,1</sub>._replace(p1
\rightarrow ((-2 * div(heapIs $heap_{funcstart\_724,1}, $heap_{funcstart\_724,1}.p1, 177).quot) +
(171 * div(\mathbf{heapIs} \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow ((-35 * div(\mathbf{heapIs} \$heap_{funcstart\_724,1},
heap_{funcstart_{724,1},p2, 176}, quot) + (172 * div(heapIs p_{funcstart_{724,1},p2}
\rho_{funcstart\_724,1.p2, 176}.rem))._replace\rho_{funcstart\_724,1.p2, 176}.rem))._replace
heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p3, 178).quot) + (170 * div(heapIs)
\theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}
 + (-2 * div(\mathbf{heapIs} \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1, 177).quot) +
(171 * div(\mathbf{heapIs} \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1, 177).rem))]
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[90.17] (false \vee false \vee (30306 < -$heap<sub>funcstart_724,1</sub>._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow ((-35 * div(heapIs $heap_{funcstart_724,1},
\text{Sheap}_{funcstart\_724,1}.\text{p2}, 176).\text{quot} + (172 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
\rho_{funcstart\_724,1.p2, 176}.rem)._replace(p3 \rightarrow ((-63 * div(heapIs
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.p3, 178).quot) + (170 * div(heapIs)
\rho_{funcstart\_724,1}, \rho_{func
(30269 + (-2 * div(heapIs $heap_{funcstart\_724,1}, $heap_{funcstart\_724,1}.p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_724,1}, \text{\$heap}_{funcstart\_724,1}.p1,
(177).rem)).p2) \lor (30322 < -\$heap_{724,1:747,8}.p3)) \lor ...
\rightarrow [simplify]
[90.23] (false \vee false \vee (30306 < ((35 * div(heapIs $heap_{funcstart_{724,1}},
\text{Sheap}_{funcstart\_724,1}.\text{p2}, 176).\text{quot} + (-172 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1.p2, 176}.\text{rem})) \lor (30322 < -\text{Sheap}_{724,1;747,8.p3})) \lor ...
\rightarrow [from term 58.12, literala < ((-172 * div(heapIs $heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724.1.p2}, 176).\text{rem} + (35 * div(\text{heapIs} \$\text{heap}_{funcstart\_724.1},
\text{Sheap}_{funcstart\_724,1}.p2, 176).quot) is false whenever -2 < (-30307 + \text{literala})
       Proof of rule precondition:
       [90.23.0] - 2 < (-30307 + 30306)
       \rightarrow [simplify]
       [90.23.2] true
[90.24] (false \vee false \vee false \vee (30322 < -$heap<sub>724.1:747.8.p3</sub>)) \vee ...
\rightarrow [from term 84.0, $heap_{724,1;747,8}$ is equal to $heap_{funcstart\_724,1}._replace(p1)
\rightarrow ((-2 * div(\mathbf{heapIs} \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1, 177).quot) +
(171 * div(heapIs heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow ((-35 * div(\mathbf{heapIs} \$heap_{funcstart\_724.1},
\text{Sheap}_{funcstart_{724,1},p2}, 176).\text{quot}) + (172 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart_{724,1}},
\rho_{funcstart\_724.1.p2, 176}.rem))._replace\rho_{funcstart\_724.1.p2, 176}.rem))._replace
heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p3, 178).quot) + (170 * div(heapIs)
\theta_{funcstart\_724.1}, \theta_{funcstart\_724.1}, \theta_{funcstart\_724.1}, \theta_{funcstart\_724.1}, \theta_{funcstart\_724.1}, \theta_{funcstart\_724.1}
 + (-2 * div(\mathbf{heapIs} \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1, 177).quot) +
(171 * div(\mathbf{heapIs} \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1, 177).rem))]
[90.25] (false \vee false \vee false \vee (30322 < -\$heap_{funcstart\_724,1}._replace(p1
\rightarrow ((-2 * div(heapIs $heap_{funcstart\_724,1}, $heap_{funcstart\_724,1}.p1, 177).quot) +
(171 * \text{div}(\textbf{heapIs} \$ \text{heap}_{funcstart\_724,1}, \$ \text{heap}_{funcstart\_724,1}.\text{p1},
177).rem)))._replace(p2 \rightarrow ((-35 * div(heapIs $heap_{funcstart_724,1},
\text{Sheap}_{funcstart\_724,1}.\text{p2}, 176).\text{quot} + (172 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
heap_{funcstart\_724,1}.p2, 176).rem))._replace(p3 \rightarrow ((-63 * div(heapIs)
\text{Sheap}_{funcstart\_724.1}, \text{Sheap}_{funcstart\_724.1}.p3, 178).quot) + (170 * div(heapIs)
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(30269 + (-2 * div(\mathbf{heapIs} \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1,
177).quot) + (171 * div(heapIs \theta_{funcstart_{724,1}}, \theta_{funcstart_{724,1}}
(177).rem))).p3)) \vee ...
\rightarrow [simplify]
[90.30] (false \vee false \vee false \vee (30322 < ((63 * div(heapIs
heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p3, 178).quot) + (-170 * div(heapIs
\text{Sheap}_{funcstart_{724,1}}, \text{Sheap}_{funcstart_{724,1}}, \text{p3}, 178).rem)))) \lor ...
\rightarrow [from term 62.13, literala < ((-170 * div(heapIs $heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1}.p3, 178).rem) + (63 * div(\text{heapIs} \text{Sheap}_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1}.p3, 178).quot) is false whenever -2 < (-30323 + \text{literala})
      Proof of rule precondition:
      [90.30.0] - 2 < (-30323 + 30322)
      \rightarrow [simplify]
      [90.30.2] true
[90.31] (false \lor false \lor false \lor false) \lor ...
\rightarrow [simplify]
[90.32] false \vee ...
[Remove 'false' term 90.32 and fetch new term from containing clause]
[91.0] ($heap<sub>724,1;747,8</sub> == $heap<sub>funcstart_724,1</sub>._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow ((-35 * div(heapIs $heap_{funcstart_724,1},
\text{Sheap}_{funcstart\_724,1.p2}, 176).\text{quot} + (172 * \text{div}(\text{heapIs} \text{Sheap}_{funcstart\_724,1},
\rho_{funcstart\_724,1.p2, 176}.rem))._replace(p3 \rightarrow ((-63 * div(heapIs
heap_{funcstart_{724,1}}, heap_{funcstart_{724,1}}.p3, 178).quot) + (170 * div(heapIs)
\rho_{funcstart_{724,1}}, \rho_{funcstart_{724,1},p3, 178}.rem))._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.p1, \ 177).rem)))) \lor
(\text{\$heap}_{funcend\_724,1} == \text{\$heap}_{724,1;748,8}.\_\mathbf{replace}(p3 \to \text{\$heap}_{724,1;748,8}.p3)) \lor
(-1 < \text{\$heap}_{724,1;748,8}.p3) \lor (\text{\$heap}_{724,1;748,8} == \text{\$heap}_{724,1;747,8}.\_\mathbf{replace}(p2)
\rightarrow $heap<sub>724,1;747,8</sub>.p2)) \lor (-1 < $heap<sub>724,1;747,8</sub>.p2)
[Remove 'false' term 90.32 and fetch new term from containing clause]
[92.0] (0 < ((-2 * div(heapIs $heap_{funcstart\_724,1}, $heap_{funcstart\_724,1}.p1,
177).quot) + (171 * div(heapIs \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}.p1,
177).rem))) \vee ($heap<sub>funcend_724,1</sub> == $heap<sub>724,1;748,8</sub>._replace(p3 \rightarrow
\text{Sheap}_{724,1:748,8}.\text{p3})) \lor (-1 < \text{Sheap}_{724,1:748,8}.\text{p3}) \lor (\text{Sheap}_{724,1:748,8} = -1)
\text{Sheap}_{724,1;747,8}._replace(p2 \to \text{Sheap}_{724,1;747,8}.p2)) \lor (-1 < \text{Sheap}_{724,1;747,8}.p2)
[Copy term 74.20]
[83.18] ((-1 < -$heap<sub>724.1:747.8.p1)</sub> \vee (30268 < $heap<sub>724.1:747.8.p1</sub>) \vee (30306 <
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-\$heap_{724,1:747,8}.p2) \lor (30322 < -\$heap_{724,1:747,8}.p3)) \lor (\$heap_{funcend\_724,1}.p3)
== $heap<sub>724,1:748,8</sub>._replace(p3 \rightarrow $heap<sub>724,1:748,8</sub>.p3)) \lor (-1 <
\text{Sheap}_{724,1;748,8}.\text{p3}) \lor (\text{Sheap}_{724,1;748,8} == \text{Sheap}_{724,1;747,8}.\text{-replace}(\text{p2} \rightarrow
\text{Sheap}_{724,1;747,8}.\text{p2}) \lor (-1 < \text{Sheap}_{724,1;747,8}.\text{p2})
\rightarrow [from term 91.0, $heap<sub>724,1;747,8</sub> is equal to $heap<sub>funcstart_724,1</sub>._replace(p1)
\rightarrow ((-2 * div(\mathbf{heapIs} \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1, 177).quot) +
(171 * div(\mathbf{heapIs} \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow ((-35 * div(\textbf{heapIs } \$heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1}.\text{p2}, 176).\text{quot} + (172 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
heap_{funcstart\_724,1}.p2, 176).rem))).\_replace(p3 \rightarrow ((-63 * div(heapIs))).\_replace(p3 \rightarrow ((-63 * div(heapIs)))))._replace(p3 \rightarrow ((-63 * div(heapIs)))))
heap_{funcstart_{-724,1}}, heap_{funcstart_{-724,1}}, p_{funcstart_{-724,1}}, p_{funcstart_{-724,1}}, p_{funcstart_{-724,1}}
\text{Sheap}_{funcstart\_724.1}, \text{Sheap}_{funcstart\_724.1}.p3, 178).rem))).\_replace(p1 \rightarrow (-2 *
div(\mathbf{heapIs} \ \$heap_{funcstart\_724.1}, \ \$heap_{funcstart\_724.1}.p1, \ 177).quot) + (171 *
div(\mathbf{heapIs} \ \$heap_{funcstart\_724,1}, \ \$heap_{funcstart\_724,1}.p1, \ 177).rem))]
[83.19] ((-1 < -$heap<sub>funcstart_724,1</sub>._replace(p1 \rightarrow ((-2 * div(heapIs
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.\text{pl}, 177).\text{quot}) + (171 * \text{div}(\text{heapIs}))
\theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}
* div(heapIs heap_{funcstart_{724,1}}, heap_{funcstart_{724,1}}, 176).quot) + (172 *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.p2,
176).rem)))._replace(p3 \rightarrow ((-63 * div(heapIs $heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724.1.p3}, 178).\text{quot} + (170 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724.1},
\rho_{funcstart\_724,1.p3}, 178).rem)._replace(p1 \rightarrow ((-2 * div(heapIs
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.\text{p1}, 177).\text{quot}) + (171 * \text{div}(\text{heapIs}))
\$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1, 177).rem))).p1) \lor (30268 <
\text{sheap}_{724,1:747,8}.\text{p1}) \lor (30306 < -\text{sheap}_{724,1:747,8}.\text{p2}) \lor (30322 <
-\$heap_{724,1;747,8}.p3)) \lor ...
\rightarrow [simplify]
[83.23] ((-1 < ((2 * div(heapIs $heap_{funcstart\_724,1}, $heap_{funcstart\_724,1}.p1,
177).quot) + (-171 * div(heapIs heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p1,
(30268 < \text{heap}_{724,1:747,8}.\text{p1}) \lor (30306 < -\text{heap}_{724,1:747,8}.\text{p2}) \lor (30306 < -\text{heap}_{724,1:747,8}.\text{p2})
(30322 < -\$heap_{724,1;747,8}.p3)) \lor ...
\rightarrow [from term 92.0, literala < ((-171 * div(heapIs $heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1}.\text{p1}, 177).\text{rem} + (2 * div(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
heap_{funcstart_{724,1}}.p1, 177).quot) is false whenever -2 < (0 + literala)
       Proof of rule precondition:
       [83.23.0] - 2 < (-1 + 0)
       \rightarrow [simplify]
       [83.23.2] true
[83.24] (false \lor (30268 < $heap<sub>724,1;747,8</sub>.p1) \lor (30306 < -$heap<sub>724,1;747,8</sub>.p2)
\vee (30322 < -\$heap_{724,1:747,8}.p3)) \vee ...
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 $\rightarrow$  [from term 91.0, \$heap<sub>724,1:747,8</sub> is equal to \$heap<sub>funcstart\_724,1</sub>.\_replace(p1)

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\rightarrow ((-2 * div(\mathbf{heapIs} \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1, 177).quot) +
(171 * div(\mathbf{heapIs} \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow ((-35 * div(\mathbf{heapIs} \$heap_{funcstart\_724,1},
heap_{funcstart\_724,1}.p2, 176).quot + (172 * div(heapIs $heap_{funcstart\_724,1}, 176).quot) + (172 * div(heapIs $heap_{funcstart\_724,1}, 17
heap_{funcstart\_724,1}.p2, 176).rem))).\_replace(p3 \rightarrow ((-63 * div(heapIs))).\_replace(p3 \rightarrow ((-63 * div(heapIs)))))._replace(p3 \rightarrow ((-63 * div(heapIs)))))
heap_{funcstart\_724,1}, pages heap_{funcstart\_724,1}, pages heap_{funcstart\_724,1}, pages heap_{funcstart\_724,1}, pages heap_{funcstart\_724,1}
heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p3, 178).rem)))._replace(p1 \rightarrow (-2 *
div(\mathbf{heapIs} \ \$heap_{funcstart\_724,1}, \ \$heap_{funcstart\_724,1}.p1, \ 177).quot) + (171 *
div(\mathbf{heapIs} \ \$heap_{funcstart\_724,1}, \ \$heap_{funcstart\_724,1}.p1, \ 177).rem))]
[83.25] (false \lor (30268 < $heap<sub>funcstart_724,1</sub>._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 \ *
\operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724.1}, \$ \operatorname{heap}_{funcstart\_724.1}.p1,
177).rem)))._replace(p2 \rightarrow ((-35 * div(heapIs $heap_{funcstart_724.1},
\text{Sheap}_{funcstart\_724,1}.\text{p2}, 176).\text{quot} + (172 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
\rho_{funcstart\_724,1.p2, 176}.rem)._replace(p3 \rightarrow ((-63 * div(heapIs
heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p3, 178).quot) + (170 * div(heapIs
\rho_{funcstart\_724,1}, \rho_{funcstart\_724,1}
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.\operatorname{p1}, \ 177).\operatorname{rem}))).\operatorname{p1}) \lor
(30306 < -\$heap_{724,1:747,8}.p2) \lor (30322 < -\$heap_{724,1:747,8}.p3)) \lor \dots
\rightarrow [simplify]
[83.26] (false \vee (30268 < ((-2 * div(heapIs $heap_{funcstart_{724,1}},
\text{Sheap}_{funcstart\_724,1}.\text{p1}, 177).\text{quot} + (171 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1.p1, 177}.\text{rem}))) \lor (30306 < -\text{Sheap}_{724,1;747,8.p2}) \lor (30322)
< -\$heap_{724,1;747,8}.p3)) \lor ...
\rightarrow [from term 56.17, literala < ((-2 * div(heapIs $heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1}.\text{p1}, 177).\text{quot} + (171 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1}.\text{p1}, 177).\text{rem} is false whenever -2 < (-30269 + \text{literala})
         Proof of rule precondition:
         [83.26.0] - 2 < (-30269 + 30268)
         \rightarrow [simplify]
          [83.26.2] true
[83.27] (false \vee false \vee (30306 < -$heap<sub>724.1:747.8</sub>.p2) \vee (30322 <
 -\$heap_{724,1;747,8}.p3)) \lor ...
\rightarrow [from term 91.0, $heap<sub>724,1;747,8</sub> is equal to $heap<sub>funcstart_724,1</sub>._replace(p1
\rightarrow ((-2 * div(\mathbf{heapIs} \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1, 177).quot) +
(171 * div(\mathbf{heapIs} \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1,
 177).rem)))._replace(p2 \rightarrow ((-35 * div(\mathbf{heapIs} \$heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1}.\text{p2},\ 176).\text{quot}) + (172 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
heap_{funcstart\_724.1}.p2, 176).rem))._replace(p3 \rightarrow ((-63 * div(heapIs)))._replace
heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p3, 178).quot) + (170 * div(heapIs)
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heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p3, 178).rem)))._replace(p1 \rightarrow (-2 *
div(\mathbf{heapIs} \ \$heap_{funcstart\_724,1}, \ \$heap_{funcstart\_724,1}.p1, \ 177).quot) + (171 *
div(\mathbf{heapIs} \ \$heap_{funcstart\_724,1}, \ \$heap_{funcstart\_724,1}.p1, \ 177).rem))]
[83.28] (false \lor false \lor (30306 < -\$heap_{funcstart\_724,1}._replace(p1 \to ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow ((-35 * div(heapIs $heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1}.\text{p2}, 176).\text{quot} + (172 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724.1.p2}, 176).rem))._replace(p3 \rightarrow ((-63 * div(heapIs)
\theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}.p3, 178).quot) + (170 * div(heapIs
\theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}.p3, 178).rem))).\_replace(p1 \rightarrow ((-2 * funcstart\_724,1)))._replace(p1 \rightarrow ((-2 * funcstart\_724,1))))
div(\mathbf{heapIs} \ \$heap_{funcstart\_724.1}, \ \$heap_{funcstart\_724.1}.p1, \ 177).quot) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724.1}, \ \$ \operatorname{heap}_{funcstart\_724.1}, p1, 177).\operatorname{rem}))).p2) \lor
(30322 < -\$ heap_{724,1;747,8}.p3)) \vee \dots
\rightarrow [simplify]
[83.34] (false \vee false \vee (30306 < ((35 * div(heapIs $heap<sub>funcstart_724,1</sub>,
\text{Sheap}_{funcstart\_724,1}.\text{p2}, 176).\text{quot}) + (-172 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1}.\text{p2}, 176).\text{rem})) \lor (30322 < -\text{Sheap}_{724,1:747,8}.\text{p3})) \lor \dots
\rightarrow [from term 58.12, literala < ((-172 * div(heapIs $heap_{tuncstart_724.1},
heap_{funcstart_{-724,1}}.p2, 176).rem + (35 * div(heapIs $heap_{funcstart_{-724,1}}, 176).rem) + (35 * di
heap_{funcstart\_724,1}.p2, 176, quot) is false whenever -2 < (-30307 + literala)
      Proof of rule precondition:
      [83.34.0] - 2 < (-30307 + 30306)
      \rightarrow [simplify]
      [83.34.2] true
[83.35] (false \vee false \vee false \vee (30322 < -$heap<sub>724,1:747,8</sub>.p3)) \vee ...
\rightarrow [from term 91.0, $heap<sub>724,1;747,8</sub> is equal to $heap<sub>funcstart_724,1</sub>._replace(p1)
\rightarrow ((-2 * div(\mathbf{heapIs} \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1, 177).quot) +
(171 * div(\mathbf{heapIs} \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1,
 177).rem)))._replace(p2 \rightarrow ((-35 * div(\mathbf{heapIs} \$heap_{funcstart\_724,1},
heap_{funcstart\_724,1}.p2, 176).quot + (172 * div(heapIs $heap_{funcstart\_724,1},
heap_{funcstart\_724,1}.p2, 176).rem))._replace(p3 \rightarrow ((-63 * div(heapIs)))._
heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p3, 178).quot) + (170 * div(heapIs)
heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p3, 178).rem)))._replace(p1 \rightarrow (-2 *
div(\mathbf{heapIs} \ \$heap_{funcstart\_724,1}, \ \$heap_{funcstart\_724,1}.p1, \ 177).quot) + (171 *
div(\mathbf{heapIs} \ \$heap_{funcstart\_724,1}, \ \$heap_{funcstart\_724,1}.p1, \ 177).rem))]
[83.36] (false \vee false \vee false \vee (30322 < -$heap<sub>funcstart_724,1</sub>._replace(p1
\rightarrow ((-2 * div(heapIs $heap_{funcstart\_724,1}, $heap_{funcstart\_724,1}.p1, 177).quot) +
(171 * div(heapIs heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow ((-35 * div(heapIs $heap_{tuncstart_724.1},
\text{Sheap}_{funcstart\_724,1}, p2, 176).quot) + (172 * div(heapIs \text{Sheap}_{funcstart\_724,1},
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\theta_{uncstart_{-724,1},p2, 176}.rem))._replace(p3 \rightarrow ((-63 * div(heapIs
heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p3, 178).quot) + (170 * div(heapIs)
\theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}.p3, 178).rem))).\_replace(p1 \rightarrow ((-2 * funcstart\_724,1)))
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}. p1, \ 177). \operatorname{quot}) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).rem))).p3)) \lor \dots
\rightarrow [simplify]
[83.41] (false \vee false \vee false \vee (30322 < ((63 * div(heapIs
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.p3, 178).quot) + (-170 * div(heapIs)
\text{Sheap}_{funcstart_{724,1}}, \text{Sheap}_{funcstart_{724,1}}, p_3, 178).rem)))) \vee ...
\rightarrow [from term 62.13, literala < ((-170 * div(heapIs $heap_{funcstart\_724.1},
heap_{funcstart\_724,1}.p3, 178).rem + (63 * div(heapIs heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1}.p3, 178).quot) is false whenever -2 < (-30323 + \text{literala})
        Proof of rule precondition:
        [83.41.0] - 2 < (-30323 + 30322)
        \rightarrow [simplify]
        [83.41.2] true
[83.42] (false \lor false \lor false \lor false) \lor ...
\rightarrow [simplify]
[83.43] false \vee \dots
[Remove 'false' term 83.43 and fetch new term from containing clause]
[95.0] ($heap<sub>724,1;748,8</sub> == $heap<sub>724,1;747,8</sub>._replace(p2 \rightarrow $heap<sub>724,1;747,8</sub>.p2))
\vee \text{ ($heap_{funcend\_724,1} == $heap_{724,1;748,8}.\_replace(p3 \rightarrow $heap_{724,1;748,8}.p3))}
\lor (-1 < \text{$heap}_{724,1;748,8}.\text{p3})
[Copy term 1.56]
[74.20] \; ((-1 < -\$heap_{724,1;748,8}.p1) \; \lor \; (-1 < -\$heap_{724,1;748,8}.p2) \; \lor \; (30268 < -\$heap_{724,1;748,8}.p2) \; \lor \;
\$heap_{724,1;748,8}.p1) \lor (30306 < \$heap_{724,1;748,8}.p2) \lor (30322 <
-\$heap_{724,1:748,8}.p3)) \lor (\$heap_{funcend\_724,1} == \$heap_{724,1:748,8}.\_replace(p3)
\rightarrow $heap<sub>724,1:748,8</sub>.p3)) \lor (-1 < $heap<sub>724,1:748,8</sub>.p3)
\rightarrow [from term 95.0, $heap<sub>724,1;748,8</sub> is equal to $heap<sub>724,1;747,8</sub>._replace(p2 \rightarrow
heap_{724.1:747.8}.p2)
[74.21] ((-1 < -$heap<sub>724,1;747,8</sub>._replace(p2 \rightarrow $heap<sub>724,1;747,8</sub>.p2).p1) \lor (-1 <
-\$heap_{724,1;748,8}.p2) \lor (30268 < \$heap_{724,1;748,8}.p1) \lor (30306 < \$heap_{724,1;748,8}.p2)
\text{$heap}_{724,1;748,8}.p2) \lor (30322 < -\text{$heap}_{724,1;748,8}.p3)) \lor \dots
\rightarrow [simplify]
[74.22] ((-1 < -$heap<sub>724,1:747,8</sub>.p1) \vee (-1 < -$heap<sub>724,1:748,8</sub>.p2) \vee (30268 <
\$heap_{724,1;748,8}.p1) \lor (30306 < \$heap_{724,1;748,8}.p2) \lor (30322 <
-\$heap_{724,1;748,8}.p3)) \lor ...
\rightarrow [from term 95.0, $heap<sub>724,1;748,8</sub> is equal to $heap<sub>724,1;747,8</sub>._replace(p2 \rightarrow
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heap_{724.1:747.8}.p2)
[74.23] ((-1 < -$heap<sub>724.1:747.8</sub>.p1) \vee (-1 < -$heap<sub>724.1:747.8</sub>.replace(p2 \rightarrow
\text{heap}_{724,1:747,8}.\text{p2}.\text{p2}) \lor (30268 < \text{heap}_{724,1:748,8}.\text{p1}) \lor (30306 <
\$ heap_{724,1;748,8}.p2) \lor (30322 < -\$ heap_{724,1;748,8}.p3)) \lor \dots
\rightarrow [simplify]
[74.24] ((-1 < -$heap<sub>724,1:747,8</sub>.p1) \vee (-1 < -$heap<sub>724,1:747,8</sub>.p2) \vee (30268 <
\text{Sheap}_{724,1:748,8}.\text{p1}) \lor (30306 < \text{Sheap}_{724,1:748,8}.\text{p2}) \lor (30322 <
-\$heap_{724,1;748,8}.p3)) \lor ...
[Remove 'false' term 83.43 and fetch new term from containing clause]
[96.0] (-1 < \text{$heap}_{724,1;747,8}.\text{p2}) \lor (\text{$heap}_{funcend\_724,1} ==
\text{Sheap}_{724,1;748,8}.\text{-replace}(p3 \to \text{Sheap}_{724,1;748,8}.p3)) \lor (-1 < \text{Sheap}_{724,1;748,8}.p3)
[Copy term 95.0]
[98.0] ($\text{heap}_{724,1;748,8} == $\text{heap}_{724,1;747,8}._\text{replace}(p2 \to $\text{heap}_{724,1;747,8}.p2))
\vee \text{ ($heap_{funcend\_724,1} == $heap_{724,1;748,8}.\_replace(p3 \rightarrow $heap_{724,1;748,8}.p3))}
\vee (-1 < \text{$heap}_{724,1;748,8}.\text{p3}) \vee (\text{$heap}_{724,1;747,8} = 
\text{Sheap}_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 * div(heapIs $heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1.p1}, 177).\text{quot} + (171 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
heap_{funcstart\_724,1}.p1, 177).rem))._replace(p2 \rightarrow ((-35 * div(heapIs))
\$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p2, 176).quot) + (172 * div(\textbf{heapIs}) + (172 * div(\textbf{heapIs})) + (172
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.p2, 176).rem))).\_replace(p3 \rightarrow ((-63)))
* div(heapIs heap_{funcstart_{724,1}}, heap_{funcstart_{724,1}}, 178).quot) + (170 *
\operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724.1}, \$ \operatorname{heap}_{funcstart\_724.1}.p3,
178).rem)))._replace(p1 \rightarrow ((-2 * div(heapIs $heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1}.\text{p1}, 177).\text{quot} + (171 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1}.\text{p1}, 177).\text{rem})))) \lor (0 < ((-2 * div(\mathbf{heapIs}))))
\text{Sheap}_{funcstart\_724.1}, \text{Sheap}_{funcstart\_724.1}.\text{p1}, 177).\text{quot}) + (171 * \text{div}(\text{heapIs}))
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.p1, 177).rem)))
\rightarrow [from term 84.0, $heap<sub>724,1;747,8</sub> is equal to $heap<sub>funcstart_724,1</sub>._replace(p1
\rightarrow ((-2 * div(\mathbf{heapIs} \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1, 177).quot) +
(171 * div(\mathbf{heapIs} \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow ((-35 * div(\mathbf{heapIs} \$heap_{funcstart\_724,1},
heap_{funcstart_{724,1},p2, 176}, quot) + (172 * div(heapIs p_{funcstart_{724,1},p2}
\rho_{uncstart_{724,1},p2,176}.rem))._replace\rho_{3} \rightarrow ((-63 * div(heapIs)))
heap_{funcstart\_724.1}, heap_{funcstart\_724.1}.p3, 178).quot) + (170 * div(heapIs)
\theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}
 + (-2 * div(\mathbf{heapIs} \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1, 177).quot) +
(171 * div(\mathbf{heapIs} \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1, 177).rem))]
[98.2] ($heap<sub>724,1:748,8</sub> == $heap<sub>funcstart_724,1</sub>._replace(p1 \rightarrow ((-2 *
div(\mathbf{heapIs} \ \$heap_{funcstart\_724,1}, \ \$heap_{funcstart\_724,1}.p1, \ 177).quot) + (171 *
\operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724,1}, \$ \operatorname{heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow ((-35 * div(heapIs $heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1.p2}, 176).\text{quot} + (172 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
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\rho_{\text{funcstart}} = 176 \cdot \text{rem}))._replace(p3 \rightarrow ((-63 * div(heapIs
heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p3, 178).quot) + (170 * div(heapIs)
heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p3, 178).rem))._replace(p1 \rightarrow
(30269 + (-2 * div(\mathbf{heapIs} \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1,
177).quot) + (171 * div(heapIs heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow $heap<sub>funcstart_724,1</sub>._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).quot) + (171 *
\operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart} 724.1, \$ \operatorname{heap}_{funcstart} 724.1.p1,
177).rem)))._replace(p2 \rightarrow ((-35 * div(heapIs $heap_{funcstart_724,1},
\text{Sheap}_{funcstart\_724,1.p2}, 176).\text{quot} + (172 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
\theta_{uncstart\_724,1.p2, 176}.rem))._replace(p3 \rightarrow ((-63 * div(heapIs
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.p3, 178).quot) + (170 * div(heapIs)
\rho_{funcstart\_724,1}, \rho_{funcstart\_724,1.p3, 178).rem))._replace(p1 \rightarrow
(30269 + (-2 * div(\mathbf{heapIs} \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_724,1}, \text{\$heap}_{funcstart\_724,1}.\text{p1},
(177).rem))).p2)) \vee ...
\rightarrow [simplify]
[98.5] ($heap<sub>724,1;748,8</sub> == $heap<sub>funcstart_724,1</sub>._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).quot) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}. \operatorname{pl},
177).rem)))._replace(p2 \rightarrow ((-35 * div(heapIs $heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1}.\text{p2}, 176).\text{quot} + (172 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
\theta_{uncstart\_724,1}.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)))))._replace(p3 \rightarrow ((-63 * div(heapIs))))._replace(p3 \rightarrow ((-63 * div(heapIs)))))._replace(p3 \rightarrow ((-63 * div(heapIs))))))))))._replace(p3 \rightarrow ((-63 * div(heapIs)))))
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.\text{p3}, 178).\text{quot}) + (170 * \text{div}(\text{heapIs}))
\text{Sheap}_{funcstart=724.1}, \text{Sheap}_{funcstart=724.1}.p3, 178).rem))).\_replace(p1 \rightarrow
(30269 + (-2 * div(\mathbf{heapIs} \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1,
177).quot) + (171 * \text{div}(\mathbf{heapIs} \$ \text{heap}_{funcstart\_724,1}, \$ \text{heap}_{funcstart\_724,1}.\text{p1},
177).rem)))._replace(p2 \rightarrow ((-35 * div(heapIs $heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\ 724.1.p2},\ 176).\text{quot}) + (172 * \text{div}(\text{heapIs} \text{Sheap}_{funcstart\ 724.1},
heap_{funcstart_{-724,1}.p2, 176).rem}))) \vee ...
[Copy term 96.0]
\text{$heap}_{724,1;748,8}.replace(p3 \rightarrow \text{$heap}_{724,1;748,8}.p3)) \lor (-1 <
\text{Sheap}_{724,1;748,8}.\text{p3}) \lor (\text{Sheap}_{724,1;747,8} == \text{Sheap}_{funcstart\_724,1}.\textbf{replace}(\text{p1} \rightarrow
((-2 * \text{div}(\mathbf{heapIs} \$ \text{heap}_{funcstart\_724,1}, \$ \text{heap}_{funcstart\_724,1}.\text{p1}, 177).\text{quot}) +
(171 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_724,1}, \text{\$heap}_{funcstart\_724,1}.\text{p1},
177).rem)))._replace(p2 \rightarrow ((-35 * div(heapIs $heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1}.\text{p2}, 176).\text{quot} + (172 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
heap_{funcstart\_724,1}.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)))))
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.p3, 178).quot) + (170 * div(heapIs)
\theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}.p3, 178).rem))).\_replace(p1 \rightarrow ((-2 * funcstart\_724,1)))._replace(p1 \rightarrow ((-2 * funcstart\_724,1))))
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).quot) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724.1}, \ \$ \operatorname{heap}_{funcstart\_724.1}, 177).\operatorname{rem})))) \vee (0 <
((-2 * div(\mathbf{heapIs} \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1, 177).quot) +
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(171 * div(\mathbf{heapIs} \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1, 177).rem)))
\rightarrow [from term 84.0, $heap<sub>724,1;747,8</sub> is equal to $heap<sub>funcstart_724,1</sub>._replace(p1
\rightarrow ((-2 * div(\mathbf{heapIs} \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1, 177).quot) +
(171 * div(heapIs heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow ((-35 * div(\mathbf{heapIs} \$heap_{funcstart\_724.1},
\text{Sheap}_{funcstart\_724,1}.\text{p2}, 176).\text{quot} + (172 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
\rho_{funcstart\_724,1.p2, 176}.rem))._replace\rho_{funcstart\_724,1.p2, 176}.rem))._replace
heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p3, 178).quot) + (170 * div(heapIs
\text{Sheap}_{funcstart\_724.1}, \text{Sheap}_{funcstart\_724.1}.p3, 178).rem))). \mathbf{replace}(p1 \rightarrow 30269)
+ (-2 * div(\mathbf{heapIs} \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1, 177).quot) +
(171 * div(\mathbf{heapIs} \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1, 177).rem))]
[99.1] (-1 < \theta) (-2 * div(heapIs
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.p1, 177).quot) + (171 * div(heapIs)
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.\text{p1}, 177).\text{rem}))._replace(p2 \rightarrow ((-35)
* div(\mathbf{heapIs} \ \$ heap_{funcstart\_724,1}, \ \$ heap_{funcstart\_724,1}.p2, \ 176).quot) + (172 \ *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p2,
176).rem)))._replace(p3 \rightarrow ((-63 * div(heapIs $heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724.1.p3}, 178).\text{quot} + (170 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724.1},
\text{heap}_{funcstart\_724.1}.\text{p3}, 178).\text{rem}))._replace(p1 \rightarrow (30269 + (-2 * div(heapIs))
\theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}.p1, 177).quot) + (171 * div(heapIs
\text{Sheap}_{funcstart_{724.1}}, \text{Sheap}_{funcstart_{724.1}}, \text{p1, 177}.rem))).p2) \vee ...
\rightarrow [simplify]
[99.4] (-1 < ((-35 * div(heapIs heap_{funcstart_{724,1}}, heap_{funcstart_{724,1}}, p_2,
176).quot) + (172 * div(heapIs heap_{funcstart_{-724,1}}, heap_{funcstart_{-724,1}}, p_2,
176).rem))) \vee ...
\rightarrow [from term 59.3, -1 < ((-35 * div(heapIs $heap_{funcstart\_724,1},
heap_{funcstart\_724,1}.p2, 176).quot + (172 * div(heapIs $heap_{funcstart\_724,1}, 176).quot) + (172 * div(heapIs $heap_{funcstart\_724,1}, 17
Sheap funcstart 724.1.p2, 176).rem) is true if and only if 0 < ((-35 * div(\mathbf{heapIs})))
heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p2, 176).quot) + (172 * div(heapIs)
\$heap_{funcstart\_724,1},\,\$heap_{funcstart\_724,1}.p2,\,176).rem))]
[99.5] (0 < ((-35 * div(heapIs $heap_{funcstart\_724.1}, $heap_{funcstart\_724.1}.p2,
176).quot) + (172 * div(heapIs \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}
176).rem))) \vee ...
[Copy term 74.20]
[102.0] ((-1 < -$heap<sub>724,1;748,8</sub>.p1) \vee (-1 < -$heap<sub>724,1;748,8</sub>.p2) \vee (30268 <
\text{$heap}_{724,1;748,8}.\text{p1}) \lor (30306 < \text{$heap}_{724,1;748,8}.\text{p2}) \lor (30322 <
-\$heap_{724,1;748,8}.p3)) \lor (\$heap_{funcend\_724,1} == \$heap_{724,1;748,8}.replace(p3)
\rightarrow \text{\$heap}_{724,1;748,8}.\text{p3})) \lor (-1 < \text{\$heap}_{724,1;748,8}.\text{p3}) \lor (\text{\$heap}_{724,1;747,8} = -1)
\text{Sheap}_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 * div(heapIs \text{Sheap}_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1}.\text{p1}, 177).\text{quot} + (171 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
\rho_{funcstart\_724,1.p1, 177).rem}))._replace(p2 \rightarrow ((-35 * div(heapIs
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.p2, 176).quot) + (172 * div(heapIs)
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\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.p2, 176).rem))._replace(p3 \rightarrow ((-63
* div(heapIs heap_{funcstart_{724,1}}, heap_{funcstart_{724,1}}, 178).quot) + (170 *
\operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724,1}, \$ \operatorname{heap}_{funcstart\_724,1}.p3,
178).rem)))._replace(p1 \rightarrow ((-2 * div(heapIs $heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1}.\text{p1}, 177).\text{quot} + (171 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1}.\text{p1}, 177).\text{rem})))) \lor (0 < ((-2 * \text{div}(\textbf{heapIs}))))) \lor (0 < ((-2 * \text{div}(\textbf{heapIs}))))))
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.p1, 177).quot) + (171 * div(heapIs)
heap_{funcstart_{-724,1}}, heap_{funcstart_{-724,1}}, 177).rem)
\rightarrow [from term 98.5, $heap<sub>724.1:748.8</sub> is equal to $heap<sub>funcstart_724,1</sub>._replace(p1
\rightarrow ((-2 * div(\mathbf{heapIs} \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1, 177).quot) +
(171 * div(\mathbf{heapIs} \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow ((-35 * div(\mathbf{heapIs} \$heap_{funcstart\_724.1},
heap_{funcstart\_724.1}.p2, 176).quot + (172 * div(heapIs $heap_{funcstart\_724.1},
\rho_{funcstart\_724,1.p2, 176}.rem))._replace\rho_{funcstart\_724,1.p2, 176}.rem))._replace
heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p3, 178).quot) + (170 * div(heapIs)
\theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}
(30269 + (-2 * div(\mathbf{heapIs} \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1),
177).quot) + (171 * div(\mathbf{heapIs} \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow (-35 * div(\mathbf{heapIs} \$heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1}.p2, 176).quot) + (172 * div(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
heap_{funcstart_{-724,1}.p2, 176).rem}
[102.1] ((-1 < -$heap<sub>funcstart_724,1</sub>._replace(p1 \rightarrow ((-2 * div(heapIs
\theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}
\$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1, 177).rem))).\_\mathbf{replace}(p2 \rightarrow ((-35), -20)))
* div(heapIs heap_{funcstart_{-724.1}}, heap_{funcstart_{-724.1}}, p2, 176).quot) + (172 *
\operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724,1}, \$ \operatorname{heap}_{funcstart\_724,1}.p2,
176).rem)))._replace(p3 \rightarrow ((-63 * div(heapIs $heap_{funcstart\_724,1},
\rho_{funcstart\_724,1.p3}, 178).quot) + (170 * div(heapIs \rho_{funcstart\_724,1},
\rho_{funcstart\_724,1.p3}, 178).rem))._replace(p1 \rightarrow (30269 + (-2 * div(heapIs
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.p1, 177).quot) + (171 * div(heapIs)
\rho_{funcstart\_724,1}, \rho_{funcstart\_724,1}, \rho_{funcstart\_724,1}, \rho_{funcstart\_724,1}, \rho_{funcstart\_724,1}, \rho_{funcstart\_724,1}, \rho_{funcstart\_724,1}
* div(heapIs heap_{funcstart_{724,1}}, heap_{funcstart_{724,1}}, 176).quot) + (172 *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.p2, \ 176).rem))).p1) \lor (-1
<-$heap<sub>724,1:748,8</sub>.p2) \lor (30268 <$heap<sub>724,1:748,8</sub>.p1) \lor (30306 <
\text{heap}_{724,1;748,8.p2}) \lor (30322 < -\text{heap}_{724,1;748,8.p3})) \lor \dots
\rightarrow [simplify]
[102.11] ((30268 < ((-171 * div(heapIs heapIs  heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1}.\text{p1}, 177).\text{rem} + (2 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1.p1, 177}.\text{quot}))) \lor (-1 < -\text{Sheap}_{724,1:748,8.p2}) \lor (30268 < -\text{Sheap}_{724,1:748,8.p2}) \lor (30268 < -\text{Sheap}_{724,1:748,8.p2})
\text{heap}_{724,1:748,8}.\text{p1}) \lor (30306 < \text{heap}_{724,1:748,8}.\text{p2}) \lor (30322 <
-\$heap_{724,1:748.8}.p3)) \lor ...
\rightarrow [from term 54.11, literala < ((-171 * div(heapIs $heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724.1.p1}, 177).rem) + (2 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724.1})
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heap_{funcstart-724,1}.p1, 177).quot) is false whenever -2 < (-30269 + literala)
    Proof of rule precondition:
    [102.11.0] - 2 < (-30269 + 30268)
    \rightarrow [simplify]
    [102.11.2] true
[102.12] (false \lor (-1 < -$heap<sub>724,1:748,8</sub>.p2) \lor (30268 < $heap<sub>724,1:748,8</sub>.p1) \lor
(30306 < \text{$heap}_{724,1;748,8}.\text{p2}) \lor (30322 < -\text{$heap}_{724,1;748,8}.\text{p3})) \lor \dots
\rightarrow [from term 98.5, $heap_{724,1;748,8}$ is equal to $heap_{funcstart\_724,1}._replace(p1)
\rightarrow ((-2 * div(heapIs $heap_{funcstart\_724,1}, $heap_{funcstart\_724,1}.p1, 177).quot) +
(171 * div(\mathbf{heapIs} \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow ((-35 * div(\mathbf{heapIs} \$heap_{funcstart\_724,1},
heap_{funcstart\_724,1}.p2, 176).quot) + (172 * div(heapIs $heap_{funcstart\_724,1}, 
\rho_{funcstart\_724.1.p2, 176).rem}))._replace\rho_{funcstart\_724.1.p2, 176).rem})._replace
heap_{funcstart\_724.1}, heap_{funcstart\_724.1}.p3, 178).quot) + (170 * div(heapIs)
heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p3, 178).rem))._replace(p1 \rightarrow
(30269 + (-2 * div(\mathbf{heapIs} \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1,
177).quot) + (171 * div(\mathbf{heapIs} \ \$heap_{funcstart\_724,1}, \ \$heap_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow (-35 * div(\mathbf{heapIs} \$heap_{funcstart\_724,1},
heap_{funcstart\_724,1}.p2, 176).quot + (172 * div(heapIs $heap_{funcstart\_724,1},
heap_{funcstart_{-724,1}}.p2, 176).rem
[102.13] (false \vee (-1 < -$heap<sub>funcstart_724,1</sub>._replace(p1 \rightarrow ((-2 * div(heapIs
\theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}
\$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1, 177).rem))).\_\mathbf{replace}(p2 \rightarrow ((-35), -2)))
* div(\mathbf{heapIs} \ \text{$heap}_{funcstart\_724,1}, \ \text{$heap}_{funcstart\_724,1}.p2, \ 176).quot) + (172 \ \text{*}
\operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724,1}, \$ \operatorname{heap}_{funcstart\_724,1}.p2,
176).rem)))._replace(p3 \rightarrow ((-63 * div(heapIs $heap_{funcstart_724.1},
\text{Sheap}_{funcstart\_724,1}.\text{p3}, 178).\text{quot} + (170 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
\rho_{uncstart_{-724.1},p3, 178, rem})._replace(p1 \rightarrow (30269 + (-2 * div(heapIs
\text{Sheap}_{funcstart\_724.1}, \text{Sheap}_{funcstart\_724.1}.\text{p1}, 177).\text{quot}) + (171 * \text{div}(\text{heapIs})
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.\text{p1}, 177).\text{rem}))._replace(p2 \rightarrow ((-35)
* div(\mathbf{heapIs} \ \$ heap_{funcstart\_724,1}, \ \$ heap_{funcstart\_724,1}.p2, \ 176).quot) + (172 \ *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p2, \ 176).rem))).p2) \lor
(30268 < \text{$heap}_{724,1;748,8}.\text{p1}) \lor (30306 < \text{$heap}_{724,1;748,8}.\text{p2}) \lor (30322 < \text{$heap}_{724,1;748,8}.\text{p2}) \lor (30322 < \text{$heap}_{724,1;748,8}.\text{p2})
-\$heap_{724,1;748,8}.p3)) \lor ...
\rightarrow [simplify]
[102.17] (false \vee (-1 < ((35 * div(heapIs $heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1}.\text{p2}, 176).\text{quot} + (-172 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
\{\text{heap}_{funcstart\_724,1.p2, 176}\}.rem))) \lor (30268 < \{\text{heap}_{724,1;748,8.p1}\} \lor (30306 < \text{heap}_{724,1;748,8.p1})
\text{sheap}_{724,1;748,8}.\text{p2}) \lor (30322 < -\text{sheap}_{724,1;748,8}.\text{p3})) \lor \dots
\rightarrow [from term 99.5, literala < ((-172 * div(heapIs $heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1}.p2, 176).rem + (35 * div(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
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heap_{funcstart-724,1}.p2, 176, quot) is false whenever -2 < (0 + literala)
    Proof of rule precondition:
    [102.17.0] - 2 < (-1 + 0)
    \rightarrow [simplify]
    [102.17.2] true
[102.18] (false \vee false \vee (30268 < $heap<sub>724,1;748,8</sub>.p1) \vee (30306 <
\text{heap}_{724,1;748,8}.\text{p2}) \lor (30322 < -\text{heap}_{724,1;748,8}.\text{p3})) \lor \dots
\rightarrow [from term 98.5, $heap_{724,1;748,8}$ is equal to $heap_{funcstart\_724,1}._replace(p1
\rightarrow ((-2 * div(heapIs $heap_{funcstart\_724,1}, $heap_{funcstart\_724,1}.p1, 177).quot) +
(171 * div(\mathbf{heapIs} \$heap_{funcstart\_724.1}, \$heap_{funcstart\_724.1}.p1,
177).rem)))._replace(p2 \rightarrow ((-35 * div(\mathbf{heapIs} \$heap_{funcstart\_724,1},
heap_{funcstart\_724,1}.p2, 176).quot) + (172 * div(heapIs $heap_{funcstart\_724,1}, 
\rho_{funcstart\_724.1.p2, 176).rem}))._replace\rho_{funcstart\_724.1.p2, 176).rem})._replace
heap_{funcstart\_724.1}, heap_{funcstart\_724.1}.p3, 178).quot) + (170 * div(heapIs)
heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p3, 178).rem))._replace(p1 \rightarrow
(30269 + (-2 * div(\mathbf{heapIs} \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1,
177).quot) + (171 * div(\mathbf{heapIs} \ \$heap_{funcstart\_724,1}, \ \$heap_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow (-35 * div(\mathbf{heapIs} \$heap_{funcstart\_724,1},
heap_{funcstart\_724,1}.p2, 176).quot + (172 * div(heapIs heap_{funcstart\_724,1},
heap_{funcstart_{-724,1}}.p2, 176).rem
[102.19] (false \lor false \lor (30268 < $heap_funcstart_724,1._replace(p1 \to ((-2 *
div(\mathbf{heapIs} \ \$heap_{funcstart\_724,1}, \ \$heap_{funcstart\_724,1}.p1, \ 177).quot) + (171 *
\operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724.1}, \$ \operatorname{heap}_{funcstart\_724.1}.p1,
177).rem)))._replace(p2 \rightarrow ((-35 * div(heapIs $heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1}.\text{p2}, 176).\text{quot} + (172 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
\rho_{funcstart\_724.1.p2, 176}.rem)._replace(p3 \rightarrow ((-63 * div(heapIs
\text{Sheap}_{funcstart\_724.1}, \text{Sheap}_{funcstart\_724.1}.p3, 178).quot) + (170 * div(heapIs)
\$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p3, 178).rem))).\_\mathbf{replace}(p1 \rightarrow
(30269 + (-2 * div(\mathbf{heapIs} \$heap_{funcstart\_724.1}, \$heap_{funcstart\_724.1}.p1,
177).quot) + (171 * \text{div}(\textbf{heapIs} \$ \text{heap}_{funcstart\_724,1}, \$ \text{heap}_{funcstart\_724,1}.\text{p1},
177).rem)))._replace(p2 \rightarrow ((-35 * div(heapIs $heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1.p2}, 176).\text{quot} + (172 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1}.\text{p2}, 176).\text{rem})).\text{p1}) \lor (30306 < \text{Sheap}_{724,1;748,8}.\text{p2}) \lor
(30322 < -\$heap_{724,1;748,8}.p3)) \lor ...
\rightarrow [simplify]
[102.23] (false \vee false \vee (-1 < ((-2 * div(heapIs $heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1}.\text{p1}, 177).\text{quot} + (171 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
\{\text{heap}_{funcstart\_724,1.p1, 177}, \text{rem}\} ) ) \lor (30306 < \{\text{heap}_{724,1;748,8.p2}\} \lor (30322 < \text{heap}_{724,1;748,8.p2})
-\$heap_{724,1;748,8}.p3)) \lor ...
\rightarrow [from term 85.0, literala < ((-2 * div(heapIs $heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1}.\text{p1}, 177).\text{quot} + (171 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
```

```
heap_{funcstart-724,1}.p1, 177).rem is false whenever -2 < (0 + literala)
    Proof of rule precondition:
    [102.23.0] - 2 < (-1 + 0)
    \rightarrow [simplify]
    [102.23.2] true
[102.24] (false \vee false \vee false \vee (30306 < $heap<sub>724.1:748.8</sub>.p2) \vee (30322 <
-\$heap_{724,1;748,8}.p3)) \lor ...
\rightarrow [from term 98.5, $heap<sub>724,1;748,8</sub> is equal to $heap<sub>funcstart_724,1</sub>._replace(p1
\rightarrow ((-2 * div(heapIs $heap_{funcstart\_724,1}, $heap_{funcstart\_724,1}.p1, 177).quot) +
(171 * div(\mathbf{heapIs} \$heap_{funcstart\_724.1}, \$heap_{funcstart\_724.1}.p1,
177).rem)))._replace(p2 \rightarrow ((-35 * div(\mathbf{heapIs} \$heap_{funcstart\_724,1},
heap_{funcstart_{724,1},p2, 176}, quot) + (172 * div(heapIs p_{funcstart_{724,1},p2})
\rho_{funcstart\_724.1.p2, 176).rem}))._replace\rho_{funcstart\_724.1.p2, 176).rem})._replace
heap_{funcstart\_724.1}, heap_{funcstart\_724.1}.p3, 178).quot) + (170 * div(heapIs)
heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p3, 178).rem))._replace(p1 \rightarrow
(30269 + (-2 * div(\mathbf{heapIs} \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1,
177).quot) + (171 * div(\mathbf{heapIs} \ \$heap_{funcstart\_724,1}, \ \$heap_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow (-35 * div(\mathbf{heapIs} \$heap_{funcstart\_724,1},
heap_{funcstart\_724,1}.p2, 176).quot + (172 * div(heapIs $heap_{funcstart\_724,1},
heap_{funcstart_{724,1},p2,176}.rem))]
\textit{[102.25]} \; (\textbf{false} \; \vee \; \textbf{false} \; \vee \; \textbf{false} \; \vee \; (30306 < \$ \text{heap}_{funcstart\_724,1}.\_\textbf{replace} (\text{p1} \; \rightarrow \;
((-2 * div(\mathbf{heapIs} \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1, 177).quot) +
(171 * div(heapIs heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow ((-35 * div(heapIs $heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1}.\text{p2}, 176).\text{quot} + (172 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
\rho_{funcstart\_724.1.p2, 176}.rem)._replace(p3 \rightarrow ((-63 * div(heapIs
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.\text{p3}, 178).\text{quot}) + (170 * \text{div}(\text{heapIs}))
\theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}.p3, 178).rem))).\_replace(p1 \rightarrow
(30269 + (-2 * div(\mathbf{heapIs} \$heap_{funcstart\_724.1}, \$heap_{funcstart\_724.1}.p1,
177).quot) + (171 * \text{div}(\textbf{heapIs} \$ \text{heap}_{funcstart\_724,1}, \$ \text{heap}_{funcstart\_724,1}.\text{p1},
177).rem)))._replace(p2 \rightarrow ((-35 * div(heapIs $heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1.p2}, 176).\text{quot} + (172 * \text{div}(\text{heapIs} \text{Sheap}_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1.p2}, 176).\text{rem})).p2) \lor (30322 < -\text{Sheap}_{724,1;748,8.p3})) \lor ...
\rightarrow [simplify]
[102.26] (false \vee false \vee false \vee (30306 < ((-35 * div(heapIs
heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p2, 176).quot) + (172 * div(heapIs)
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.p2, 176).rem))) \lor (30322 <
-\$heap_{724,1:748,8}.p3)) \lor ...
\rightarrow [from term 60.18, literala < ((-35 * div(heapIs $heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1}.p2, 176).quot) + (172 * div(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
heap_{funcstart_{724,1}.p2, 176).rem is false whenever -2 < (-30307 + literala)
```

 $\begin{array}{l} \text{Sheap}_{funcstart\_724,1}.p2,\ 176).\text{quot}) + (172*\text{div}(\textbf{heapIs}\ \textbf{Sheap}_{funcstart\_724,1},\\ \textbf{Sheap}_{funcstart\_724,1}.p2,\ 176).\text{rem}))).\_\textbf{replace}(p3 \rightarrow ((-63*\text{div}(\textbf{heapIs}\ \textbf{Sheap}_{funcstart\_724,1},\ \textbf{Sheap}_{funcstart\_724,1}.p3,\ 178).\text{quot}) + (170*\text{div}(\textbf{heapIs}\ \textbf{Sheap}_{funcstart\_724,1},\ \textbf{Sheap}_{funcstart\_724,1}.p3,\ 178).\text{rem}))).\_\textbf{replace}(p1 \rightarrow (30269 + (-2*\text{div}(\textbf{heapIs}\ \textbf{Sheap}_{funcstart\_724,1},\ \textbf{Sheap}_{funcstart\_724,1}.p1,\ 177).\text{quot}) + (171*\text{div}(\textbf{heapIs}\ \textbf{Sheap}_{funcstart\_724,1},\ \textbf{Sheap}_{funcstart\_724,1}.p1,\ 177).\text{rem}))).\_\textbf{replace}(p2 \rightarrow (-35*\text{div}(\textbf{heapIs}\ \textbf{Sheap}_{funcstart\_724,1},\ \textbf{Sheap}_{funcstart$ 

[102.28] (false  $\vee$  false  $\vee$  false  $\vee$  false  $\vee$  (30322 < —\$heap\_{tuncstart\_724,1}.\_replace(p1  $\rightarrow$  ((-2 \* div(heapIs \$heap\_{tuncstart\_724,1}, \$heap\_{tuncstart\_724,1}.p1, 177).quot) + (171 \* div(heapIs \$heap\_{tuncstart\_724,1}, \$heap\_{tuncstart\_724,1}.p1, 177).rem))).\_replace(p2  $\rightarrow$  ((-35 \* div(heapIs \$heap\_{tuncstart\_724,1}, \$heap\_{tuncstart\_724,1}.p2, 176).quot) + (172 \* div(heapIs \$heap\_{tuncstart\_724,1}, \$heap\_{tuncstart\_724,1}.p2, 176).rem))).\_replace(p3  $\rightarrow$  ((-63 \* div(heapIs \$heap\_{tuncstart\_724,1}, \$heap\_{tuncstart\_724,1}.p3, 178).quot) + (170 \* div(heapIs \$heap\_{tuncstart\_724,1}, \$heap\_{tuncstart\_724,1}.p3, 178).rem))).\_replace(p1  $\rightarrow$  (30269 + (-2 \* div(heapIs \$heap\_{tuncstart\_724,1}, \$heap\_{tuncstart\_724,1}.p1, 177).quot) + (171 \* div(heapIs \$heap\_{tuncstart\_724,1}, \$heap\_{tuncstart\_724,1}.p1, 177).rem))).\_replace(p2  $\rightarrow$  ((-35 \* div(heapIs \$heap\_{tuncstart\_724,1}, \$heap\_{

 $\rightarrow$  [simplify]

[102.34] (false  $\vee$  false  $\vee$  false  $\vee$  false  $\vee$  (30322 < ((63 \* div(heapIs \$heap\_{tuncstart\\_724,1}, \$heap\_{tuncstart\\_724,1}.p3, 178).quot) + (-170 \* div(heapIs \$heap\_{tuncstart\\_724,1}, \$heap\_{tuncstart\\_724,1}.p3, 178).rem))))  $\vee$  ...

 $\theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}.p2, 176).rem)).p3)) \lor ...$ 

 $\rightarrow$  [from term 62.13, literala < ((-170 \* div(heapIs \$heap\_{funcstart\\_724,1}, \$heap\_{funcstart\\_724,1}.p3, 178).rem) + (63 \* div(heapIs \$heap\_{funcstart\\_724,1}, \$heap\_{funcstart\\_724,1}.p3, 178).quot)) is false whenever -2 < (-30323 + literala)]

## Proof of rule precondition:

```
[102.34.0] -2 < (-30323 + 30322)

\rightarrow [simplify]
```

```
[102.34.2] true
[102.35] (false \vee false \vee false \vee false \vee false) \vee ...
\rightarrow [simplify]
[102.36] false \vee ...
[Remove 'false' term 102.36 and fetch new term from containing clause]
[103.0] (\text{$heap}_{724,1;747,8} == \text{$heap}_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 *
\operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724,1}, \$ \operatorname{heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow ((-35 * div(heapIs $heap_{funcstart_724,1},
\text{Sheap}_{funcstart\_724,1}.\text{p2}, 176).\text{quot} + (172 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
\rho_{funcstart\_724,1.p2, 176).rem}))._replace(p3 \rightarrow ((-63 * div(heapIs
heap_{funcstart_{-724,1}}, heap_{funcstart_{-724,1}}.p3, 178).quot) + (170 * div(heapIs)
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.\text{p3}, 178).\text{rem}))).\_\textbf{replace}(\text{p1} \rightarrow ((-2 * 
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).quot) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).rem)))) \lor
(\text{\$heap}_{funcend\_724,1} == \text{\$heap}_{724,1;748,8}.\_\mathbf{replace}(p3 \to \text{\$heap}_{724,1;748,8}.p3)) \lor
(-1 < \text{$heap}_{724,1;748,8}.p3)
[Remove 'false' term 102.36 and fetch new term from containing clause]
[104.0] (0 < ((-2 * div(heapIs heapIs funcstart_{-724,1}, heap_{funcstart_{-724,1}}.p1,
177).quot) + (171 * div(heapIs \theta_{funcstart_{-724,1}}, \theta_{funcstart_{-724,1}}, p1,
(177).rem))) \lor (\$heap_{funcend\_724,1} == \$heap_{724,1;748,8}.\_replace(p3 \rightarrow
heap_{724,1;748,8}.p3) \lor (-1 < heap_{724,1;748,8}.p3)
[Copy term 1.56]
[74.24] ((-1 < -$heap<sub>724,1:747,8</sub>.p1) \vee (-1 < -$heap<sub>724,1:747,8</sub>.p2) \vee (30268 <
heap_{724,1;748,8}.p1) \lor (30306 < heap_{724,1;748,8}.p2) \lor (30322 < heap_{724,1;748,8}.p2) \lor (30322 < heap_{724,1;748,8}.p2)
-\$heap_{724,1;748,8}.p3)) \lor (\$heap_{funcend\_724,1} == \$heap_{724,1;748,8}.\mathbf{replace}(p3)
\rightarrow $heap<sub>724.1:748.8</sub>.p3)) \lor (-1 < $heap<sub>724.1:748.8</sub>.p3)
\rightarrow [from term 96.0, -1 < -$heap<sub>724.1:747.8</sub>.p2 is true if and only if 0 ==
$heap<sub>724,1;747,8</sub>.p2|
[74.25] ((-1 < -\$heap_{724,1;747,8}.p1) \lor (0 == \$heap_{724,1;747,8}.p2) \lor (30268 <
\text{heap}_{724,1:748,8}.\text{p1}) \lor (30306 < \text{heap}_{724,1:748,8}.\text{p2}) \lor (30322 <
-\$heap_{724,1;748,8}.p3)) \lor ...
\rightarrow [from term 95.0, $heap_{724,1;748,8}$ is equal to $heap_{724,1;747,8}._replace(p2 \rightarrow
heap_{724,1;747,8}.p2)
[74.26] ((-1 < -$heap<sub>724,1:747,8</sub>.p1) \vee (0 == $heap<sub>724,1:747,8</sub>.p2) \vee (30268 <
\text{$heap}_{724,1;747,8}.\_\mathbf{replace}(p2 \to \text{$heap}_{724,1;747,8}.p2).p1) \lor (30306 < 0.000)
\text{heap}_{724,1;748,8}.\text{p2}) \lor (30322 < -\text{heap}_{724,1;748,8}.\text{p3})) \lor \dots
\rightarrow [simplify]
[74.27] ((-1 < -$heap<sub>724,1;747,8</sub>.p1) \vee (0 == $heap<sub>724,1;747,8</sub>.p2) \vee (30268 <
```

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\text{heap}_{724.1:747.8.p1} \lor (30306 < \text{heap}_{724.1:748.8.p2}) \lor (30322 <
-\$heap_{724,1;748,8}.p3)) \lor ...
\rightarrow [from term 95.0, $heap<sub>724,1:748,8</sub> is equal to $heap<sub>724,1:747,8</sub>._replace(p2 \rightarrow
heap_{724,1;747,8}.p2)
[74.28] ((-1 < -$heap<sub>724,1;747,8</sub>.p1) \vee (0 == $heap<sub>724,1;747,8</sub>.p2) \vee (30268 <
\text{heap}_{724.1:747.8}.\text{p1}) \lor (30306 < \text{heap}_{724.1:747.8}.\text{-replace}(\text{p2} \rightarrow
heap_{724,1;747,8}.p_{2}).p_{2} \lor (30322 < -heap_{724,1;748,8}.p_{3})) \lor ...
\rightarrow [simplify]
[74.29] ((-1 < -$heap<sub>724.1:747.8</sub>.p1) \lor (0 == $heap<sub>724.1:747.8</sub>.p2) \lor (30268 <
\text{heap}_{724,1:747,8}.\text{p1}) \lor (30306 < \text{heap}_{724,1:747,8}.\text{p2}) \lor (30322 <
-\$heap_{724,1:748,8}.p3)) \lor ...
\rightarrow [from term 95.0, $heap_{724,1;748,8}$ is equal to $heap_{724,1;747,8}._replace(p2 \rightarrow
heap_{724,1;747,8}.p2)
[74.30] ((-1 < -$heap<sub>724.1:747.8.p1) \vee (0 == $heap<sub>724.1:747.8.p2) \vee (30268 <</sub></sub>
\text{$heap}_{724,1;747,8}.\text{p1}) \lor (30306 < \text{$heap}_{724,1;747,8}.\text{p2}) \lor (30322 <
-\$heap_{724,1;747,8}.replace(p2 \rightarrow \$heap_{724,1;747,8}.p2).p3)) \lor ...
\rightarrow [simplify]
[74.31] \; ((-1 < -\$heap_{724,1;747,8}.p1) \; \lor \; (0 == \$heap_{724,1;747,8}.p2) \; \lor \; (30268 < -1) \; \lor \; (-1 <
\text{$heap}_{724,1;747,8}.\text{p1}) \lor (30306 < \text{$heap}_{724,1;747,8}.\text{p2}) \lor (30322 <
-\$heap_{724,1;747,8}.p3)) \lor ...
\rightarrow [from term 103.0, $heap<sub>724,1;747,8</sub> is equal to
heap_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 * div(heapIs $heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1}.p1, 177).quot) + (171 * div(\textbf{heapIs} \text{Sheap}_{funcstart\_724,1},
 heap_{funcstart\_724,1}.p1, 177).rem))._replace(p2 \rightarrow ((-35 * div(heapIs)))._
heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p2, 176).quot) + (172 * div(heapIs)
\theta_{uncstart\_724,1}, \theta_{uncstart\_724,1},
 * div(\mathbf{heapIs} \ \$heap_{funcstart\_724,1}, \ \$heap_{funcstart\_724,1}.p3, \ 178).quot) + (170 \ *
div(\mathbf{heapIs} \ \$heap_{funcstart\_724,1}, \ \$heap_{funcstart\_724,1}.p3,
 178).rem)))._replace(p1 \rightarrow (-2 * div(\mathbf{heapIs} \$heap_{funcstart\_724,1},
heap_{funcstart\_724,1}.p1, 177).quot + (171 * div(heapIs $heap_{funcstart\_724,1},
heap_{funcstart_{-724,1}}.p1, 177).rem)
[74.32] ((0 == \text{heap}_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 * div(heapIs
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.p1, 177).quot) + (171 * div(heapIs)
\theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}
* div(heapIs heap_{funcstart_{724,1}}, heap_{funcstart_{724,1}}, 176).quot) + (172 *
\operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724,1}, \$ \operatorname{heap}_{funcstart\_724,1}.p2,
176).rem)))._replace(p3 \rightarrow ((-63 * div(heapIs $heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1.p3}, 178).quot) + (170 * div(heapIs \text{Sheap}_{funcstart\_724,1},
\rho_{funcstart\_724,1.p3}, 178).rem)._replace(p1 \rightarrow ((-2 * div(heapIs
\text{Sheap}_{funcstart\_724.1}, \text{Sheap}_{funcstart\_724.1}.\text{p1}, 177).\text{quot}) + (171 * \text{div}(\text{heapIs})
\$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1, 177).rem))).p2) \lor (-1 <
```

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-\$heap_{724,1:747,8}.p1) \lor (30268 < \$heap_{724,1:747,8}.p1) \lor (30306 < \$heap_{724,1:747,8}.p1)
\text{sheap}_{724,1:747,8}.\text{p2}) \lor (30322 < -\text{sheap}_{724,1:747,8}.\text{p3})) \lor \dots
\rightarrow [simplify]
[74.35] ((0 == ((-35 * div(heapIs $heap_{funcstart\_724,1}, $heap_{funcstart\_724,1}.p2,
176).quot) + (172 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_724,1}, \text{\$heap}_{funcstart\_724,1}.\text{p2},
176).rem))) \vee (-1 < -$heap<sub>724.1:747.8</sub>.p1) \vee (30268 < $heap<sub>724.1:747.8</sub>.p1) \vee
(30306 < \text{$heap}_{724,1:747,8}.\text{p2}) \lor (30322 < -\text{$heap}_{724,1:747,8}.\text{p3})) \lor \dots
\rightarrow [from term 59.3, 0 == ((-35 * div(heapIs $heap_{funcstart\_724,1},
heap_{funcstart\_724,1}.p2, 176).quot + (172 * div(heapIs $heap_{funcstart\_724,1},
heap_{funcstart\_724,1}.p2, 176).rem) is false
[74.36] (false \lor (-1 < -$heap<sub>724.1:747.8.</sub>p1) \lor (30268 < $heap<sub>724.1:747.8.</sub>p1) \lor
(30306 < \text{heap}_{724,1:747,8}.\text{p2}) \lor (30322 < -\text{heap}_{724,1:747,8}.\text{p3})) \lor \dots
\rightarrow [from term 103.0, $heap<sub>724,1;747,8</sub> is equal to
heap_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 * div(heapIs $heap_{funcstart\_724,1},
heap_{funcstart_{724,1},p1, 177}, quot) + (171 * div(heapIs p_{funcstart_{724,1},p1, 177}), quot)
\rho_{tuncstart\_724.1.p1, 177).rem}))._replace\rho_{tuncstart\_724.1.p1, 177).rem})
heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p2, 176).quot) + (172 * div(heapIs)
\theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}.
* div(\mathbf{heapIs} \ \$heap_{funcstart\_724,1}, \ \$heap_{funcstart\_724,1}.p3, \ 178).quot) + (170 \ *
div(\mathbf{heapIs} \$heap_{funcstart\_724.1}, \$heap_{funcstart\_724.1}.p3,
178).rem)))._replace(p1 \rightarrow (-2 * div(\mathbf{heapIs} \$heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1}.\text{p1}, 177).\text{quot} + (171 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
heap_{funcstart_{-724,1}.p1, 177).rem}
[74.37] (false \vee (-1 < -$heap<sub>funcstart_724,1</sub>._replace(p1 \rightarrow ((-2 * div(heapIs
heap_{funcstart_{-724,1}}, heap_{funcstart_{-724,1}}, 177).quot) + (171 * div(heapIs)
* div(heapIs heap_{funcstart_{724,1}}, heap_{funcstart_{724,1},p2,176}).quot) + (172 *
\operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724,1}, \$ \operatorname{heap}_{funcstart\_724,1}.p2,
176).rem)))._replace(p3 \rightarrow ((-63 * div(heapIs $heap_{tuncstart_724.1},
\text{Sheap}_{funcstart\_724,1}.\text{p3}, 178).\text{quot} + (170 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
\rho_{tuncstart\_724.1.p3, 178.rem})._replace(p1 \rightarrow ((-2 * div(heapIs
\text{Sheap}_{funcstart\_724.1}, \text{Sheap}_{funcstart\_724.1}.\text{p1}, 177).\text{quot}) + (171 * \text{div}(\text{heapIs}))
\text{Sheap}_{funcstart\_724.1}, \text{Sheap}_{funcstart\_724.1}.\text{p1}, 177).\text{rem})).\text{p1}) \lor (30268 <
\text{heap}_{724,1:747,8}.\text{p1}) \lor (30306 < \text{heap}_{724,1:747,8}.\text{p2}) \lor (30322 <
-\$heap_{724,1;747,8}.p3)) \lor ...
\rightarrow [simplify]
[74.41] (false \vee (-1 < ((2 * div(heapIs $heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1}.\text{p1}, 177).\text{quot} + (-171 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
\{\text{heap}_{funcstart\_724,1}.\text{p1}, 177\}.\text{rem}\}
\text{heap}_{724,1;747,8}.\text{p2}) \lor (30322 < -\text{heap}_{724,1;747,8}.\text{p3})) \lor \dots
\rightarrow [from term 104.0, literala < ((-171 * div(heapIs $heap_{funcstart\_724.1},
\text{Sheap}_{funcstart\_724,1}.\text{p1}, 177).\text{rem} + (2 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
```

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heap_{funcstart-724,1}.p1, 177).quot) is false whenever -2 < (0 + literala)
     Proof of rule precondition:
     [74.41.0] - 2 < (-1 + 0)
     \rightarrow [simplify]
     [74.41.2] true
[74.42] (false \vee false \vee (30268 < $heap<sub>724.1:747.8</sub>.p1) \vee (30306 <
\text{heap}_{724,1:747,8}.\text{p2}) \lor (30322 < -\text{heap}_{724,1:747,8}.\text{p3})) \lor \dots
\rightarrow [from term 103.0, $heap<sub>724,1;747,8</sub> is equal to
heap_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 * div(heapIs $heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724.1.p1}, 177).\text{quot}) + (171 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724.1},
\rho_{funcstart\_724,1}.p1, 177).rem))).\_replace(p2 \rightarrow ((-35 * div(heapIs))).\_replace(p2 \rightarrow ((-35 * div(heapIs)))).\_replace(p2 \rightarrow ((-35 * div(heapIs)))).\_replace(p2 \rightarrow ((-35 * div(heapIs)))))
heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p2, 176).quot) + (172 * div(heapIs)
\theta_{funcstart\_724.1}, \theta_{funcstart\_724.1}, \theta_{funcstart\_724.1}, \theta_{funcstart\_724.1}, \theta_{funcstart\_724.1}, \theta_{funcstart\_724.1}
* div(heapIs heap_{funcstart\_724.1}, heap_{funcstart\_724.1}, p_{funcstart\_724.1}), quot) + (170 *
div(\mathbf{heapIs} \ \$heap_{funcstart\_724,1}, \ \$heap_{funcstart\_724,1}.p3,
178).rem)))._replace(p1 \rightarrow (-2 * div(\mathbf{heapIs} \$heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1}.\text{p1}, 177).\text{quot} + (171 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
heap_{funcstart_{724,1},p1,177,rem})
[74.43] (false \vee false \vee (30268 < $heap<sub>funcstart_724,1</sub>._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}. p1, \ 177). \operatorname{quot}) + (171 *
\operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724,1}, \$ \operatorname{heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow ((-35 * div(heapIs $heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1}.\text{p2}, 176).\text{quot} + (172 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
\rho_{funcstart\_724,1.p2, 176}.rem)._replace(p3 \rightarrow ((-63 * div(heapIs
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.\text{p3}, 178).\text{quot}) + (170 * \text{div}(\text{heapIs}))
\theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}.p3, 178).rem))._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.\operatorname{p1}, \ 177).\operatorname{rem}))).\operatorname{p1}) \lor
(30306 < \text{$heap}_{724,1:747.8}.\text{p2}) \lor (30322 < -\text{$heap}_{724,1:747.8}.\text{p3})) \lor \dots
\rightarrow [simplify]
[74.44] (false \vee false \vee (30268 < ((-2 * div(heapIs $heap_{funcstart_{-724.1}},
\text{Sheap}_{funcstart\_724,1}.\text{p1}, 177).\text{quot} + (171 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1}.\text{p1}, 177).\text{rem}))) \lor (30306 < \text{Sheap}_{724,1;747,8}.\text{p2}) \lor (30322 <
-\$heap_{724,1;747,8}.p3)) \lor ...
\rightarrow [from term 56.17, literala < ((-2 * div(heapIs $heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1}.p1, 177).quot) + (171 * div(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
\rho_{funcstart\_724,1}.p1, 177).rem is false whenever -2 < (-30269 + literala)
     Proof of rule precondition:
     [74.44.0] - 2 < (-30269 + 30268)
     \rightarrow [simplify]
```

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[74.44.2] true
[74.45] (false \vee false \vee false \vee (30306 < $heap<sub>724,1:747,8</sub>.p2) \vee (30322 <
-\$heap_{724,1;747,8}.p3)) \lor ...
\rightarrow [from term 103.0, $heap<sub>724,1;747,8</sub> is equal to
heap_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 * div(heapIs *heap_{funcstart\_724,1},
heap_{funcstart\_724,1}.p1, 177).quot + (171 * div(heapIs p_{funcstart\_724,1})
heap_{funcstart\_724,1}.p1, 177).rem))).\_replace(p2 \rightarrow ((-35 * div(heapIs))).\_replace(p2 \rightarrow ((-35 * div(heapIs)))))._replace(p2 \rightarrow ((-35 * div(heapIs)))))
heap_{funcstart\_724,1}, p_{funcstart\_724,1}, p_{funcstart\_724,1}, p_{funcstart\_724,1}, p_{funcstart\_724,1}
heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p2, 176).rem)))._replace(p3 \rightarrow ((-63)
 * div(\mathbf{heapIs} \ \$heap_{funcstart\_724,1}, \ \$heap_{funcstart\_724,1}.p3, \ 178).quot) + (170 \ *
div(\textbf{heapIs}~\$heap_{funcstart\_724,1},~\$heap_{funcstart\_724,1}.p3,
178).rem))). replace(p1 \rightarrow (-2 * div(heapIs $heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1}.p1, 177).quot) + (171 * div(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
$heap_{funcstart\_724,1}.p1, 177).rem))]
[74.46] \; \textbf{(false} \; \lor \; \textbf{false} \; \lor \; \textbf{(30306} \; < \; \$ \\ \text{heap}_{funcstart\_724,1}. \_\textbf{replace} \\ (\text{p1} \; \to \; \texttt{1}) \\ \text{p2} \; \text{p3} \; \text{p3} \; \text{p3} \; \text{p4} \\ \text{p3} \; \text{p4} \; \text{p4} \; \text{p4} \\ \text{p4} \text{p4} \; \text{p4} \\ \text{p4} \; \text{p4} \; \text{p4} \\ \text{p4} \; \text{p4} \; \text{p4} \\ \text{p4} \; \text{p4} \\ \text{p4} \; \text{p4} \; \text{p4} \; \text{p4} \\ \text{p4} \; \text{p4} \; \text{p4} \; \text{p4} \\ \text{p4} \; \text{p4} \; \text
((-2 * div(\mathbf{heapIs} \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1, 177).quot) +
(171 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_724,1}, \text{\$heap}_{funcstart\_724,1}.\text{p1},
177).rem)))._replace(p2 \rightarrow ((-35 * div(heapIs $heap_{funcstart_724.1},
\text{Sheap}_{funcstart_{724,1},p2}, 176).\text{quot} + (172 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart_{724,1}},
heap_{funcstart\_724,1.p2, 176}.rem)._replace(p3 \rightarrow ((-63 * div(heapIs
\theta_{funcstart_{724,1}}, \theta_{funcstart_{724,1}}, \theta_{funcstart_{724,1}}, \theta_{funcstart_{724,1}}, \theta_{funcstart_{724,1}}
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.p3, 178).rem))).\_replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.p1, \ 177).rem))).p2) \lor
(30322 < -\$heap_{724,1;747,8}.p3)) \lor \dots
\rightarrow [simplify]
[74.49] (false \vee false \vee false \vee (30306 < ((-35 * div(heapIs
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.p2, 176).quot) + (172 * div(heapIs)
heap_{funcstart_{-724,1}}, heap_{funcstart_{-724,1},p2, 176}.rem))) \lor (30322 < 6000)
-\$heap_{724,1;747,8}.p3)) \lor ...
\rightarrow [from term 60.18, literala < ((-35 * div(heapIs $heap_{tuncstart\_724.1},
heap_{funcstart_{724,1},p2, 176}, quot) + (172 * div(heapIs p_{funcstart_{724,1},p2}
\rho_{funcstart\_724,1.p2, 176}.rem)) is false whenever -2 < (-30307 + literala)
        Proof of rule precondition:
        [74.49.0] - 2 < (-30307 + 30306)
        \rightarrow [simplify]
        [74.49.2] true
[74.50] (false \vee false \vee false \vee false \vee (30322 < -$heap<sub>724.1:747.8</sub>.p3)) \vee ...
\rightarrow [from term 103.0, $heap<sub>724,1;747,8</sub> is equal to
heap_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 * div(heapIs p_{funcstart\_724,1}),
heap_{funcstart\_724,1}.p1, 177).quot + (171 * div(heapIs $heap_{funcstart\_724,1},
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heap_{funcstart\_724.1.p1, 177).rem}))._replace(p2 \rightarrow ((-35 * div(heapIs)))
heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p2, 176).quot) + (172 * div(heapIs)
heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p2, 176).rem)))._replace(p3 \rightarrow ((-63)
 * div(\mathbf{heapIs} \ \$heap_{funcstart\_724,1}, \ \$heap_{funcstart\_724,1}.p3, \ 178).quot) + (170 \ *
div(\mathbf{heapIs} \ \$heap_{funcstart\_724,1}, \ \$heap_{funcstart\_724,1}.p3,
 178).rem)))._replace(p1 \rightarrow (-2 * div(\textbf{heapIs } \$heap_{funcstart\_724,1},
heap_{funcstart\_724,1}.p1, 177).quot + (171 * div(heapIs $heap_{funcstart\_724,1}, 177).quot) + (171 * div(heapIs $heap_{funcstart\_724,1}, 17
heap_{funcstart_{-724,1}}.p1, 177).rem)
[74.51] (false \vee false \vee false \vee false \vee (30322 <
-\text{\$heap}_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 * div(heapIs $heap_{funcstart\_724,1},
\theta_{funcstart\_724,1}.p1, 177).quot + (171 * div(heapIs \theta_{funcstart\_724,1}),
\theta_{1.5} = \theta_{1
\text{Sheap}_{funcstart_{-724.1}}, \text{Sheap}_{funcstart_{-724.1}}.p2, 176).quot) + (172 * div(heapIs)
\$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p2, 176).rem))).\_\mathbf{replace}(p3 \rightarrow ((-63 - 200))))
* div(\mathbf{heapIs} \ \$ heap_{funcstart\_724,1}, \ \$ heap_{funcstart\_724,1}.p3, \ 178).quot) + (170 \ *
\operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724,1}, \$ \operatorname{heap}_{funcstart\_724,1}.p3,
178).rem)))._replace(p1 \rightarrow ((-2 * div(heapIs $heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1}.\text{p1}, 177).\text{quot} + (171 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
heap_{funcstart_{-724,1}.p1, 177).rem})).p3)) \lor ...
\rightarrow [simplify]
[74.56] (false \vee false \vee false \vee false \vee (30322 < ((63 * div(heapIs
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.\text{p3}, 178).\text{quot}) + (-170 * \text{div}(\text{heapIs}))
{\tt Sheap}_{funcstart\_724,1},\,{\tt Sheap}_{funcstart\_724,1}.p3,\,178).rem)))) \vee ...
\rightarrow [from term 62.13, literala < ((-170 * div(heapIs $heap_{funcstart\_724.1},
\text{Sheap}_{funcstart\_724,1}.p3, 178).rem + (63 * div(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
heap_{funcstart_{-724,1}.p3}, 178).quot)) is false whenever -2 < (-30323 + literala)
           Proof of rule precondition:
           [74.56.0] - 2 < (-30323 + 30322)
           \rightarrow [simplify]
           [74.56.2] true
[74.57] (false \vee false \vee false \vee false \vee false) \vee ...
\rightarrow [simplify]
[74.58] false \vee \dots
[Remove 'false' term 74.58 and fetch new term from containing clause]
[106.0] $heap<sub>funcend_724,1</sub> == $heap<sub>724,1;748,8</sub>._replace(p3 \rightarrow
heap_{724,1;748,8}.p3
[Take goal term]
[1.56] (30322 < \text{$heap_{funcend\_724,1}.p3}) \lor (30306 < \text{$heap_{funcend\_724,1}.p2}) \lor
(30268 < \text{$heap_{funcend\_724,1}.p1}) \lor (-1 < -\text{$heap_{funcend\_724,1}.p1}) \lor (-1 < -\text{$heap_{funcend\_724,1}.p1})
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-\$heap_{funcend\_724,1}.p2) \lor (-1 < -\$heap_{funcend\_724,1}.p3)
\rightarrow [from term 106.0, $heap_{funcend\_724,1}$ is equal to $heap_{724,1;748,8}._replace(p3
\rightarrow \$heap_{724,1;748,8}.p3)]
[1.57] (-1 < -\$heap_{724,1;748,8}.replace(p3 \rightarrow \$heap_{724,1;748,8}.p3).p1) \lor (-1 <
-\$heap_{funcend\_724,1}.p2) \lor (-1 < -\$heap_{funcend\_724,1}.p3) \lor (30268 <
\text{Sheap}_{funcend\_724,1}.\text{p1}) \lor (30306 < \text{Sheap}_{funcend\_724,1}.\text{p2}) \lor (30322 <
heap_{funcend\_724,1.p3}
\rightarrow [simplify]
[1.58] (-1 < -\$heap_{724,1;748,8}.p1) \lor (-1 < -\$heap_{funcend\_724,1}.p2) \lor (-1 < -\$heap_{funcend\_724,1}.p2)
-\$heap_{funcend\_724,1}.p3) \lor (30268 < \$heap_{funcend\_724,1}.p1) \lor (30306 < funcend\_724,1)
\$heap_{funcend\_724,1}.p2) \lor (30322 < \$heap_{funcend\_724,1}.p3)
\rightarrow [from term 106.0, $heap_{funcend\_724,1}$ is equal to $heap_{724,1;748,8}.\_replace(p3)
\rightarrow $heap<sub>724,1;748,8</sub>.p3)]
[1.59] (-1 < -\$heap_{724,1;748,8}.p1) \lor (-1 < -\$heap_{724,1;748,8}.\_replace(p3 \rightarrow
\text{Sheap}_{724,1;748,8}.\text{p3}).\text{p2}) \lor (-1 < -\text{Sheap}_{funcend\_724,1}.\text{p3}) \lor (30268 <
\text{Sheap}_{funcend\_724,1}.\text{p1}) \lor (30306 < \text{Sheap}_{funcend\_724,1}.\text{p2}) \lor (30322 <
heap_{funcend_{-724,1}.p3}
\rightarrow [simplify]
[1.60] (-1 < -$heap<sub>724,1;748,8</sub>.p1) \vee (-1 < -$heap<sub>724,1;748,8</sub>.p2) \vee (-1 <
-\$heap_{funcend\_724,1}.p3) \lor (30268 < \$heap_{funcend\_724,1}.p1) \lor (30306 < funcend\_724,1)
\text{Sheap}_{funcend\_724,1}.\text{p2}) \lor (30322 < \text{Sheap}_{funcend\_724,1}.\text{p3})
\rightarrow [from term 106.0, $heap_{funcend\_724,1}$ is equal to $heap_{724,1;748,8}._replace(p3)
\rightarrow $heap_{724,1;748,8}.p3)
 [1.61] \; (\text{-}1 < -\$ \text{heap}_{724,1;748,8}.\text{p1}) \; \lor \; (\text{-}1 < -\$ \text{heap}_{724,1;748,8}.\text{p2}) \; \lor \; (\text{-}1 < -\$ \text
-\$heap_{724,1:748.8}.replace(p3 \rightarrow \$heap_{724,1:748.8}.p3).p3) \lor (30268 <
\text{Sheap}_{funcend\_724,1}.\text{p1}) \lor (30306 < \text{Sheap}_{funcend\_724,1}.\text{p2}) \lor (30322 <
heap_{funcend\_724,1.p3}
\rightarrow [simplify]
[1.62] (-1 < -$heap<sub>724,1;748,8</sub>.p1) \vee (-1 < -$heap<sub>724,1;748,8</sub>.p2) \vee (-1 <
 -\$heap_{724,1;748,8}.p3) \lor (30268 < \$heap_{funcend\_724,1}.p1) \lor (30306 < function for the second content of 
\text{Sheap}_{funcend\_724,1}.\text{p2}) \lor (30322 < \text{Sheap}_{funcend\_724,1}.\text{p3})
[Remove 'false' term 74.58 and fetch new term from containing clause]
[107.0] -1 < \text{$heap}_{724,1;748,8}.p3
[Take goal term]
[1.62] (-1 < -$heap<sub>724,1:748,8</sub>.p1) \vee (-1 < -$heap<sub>724,1:748,8</sub>.p2) \vee (-1 <
-\$heap_{724,1;748,8}.p3) \lor (30268 < \$heap_{funcend\_724,1}.p1) \lor (30306 < functions)
\text{Sheap}_{funcend\_724.1.p2}) \lor (30322 < \text{Sheap}_{funcend\_724.1.p3})
\rightarrow [from term 107.0, -1 < -$heap<sub>724.1:748.8</sub>.p3 is true if and only if 0 ==
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$heap<sub>724,1;748,8</sub>.p3]
[1.63] (-1 < -$heap<sub>724,1:748,8</sub>.p1) \vee (-1 < -$heap<sub>724,1:748,8</sub>.p2) \vee (0 ==
\text{heap}_{724,1:748,8}.\text{p3}) \lor (30268 < \text{heap}_{funcend\_724,1}.\text{p1}) \lor (30306 <
\text{Sheap}_{funcend\_724,1}.\text{p2}) \lor (30322 < \text{Sheap}_{funcend\_724,1}.\text{p3})
\rightarrow [from term 106.0, $heap_{funcend\_724,1}$ is equal to $heap_{724,1;748,8}._replace(p3
\rightarrow $heap_{724,1;748,8}.p3)]
[1.64] (-1 < -\$heap_{724,1;748,8}.p1) \lor (-1 < -\$heap_{724,1;748,8}.p2) \lor (0 ==
\text{$heap}_{724,1;748,8}.p3) \lor (30268 < \text{$heap}_{724,1;748,8}.\_\textbf{replace}(p3 \rightarrow
\text{Sheap}_{724,1;748,8}.\text{p3}).\text{p1}) \lor (30306 < \text{Sheap}_{funcend\_724,1}.\text{p2}) \lor (30322 <
heap_{funcend\_724,1}.p3
\rightarrow [simplify]
[1.65] (-1 < -$heap<sub>724,1;748,8</sub>.p1) \vee (-1 < -$heap<sub>724,1;748,8</sub>.p2) \vee (0 ==
\text{$heap}_{724,1;748,8}.p3) \lor (30268 < \text{$heap}_{724,1;748,8}.p1) \lor (30306 < \text{$heap}_{724,1;748,8}.p3) \lor (30306 < \text{$heap}_{724,1;748,8}.p3)
\text{heap}_{funcend\_724,1}.\text{p2}) \lor (30322 < \text{heap}_{funcend\_724,1}.\text{p3})
\rightarrow [from term 106.0, $heap_{funcend\_724,1}$ is equal to $heap_{724,1;748,8}._replace(p3
\rightarrow $heap_{724,1;748,8}.p3)
[1.66] (-1 < -$heap<sub>724,1:748,8</sub>.p1) \vee (-1 < -$heap<sub>724,1:748,8</sub>.p2) \vee (0 ==
\text{heap}_{724,1;748,8}.\text{p3}) \lor (30268 < \text{heap}_{724,1;748,8}.\text{p1}) \lor (30306 <
\text{$heap}_{724,1;748,8}.replace(p3 \rightarrow \text{$heap}_{724,1;748,8}.p3).p2) \lor (30322 <
heap_{funcend_{-724,1}.p3}
\rightarrow [simplify]
[1.67] (-1 < -\$heap_{724,1;748,8}.p1) \lor (-1 < -\$heap_{724,1;748,8}.p2) \lor (0 ==
\text{heap}_{724,1;748,8}.\text{p3}) \lor (30268 < \text{heap}_{724,1;748,8}.\text{p1}) \lor (30306 <
\text{heap}_{724,1;748,8}.\text{p2}) \vee (30322 < \text{heap}_{funcend\_724,1}.\text{p3})
\rightarrow [from term 106.0, $heap_{funcend\_724,1}$ is equal to $heap_{724,1:748,8}._replace(p3)
\rightarrow $heap_{724,1;748,8}.p3)]
[1.68] (-1 < -\$heap_{724,1:748,8}.p1) \lor (-1 < -\$heap_{724,1:748,8}.p2) \lor (0 ==
\text{heap}_{724,1;748,8}.\text{p3}) \lor (30268 < \text{heap}_{724,1;748,8}.\text{p1}) \lor (30306 <
\text{heap}_{724,1;748,8}.\text{p2}) \lor (30322 < \text{heap}_{724,1;748,8}.\text{-replace}(\text{p3} \rightarrow
heap_{724,1;748,8}.p3).p3
\rightarrow [simplify]
[1.69] (-1 < -\$heap_{724,1;748,8}.p1) \lor (-1 < -\$heap_{724,1;748,8}.p2) \lor (0 ==
\text{heap}_{724,1;748,8}.\text{p3}) \lor (30268 < \text{heap}_{724,1;748,8}.\text{p1}) \lor (30306 <
heap_{724,1;748,8}.p2) \lor (30322 < heap_{724,1;748,8}.p3)
[Copy term 106.0]
[109.0] ($heap<sub>funcend_724,1</sub> == $heap<sub>724,1;748,8</sub>._replace(p3 \rightarrow
\text{Sheap}_{724,1;748,8}.\text{p3})) \lor (\text{Sheap}_{724,1;748,8} == \text{Sheap}_{724,1;747,8}.\_\text{replace}(\text{p2} \to \text{p3}))
\text{Sheap}_{724,1;747,8}.\text{p2})) \lor (-1 < \text{Sheap}_{724,1;747,8}.\text{p2}) \lor (\text{Sheap}_{724,1;747,8} = -1)
\text{Sheap}_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 * div(heapIs \text{Sheap}_{funcstart\_724,1},
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\text{Sheap}_{funcstart_{-724,1},p1, 177}.\text{quot}) + (171 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart_{-724,1}})
heap_{funcstart\_724,1.pl}, 177).rem))._replace(p2 \rightarrow ((-35 * div(heapIs
\$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p2, 176).quot) + (172 * div(\textbf{heapIs}) + (172 * div(\textbf{heapIs})) + (172
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.p2, 176).rem))).\_replace(p3 \rightarrow ((-63)))
* div(\mathbf{heapIs} \ \$ heap_{funcstart\_724,1}, \ \$ heap_{funcstart\_724,1}.p3, \ 178).quot) + (170 \ *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p3,
178).rem)))._replace(p1 \rightarrow ((-2 * div(heapIs $heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724.1.p1}, 177).\text{quot} + (171 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724.1},
\$heap_{funcstart\_724,1}.p1,\ 177).rem)))) \ \lor \ (0 < ((-2 * div(\mathbf{heapIs}
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.p1, 177).quot) + (171 * div(heapIs)
heap_{funcstart_{724,1}}, heap_{funcstart_{724,1}}, 177).rem)
\rightarrow [from term 86.6, $heap<sub>724.1:748.8</sub> is equal to $heap<sub>funcstart_724.1</sub>._replace(p1)
\rightarrow ((-2 * div(\mathbf{heapIs} \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1, 177).quot) +
(171 * div(\mathbf{heapIs} \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1,
 177).rem)))._replace(p2 \rightarrow ((-35 * div(\mathbf{heapIs} \$heap_{funcstart\_724,1},
heap_{funcstart\_724,1}.p2, 176).quot + (172 * div(heapIs $heap_{funcstart\_724,1}, 176).quot) + (172 * div(heapIs $heap_{funcstart\_724,1}, 17
heap_{funcstart\_724,1}.p2, 176).rem))._replace(p3 \rightarrow ((-63 * div(heapIs)))._
\theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}
\theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}.
 (30269 + (-2 * div(\mathbf{heapIs} \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1,
 177).quot) + (171 * div(\mathbf{heapIs} \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1,
 177).rem)))._replace(p2 \rightarrow 30307 + (-35 * div(heapIs $heap_{funcstart\_724,1},
heap_{funcstart_{-724,1},p2, 176}, quot) + (172 * div(heapIs p_{funcstart_{-724,1},p2})
heap_{funcstart_{724,1}}.p2, 176).rem)
[109.2] (\text{$heap}_{funcend\_724,1} == \text{$heap}_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).quot) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow ((-35 * div(heapIs $heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\ 724.1.p2}, 176).\text{quot} + (172 * \text{div}(\text{heapIs} \text{Sheap}_{funcstart\ 724.1},
\theta_{funcstart\_724,1.p2, 176}.rem))._replace(p3 \rightarrow ((-63 * div(heapIs
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.p3, 178).quot) + (170 * div(heapIs)
\rho_{funcstart\_724,1}, \rho_{funcstart\_724,1}
(30269 + (-2 * div(\mathbf{heapIs} \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1,
177).quot) + (171 * div(heapIs $heap_{funcstart\_724,1}, $heap_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow (30307 + (-35 * div(heapIs $heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1}.\text{p2}, 176).\text{quot} + (172 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
\theta_{tuncstart_{724.1},p2,176}.rem)._replace(p3 \rightarrow
\rho_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 * div(heapIs \rho_{funcstart\_724,1}),
\text{Sheap}_{funcstart\_724,1}.\text{p1}, 177).\text{quot} + (171 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724.1}, \text{Sheap}_{funcstart\_724.1}.p2, 176).quot) + (172 * div(heapIs)
\theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}.
* div(heapIs heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p3, 178).quot) + (170 *
\operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724.1}, \$ \operatorname{heap}_{funcstart\_724.1}.p3,
178).rem)))._replace(p1 \rightarrow (30269 + (-2 * div(heapIs $heap_{funcstart\_724.1},
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\text{Sheap}_{funcstart_{-724,1},p1, 177}.\text{quot}) + (171 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart_{-724,1}})
\rho_{uncstart\_724,1.p1, 177).rem})).\_replace(p2 \to (30307 + (-35)^*)
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p2, \ 176).quot) + (172 *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.p2, \ 176).rem))).p3)) \lor \dots
\rightarrow [simplify]
[109.5] (\text{$heap}_{funcend\_724,1} == \text{$heap}_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow ((-35 * div(heapIs $heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1}.\text{p2}, 176).\text{quot} + (172 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
\rho_{funcstart\_724,1.p2, 176}.rem))._replace(p3 \rightarrow ((-63 * div(heapIs
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.p3, 178).quot) + (170 * div(heapIs)
\rho_{funcstart\_724,1}, \rho_{func
(30269 + (-2 * div(\mathbf{heapIs} \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1,
177).quot) + (171 * div(heapIs heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow (30307 + (-35 * div(heapIs $heap_{funcstart\_724.1},
\text{Sheap}_{funcstart\_724,1}.\text{p2}, 176).\text{quot} + (172 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
\rho_{tuncstart\_724.1.p2, 176}.rem)._replace(p3 \rightarrow ((-63 * div(heapIs
heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p3, 178).quot) + (170 * div(heapIs
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.p3, 178).rem)))) \lor ...
[Copy term 107.0]
[110.0] (-1 < \text{$heap}_{724,1;748,8}.p3) \vee (\text{$heap}_{724,1;748,8} ==
\text{heap}_{724,1:747,8}._replace(p2 \rightarrow \text{heap}_{724,1:747,8}.p2)) \rightarrow (-1 <
\text{Sheap}_{724,1;747,8}.\text{p2}) \lor (\text{Sheap}_{724,1;747,8} == \text{Sheap}_{funcstart\_724,1}.\_\mathbf{replace}(\text{p1} \to \text{p1})
((-2 * div(\mathbf{heapIs} \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1, 177).quot) +
(171 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_724,1}, \text{\$heap}_{funcstart\_724,1}.\text{p1},
177).rem)))._replace(p2 \rightarrow ((-35 * div(heapIs $heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1}.\text{p2}, 176).\text{quot} + (172 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
\rho_{funcstart\_724,1.p2, 176).rem}))._replace(p3 \rightarrow ((-63 * div(heapIs
\text{Sheap}_{funcstart_{-724,1}}, \text{Sheap}_{funcstart_{-724,1}}.\text{p3}, 178).\text{quot}) + (170 * \text{div}(\text{heapIs}))
\rho_{uncstart_724,1}, \rho_{uncstart_724,1},
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}. p1, \ 177).rem)))) \lor (0 <
((-2 * div(\mathbf{heapIs} \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1, 177).quot) +
(171 * \operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724,1}, \$ \operatorname{heap}_{funcstart\_724,1}.\operatorname{p1}, 177).\operatorname{rem})))
\rightarrow [from term 86.6, $heap<sub>724,1:748,8</sub> is equal to $heap<sub>funcstart_724,1</sub>._replace(p1
\rightarrow ((-2 * div(heapIs $heap_{funcstart\_724,1}, $heap_{funcstart\_724,1}.p1, 177).quot) +
(171 * div(heapIs heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p1,
 177).rem)))._replace(p2 \rightarrow ((-35 * div(\mathbf{heapIs} \$heap_{funcstart\_724.1},
\text{Sheap}_{funcstart\_724,1}.\text{p2},\ 176).\text{quot}) + (172 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
 heap_{funcstart\_724,1}.p2, 176).rem))._replace(p3 \rightarrow ((-63 * div(heapIs)))._
heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p3, 178).quot) + (170 * div(heapIs)
 heap_{funcstart_{-724,1}}, heap_{funcstart_{-724,1}}, 178).rem)))._replace(p1 \rightarrow
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(30269 + (-2 * div(\mathbf{heapIs} \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1,
177).quot) + (171 * div(heapIs heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow 30307 + (-35 * div(heapIs $heap_{tuncstart\_724,1},
heap_{funcstart\_724,1}.p2, 176).quot + (172 * div(heapIs $heap_{funcstart\_724,1}, 176).quot) + (172 * div(heapIs $heap_{funcstart\_724,1}, 17
heap_{funcstart_{-724,1}.p2, 176).rem}
[110.1] (-1 < \text{heap}_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 * div(heapIs
\theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}
\theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}
* div(heapIs heap_{funcstart_{-724,1}}, heap_{funcstart_{-724,1}}, p2, 176).quot) + (172 *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.p2,
176).rem)))._replace(p3 \rightarrow ((-63 * div(heapIs $heap_{funcstart\_724,1},
\text{Sheap}_{funcstart_724.1.p3}, 178).\text{quot} + (170 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart_724.1},
\text{heap}_{funcstart\_724.1}.\text{p3}, 178).\text{rem}))._replace(p1 \rightarrow (30269 + (-2 * div(heapIs
\theta_{funcstart_{724,1}}, \theta_{funcstart_{724,1},p1, 177}.quot + (171 * div(heapIs))
\rho_{funcstart\_724,1}, \rho_{funcstart\_724,1}
(30307 + (-35 * div(\mathbf{heapIs} \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p2,
(176).quot + (172 * div(heapIs \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p2,
176).rem))).p3) \vee \dots
\rightarrow [simplify]
\textit{[110.4]} \ (\text{-}1 < ((\text{-}63 * \mathrm{div}(\mathbf{heapIs} \ \$ \mathrm{heap}_{funcstart\_724,1}, \ \$ \mathrm{heap}_{funcstart\_724,1}.\mathrm{p3},
178).quot) + (170 * div(heapIs \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}.p3,
178).rem))) \vee ...
\rightarrow [from term 63.3, -1 < ((-63 * div(heapIs $heap_{funcstart_724.1},
\text{Sheap}_{funcstart\_724,1}.\text{p3}, 178).\text{quot} + (170 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
heap_{funcstart_{-724,1}.p3}, 178).rem) is true if and only if 0 < ((-63 * div(heapIs)))
heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p3, 178).quot) + (170 * div(heapIs)
heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p3, 178).rem)
[110.5] (0 < ((-63 * div(heapIs heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p3,
178).quot) + (170 * div(heapIs \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}.p3,
178).rem))) \vee ...
[Copy term 1.56]
[111.0] ((-1 < -\$heap_{funcend\_724,1}.p1) \vee (-1 < -\$heap_{funcend\_724,1}.p2) \vee (-1 <
-\$heap_{funcend\_724,1}.p3) \lor (30268 < \$heap_{funcend\_724,1}.p1) \lor (30306 < funcend\_724,1)
\text{Sheap}_{funcend\_724,1.p2}) \lor (30322 < \text{Sheap}_{funcend\_724,1.p3})) \lor (\text{Sheap}_{724,1;748,8})
== $heap<sub>724,1;747,8</sub>._replace(p2 \rightarrow $heap<sub>724,1;747,8</sub>.p2)) \lor (-1 <
\text{Sheap}_{724,1:747,8}.\text{p2}) \lor (\text{Sheap}_{724,1:747,8} == \text{Sheap}_{funcstart\_724,1}.\_\mathbf{replace}(\text{p1} \to \text{p1})
((-2 * \text{div}(\mathbf{heapIs} \$ \text{heap}_{funcstart\_724,1}, \$ \text{heap}_{funcstart\_724,1}.\text{p1}, 177).\text{quot}) +
(171 * \operatorname{div}(\mathbf{heapIs} \ \text{$heap}_{funcstart\_724,1}, \ \text{$heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow ((-35 * div(heapIs $heap_{funcstart_{-724,1}},
\theta_{funcstart\_724,1.p2}, 176).quot) + (172 * div(heapIs \theta_{funcstart\_724,1},
\rho_{funcstart\_724.1.p2, 176}.rem)._replace(p3 \rightarrow ((-63 * div(heapIs
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.p3, 178).quot) + (170 * div(heapIs)
\theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}
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\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).rem)))) \lor (0 <
((-2*\operatorname{div}(\mathbf{heapIs}\ \$ \operatorname{heap}_{funcstart\_724,1},\ \$ \operatorname{heap}_{funcstart\_724,1}.\operatorname{p1},\ 177).\operatorname{quot}) +\\
(171 * \text{div}(\textbf{heapIs} \$ \text{heap}_{funcstart\_724,1}, \$ \text{heap}_{funcstart\_724,1}.\text{p1}, 177).\text{rem})))
\rightarrow [from term 109.5, $heap<sub>funcend_724,1</sub> is equal to
heap_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 * div(heapIs *heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1}.\text{p1}, 177).\text{quot} + (171 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
\rho_{funcstart\_724,1}.p1, 177).rem))).\_replace(p2 \rightarrow ((-35 * div(heapIs))).\_replace(p2 \rightarrow ((-35 * div(heapIs)))).\_replace(p2 \rightarrow ((-35 * div(heapIs)))))
heap_{funcstart\_724.1}, heap_{funcstart\_724.1}, p2, 176).quot) + (172 * div(heapIs)
\theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}
* div(\mathbf{heapIs} \ \$heap_{funcstart\_724,1}, \ \$heap_{funcstart\_724,1}.p3, \ 178).quot) + (170 \ *
div(\mathbf{heapIs} \ \$heap_{funcstart\_724.1}, \ \$heap_{funcstart\_724.1}.p3,
178).rem)))._replace(p1 \rightarrow (30269 + (-2 * div(heapIs $heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1}.p1, 177).quot) + (171 * div(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
heap_{funcstart\_724,1}.p1, 177).rem))._replace(p2 	o (30307 + (-35 *
div(\mathbf{heapIs} \ \$heap_{funcstart\_724,1}, \ \$heap_{funcstart\_724,1}.p2, \ 176).quot) + (172 *
div(\mathbf{heapIs} \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p2,
176).rem)))._replace(p3 \rightarrow (-63 * div(\mathbf{heapIs} \$heap_{funcstart\_724,1},
heap_{funcstart\_724,1}.p3, 178).quot + (170 * div(heapIs $heap_{funcstart\_724,1}),
heap_{funcstart_{-724,1}}.p3, 178).rem
[111.1] ((-1 < -$heap<sub>funcstart_724,1</sub>._replace(p1 \rightarrow ((-2 * div(heapIs
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.\text{p1}, 177).\text{quot}) + (171 * \text{div}(\text{heapIs})
\theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}
* div(heapIs heap_{funcstart_{-724,1}}, heap_{funcstart_{-724,1}}.p2, 176).quot) + (172 *
\operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724.1}, \$ \operatorname{heap}_{funcstart\_724.1}.p2,
176).rem)))._replace(p3 \rightarrow ((-63 * div(heapIs $heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1}.\text{p3}, 178).\text{quot} + (170 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
\rho_{funcstart\_724,1.p3}, 178).rem))._replace(p1 \rightarrow (30269 + (-2 * div(heapIs
\text{Sheap}_{funcstart\ 724.1}, \text{Sheap}_{funcstart\ 724.1}, \text{p1}, 177).\text{quot}) + (171 * \text{div}(\text{heapIs})
\theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}.p1, 177).rem))).\_replace(p2 \rightarrow
(30307 + (-35 * div(\mathbf{heapIs} \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p2,
176).quot) + (172 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_724,1}, \text{\$heap}_{funcstart\_724,1}.p2,
176).rem)))._replace(p3 \rightarrow ((-63 * div(heapIs $heap_{funcstart_724,1},
heap_{funcstart\_724,1.p3}, 178).quot) + (170 * div(heapIs heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1.p3}, 178).rem))).p1) \lor (-1 < -\text{Sheap}_{funcend\_724,1.p2}) \lor (-1
<-$heap<sub>funcend_724,1</sub>.p3) \lor (30268 <$heap<sub>funcend_724,1</sub>.p1) \lor (30306 <
\text{Sheap}_{funcend\_724,1}.\text{p2}) \vee (30322 < \text{Sheap}_{funcend\_724,1}.\text{p3})) \vee ...
\rightarrow [simplify]
[111.12] ((30268 < ((-171 * div(heapIs $heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1}.\text{p1}, 177).\text{rem} + (2 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1}.\text{p1}, 177).\text{quot}))) \lor (-1 < -\text{Sheap}_{funcend\_724,1}.\text{p2}) \lor (-1 < -\text{Sheap}_{funcend\_724,1}.\text{p2})
-\$heap_{funcend\_724,1}.p3) \lor (30268 < \$heap_{funcend\_724,1}.p1) \lor (30306 < \$heap_{funcend\_724,1}.p3)
\text{Sheap}_{funcend\_724.1.p2}) \vee (30322 < \text{Sheap}_{funcend\_724.1.p3})) \vee ...
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\rightarrow [from term 54.11, literala < ((-171 * div(heapIs $heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1}.\text{p1}, 177).\text{rem} + (2 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
heap_{funcstart_{-724,1}}.p1, 177).quot) is false whenever -2 < (-30269 + literala)
          Proof of rule precondition:
          [111.12.0] -2 < (-30269 + 30268)
          \rightarrow [simplify]
          [111.12.2] true
[111.13] (false \vee (-1 < –$heap _ funcend_724,1.p2) \vee (-1 <
-\$heap_{funcend\_724,1}.p3) \lor (30268 < \$heap_{funcend\_724,1}.p1) \lor (30306 < funcend\_724,1)
\text{Sheap}_{funcend\_724,1}.\text{p2}) \lor (30322 < \text{Sheap}_{funcend\_724,1}.\text{p3})) \lor \dots
\rightarrow [from term 109.5, $heap<sub>funcend_724,1</sub> is equal to
heap_{funcstart\_724.1}._replace(p1 \rightarrow ((-2 * div(heapIs $heap_{funcstart\_724.1},
heap_{funcstart_{724,1},p1, 177}, quot) + (171 * div(heapIs p_{funcstart_{724,1},p1, 177}), quot)
\rho_{tuncstart\_724.1.p1, 177).rem}))._replace(p2 \rightarrow ((-35 * div(heapIs
heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p2, 176).quot) + (172 * div(heapIs)
\theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}
 * div(\mathbf{heapIs} \ \$heap_{funcstart\_724,1}, \ \$heap_{funcstart\_724,1}.p3, \ 178).quot) + (170 \ *
div(\mathbf{heapIs} \ \$heap_{funcstart\_724,1}, \ \$heap_{funcstart\_724,1}.p3,
 178).rem)))._replace(p1 \rightarrow (30269 + (-2 * div(heapIs $heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1}.p1, 177).quot) + (171 * div(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
p_{funcstart\ 724.1}.p1,\ 177).rem))._replacep_{funcstart\ 724.1}.p1,\ 177).rem)
div(\mathbf{heapIs} \ \$heap_{funcstart\_724,1}, \ \$heap_{funcstart\_724,1}.p2, \ 176).quot) + (172 *
div(\mathbf{heapIs} \ \$heap_{funcstart\_724,1}, \ \$heap_{funcstart\_724,1}.p2,
 176).rem)))._replace(p3 \rightarrow (-63 * div(heapIs $heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1}.p3, 178).quot) + (170 * div(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
heap_{funcstart_{-724,1}.p3, 178).rem}
[111.14] (false \vee (-1 < -$heap<sub>funcstart_724,1</sub>._replace(p1 \rightarrow ((-2 * div(heapIs
\theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}
\rho_{tuncstart,724,1}, \rho_{tuncstart,724,1}
* div(heapIs heap_{funcstart_{724,1}}, heap_{funcstart_{724,1}}, p2, 176).quot) + (172 *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.p2,
176).rem)))._replace(p3 \rightarrow ((-63 * div(heapIs $heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1.p3}, 178).\text{quot} + (170 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
\rho_{funcstart\_724,1.p3, 178).rem})).\_replace(p1 \to (30269 + (-2 * div(heapIs)))._replace(p1 \to (30269 + (-2 * div(heapIs))))._replace(p1 \to (30269 + (-2 * div(heapIs)))))
\theta_{funcstart_{724,1}}, \theta_{funcstart_{724,1},p1, 177}.quot + (171 * div(heapIs))
\rho_{funcstart\_724,1}, \rho_{funcstart\_724,1}
(30307 + (-35 * div(\mathbf{heapIs} \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p2,
176).quot) + (172 * div(heapIs heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p2,
176).rem)))._replace(p3 \rightarrow ((-63 * div(heapIs $heap_{funcstart_724,1},
\text{Sheap}_{funcstart\_724,1}.\text{p3}, 178).\text{quot}) + (170 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
\text{Sheap}_{funcstart_{724,1},p3, 178,rem})).p2) \lor (-1 < -\text{Sheap}_{funcend_{724,1},p3}) \lor
(30268 < \text{\$heap}_{funcend\_724,1}.\text{p1}) \lor (30306 < \text{\$heap}_{funcend\_724,1}.\text{p2}) \lor (30322 < \text{property})
heap_{funcend\_724,1.p3}) \lor ...
```

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[111.24] (false \vee (30306 < ((-172 * div(heapIs $heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1}.\text{p2}, 176).\text{rem} + (35 * \text{div}(\text{heapIs} \text{Sheap}_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1}.\text{p2}, 176).\text{quot}))) \lor (-1 < -\text{Sheap}_{funcend\_724,1}.\text{p3}) \lor (30268)
< $heap<sub>funcend_724,1.</sub>p1) \lor (30306 < $heap<sub>funcend_724,1.</sub>p2) \lor (30322 <
heap_{funcend\_724,1.p3}) \lor ...
\rightarrow [from term 58.12, literala < ((-172 * div(heapIs $heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1}.p2, 176).rem) + (35 * div(\text{heapIs} \text{Sheap}_{funcstart\_724,1},
heap_{funcstart_{-724,1}.p2, 176}, quot)) is false whenever -2 < (-30307 + literala)
      Proof of rule precondition:
      [111.24.0] - 2 < (-30307 + 30306)
      \rightarrow [simplify]
      [111.24.2] true
[111.25] (false \vee false \vee (-1 < -$heap<sub>funcend_724,1.</sub>p3) \vee (30268 <
\text{Sheap}_{funcend\_724,1}.\text{p1}) \lor (30306 < \text{Sheap}_{funcend\_724,1}.\text{p2}) \lor (30322 <
heap_{funcend\_724,1.p3}) \vee ...
\rightarrow [from term 109.5, $heap<sub>funcend_724,1</sub> is equal to
heap_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 * div(heapIs $heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1}.\text{p1}, 177).\text{quot} + (171 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
\rho_{uncstart\_724,1}.p1, 177).rem))).\_replace(p2 \rightarrow ((-35 * div(heapIs))).\_replace(p2 \rightarrow ((-35 * div(heapIs)))).\_replace(p2 \rightarrow ((-35 * div(heapIs)))).\_replace(p2 \rightarrow ((-35 * div(heapIs)))))
heap_{funcstart\_724.1}, heap_{funcstart\_724.1}.p2, 176).quot) + (172 * div(heapIs)
\theta_{funcstart_{-724,1}}, \theta_{funcstart_{-724,1}}
 * div(heapIs heap_{funcstart\_724,1}, heap_{funcstart\_724,1}, p_{funcstart\_724,1}, p_{funcstart\_724,1}
div(\textbf{heapIs}~\$heap_{funcstart\_724,1},~\$heap_{funcstart\_724,1}.p3,
178).rem)))._replace(p1 \rightarrow (30269 + (-2 * div(heapIs $heap_{funcstart\_724,1},
heap_{funcstart\_724,1}.p1, 177).quot + (171 * div(heapIs p_{funcstart\_724,1})
heap_{funcstart\_724,1}.p1, 177).rem))._replace(p2 \rightarrow (30307 + (-35 * 
div(\mathbf{heapIs} \ \$heap_{funcstart\_724,1}, \ \$heap_{funcstart\_724,1}.p2, \ 176).quot) + (172 *
div(\mathbf{heapIs} \ \$heap_{funcstart\_724,1}, \ \$heap_{funcstart\_724,1}.p2,
176).rem)))._replace(p3 \rightarrow (-63 * div(\mathbf{heapIs} \$heap_{funcstart\_724,1},
heap_{funcstart\_724,1}.p3, 178).quot + (170 * div(heapIs $heap_{funcstart\_724,1},
heap_{funcstart_{-724,1}.p3, 178).rem}
[111.26] (false \vee false \vee (-1 < -$heap_{funcstart\_724,1}.\_replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).quot) + (171 *
\operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724.1}, \$ \operatorname{heap}_{funcstart\_724.1}.p1,
177).rem)))._replace(p2 \rightarrow ((-35 * div(heapIs $heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1.p2}, 176).\text{quot} + (172 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
\rho_{funcstart\_724,1.p2, 176}.rem)._replace(p3 \rightarrow ((-63 * div(heapIs
\text{Sheap}_{funcstart\ 724.1}, \text{Sheap}_{funcstart\ 724.1}, \text{p3}, 178).\text{quot}) + (170 * \text{div}(\text{heapIs}))
\theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}.p3, 178).rem))).\_replace(p1 \rightarrow
(30269 + (-2 * div(\mathbf{heapIs} \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1,
177).quot) + (171 * div(heapIs heapIs = f_{uncstart_{-724,1}}, heap_{funcstart_{-724,1}}.p1,
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 $\rightarrow$  [simplify]

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177).rem)))._replace(p2 \rightarrow (30307 + (-35 * div(heapIs $heap_{tuncstart\_724,1},
\text{Sheap}_{funcstart\_724,1.p2}, 176).\text{quot} + (172 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1}.\text{p2}, 176).\text{rem}))._replace(p3 \rightarrow ((-63 * div(heapIs)
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.p3, 178).quot) + (170 * div(heapIs)
\text{Sheap}_{funcend\_724,1}.\text{p1}) \lor (30306 < \text{Sheap}_{funcend\_724,1}.\text{p2}) \lor (30322 <
heap_{funcend\_724,1}.p3) \lor ...
\rightarrow [simplify]
[111.30] (false \vee false \vee (-1 < ((63 * div(heapIs $heap<sub>funcstart_724,1</sub>,
\text{Sheap}_{funcstart\_724,1.p3}, 178).\text{quot} + (-170 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1.p3}, 178).\text{rem}))) \lor (30268 < \text{Sheap}_{funcend\_724,1.p1}) \lor
(30306 < \$heap_{funcend\_724,1}.p2) \lor (30322 < \$heap_{funcend\_724,1}.p3)) \lor \dots
\rightarrow [from term 110.5, literala < ((-170 * div(heapIs $heap_{funcstart\_724.1},
\text{Sheap}_{funcstart\_724.1.p3}, 178).\text{rem} + (63 * div(\text{heapIs} \$\text{heap}_{funcstart\_724.1},
heap_{funcstart\_724.1.p3}, 178).quot) is false whenever -2 < (0 + literala)
    Proof of rule precondition:
    [111.30.0] - 2 < (-1 + 0)
    \rightarrow [simplify]
    [111.30.2] true
[111.31] (false \vee false \vee false \vee (30268 < $heap<sub>funcend_724,1.</sub>p1) \vee (30306 <
\text{heap}_{funcend_{-724,1},p2}) \vee (30322 < \text{heap}_{funcend_{-724,1},p3})) \vee ...
\rightarrow [from term 109.5, $heap<sub>funcend_724,1</sub> is equal to
heap_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 * div(heapIs $heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1}.p1, 177).quot) + (171 * div(\textbf{heapIs} \text{Sheap}_{funcstart\_724,1},
heap_{funcstart\_724,1}.p1, 177).rem))).\_replace(p2 \rightarrow ((-35 * div(heapIs))).\_replace(p2 \rightarrow ((-35 * div(heapIs))))._replace(p2 \rightarrow ((-35 * div(heapIs)))))._replace(p2 \rightarrow ((-35 * div(heapIs)))))._replace(p2 \rightarrow ((-35 * div(heapIs)))))._replace(p2 \rightarrow ((-35 * div(heapIs)))))._replace(p2 \rightarrow ((-35 * div(heapIs)))))
heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p2, 176).quot) + (172 * div(heapIs)
\theta_{funcstart\_724.1}, \theta_{funcstart\_724.1}, \theta_{funcstart\_724.1}, \theta_{funcstart\_724.1}, \theta_{funcstart\_724.1}, \theta_{funcstart\_724.1}
* div(\mathbf{heapIs} \ \$heap_{funcstart\_724,1}, \ \$heap_{funcstart\_724,1}.p3, \ 178).quot) + (170 \ *
div(\mathbf{heapIs} \ \$heap_{funcstart\_724,1}, \ \$heap_{funcstart\_724,1}.p3,
178).rem)))._replace(p1 \rightarrow (30269 + (-2 * div(heapIs $heap_{funcstart\_724.1},
\text{Sheap}_{funcstart\_724,1}.p1, 177).quot) + (171 * div(\mathbf{heapIs} \; \text{Sheap}_{funcstart\_724,1},
\rho_{funcstart_{-724,1},p1, 177).rem})).\_replace(p2 \to (30307 + (-35 * 
div(\mathbf{heapIs} \ \$heap_{funcstart\_724,1}, \ \$heap_{funcstart\_724,1}.p2, \ 176).quot) + (172 *
div(\mathbf{heapIs} \ \$heap_{funcstart\_724,1}, \ \$heap_{funcstart\_724,1}.p2,
(176).\text{rem})._replace(p3 \rightarrow (-63 * \text{div}(\text{heapIs } \$\text{heap}_{funcstart}))._
heap_{funcstart\_724,1}.p3, 178).quot) + (170 * div(heapIs p_{funcstart\_724,1}),
heap_{funcstart_{-724,1}}.p3, 178).rem
[111.32] (false \vee false \vee false \vee (30268 < $heap_{tuncstart\_724,1}._replace(p1 \rightarrow
((-2 * div(\mathbf{heapIs} \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1, 177).quot) +
(171 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_724.1}, \text{\$heap}_{funcstart\_724.1}.\text{p1},
177).rem)))._replace(p2 \rightarrow ((-35 * div(heapIs $heap_{funcstart\_724,1},
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\text{Sheap}_{funcstart_{-724,1},p2, 176}.quot) + (172 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart_{-724,1}},
\theta_{funcstart\_724,1}.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\_724,1}, \$heap_{funcstart\_724,1}.p3, 178).quot) + (170 * div(\textbf{heapIs}))
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.p3, 178).rem))).\_replace(p1 \rightarrow
(30269 + (-2 * div(\mathbf{heapIs} \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1,
177).quot) + (171 * \text{div}(\mathbf{heapIs} \$ \text{heap}_{funcstart\_724,1}, \$ \text{heap}_{funcstart\_724,1}.\text{p1},
177).rem)))._replace(p2 \rightarrow (30307 + (-35 * div(heapIs $heap_{funcstart_724.1},
\text{Sheap}_{funcstart_{724,1},p2,176}, quot) + (172 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart_{724,1}})
\rho_{funcstart\_724,1.p2, 176}.rem)._replace(p3 \rightarrow ((-63 * div(heapIs
heap_{funcstart_{-724,1}}, heap_{funcstart_{-724,1}}.p3, 178).quot) + (170 * div(heapIs
\$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p3, 178).rem))).p1) \lor (30306 <
\$ heap_{funcend\_724,1}.p2) \lor (30322 < \$ heap_{funcend\_724,1}.p3)) \lor \dots
\rightarrow [simplify]
[111.37] (false \vee false \vee (-1 < ((-2 * div(heapIs $heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1}.\text{p1}, 177).\text{quot} + (171 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
\text{Sheap}_{funcstart_{-724,1},p1, 177).rem})) \lor (30306 < \text{Sheap}_{funcend_{-724,1},p2}) \lor (30306 < \text{Sheap}_{
(30322 < \text{$heap}_{funcend\_724,1}.p3)) \lor \dots
\rightarrow [from term 85.0, literala < ((-2 * div(heapIs $heap_{funcstart_724.1},
\text{Sheap}_{funcstart\_724,1}.p1, 177).quot) + (171 * div(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
heap_{funcstart\_724,1}.p1, 177).rem) is false whenever -2 < (0 + literala)
             Proof of rule precondition:
             [111.37.0] - 2 < (-1 + 0)
             \rightarrow [simplify]
             [111.37.2] true
[111.38] (false \vee false \vee false \vee false \vee (30306 < $heap<sub>funcend_724,1.</sub>p2) \vee
(30322 < \text{$heap}_{funcend\_724,1}.p3)) \lor ...
\rightarrow [from term 109.5, $heap_{funcend\_724,1}$ is equal to
heap_{funcstart\_724.1}._replace(p1 \rightarrow ((-2 * div(heapIs $heap_{funcstart\_724.1},
heap_{funcstart\_724,1}.p1, 177).quot + (171 * div(heapIs $heap_{funcstart\_724,1},
\rho_{funcstart\_724.1}.p1, 177).rem))._replace\rho_{funcstart\_724.1}.p1, 177).rem))
 heap_{funcstart\_724.1}, heap_{funcstart\_724.1}.p2, 176).quot) + (172 * div(heapIs)
heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p2, 176).rem)))._replace(p3 \rightarrow ((-63)
  * div(\mathbf{heapIs} \ \$heap_{funcstart\_724,1}, \ \$heap_{funcstart\_724,1}.p3, \ 178).quot) + (170 \ *
div(\mathbf{heapIs} \ \$heap_{funcstart\_724,1}, \ \$heap_{funcstart\_724,1}.p3,
 178).rem)))._replace(p1 \rightarrow (30269 + (-2 * div(heapIs $heap_{funcstart\_724.1},
heap_{funcstart\_724,1}.p1, 177).quot + (171 * div(heapIs $heap_{funcstart\_724,1}, p1, 177).quot) + (171 * div(heapIs $heap_{funcstart\_724,1}, p1, 177).quot)
heap_{funcstart\_724,1}.p1, 177).rem))).\_replace(p2 \rightarrow (30307 + (-35 * -45 + (-35 * -45 + (-35 * -45 + (-35 * -45 + (-35 * -45 + (-35 * -45 + (-35 * -45 + (-35 * -45 + (-35 * -45 + (-35 * -45 + (-35 * -45 + (-35 * -45 + (-35 * -45 + (-35 * -45 + (-35 * -45 + (-35 * -45 + (-35 * -45 + (-35 * -45 + (-35 * -45 + (-35 * -45 + (-35 * -45 + (-35 * -45 + (-35 * -45 + (-35 * -45 + (-35 * -45 + (-35 * -45 + (-35 * -45 + (-35 * -45 + (-35 * -45 + (-35 * -45 + (-35 * -45 + (-35 * -45 + (-35 * -45 + (-35 * -45 + (-35 * -45 + (-35 * -45 + (-35 * -45 + (-35 * -45 + (-35 * -45 + (-35 * -45 + (-35 * -45 + (-35 * -45 + (-35 * -45 + (-35 * -45 + (-35 * -45 + (-35 * -45 + (-35 * -45 + (-35 * -45 + (-35 * -45 + (-35 * -45 + (-35 * -45 + (-35 * -45 + (-35 * -45 + (-35 * -45 + (-35 * -45 + (-35 * -45 + (-35 * -45 + (-35 * -45 + (-35 * -45 + (-35 * -45 + (-35 * -45 + (-35 * -45 + (-35 * -45 + (-35 * -45 + (-35 * -45 + (-35 * -45 + (-35 * -45 + (-35 * -45 + (-35 * -45 + (-35 * -45 + (-35 * -45 + (-35 * -45 + (-35 * -45 + (-35 * -45 + (-35 * -45 + (-35 * -45 + (-35 * -45 + (-35 * -45 + (-35 * -45 + (-35 * -45 + (-35 * -45 + (-35 * -45 + (-35 * -45 + (-35 * -45 + (-35 * -45 + (-35 * -45 + (-35 * -45 + (-35 * -45 + (-35 * -45 + (-35 * -45 + (-35 * -45 + (-35 * -45 + (-35 * -45 + (-35 * -45 + (-35 * -45 + (-35 * -45 + (-35 * -45 + (-35 * -45 + (-35 * -45 + (-35 * -45 + (-35 * -45 + (-35 * -45 + (-35 * -45 + (-35 * -45 + (-35 * -45 + (-35 * -45 + (-35 * -45 + (-35 * -45 + (-35 * -45 + (-35 * -45 + (-35 * -45 + (-35 * -45 + (-35 * -45 + (-35 * -45 + (-35 * -45 + (-35 * -45 + (-35 * -45 + (-35 * -45 + (-35 * -45 + (-35 * -45 + (-35 * -45 + (-35 * -45 + (-35 * -45 + (-35 * -45 + (-35 * -45 + (-35 * -45 + (-35 * -45 + (-35 * -45 + (-35 * -45 + (-35 * -45 + (-35 * -45 + (-35 * -45 + (-35 * -45 + (-35 * -45 + (-35 * -45 + (-35 * -45 + (-35 * -45 + (-35 * -45 + (-35 * -45 + (-35 * -45 + (-35 * -45 + (-35 * -45 + (-35 * -45 + (-35 * -45 + (-35 * -45 + (-35 * -45 + (-35 * -45 + (-35 * -45 + (-35 * -45 + (-35 * -45 + (-35 * -45 + (-35 * -45 + (-35 *
div(\mathbf{heapIs} \ \$heap_{funcstart\_724,1}, \ \$heap_{funcstart\_724,1}.p2, \ 176).quot) + (172 *
div(\mathbf{heapIs} \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p2,
 176).rem)))._replace(p3 \rightarrow (-63 * div(\mathbf{heapIs} \$heap_{funcstart\_724,1},
heap_{funcstart\_724,1}.p3, 178).quot + (170 * div(heapIs $heap_{funcstart\_724,1}, 178).quot) + (170 * div(heapIs $heap_{funcstart\_724,1}, 17
heap_{funcstart_{-724,1}}.p3, 178).rem)
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[111.39] (false \vee false \vee false \vee false \vee (30306 <
heap_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 * div(heapIs p_{funcstart\_724,1}),
\theta_{funcstart\_724,1}.p1, 177).quot + (171 * div(heapIs \theta_{funcstart\_724,1}, 177).quot) + (171 * div(heapIs \theta_{funcstart\_7
\text{Sheap}_{funcstart\_724,1}.\text{p1}, 177).\text{rem}))._replace(p2 \rightarrow ((-35 * div(heapIs
\theta_{funcstart_{724,1}}, \theta_{funcstart_{724,1},p2}, \theta_{funcstart_{724,1},p2}, \theta_{funcstart_{724,1}}
\theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}.p2, 176).rem)))._replace(p3 \theta_{funcstart\_724,1}.p2, 176).rem)))._replace(p3 \theta_{funcstart\_724,1}
* div(heapIs heap_{funcstart\_724,1}, heap_{funcstart\_724,1}, 178).quot) + (170 *
\operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724,1}, \$ \operatorname{heap}_{funcstart\_724,1}.p3,
178).rem)))._replace(p1 \rightarrow (30269 + (-2 * div(heapIs $heap_{funcstart\_724.1},
\rho_{tuncstart_{-724,1},p1,177} (unit) + (171 * div(heapIs \rho_{tuncstart_{-724,1},p1,177}
\rho_{uncstart\_724,1.p1, 177).rem})).\_replace(p2 \rightarrow (30307 + (-35 * 
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}. p2, 176). \operatorname{quot}) + (172 *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.p2,
176).rem)))._replace(p3 \rightarrow ((-63 * div(heapIs $heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1}.\text{p3}, 178).\text{quot} + (170 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1.p3}, 178).rem))).p2) \lor (30322 < \text{Sheap}_{funcend\_724,1.p3})) \lor
\rightarrow [simplify]
[111.43] (false \vee false \vee false \vee false \vee (-1 < ((-35 * div(heapIs
\theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}. \theta_{funcstart\_724,1}
\text{Sheap}_{funcstart_{724.1}}, \text{Sheap}_{funcstart_{724.1}}, \text{p2}, 176).rem))) \lor (30322 <
heap_{funcend\_724.1}.p3) \vee ...
\rightarrow [from term 88.7, literala < ((-35 * div(heapIs $heap_{funcstart\_724,1},
heap_{funcstart\_724,1}.p2, 176).quot + (172 * div(heapIs $heap_{funcstart\_724,1}, 176).quot) + (172 * div(heapIs $heap_{funcstart\_724,1}, 17
heap_{funcstart_{724,1}.p2, 176).rem) is false whenever -2 < (0 + literala)
               Proof of rule precondition:
               [111.43.0] - 2 < (-1 + 0)
               \rightarrow [simplify]
               [111.43.2] true
[111.44] (false \lor false \lor false \lor false \lor false \lor (30322 <
heap_{funcend\_724,1}.p3) \vee ...
\rightarrow [from term 109.5, $heap<sub>funcend_724,1</sub> is equal to
heap_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 * div(heapIs $heap_{funcstart\_724,1},
heap_{funcstart\_724,1}.p1, 177).quot + (171 * div(heapIs p_{funcstart\_724,1})
\rho_{tuncstart\_724.1.p1, 177).rem}))._replace\rho_{tuncstart\_724.1.p1, 177).rem})
heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p2, 176).quot) + (172 * div(heapIs)
\rho_{funcstart\_724,1}, \rho_{funcstart\_724,1}
  * div(heapIs heap_{funcstart_{-724,1}}, heap_{funcstart_{-724,1}}, 178).quot) + (170 *
div(\mathbf{heapIs} \ \$heap_{funcstart\_724,1}, \ \$heap_{funcstart\_724,1}.p3,
 178).rem))). replace(p1 \rightarrow (30269 + (-2 * div(heapIs $heap_{funcstart\_724.1},
heap_{funcstart\_724,1}.p1, 177).quot + (171 * div(heapIs p_{funcstart\_724,1})
heap_{funcstart_{-724,1}}.p1, 177).rem)))._replace(p2 	o (30307 + (-35)^*))
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```
div(\mathbf{heapIs} \ \$heap_{funcstart\_724,1}, \ \$heap_{funcstart\_724,1}.p2, \ 176).quot) + (172 *
div(\mathbf{heapIs} \ \$heap_{funcstart\_724,1}, \ \$heap_{funcstart\_724,1}.p2,
176).rem)))._replace(p3 \rightarrow (-63 * div(heapIs $heap_{funcstart\_724,1},
heap_{funcstart\_724,1}.p3, 178).quot + (170 * div(heapIs heap_{funcstart\_724,1},
heap_{funcstart_{-724,1}.p3, 178).rem}
[111.45] (false \vee false \vee false \vee false \vee false \vee (30322 <
\text{Sheap}_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 * div(heapIs \text{Sheap}_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1}.\text{p1}, 177).\text{quot} + (171 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724.1}.\text{p1}, 177).\text{rem}))._replace(p2 \rightarrow ((-35 * div(heapIs
\theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}
\theta_{funcstart_{724,1}}, \theta_{funcstart_{724,1},p2,176}.rem)))._replace(p3 \theta_{funcstart_{724,1}}
* div(heapIs heap_{funcstart_{724.1}}, heap_{funcstart_{724.1}}, 178).quot) + (170 *
div(heapIs $heap<sub>funcstart</sub>, 724.1, $heap<sub>funcstart</sub>, 724.1,p3,
178).rem)))._replace(p1 \rightarrow (30269 + (-2 * div(heapIs $heap_{tuncstart\_724,1},
\text{Sheap}_{funcstart\_724,1}.\text{p1}, 177).\text{quot} + (171 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
\rho_{funcstart\_724,1.p1, 177}.rem))._replace(p2 \rightarrow (30307 + (-35 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p2, \ 176).quot) + (172 *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.p2,
176).rem)))._replace(p3 \rightarrow ((-63 * div(heapIs $heap_{funcstart\_724,1},
heap_{funcstart\_724,1}.p3, 178).quot + (170 * div(heapIs $heap_{funcstart\_724,1},
heap_{funcstart_{-724,1}.p3, 178).rem})).p3)) \lor ...
\rightarrow [simplify]
[111.46] (false \vee false \vee false \vee false \vee false \vee (30322 < ((-63 * div(heapIs
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.p3, 178).quot) + (170 * div(heapIs)
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.p3, 178).rem)))) \lor ...
\rightarrow [from term 64.19, literala < ((-63 * div(heapIs $heap_{funcstart_724.1},
\text{Sheap}_{funcstart\_724,1}.p3, 178).quot) + (170 * div(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
heap_{funcstart_{-724,1}.p3}, 178).rem) is false whenever -2 < (-30323 + literala)
    Proof of rule precondition:
    [111.46.0] - 2 < (-30323 + 30322)
    \rightarrow [simplify]
    [111.46.2] true
[111.47] (false \vee false \vee false \vee false \vee false \vee false) \vee ...
\rightarrow [simplify]
[111.48] false \vee ...
[Remove 'false' term 111.48 and fetch new term from containing clause]
[112.0] (heap_{724,1;747,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow ((-35 * div(heapIs $heap_{funcstart\_724,1},
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\text{Sheap}_{funcstart\_724,1}.\text{p2}, 176).\text{quot} + (172 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
heap_{funcstart\_724,1.p2, 176}.rem)._replace(p3 \rightarrow ((-63 * div(heapIs
heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p3, 178).quot) + (170 * div(heapIs)
\rho_{funcstart\_724,1}, \rho_{funcstart\_724,1}
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}. p1, \ 177). \operatorname{quot}) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.p1, \ 177).rem)))) \lor
(\text{\$heap}_{724,1:748,8} == \text{\$heap}_{724,1:747,8}.\mathbf{replace}(p2 \to \text{\$heap}_{724,1:747,8}.p2)) \lor (-1)
< $heap<sub>724,1;747,8</sub>.p2)
[Remove 'false' term 111.48 and fetch new term from containing clause]
[113.0] (0 < ((-2 * div(heapIs heapIs funcstart_{-724,1}, heap_{funcstart_{-724,1}}.p1,
177).quot) + (171 * div(heapIs \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}.p1,
177).rem))) \vee ($heap_{724,1;748,8} == $heap_{724,1;747,8}.replace(p2 \rightarrow
heap_{724,1;747,8}.p2) \lor (-1 < heap_{724,1;747,8}.p2)
[Copy term 1.69]
[114.0] ((0 == $heap<sub>724,1:748,8</sub>.p3) \vee (-1 < -$heap<sub>724,1:748,8</sub>.p1) \vee (-1 <
-\$heap_{724,1;748,8}.p2) \lor (30268 < \$heap_{724,1;748,8}.p1) \lor (30306 < \$heap_{724,1;748,8}.p2)
\text{Sheap}_{724,1;748,8}.\text{p2}) \lor (30322 < \text{Sheap}_{724,1;748,8}.\text{p3})) \lor (\text{Sheap}_{724,1;748,8} = =
\text{Sheap}_{724,1;747,8}.\text{-replace}(p2 \to \text{Sheap}_{724,1;747,8}.p2)) \lor (-1 < \text{Sheap}_{724,1;747,8}.p2)
\rightarrow [from term 75.0, $heap<sub>724,1;748,8</sub> is equal to $heap<sub>724,1;747,8</sub>._replace(p2 \rightarrow
30307 + \$heap_{724,1:747,8}.p2)
[114.1] ((0 == $heap<sub>724,1;747,8</sub>._replace(p2 \rightarrow (30307 +
\text{heap}_{724,1;747,8}.\text{p2}).\text{p3}) \lor (-1 < -\text{heap}_{724,1;748,8}.\text{p1}) \lor (-1 <
-\$heap_{724,1:748,8}.p2) \lor (30268 < \$heap_{724,1:748,8}.p1) \lor (30306 < \$heap_{724,1:748,8}.p2)
\text{Sheap}_{724,1;748,8}.\text{p2}) \lor (30322 < \text{Sheap}_{724,1;748,8}.\text{p3})) \lor \dots
\rightarrow [simplify]
[114.2] ((0 == $heap<sub>724,1:747,8</sub>.p3) \vee (-1 < -$heap<sub>724,1:748,8</sub>.p1) \vee (-1 <
-\$heap_{724,1:748,8}.p2) \lor (30268 < \$heap_{724,1:748,8}.p1) \lor (30306 < \$heap_{724,1:748,8}.p2)
\text{Sheap}_{724,1;748,8}.\text{p2}) \lor (30322 < \text{Sheap}_{724,1;748,8}.\text{p3})) \lor \dots
\rightarrow [from term 75.0, $heap<sub>724,1;748,8</sub> is equal to $heap<sub>724,1;747,8</sub>._replace(p2 \rightarrow
30307 + \text{$heap}_{724.1:747.8}.p2)
[114.3] ((0 == $heap<sub>724,1;747,8</sub>.p3) \vee (-1 < -$heap<sub>724,1;747,8</sub>._replace(p2 \rightarrow
(30307 + \text{$heap}_{724,1;747,8}.\text{p2})).\text{p1}) \lor (-1 < -\text{$heap}_{724,1;748,8}.\text{p2}) \lor (30268 < -\text{$heap}_{724,1;748,8})
\text{heap}_{724,1:748.8}.p1) \vee (30306 < \text{heap}_{724,1:748.8}.p2) \vee (30322 <
heap_{724,1;748,8}.p3) \lor ...
\rightarrow [simplify]
[114.4] ((0 == $heap<sub>724,1:747,8</sub>.p3) \vee (-1 < -$heap<sub>724,1:747,8</sub>.p1) \vee (-1 <
-\$heap_{724,1:748,8}.p2) \lor (30268 < \$heap_{724,1:748,8}.p1) \lor (30306 < \$heap_{724,1:748,8}.p2)
\text{heap}_{724,1;748,8}.\text{p2}) \lor (30322 < \text{heap}_{724,1;748,8}.\text{p3})) \lor \dots
\rightarrow [from term 75.0, $heap<sub>724,1;748,8</sub> is equal to $heap<sub>724,1;747,8</sub>._replace(p2 \rightarrow
30307 + \$heap_{724,1:747,8}.p2)
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[114.5] ((0 == $heap<sub>724,1;747,8</sub>.p3) \vee (-1 < -$heap<sub>724,1;747,8</sub>.p1) \vee (-1 <
-\$heap_{724,1;747,8}.\mathbf{replace}(p2 \rightarrow (30307 + \$heap_{724,1;747,8}.p2)).p2) \lor (30268 < 30307 + \$heap_{724,1;747,8}.p2)
\text{heap}_{724,1:748,8}.\text{p1}) \lor (30306 < \text{heap}_{724,1:748,8}.\text{p2}) \lor (30322 <
heap_{724,1;748,8}.p3) \vee ...
\rightarrow [simplify]
[114.10] ((0 == $heap<sub>724,1;747,8</sub>.p3) \vee (-1 < -$heap<sub>724,1;747,8</sub>.p1) \vee (30306 <
-\$heap_{724,1:747,8}.p2) \lor (30268 < \$heap_{724,1:748,8}.p1) \lor (30306 < \$heap_{724,1:748,8}.p2)
\text{heap}_{724,1:748,8}.\text{p2}) \lor (30322 < \text{heap}_{724,1:748,8}.\text{p3})) \lor \dots
\rightarrow [from term 75.0, $heap<sub>724,1;748,8</sub> is equal to $heap<sub>724,1;747,8</sub>._replace(p2 \rightarrow
30307 + \text{$heap}_{724,1;747,8}.p2)
[114.11] ((0 == $heap<sub>724.1:747.8</sub>.p3) \vee (-1 < -$heap<sub>724.1:747.8</sub>.p1) \vee (30306 <
-\$heap_{724,1:747.8}.p2) \lor (30268 < \$heap_{724,1:747.8}.-replace(p2 \rightarrow (30307 + 
\text{heap}_{724,1;747,8}.\text{p2}).\text{p1}) \lor (30306 < \text{heap}_{724,1;748,8}.\text{p2}) \lor (30322 <
heap_{724,1;748,8}.p3) \lor ...
\rightarrow [simplify]
[114.12] ((0 == $heap<sub>724,1;747,8</sub>.p3) \vee (-1 < -$heap<sub>724,1;747,8</sub>.p1) \vee (30306 <
-\$heap_{724,1;747,8}.p2) \lor (30268 < \$heap_{724,1;747,8}.p1) \lor (30306 < \$heap_{724,1;747,8}.p2)
\text{sheap}_{724,1;748,8}.\text{p2}) \lor (30322 < \text{sheap}_{724,1;748,8}.\text{p3})) \lor \dots
\rightarrow [from term 75.0, $heap_{724,1;748,8}$ is equal to $heap_{724,1;747,8}._replace(p2 \rightarrow
30307 + \text{$heap}_{724,1;747,8}.p2)
[114.13] ((0 == $heap<sub>724,1;747,8</sub>.p3) \vee (-1 < -$heap<sub>724,1;747,8</sub>.p1) \vee (30306 <
-\$heap_{724,1:747,8}.p2) \lor (30268 < \$heap_{724,1:747,8}.p1) \lor (30306 < \$heap_{724,1:747,8}.p2)
\text{sheap}_{724,1:747,8}.replace(p2 \rightarrow (30307 + \text{sheap}_{724,1:747,8}.p2)).p2) \lor (30322 <
heap_{724,1;748,8}.p3) \lor ...
\rightarrow [simplify]
[114.16] ((0 == $heap<sub>724,1;747,8</sub>.p3) \vee (-1 < -$heap<sub>724,1;747,8</sub>.p1) \vee (30306 <
-\$heap_{724,1;747,8}.p2) \lor (30268 < \$heap_{724,1;747,8}.p1) \lor (-1 <
\text{Sheap}_{724,1;747,8}.\text{p2}) \lor (30322 < \text{Sheap}_{724,1;748,8}.\text{p3})) \lor \dots
\rightarrow [from term 76.0, literala < $heap<sub>724.1:747.8</sub>.p2 is false whenever -2 < (0 +
literala)]
     Proof of rule precondition:
     [114.16.0] - 2 < (-1 + 0)
     \rightarrow [simplify]
     [114.16.2] true
[114.17] ((0 == $heap<sub>724,1:747,8</sub>.p3) \vee (-1 < -$heap<sub>724,1:747,8</sub>.p1) \vee (30306 <
-\$heap_{724,1:747,8}.p2) \lor (30268 < \$heap_{724,1:747,8}.p1) \lor false \lor (30322 < false)
heap_{724,1:748,8}.p3) \lor ...
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 $\rightarrow$  [from term 75.0, \$heap<sub>724,1;748,8</sub> is equal to \$heap<sub>724,1;747,8</sub>.\_**replace**( $p2 \rightarrow$ 

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30307 + \$heap_{724,1:747,8}.p2)
[114.18] ((0 == $heap<sub>724,1:747,8</sub>.p3) \vee (-1 < -$heap<sub>724,1:747,8</sub>.p1) \vee (30306 <
-\$heap_{724,1:747.8}.p2) \lor (30268 < \$heap_{724,1:747.8}.p1) \lor  false \lor (30322 < 1)
\text{heap}_{724,1;747,8}.\text{-replace}(\text{p2} \rightarrow (30307 + \text{heap}_{724,1;747,8}.\text{p2})).\text{p3})) \lor \dots
\rightarrow [simplify]
[114.20] ((0 == \$heap_{724,1;747,8}.p3) \lor (-1 < -\$heap_{724,1;747,8}.p1) \lor (30268 < -\$heap_{724,1;747,8}.p3) \lor (-1 < -\$heap_{724,1
\text{Sheap}_{724,1;747,8}.\text{p1}) \lor (30306 < -\text{Sheap}_{724,1;747,8}.\text{p2}) \lor (30322 <
heap_{724,1;747,8}.p3) \vee ...
\rightarrow [from term 112.0, $heap<sub>724.1:747.8</sub> is equal to
heap_{funcstart\_724.1}._replace(p1 \rightarrow ((-2 * div(heapIs heap_{funcstart\_724.1}),
\text{Sheap}_{funcstart_{-724,1},p1, 177}.\text{quot}) + (171 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart_{-724,1}})
heap_{funcstart\_724.1.p1, 177).rem}))._replace(p2 \rightarrow ((-35 * div(heapIs)))
heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p2, 176).quot) + (172 * div(heapIs)
\$heap_{funcstart\_724,1},\,\$heap_{funcstart\_724,1}.p2,\,176).rem))).\_\mathbf{replace}(p3\rightarrow((\text{-}63
 * div(\mathbf{heapIs} \ \$heap_{funcstart\_724,1}, \ \$heap_{funcstart\_724,1}.p3, \ 178).quot) + (170 \ *
div(\mathbf{heapIs}\ \$heap_{funcstart\_724,1},\ \$heap_{funcstart\_724,1}.p3,
 178).rem)))._replace(p1 \rightarrow (-2 * div(\mathbf{heapIs} \$heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1}.\text{p1}, 177).\text{quot} + (171 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
heap_{funcstart_{-724,1}}.p1, 177).rem)
[114.21] ((0 == \text{heap}_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 * div(heapIs
\theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}
\rho_{uncstart_{-724,1}}, \rho_{uncstart_{-724,1},p1, 177}.rem))._replace(p2 \rightarrow ((-35)
* div(heapIs heap_{funcstart_{-724,1}}, heap_{funcstart_{-724,1}}, p2, 176).quot) + (172 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p2,
176).rem)))._replace(p3 \rightarrow ((-63 * div(heapIs $heap_{funcstart_724,1},
\text{Sheap}_{funcstart\_724,1.p3}, 178).\text{quot} + (170 * \text{div}(\text{heapIs} \text{Sheap}_{funcstart\_724,1},
\theta_{funcstart\_724,1}.p3, 178).rem))._replace(p1 \rightarrow ((-2 * div(heapIs
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.\text{p1}, 177).\text{quot}) + (171 * \text{div}(\text{heapIs}))
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.\text{p1}, 177).\text{rem})).\text{p3}) \lor (-1 <
-\$heap_{724,1:747,8}.p1) \lor (30268 < \$heap_{724,1:747,8}.p1) \lor (30306 < \$heap_{724,1:747,8}.p1)
-\$heap_{724,1;747,8}.p2) \lor (30322 < \$heap_{724,1;747,8}.p3)) \lor ...
\rightarrow [simplify]
[114.23] ((0 == ((-63 * div(heapIs $heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1}.\text{p3}, 178).\text{quot} + (170 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1.p3}, 178).rem))) \lor (-1 < -\text{Sheap}_{724,1;747,8.p1}) \lor (30268 < -\text{Sheap}_{724,1;747,8.p1}) \lor (30268 < -\text{Sheap}_{724,1;747,8.p1})
\text{heap}_{724,1:747,8}.\text{p1}) \lor (30306 < -\text{heap}_{724,1:747,8}.\text{p2}) \lor (30322 <
heap_{724,1:747,8}.p3) \vee ...
\rightarrow [from term 63.3, 0 == ((-63 * div(heapIs $heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1}.\text{p3}, 178).\text{quot} + (170 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
heap_{funcstart\_724,1}.p3, 178).rem) is false
[114.24] (false \vee (-1 < -$heap<sub>724,1;747,8</sub>.p1) \vee (30268 < $heap<sub>724,1;747,8</sub>.p1) \vee
(30306 < -\$heap_{724,1:747,8}.p2) \lor (30322 < \$heap_{724,1:747,8}.p3)) \lor \dots
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\rightarrow [from term 112.0, $heap<sub>724.1:747.8</sub> is equal to
heap_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 * div(heapIs $heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1}.p1, 177).quot) + (171 * div(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
heap_{funcstart\_724,1}.p1, 177).rem))._replace(p2 \rightarrow ((-35 * div(heapIs)))._
heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p2, 176).quot) + (172 * div(heapIs)
\rho_{funcstart\_724,1}, \rho_{funcstart\_724,1}, \rho_{funcstart\_724,1}, \rho_{funcstart\_724,1}, \rho_{funcstart\_724,1}, \rho_{funcstart\_724,1}
 * div(heapIs heap_{funcstart_{-724,1}}, heap_{funcstart_{-724,1}}, n_{724,1}, n_{724,1}, n_{724,1}, n_{724,1}
div(\mathbf{heapIs} \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p3,
178).rem)))._replace(p1 \rightarrow (-2 * div(\textbf{heapIs } \$heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1}.p1, 177).quot) + (171 * div(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
heap_{funcstart_{724,1}.p1, 177).rem}
[114.25] (false \vee (-1 < -$heap<sub>funcstart_724.1</sub>._replace(p1 \rightarrow ((-2 * div(heapIs
\theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}.p1, 177).quot) + (171 * div(heapIs
\rho_{funcstart\_724,1}, \rho_{funcstart\_724,1}
* div(heapIs heap_{funcstart_{724,1}}, heap_{funcstart_{724,1}}, 176).quot) + (172 *
\operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724,1}, \$ \operatorname{heap}_{funcstart\_724,1}.p2,
176).rem)))._replace(p3 \rightarrow ((-63 * div(heapIs $heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1}.\text{p3}, 178).\text{quot} + (170 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
\theta_{funcstart\_724,1}.p3, 178).rem))._replace(p1 \rightarrow ((-2 * div(heapIs
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.\text{p1}, 177).\text{quot}) + (171 * \text{div}(\text{heapIs}))
\text{$heap}_{724,1;747,8}.\text{p1}) \lor (30306 < -\text{$heap}_{724,1;747,8}.\text{p2}) \lor (30322 < -\text{$heap}_{724,1;747,8}.\text{p2}) \lor (30322 < -\text{$heap}_{724,1;747,8}.\text{p2})
heap_{724.1:747.8}.p_{3}) \vee ...
\rightarrow [simplify]
[114.29] (false \vee (-1 < ((2 * div(heapIs $heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724.1.p1}, 177).\text{quot} + (-171 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724.1},
\text{Sheap}_{funcstart\_724,1}.\text{p1}, 177).\text{rem}))) \lor (30268 < \text{Sheap}_{724,1;747,8}.\text{p1}) \lor (30306 < \text{Sheap}_{724,1;747,8}.\text{p1})
-\$heap_{724,1;747,8}.p2) \lor (30322 < \$heap_{724,1;747,8}.p3)) \lor ...
\rightarrow [from term 113.0, literala < ((-171 * div(heapIs $heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724.1}.\text{p1, }177).\text{rem} + (2 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724.1},
heap_{funcstart\_724,1}.p1, 177).quot) is false whenever -2 < (0 + literala)
       Proof of rule precondition:
       [114.29.0] - 2 < (-1 + 0)
       \rightarrow [simplify]
       [114.29.2] true
[114.30] (false \vee false \vee (30268 < $heap<sub>724,1:747,8.p1) \vee (30306 <</sub>
-\$heap_{724,1;747,8}.p2) \lor (30322 < \$heap_{724,1;747,8}.p3)) \lor \dots
\rightarrow [from term 112.0, $heap<sub>724,1;747,8</sub> is equal to
heap_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 * div(heapIs *heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724.1}.p1, 177).quot) + (171 * div(\text{heapIs } \text{Sheap}_{funcstart\_724.1},
\rho_{uncstart\_724,1}.p1, 177).rem))).\_replace(p2 \rightarrow ((-35 * div(heapIs))).\_replace(p2 \rightarrow ((-35 * div(heapIs)))).\_replace(p2 \rightarrow ((-35 * div(heapIs)))).\_replace(p2 \rightarrow ((-35 * div(heapIs)))))
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heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p2, 176).quot) + (172 * div(heapIs)
\$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p2, 176).rem))).\_\mathbf{replace}(p3 \rightarrow ((-63
 * div(\mathbf{heapIs} \ \$heap_{funcstart\_724,1}, \ \$heap_{funcstart\_724,1}.p3, \ 178).quot) + (170 \ *
div(\mathbf{heapIs} \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p3,
178).rem)))._replace(p1 \rightarrow (-2 * div(\mathbf{heapIs} \$heap_{funcstart\_724,1},
heap_{funcstart\_724,1}.p1, 177).quot + (171 * div(heapIs $heap_{funcstart\_724,1}, 177).quot) + (171 * div(heapIs $heap_{funcstart\_724,1}, 17
heap_{funcstart_{-724,1}}.p1, 177).rem)
[114.31] (false \lor false \lor (30268 < $heap_{tuncstart\_724,1}._replace(p1 \to ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).quot) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow ((-35 * div(heapIs $heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724.1.p2}, 176).\text{quot} + (172 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724.1},
\rho_{tuncstart\_724.1.p2, 176}.rem)._replace(p3 \rightarrow ((-63 * div(heapIs
heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p3, 178).quot) + (170 * div(heapIs
\theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}.p3, 178).rem))).\_replace(p1 \rightarrow ((-2 * funcstart\_724,1)))
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.\operatorname{p1}, \ 177).\operatorname{rem}))).\operatorname{p1}) \lor
(30306 < -\$heap_{724,1;747,8}.p2) \lor (30322 < \$heap_{724,1;747,8}.p3)) \lor \dots
\rightarrow [simplify]
[114.32] (false \vee false \vee (30268 < ((-2 * div(heapIs $heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1}.\text{p1}, 177).\text{quot} + (171 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1.p1, 177).rem})) \lor (30306 < -\text{Sheap}_{724,1:747,8.p2}) \lor (30322)
< $heap<sub>724,1;747,8</sub>.p3)) \lor ...
\rightarrow [from term 56.17, literala < ((-2 * div(heapIs $heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1}.\text{p1}, 177).\text{quot} + (171 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
heap_{funcstart_{-724,1}}.p1, 177).rem) is false whenever -2 < (-30269 + literala)
       Proof of rule precondition:
       [114.32.0] - 2 < (-30269 + 30268)
       \rightarrow [simplify]
       [114.32.2] true
[114.33] (false \vee false \vee false \vee (30306 < -$heap<sub>724.1:747.8</sub>.p2) \vee (30322 <
heap_{724,1;747,8}.p3) \lor ...
\rightarrow [from term 112.0, $heap<sub>724.1:747.8</sub> is equal to
heap_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 * div(heapIs $heap_{funcstart\_724,1},
heap_{funcstart\_724,1}.p1, 177).quot + (171 * div(heapIs p_{funcstart\_724,1})
heap_{funcstart\_724,1}.p1, 177).rem))._replace(p2 \rightarrow ((-35 * div(heapIs)))._
heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p2, 176).quot) + (172 * div(heapIs)
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.p2, 176).rem))._replace(p3 \rightarrow ((-63)
 * div(\mathbf{heapIs} \ \$heap_{funcstart\_724,1}, \ \$heap_{funcstart\_724,1}.p3, \ 178).quot) + (170 \ *
div(\mathbf{heapIs} \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p3,
178).rem)))._replace(p1 \rightarrow (-2 * div(\mathbf{heapIs} \$heap_{funcstart\_724,1},
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heap_{funcstart\_724,1}.p1, 177).quot + (171 * div(heapIs $heap_{funcstart\_724,1},
$heap_{funcstart\_724,1}.p1, 177).rem))]
[114.34] (false \vee false \vee false \vee (30306 < -$heap_{funcstart\_724,1}._replace(p1
\rightarrow ((-2 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_724,1}, \text{\$heap}_{funcstart\_724,1}.\text{p1}, 177).\text{quot}) +
(171 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_724.1}, \text{\$heap}_{funcstart\_724.1}.\text{p1},
177).rem)))._replace(p2 \rightarrow ((-35 * div(heapIs $heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1}.\text{p2}, 176).\text{quot} + (172 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
\rho_{funcstart\_724,1.p2, 176}.rem))._replace(p3 \rightarrow ((-63 * div(heapIs
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.p3, 178).quot) + (170 * div(heapIs)
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.p3, 178).rem))).\_replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724.1}, \ \$ \operatorname{heap}_{funcstart\_724.1}, p1, 177).\operatorname{rem}))).p2) \lor
(30322 < \text{\$heap}_{724,1:747,8}.\text{p3})) \lor \dots
\rightarrow [simplify]
[114.40] (false \vee false \vee false \vee (30306 < ((35 * div(heapIs
\theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.p2, 176).rem))) \lor (30322 <
heap_{724.1:747.8}.p_3) \vee ...
\rightarrow [from term 58.12, literala < ((-172 * div(heapIs $heap_{tuncstart_724.1},
heap_{funcstart_{-724,1}.p2, 176}.rem) + (35 * div(heapIs $heap_{funcstart_{-724,1}}, 176).rem) + (35 * di
heap_{funcstart\_724,1}.p2, 176, quot) is false whenever -2 < (-30307 + literala)
         Proof of rule precondition:
         [114.40.0] - 2 < (-30307 + 30306)
         \rightarrow [simplify]
         [114.40.2] true
[114.41] (false \vee false \vee false \vee false \vee (30322 < \text{$heap}_{724.1:747.8}.\text{p3})) <math>\vee \dots
\rightarrow [from term 112.0, p_{724,1;747,8} is equal to
heap_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 * div(heapIs $heap_{funcstart\_724,1},
\operatorname{Sheap}_{funcstart\_724,1}.p1, 177).\operatorname{quot} + (171 * \operatorname{div}(\mathbf{heapIs} \operatorname{Sheap}_{funcstart\_724,1},
heap_{funcstart\_724,1}.p1, 177).rem))._replace(p2 \rightarrow ((-35 * div(heapIs))).
heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p2, 176).quot) + (172 * div(heapIs)
\rho_{funcstart\_724,1}, \rho_{funcstart\_724,1}
 * div(heapIs heap_{funcstart_{-724,1}}, heap_{funcstart_{-724,1}}, 178).quot) + (170 *
div(\textbf{heapIs}~\$heap_{funcstart\_724,1},~\$heap_{funcstart\_724,1}.p3,
 178).rem)))._replace(p1 \rightarrow (-2 * div(\mathbf{heapIs} \$heap_{funcstart\_724,1},
heap_{funcstart\_724,1}.p1, 177).quot + (171 * div(heapIs $heap_{funcstart\_724,1},
heap_{funcstart_{-724,1}.p1, 177).rem}
[114.42] (false \lor false \lor false \lor false \lor (30322 <
\text{Sheap}_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 * div(heapIs \text{Sheap}_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724.1.p1}, 177).\text{quot} + (171 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724.1},
heap_{funcstart\_724,1}.p1, 177).rem))._replace(p2 \rightarrow ((-35 * div(heapIs
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\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.\text{p2}, 176).\text{quot}) + (172 * \text{div}(\text{heapIs}))
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.p2, 176).rem))._replace(p3 \rightarrow ((-63)
* div(\mathbf{heapIs} \ \$ heap_{funcstart\_724,1}, \ \$ heap_{funcstart\_724,1}.p3, \ 178).quot) + (170 \ *
\operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724,1}, \$ \operatorname{heap}_{funcstart\_724,1}.p3,
178).rem)))._replace(p1 \rightarrow ((-2 * div(heapIs $heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1.p1}, 177).\text{quot} + (171 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
heap_{funcstart_{724,1}}.p1, 177).rem)).p3)) \vee ...
\rightarrow [simplify]
[114.44] (false \vee false \vee false \vee false \vee (30322 < ((-63 * div(heapIs
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.\text{p3}, 178).\text{quot}) + (170 * \text{div}(\text{heapIs}))
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.p3, 178).rem)))) \lor ...
\rightarrow [from term 64.19, literala < ((-63 * div(heapIs $heap_{funcstart\_724,1},
heap_{funcstart_{724,1},p3}, 178).quot) + (170 * div(heapIs heap_{funcstart_{724,1}},
heap_{funcstart_{-724,1}.p3}, 178).rem) is false whenever -2 < (-30323 + literala)
    Proof of rule precondition:
    [114.44.0] - 2 < (-30323 + 30322)
    \rightarrow [simplify]
    [114.44.2] true
[114.45] (false \lor false \lor false \lor false \lor false) \lor ...
\rightarrow [simplify]
[114.46] false \vee \dots
[Remove 'false' term 114.46 and fetch new term from containing clause]
[117.0] $\text{heap}_{724,1:748.8} == \text{$heap}_{724,1:747.8}. \text{$replace}(p2 \to \text{$heap}_{724,1:747.8}.p2)
[Take goal term]
[1.69] (-1 < -\$heap_{724,1;748,8}.p1) \lor (-1 < -\$heap_{724,1;748,8}.p2) \lor (0 ==
\text{heap}_{724,1:748,8}.\text{p3}) \lor (30268 < \text{heap}_{724,1:748,8}.\text{p1}) \lor (30306 <
\text{heap}_{724,1;748,8}.\text{p2}) \lor (30322 < \text{heap}_{724,1;748,8}.\text{p3})
\rightarrow [from term 117.0, $heap<sub>724,1;748,8</sub> is equal to $heap<sub>724,1;747,8</sub>._replace(p2 \rightarrow
heap_{724.1:747.8}.p2)
[1.70] (0 == $heap<sub>724,1;747,8</sub>._replace(p2 \rightarrow $heap<sub>724,1;747,8</sub>.p2).p3) \lor (-1 <
-\$heap_{724,1;748,8}.p1) \lor (-1 < -\$heap_{724,1;748,8}.p2) \lor (30268 < -\$heap_{724,1;748,8}.p3)
\text{$heap}_{724,1;748,8}.\text{p1}) \lor (30306 < \text{$heap}_{724,1;748,8}.\text{p2}) \lor (30322 <
heap_{724,1;748,8}.p3
\rightarrow [simplify]
[1.71] (0 == \text{$heap}_{724,1:747,8}.\text{p3}) \vee (-1 < -\text{$heap}_{724,1:748,8}.\text{p1}) \vee (-1 <
-\$heap_{724,1:748,8}.p2) \lor (30268 < \$heap_{724,1:748,8}.p1) \lor (30306 < \$heap_{724,1:748,8}.p2)
\text{heap}_{724,1;748,8}.\text{p2}) \lor (30322 < \text{heap}_{724,1;748,8}.\text{p3})
\rightarrow [from term 117.0, $heap<sub>724,1;748,8</sub> is equal to $heap<sub>724,1;747,8</sub>._replace(p2 \rightarrow
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heap_{724,1;747,8}.p2)
[1.72] (0 == \$heap_{724,1:747,8},p3) \lor (-1 < -\$heap_{724,1:747,8}, \_replace(p2 \rightarrow
\text{heap}_{724,1:747,8}.\text{p2}.\text{p1}) \lor (-1 < -\text{heap}_{724,1:748,8}.\text{p2}) \lor (30268 < -\text{heap}_{724,1:748,8}.\text{p2})
\text{Sheap}_{724,1:748.8}.\text{p1}) \lor (30306 < \text{Sheap}_{724,1:748.8}.\text{p2}) \lor (30322 <
$heap<sub>724.1:748.8</sub>.p3)
\rightarrow [simplify]
[1.73] (0 == \text{\$heap}_{724,1;747,8}.\text{p3}) \lor (-1 < -\text{\$heap}_{724,1;747,8}.\text{p1}) \lor (-1 <
-\$heap_{724,1:748,8}.p2) \lor (30268 < \$heap_{724,1:748,8}.p1) \lor (30306 < \$heap_{724,1:748,8}.p2)
\text{heap}_{724,1:748,8}.\text{p2}) \lor (30322 < \text{heap}_{724,1:748,8}.\text{p3})
\rightarrow [from term 117.0, $heap<sub>724,1;748,8</sub> is equal to $heap<sub>724,1;747,8</sub>._replace(p2 \rightarrow
heap_{724.1:747.8}.p2)
[1.74] (0 == $heap<sub>724,1:747,8</sub>.p3) \vee (-1 < -$heap<sub>724,1:747,8</sub>.p1) \vee (-1 <
-\$heap_{724,1;747,8}.replace(p2 \rightarrow \$heap_{724,1;747,8}.p2).p2) \lor (30268 <
\text{heap}_{724,1:748,8}.\text{p1}) \lor (30306 < \text{heap}_{724,1:748,8}.\text{p2}) \lor (30322 <
$heap<sub>724.1:748.8</sub>.p3)
\rightarrow [simplify]
[1.75] (0 == $heap<sub>724,1:747,8</sub>.p3) \vee (-1 < -$heap<sub>724,1:747,8</sub>.p1) \vee (-1 <
 -\$heap_{724,1:747,8}.p2) \lor (30268 < \$heap_{724,1:748,8}.p1) \lor (30306 < \$heap_{724,1:748,8}.p2)
\text{heap}_{724,1;748,8}.\text{p2}) \lor (30322 < \text{heap}_{724,1;748,8}.\text{p3})
[Remove 'false' term 114.46 and fetch new term from containing clause]
[118.0] -1 < \text{$heap}_{724,1;747,8}.p2
[Copy term 117.0]
[120.0] ($\text{heap}_{724,1;748,8} == $\text{heap}_{724,1;747,8}._\text{replace}(p2 \rightarrow)
\text{$heap}_{724,1;747,8}.\text{p2})) \lor (\text{$heap}_{724,1;747,8} == \text{$heap}_{funcstart\_724,1}.\textbf{\_replace}(\text{p1} \to \text{$heap}_{funcstart\_724,1})
((-2 * \text{div}(\mathbf{heapIs} \$ \text{heap}_{funcstart\_724,1}, \$ \text{heap}_{funcstart\_724,1}.\text{p1}, 177).\text{quot}) +
(171 * div(heapIs heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow ((-35 * div(heapIs $heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1.p2}, 176).\text{quot} + (172 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1}.\text{p2}, 176).\text{rem}))._replace(p3 \rightarrow ((-63 * div(heapIs
\$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p3, 178).quot) + (170 * div(\textbf{heapIs}))
\theta_{funcstart_{-724,1}}, \theta_{f
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).quot) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.\operatorname{pl}, \ 177).\operatorname{rem})))) \vee (0 <
((-2 * div(\mathbf{heapIs} \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1, 177).quot) +
(171 * \text{div}(\textbf{heapIs} \$ \text{heap}_{funcstart\_724,1}, \$ \text{heap}_{funcstart\_724,1}.\text{p1}, 177).\text{rem})))
\rightarrow [from term 84.0, $heap<sub>724,1;747,8</sub> is equal to $heap<sub>funcstart_724,1</sub>._replace(p1
\rightarrow ((-2 * div(\mathbf{heapIs} \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1, 177).quot) +
(171 * div(\mathbf{heapIs} \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1,
 177).rem)))._replace(p2 \rightarrow ((-35 * div(\mathbf{heapIs} \$heap_{funcstart\_724,1},
heap_{funcstart\_724,1}.p2, 176).quot + (172 * div(heapIs $heap_{funcstart\_724,1}, 176).quot) + (172 * div(heapIs $heap_{funcstart\_724,1}, 17
heap_{funcstart\_724,1}.p2, 176).rem))._replace(p3 \rightarrow ((-63 * div(heapIs)))._
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heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p3, 178).quot) + (170 * div(heapIs)
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.p3, 178).rem))).\_replace(p1 \rightarrow 30269)
+ (-2 * div(heapIs $heap_{funcstart\_724,1}, $heap_{funcstart\_724,1}.p1, 177).quot) +
(171 * div(\mathbf{heapIs} \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1, 177).rem))]
[120.2] ($heap<sub>724.1:748.8</sub> == $heap<sub>funcstart_724.1</sub>._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).quot) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow ((-35 * div(heapIs $heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724.1}, p2, 176).quot) + (172 * div(heapIs \text{Sheap}_{funcstart\_724.1},
\rho_{tuncstart\_724.1.p2, 176}.rem)._replace(p3 \rightarrow ((-63 * div(heapIs
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.\text{p3}, 178).\text{quot}) + (170 * \text{div}(\text{heapIs}))
\rho_{funcstart_{724,1}}, \rho_{funcstart_{724,1},p3,178}.rem))._replace(p1 \rightarrow
(30269 + (-2 * div(heapIs \$heap_{funcstart\_724.1}, \$heap_{funcstart\_724.1}, p1,
177).quot) + (171 * \text{div}(\mathbf{heapIs} \$ \text{heap}_{funcstart\_724,1}, \$ \text{heap}_{funcstart\_724,1}.\text{p1},
177).rem)))._replace(p2 \rightarrow $heap<sub>funcstart_724,1</sub>._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 *
\operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724,1}, \$ \operatorname{heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow ((-35 * div(heapIs $heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1.p2}, 176).\text{quot} + (172 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1}.\text{p2}, 176).\text{rem}))._replace(p3 \rightarrow ((-63 * div(heapIs
heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p3, 178).quot) + (170 * div(heapIs
\$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p3, 178).rem))).\_\mathbf{replace}(p1 \rightarrow
(30269 + (-2*div(\mathbf{heapIs} \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_724.1}, \text{\$heap}_{funcstart\_724.1}, \text{p1},
(177).rem))).p2)) \vee ...
\rightarrow [simplify]
[120.5] (heap_{724,1;748,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow ((-35 * div(heapIs $heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1}.\text{p2}, 176).\text{quot} + (172 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
\rho_{funcstart\_724,1.p2, 176}.rem)._replace(p3 \rightarrow ((-63 * div(heapIs
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.\text{p3}, 178).\text{quot}) + (170 * \text{div}(\text{heapIs}))
\rho_{funcstart\_724,1}, \rho_{funcstart\_724,1}
(30269 + (-2 * div(\mathbf{heapIs} \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1,
177).quot) + (171 * div(heapIs \theta_{funcstart_{-724,1}}, \theta_{funcstart_{-724,1}}, p1,
177).rem)))._replace(p2 \rightarrow ((-35 * div(heapIs $heap_{funcstart_724.1},
\text{Sheap}_{funcstart_{724,1},p2, 176}.quot) + (172 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart_{724,1}},
heap_{funcstart_{724,1}.p2, 176).rem}))) \vee ...
[Copy term 118.0]
[121.0] (-1 < \text{$heap}_{724,1;747,8}.p2) \vee (\text{$heap}_{724,1;747,8} ==
\text{Sheap}_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 * div(heapIs \text{Sheap}_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724.1}.\text{p1}, 177).\text{quot} + (171 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724.1},
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\rho_{tuncstart\_724.1.p1, 177).rem})._replace(p2 \rightarrow ((-35 * div(heapIs)
\theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}
\$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p2, 176).rem))).\_\mathbf{replace}(p3 \rightarrow ((-63 - 200))))
* div(heapIs heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p3, 178).quot) + (170 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p3,
178).rem)))._replace(p1 \rightarrow ((-2 * div(heapIs $heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1.p1}, 177).\text{quot} + (171 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
\text{Sheap}_{funcstart_{-724,1},p1, 177}.\text{rem}))) \lor (0 < ((-2 * div(\textbf{heapIs})))) \lor (0 < ((-2 * div(\textbf{heapIs})))))
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.p1, 177).quot) + (171 * div(heapIs)
heap_{funcstart_{-724,1}}, heap_{funcstart_{-724,1}}, 177).rem)
\rightarrow [from term 84.0, $heap<sub>724,1;747,8</sub> is equal to $heap<sub>funcstart_724,1</sub>._replace(p1
\rightarrow ((-2 * div(\mathbf{heapIs} \$heap_{funcstart\_724.1}, \$heap_{funcstart\_724.1}.p1, 177).quot) +
(171 * div(\mathbf{heapIs} \$heap_{funcstart\_724.1}, \$heap_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow ((-35 * div(\mathbf{heapIs} \$heap_{funcstart\_724,1},
heap_{funcstart_{724,1},p2, 176}, quot) + (172 * div(heapIs p_{funcstart_{724,1},p2}
\rho_{uncstart_{-724,1},p2,176,rem}))._replace\rho_{uncstart_{-724,1},p2,176,rem})._replace
heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p3, 178).quot) + (170 * div(heapIs)
\$heap_{funcstart\_724,1},\,\$heap_{funcstart\_724,1}.p3,\,178).rem))).\_\mathbf{replace}(p1\rightarrow30269)
+ (-2 * div(heapIs $heap_{funcstart\_724,1}, $heap_{funcstart\_724,1}.p1, 177).quot) +
(171 * div(\mathbf{heapIs} \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1, 177).rem))]
[121.1] (-1 < \text{heap}_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 * div(heapIs
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.\text{p1}, 177).\text{quot}) + (171 * \text{div}(\text{heapIs})
* div(heapIs heap_{funcstart_{-724,1}}, heap_{funcstart_{-724,1}}.p2, 176).quot) + (172 *
\operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724.1}, \$ \operatorname{heap}_{funcstart\_724.1}.p2,
176).rem)))._replace(p3 \rightarrow ((-63 * div(heapIs $heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1}.\text{p3}, 178).\text{quot} + (170 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
\rho_{funcstart\_724,1.p3, 178).rem}))._replace(p1 \rightarrow (30269 + (-2 * div(heapIs
\theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.p1, 177).rem))).p2) \lor ...
\rightarrow [simplify]
\label{eq:loss_function} \mbox{$[121.4]$ (-1 < ((-35 * div(\mathbf{heapIs} \ \$heap_{funcstart\_724,1}, \ \$heap_{funcstart\_724,1}.p2, \ ) $]}
176).quot) + (172 * div(heapIs \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}.p2,
176).rem))) \vee ...
\rightarrow [from term 59.3, -1 < ((-35 * div(heapIs $heap_{funcstart\_724,1},
heap_{funcstart\_724.1}.p2, 176).quot + (172 * div(heapIs heap_{funcstart\_724.1}, function))
heap_{funcstart\_724,1.p2}, 176).rem) is true if and only if 0 < ((-35 * div(\mathbf{heapIs})))
heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p2, 176).quot) + (172 * div(heapIs)
heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p2, 176).rem))]
[121.5] (0 < ((-35 * div(heapIs $heap_{funcstart\_724,1}, $heap_{funcstart\_724,1}.p2,
176).quot) + (172 * div(heapIs \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}.p2,
176).rem))) \vee ...
[Copy term 1.69]
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[123.0] ((0 == $heap<sub>724,1;748,8</sub>.p3) \vee (-1 < -$heap<sub>724,1;748,8</sub>.p1) \vee (-1 <
-\$heap_{724,1;748,8}.p2) \lor (30268 < \$heap_{724,1;748,8}.p1) \lor (30306 < \$heap_{724,1;748,8}.p2)
\text{Sheap}_{724,1;748,8}.\text{p2}) \lor (30322 < \text{Sheap}_{724,1;748,8}.\text{p3})) \lor (\text{Sheap}_{724,1;747,8} = =
\text{Sheap}_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 * div(heapIs \text{Sheap}_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1}.\text{p1}, 177).\text{quot} + (171 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
\rho_{funcstart\_724,1.p1, 177}.rem).-replace(p2 \rightarrow ((-35 * div(heapIs
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.p2, 176).quot) + (172 * div(heapIs)
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.p2, 176).rem))).\_replace(p3 \rightarrow ((-63)))
* div(heapIs heap_{funcstart_{724,1}}, heap_{funcstart_{724,1}}, 178).quot) + (170 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p3,
178).rem)))._replace(p1 \rightarrow ((-2 * div(heapIs $heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1}.\text{p1}, 177).\text{quot} + (171 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1}.\text{p1}, 177).\text{rem})))) \lor (0 < ((-2 * div(\textbf{heapIs})))))
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.\text{p1}, 177).\text{quot}) + (171 * \text{div}(\text{heapIs}))
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.p1, 177).rem)))
\rightarrow [from term 120.5, $heap<sub>724,1;748,8</sub> is equal to
heap_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 * div(heapIs $heap_{funcstart\_724,1},
heap_{funcstart\_724,1}.p1, 177).quot + (171 * div(heapIs $heap_{funcstart\_724,1}, 177).quot) + (171 * div(heapIs $heap_{funcstart\_724,1}, 17
\rho_{funcstart\_724,1.p1, 177}.rem))._replace\rho_{funcstart\_724,1.p1, 177}.rem))._replace
 heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p2, 176).quot) + (172 * div(heapIs)
\rho_{funcstart\_724,1}, \rho_{funcstart\_724,1}
 * div(\mathbf{heapIs} \ \$heap_{funcstart\_724,1}, \ \$heap_{funcstart\_724,1}.p3, \ 178).quot) + (170 \ *
div(\mathbf{heapIs} \ \$heap_{funcstart\_724,1}, \ \$heap_{funcstart\_724,1}.p3,
 178).rem)))._replace(p1 \rightarrow (30269 + (-2 * div(heapIs $heap_{funcstart\_724.1},
heap_{funcstart_{724,1},p1, 177}, quot) + (171 * div(heapIs p_{funcstart_{724,1},p1, 177}), quot)
\rho_{funcstart\_724,1}.p1, 177).rem))._replace\rho_{funcstart\_724,1}.p1, 177).rem))._replace
heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p2, 176).quot) + (172 * div(heapIs)
heap_{funcstart_{724,1}}, heap_{funcstart_{724,1},p2, 176}.rem))]
[123.1] ((0 == \text{heap}_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 * div(heapIs
\$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1, 177).quot) + (171 * div(\textbf{heapIs}) + (171 * div(\textbf{heapIs})) + (171
* div(\mathbf{heapIs} \ \$ heap_{funcstart\_724,1}, \ \$ heap_{funcstart\_724,1}.p2, \ 176).quot) + (172 \ *
\operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724,1}, \$ \operatorname{heap}_{funcstart\_724,1}.p2,
176).rem)))._replace(p3 \rightarrow ((-63 * div(heapIs $heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1.p3}, 178).quot) + (170 * div(heapIs \text{Sheap}_{funcstart\_724,1},
\theta_{funcstart\_724,1.p3}, 178).rem)))._replace(p1 \rightarrow (30269 + (-2 * div(heapIs
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.\text{p1}, 177).\text{quot}) + (171 * \text{div}(\text{heapIs})
\rho_{uncstart\_724,1}, \rho_{uncstart\_724,1}, \rho_{uncstart\_724,1}, \rho_{uncstart\_724,1}, \rho_{uncstart\_724,1}, \rho_{uncstart\_724,1}
* div(heapIs heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p2, 176).quot) + (172 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p2, \ 176).rem))).p3) \lor (-1
 <-\$heap_{724.1;748.8}.p1) \lor (-1 < -\$heap_{724.1;748.8}.p2) \lor (30268 < -\$heap_{724.1;748.8}.p2)
\text{heap}_{724,1:748,8}.\text{p1}) \lor (30306 < \text{heap}_{724,1:748,8}.\text{p2}) \lor (30322 <
heap_{724,1;748,8}.p3) \lor ...
\rightarrow [simplify]
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 [123.4] \ ((0 == ((-63 * div(\mathbf{heapIs} \$ heap_{funcstart\_724,1}, \$ heap_{funcstart\_724,1}.p3,
178).quot) + (170 * div(heapIs heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p3,
178).rem))) \vee (-1 < -$heap<sub>724,1;748,8</sub>.p1) \vee (-1 < -$heap<sub>724,1;748,8</sub>.p2) \vee
(30268 < \text{$heap}_{724,1;748,8}.\text{p1}) \lor (30306 < \text{$heap}_{724,1;748,8}.\text{p2}) \lor (30322 < \text{$heap}_{724,1;748,8}.\text{p2}) \lor (30322 < \text{$heap}_{724,1;748,8}.\text{p2})
heap_{724,1;748,8}.p3) \vee ...
\rightarrow [from term 63.3, 0 == ((-63 * div(heapIs $heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1}.\text{p3}, 178).\text{quot} + (170 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
heap_{funcstart\_724,1}.p3,\ 178).rem)) is false]
[123.5] (false \vee (-1 < -$heap_{724,1;748,8}.p1) \vee (-1 < -$heap_{724,1;748,8}.p2) \vee
(30268 < \text{heap}_{724,1:748,8}.\text{p1}) \lor (30306 < \text{heap}_{724,1:748,8}.\text{p2}) \lor (30322 <
heap_{724,1;748,8}.p3) \vee ...
\rightarrow [from term 120.5, $heap<sub>724,1;748,8</sub> is equal to
heap_{funcstart\_724.1}._replace(p1 \rightarrow ((-2 * div(heapIs $heap_{funcstart\_724.1},
heap_{funcstart\_724.1.p1}, 177).quot + (171 * div(heapIs $heap_{funcstart\_724.1}, 177).quot) + (171 * div(heapIs $heap_{funcstart\_724.1}, 17
\theta_{uncstart\_724.1.p1, 177).rem}))._replace\theta_{uncstart\_724.1.p1, 177).rem})._replace
heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p2, 176).quot) + (172 * div(heapIs)
\$heap_{funcstart\_724,1},\,\$heap_{funcstart\_724,1}.p2,\,176).rem))).\_\mathbf{replace}(p3\rightarrow((-63-2)))
 * div(\mathbf{heapIs} \ \$heap_{funcstart\_724,1}, \ \$heap_{funcstart\_724,1}.p3, \ 178).quot) + (170 \ *
div(\mathbf{heapIs} \ \$heap_{funcstart\_724,1}, \ \$heap_{funcstart\_724,1}.p3,
178).rem)))._replace(p1 \rightarrow (30269 + (-2 * div(heapIs $heap_{funcstart\_724,1},
heap_{funcstart\_724,1}.p1, 177).quot) + (171 * div(heapIs $heap_{funcstart\_724,1},
heap_{funcstart\_724,1}.p1, 177).rem)._replace(p2 \rightarrow (-35 * div(heapIs)))._
heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p2, 176).quot) + (172 * div(heapIs)
heap_{funcstart_{724,1}}, heap_{funcstart_{724,1}}, p2, 176).rem)
[123.6] (false \lor (-1 < -\$heap_{funcstart\_724,1}._replace(p1 \to ((-2 * div(heapIs
heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p1, 177).quot) + (171 * div(heapIs)
\theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}
* div(heapIs heap_{funcstart_{-724,1}}, heap_{funcstart_{-724,1}}, p2, 176).quot) + (172 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p2,
176).rem)))._replace(p3 \rightarrow ((-63 * div(heapIs $heap_{funcstart_724.1},
\text{Sheap}_{funcstart_{724,1},p3, 178}.quot) + (170 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart_{724,1},p3})
\rho_{funcstart\_724,1.p3}, 178).rem)._replace(p1 \rightarrow (30269 + (-2 * div(heapIs
\theta_{funcstart_{724,1}}, \theta_{funcstart_{724,1},p1, 177}.quot) + (171 * div(heapIs)
\rho_{funcstart\_724,1}, \rho_{funcstart\_724,1}
* div(\mathbf{heapIs} \ \$heap_{funcstart\_724,1}, \ \$heap_{funcstart\_724,1}.p2, \ 176).quot) + (172 \ *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p2, \ 176).rem))).p1) \lor (-1)
<-$heap<sub>724,1;748,8</sub>.p2) \lor (30268 <$heap<sub>724,1;748,8</sub>.p1) \lor (30306 <
\text{Sheap}_{724,1;748,8}.\text{p2}) \lor (30322 < \text{Sheap}_{724,1;748,8}.\text{p3})) \lor \dots
\rightarrow [simplify]
[123.16] (false \vee (30268 < ((-171 * div(heapIs $heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1}.\text{p1}, 177).\text{rem} + (2 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1.p1, 177}.\text{quot}))) \lor (-1 < -\text{Sheap}_{724,1:748,8.p2}) \lor (30268 < -\text{Sheap}_{724,1:748,8.p2}) \lor (30268 < -\text{Sheap}_{724,1:748,8.p2})
\text{heap}_{724,1:748,8}.\text{p1}) \lor (30306 < \text{heap}_{724,1:748,8}.\text{p2}) \lor (30322 <
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heap_{724.1:748.8}.p3) \lor ...
\rightarrow [from term 54.11, literala < ((-171 * div(heapIs $heap_{funcstart\_724,1},
heap_{funcstart\_724,1}.p1, 177).rem + (2 * div(heapIs $heap_{funcstart\_724,1}, 177).rem) + (2 * div(heapIs $heap_{funcstart\_724,1}, 177)
heap_{funcstart\_724,1}.p1, 177).quot) is false whenever -2 < (-30269 + literala)
       Proof of rule precondition:
       [123.16.0] - 2 < (-30269 + 30268)
       \rightarrow [simplify]
       [123.16.2] true
[123.17] (false \lor false \lor (-1 < -\$heap_{724,1;748,8}.p2) \lor (30268 <
\text{Sheap}_{724,1:748,8}.\text{p1}) \lor (30306 < \text{Sheap}_{724,1:748,8}.\text{p2}) \lor (30322 <
heap_{724.1:748.8}.p_{3}) \vee ...
\rightarrow [from term 120.5, $heap<sub>724,1;748,8</sub> is equal to
\text{Sheap}_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 * div(\textbf{heapIs } \$heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1}.p1, 177).quot) + (171 * div(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
\rho_{1.5}(p_1, p_1, p_2, p_3, p_4, p_5)._replace(p_2 \rightarrow ((-35 * div(\mathbf{heapIs})))._replace(p_3, p_4, p_4, p_5)
heap_{funcstart\_724,1}, p_{funcstart\_724,1}, p_{funcstart\_724,1}, p_{funcstart\_724,1}, p_{funcstart\_724,1}
heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p2, 176).rem)))._replace(p3 \rightarrow ((-63)
 * div(heapIs heap_{funcstart_{-724,1}}, heap_{funcstart_{-724,1}}, p_{3,178}).quot) + (170 *
div(\textbf{heapIs}~\$heap_{funcstart\_724,1},~\$heap_{funcstart\_724,1}.p3,
178).rem)))._replace(p1 \rightarrow (30269 + (-2 * div(heapIs $heap_{funcstart\_724,1},
heap_{funcstart\_724,1}.p1, 177).quot + (171 * div(heapIs $heap_{funcstart\_724,1},
heap_{funcstart\_724.1}.p1, 177).rem)._replace(p2 \rightarrow (-35 * div(heapIs)))._
heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p2, 176).quot) + (172 * div(heapIs)
heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p2, 176).rem))]
[123.18] (false \vee false \vee (-1 < -$heap<sub>funcstart_724,1</sub>._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 *
\operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724,1}, \$ \operatorname{heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow ((-35 * div(heapIs $heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1}.\text{p2}, 176).\text{quot} + (172 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
\rho_{funcstart\_724,1.p2, 176}.rem)._replace(p3 \rightarrow ((-63 * div(heapIs
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.p3, 178).quot) + (170 * div(heapIs)
\rho_{funcstart_{724,1}}, \rho_{funcstart_{724,1},p3, 178}.rem))._replace(p1 \rightarrow
(30269 + (-2 * div(\mathbf{heapIs} \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_724.1}, \text{\$heap}_{funcstart\_724.1}, \text{p1},
177).rem)))._replace(p2 \rightarrow ((-35 * div(heapIs $heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1}.\text{p2}, 176).\text{quot} + (172 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1.p2}, 176).rem))).p2) \lor (30268 < \text{Sheap}_{724,1;748,8.p1}) \lor
(30306 < \text{$heap}_{724,1:748,8}.\text{p2}) \lor (30322 < \text{$heap}_{724,1:748,8}.\text{p3})) \lor \dots
\rightarrow [simplify]
[123.22] (false \vee false \vee (-1 < ((35 * div(heapIs $heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1}.\text{p2}, 176).\text{quot} + (-172 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
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\text{Sheap}_{funcstart_{724,1}.p2, 176).rem})) \lor (30268 < \text{Sheap}_{724,1:748.8.p1}) \lor (30306 < \text{Sheap}_{724,1:748.8.p1})
\text{Sheap}_{724,1;748,8}.\text{p2}) \lor (30322 < \text{Sheap}_{724,1;748,8}.\text{p3})) \lor \dots
\rightarrow [from term 121.5, literala < ((-172 * div(heapIs $heap_{funcstart\_724,1},
heap_{funcstart_{-724,1},p2,176}.rem) + (35 * div(heapIs heap_{funcstart_{-724,1},p2})
heap_{funcstart_{-724,1},p2,176}, quot) is false whenever -2 < (0 + literala)
        Proof of rule precondition:
        [123.22.0] - 2 < (-1 + 0)
        \rightarrow [simplify]
        [123.22.2] true
[123.23] (false \vee false \vee false \vee (30268 < $heap<sub>724,1;748,8</sub>.p1) \vee (30306 <
\text{heap}_{724,1:748.8}.\text{p2}) \lor (30322 < \text{heap}_{724,1:748.8}.\text{p3})) \lor \dots
\rightarrow [from term 120.5, $heap<sub>724,1;748,8</sub> is equal to
heap_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 * div(heapIs $heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1}.p1, 177).quot + (171 * div(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
\rho_{1.5}(p_1, p_1, p_2, p_3, p_4, p_5)._replace(p_2 \rightarrow ((-35 * div(\mathbf{heapIs})))._replace(p_3, p_4, p_4, p_5)
heap_{funcstart\_724,1}, p_{funcstart\_724,1}, p_{funcstart\_724,1}, p_{funcstart\_724,1}, p_{funcstart\_724,1}
heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p2, 176).rem)))._replace(p3 \rightarrow ((-63)
 * div(heapIs heap_{funcstart_{-724,1}}, heap_{funcstart_{-724,1}}, p_{3,178}).quot) + (170 *
div(\textbf{heapIs}~\$heap_{funcstart\_724,1},~\$heap_{funcstart\_724,1}.p3,
178).rem)))._replace(p1 \rightarrow (30269 + (-2 * div(heapIs $heap_{funcstart\_724,1},
heap_{funcstart\_724,1}.p1, 177).quot + (171 * div(heapIs p_{funcstart\_724,1}),
heap_{funcstart\_724,1}.p1, 177).rem))._replace(p2 \rightarrow (-35 * div(heapIs)))._
heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p2, 176).quot) + (172 * div(heapIs)
heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p2, 176).rem)
[123.24] (false \vee false \vee false \vee (30268 < $heap<sub>funcstart_724,1</sub>._replace(p1 \rightarrow
((-2 * div(\mathbf{heapIs} \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1, 177).quot) +
(171 * \text{div}(\textbf{heapIs} \$ \text{heap}_{funcstart\_724,1}, \$ \text{heap}_{funcstart\_724,1}.\text{p1},
177).rem)))._replace(p2 \rightarrow ((-35 * div(heapIs $heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1}.\text{p2}, 176).\text{quot} + (172 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
\rho_{funcstart\_724,1.p2, 176}.rem))._replace(p3 \rightarrow ((-63 * div(heapIs
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.p3, 178).quot) + (170 * div(heapIs)
\rho_{funcstart_{724,1}}, \rho_{funcstart_{724,1},p3, 178}.rem))._replace(p1 \rightarrow
(30269 + (-2 * div(\mathbf{heapIs} \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1,
177).quot) + (171 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_724.1}, \text{\$heap}_{funcstart\_724.1}, \text{p1},
177).rem)))._replace(p2 \rightarrow ((-35 * div(heapIs $heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1}.\text{p2}, 176).\text{quot} + (172 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
\rho_{funcstart_{-724,1}.p2, 176, rem)}).p1) \lor (30306 < \rho_{724,1:748,8}.p2) \lor (30306 < \rho_{724,
(30322 < \text{$heap}_{724.1:748.8}.\text{p3})) \lor \dots
\rightarrow [simplify]
[123.28] (false \vee false \vee false \vee (-1 < ((-2 * div(heapIs $heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1}.\text{p1}, 177).\text{quot} + (171 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
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\text{Sheap}_{funcstart\_724,1}.\text{p1}, 177).\text{rem}))) \lor (30306 < \text{Sheap}_{724,1;748.8}.\text{p2}) \lor (30322 <
heap_{724,1;748,8}.p3) \vee ...
\rightarrow [from term 85.0, literala < ((-2 * div(heapIs $heap_{funcstart\_724,1},
heap_{funcstart_{724,1},p1, 177}, quot) + (171 * div(heapIs p_{funcstart_{724,1},p1, 177}), quot)
heap_{funcstart_{-724,1}}.p1, 177).rem is false whenever -2 < (0 + literala)
        Proof of rule precondition:
        [123.28.0] - 2 < (-1 + 0)
        \rightarrow [simplify]
        [123.28.2] true
[123.29] (false \times false \times false \times false \times (30306 < $heap_{724,1.748,8.}p2) \times
(30322 < \text{$heap}_{724,1:748.8}.\text{p3})) \lor \dots
\rightarrow [from term 120.5, p_{724,1;748,8} is equal to
heap_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 * div(heapIs $heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1}.p1, 177).quot + (171 * div(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
\rho_{1.5}(p_1, p_1, p_2, p_3, p_4, p_5)._replace(p_2 \rightarrow ((-35 * div(\mathbf{heapIs})))._replace(p_3, p_4, p_4, p_5)
heap_{funcstart\_724,1}, p_{funcstart\_724,1}, p_{funcstart\_724,1}, p_{funcstart\_724,1}, p_{funcstart\_724,1}
heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p2, 176).rem)))._replace(p3 \rightarrow ((-63)
 * div(\mathbf{heapIs} \ \$heap_{funcstart\_724,1}, \ \$heap_{funcstart\_724,1}.p3, \ 178).quot) + (170 \ *
div(\textbf{heapIs}~\$heap_{funcstart\_724,1},~\$heap_{funcstart\_724,1}.p3,
178).rem)))._replace(p1 \rightarrow (30269 + (-2 * div(heapIs $heap_{funcstart\_724,1},
heap_{funcstart\_724,1}.p1, 177).quot + (171 * div(heapIs p_{funcstart\_724,1}),
heap_{funcstart\_724,1}.p1, 177).rem))._replace(p2 \rightarrow (-35 * div(heapIs)))._
heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p2, 176).quot) + (172 * div(heapIs)
heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p2, 176).rem)
[123.30] (false \lor false \lor false \lor false \lor (30306 <
\rho_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 * div(heapIs $heap_{funcstart\_724,1}),
\text{Sheap}_{funcstart\_724,1}.\text{p1}, 177).\text{quot} + (171 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
\theta_{funcstart\_724,1}.p1, 177).rem))).\_replace(p2 \rightarrow ((-35 * div(heapIs))).\_replace(p2 \rightarrow ((-35 * div(heapIs)))).\_replace(p2 \rightarrow ((-35 * div(heapIs)))).\_replace(p2 \rightarrow ((-35 * div(heapIs))))).\_replace(p2 \rightarrow ((-35 * div(heapIs)))))
\$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p2, 176).quot) + (172 * div(\textbf{heapIs}) + (172 * div(\textbf{heapIs})) + (172
\theta_{funcstart_{724,1}}, \theta_{funcstart_{724,1},p2,176}.rem))._replace(p3 \rightarrow ((-63
* div(heapIs heap_{funcstart_{724,1}}, heap_{funcstart_{724,1}}, 178).quot) + (170 *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.p3,
178).rem)))._replace(p1 \rightarrow (30269 + (-2 * div(heapIs $heap_{tuncstart\_724.1},
\rho_{tuncstart_{-724,1},p1,177} (quot) + (171 * div(heapIs $heap_{tuncstart_{-724,1}})
\theta_{funcstart\_724,1.p1, 177).rem}))._replace(p2 \to ((-35 * div(heapIs
\theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}
heap_{724.1:748.8}.p3) \lor ...
\rightarrow [simplify]
[123.31] (false \vee false \vee false \vee false \vee (30306 < ((-35 * div(heapIs
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.p2, 176).quot) + (172 * div(heapIs)
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\$ heap_{funcstart\_724,1}, \$ heap_{funcstart\_724,1}.p2, 176).rem))) \lor (30322 <
heap_{724,1;748,8}.p3) \vee ...
\rightarrow [from term 60.18, literala < ((-35 * div(heapIs $heap_{funcstart\_724,1},
heap_{funcstart_{724,1},p2, 176}, quot) + (172 * div(heapIs p_{funcstart_{724,1},p2})
heap_{funcstart_724,1}.p2, 176).rem is false whenever -2 < (-30307 + literala)
    Proof of rule precondition:
    [123.31.0] - 2 < (-30307 + 30306)
    \rightarrow [simplify]
    [123.31.2] true
[123.32] (false \vee false \vee false \vee false \vee false \vee (30322 < $heap<sub>724 1.748 8.p3</sub>))
\rightarrow [from term 120.5, $heap<sub>724,1;748,8</sub> is equal to
heap_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 * div(heapIs $heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1}.p1, 177).quot + (171 * div(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
\rho_{1.5}(p_1, p_1, p_2, p_3, p_4, p_5)._replace(p_2 \rightarrow ((-35 * div(\mathbf{heapIs})))._replace(p_3 \rightarrow ((-35 * div(\mathbf{heapIs}))))
heap_{funcstart\_724,1}, p_{funcstart\_724,1}, p_{funcstart\_724,1}, p_{funcstart\_724,1}, p_{funcstart\_724,1}
heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p2, 176).rem)))._replace(p3 \rightarrow ((-63)
* div(heapIs heap_{funcstart_{-724,1}}, heap_{funcstart_{-724,1}}, p_{3,178}).quot) + (170 *
div(\textbf{heapIs}~\$heap_{funcstart\_724,1},~\$heap_{funcstart\_724,1}.p3,
178).rem)))._replace(p1 \rightarrow (30269 + (-2 * div(heapIs $heap_{funcstart\_724,1},
heap_{funcstart\_724,1}.p1, 177).quot + (171 * div(heapIs p_{funcstart\_724,1}),
heap_{funcstart\_724,1}.p1, 177).rem))._replace(p2 \rightarrow (-35 * div(heapIs)))._
heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p2, 176).quot) + (172 * div(heapIs)
heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p2, 176).rem)
[123.33] (false \lor false \lor false \lor false \lor false \lor (30322 <
\rho_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 * div(heapIs $heap_{funcstart\_724,1}),
\text{Sheap}_{funcstart\_724,1}.\text{p1}, 177).\text{quot} + (171 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
\theta_{funcstart\_724,1}.p1, 177).rem))).\_replace(p2 \rightarrow ((-35 * div(heapIs))).\_replace(p2 \rightarrow ((-35 * div(heapIs)))).\_replace(p2 \rightarrow ((-35 * div(heapIs)))).\_replace(p2 \rightarrow ((-35 * div(heapIs))))).\_replace(p2 \rightarrow ((-35 * div(heapIs)))))
\theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}
\theta_{funcstart_{724,1}}, \theta_{funcstart_{724,1},p2,176}.rem))._replace(p3 \rightarrow ((-63
* div(heapIs heap_{funcstart_{724,1}}, heap_{funcstart_{724,1}}, 178).quot) + (170 *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.p3,
178).rem)))._replace(p1 \rightarrow (30269 + (-2 * div(heapIs $heap_{tuncstart\_724.1},
\rho_{tuncstart_{-724,1},p1,177} (quot) + (171 * div(heapIs $heap_{tuncstart_{-724,1}})
\rho_{funcstart\_724,1.p1, 177).rem}))._replace(p2 \rightarrow ((-35 * div(heapIs
\theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}
\$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p2, 176).rem))).p3)) \lor \dots
\rightarrow [simplify]
[123.36] (false \vee false \vee false \vee false \vee false \vee (30322 < ((-63 * div(heapIs
\text{Sheap}_{funcstart\_724.1}, \text{Sheap}_{funcstart\_724.1}.\text{p3}, 178).\text{quot}) + (170 * \text{div}(\text{heapIs}))
\$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p3, 178).rem)))) \lor \dots
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\rightarrow [from term 64.19, literala < ((-63 * div(heapIs $heap_{funcstart\_724,1},
heap_{funcstart\_724,1}.p3, 178).quot + (170 * div(heapIs $heap_{funcstart\_724,1}),
heap_{funcstart_{724,1}.p3}, 178).rem) is false whenever -2 < (-30323 + literala)
    Proof of rule precondition:
    [123.36.0] - 2 < (-30323 + 30322)
    \rightarrow [simplify]
    [123.36.2] true
[123.37] (false \vee false \vee false \vee false \vee false \vee false) \vee ...
\rightarrow [simplify]
[123.38] false \vee \dots
[Remove 'false' term 123.38 and fetch new term from containing clause]
[124.0] $heap<sub>724,1;747,8</sub> == $heap<sub>funcstart_724,1</sub>._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).quot) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow ((-35 * div(heapIs $heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724.1.p2}, 176).\text{quot} + (172 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724.1},
\rho_{funcstart\_724,1.p2, 176}.rem)._replace(p3 \rightarrow ((-63 * div(heapIs
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.p3, 178).quot) + (170 * div(heapIs)
\rho_{funcstart\_724.1}, \rho_{funcstart\_724.1}, \rho_{funcstart\_724.1}, \rho_{funcstart\_724.1}, \rho_{funcstart\_724.1}
div(\mathbf{heapIs} \ \text{$heap}_{funcstart\_724,1}, \ \text{$heap}_{funcstart\_724,1}.p1, \ 177).quot) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).rem)))
[Remove 'false' term 123.38 and fetch new term from containing clause]
[125.0] 0 < ((-2 * \text{div}(\textbf{heapIs} \$\text{heap}_{funcstart\_724,1}, \$\text{heap}_{funcstart\_724,1}.\text{p1},
177).quot) + (171 * div(heapIs $heap_{funcstart\_724,1}, $heap_{funcstart\_724,1}.p1,
177).rem))
[Take goal term]
[1.75] (0 == $heap<sub>724,1;747,8</sub>.p3) \vee (-1 < -$heap<sub>724,1;747,8</sub>.p1) \vee (-1 <
-\$heap_{724,1:747,8}.p2) \lor (30268 < \$heap_{724,1:748,8}.p1) \lor (30306 < \$heap_{724,1:748,8}.p2)
\$heap_{724,1;748,8}.p2) \lor (30322 < \$heap_{724,1;748,8}.p3)
\rightarrow [from term 118.0, -1 < -$heap<sub>724,1;747,8</sub>.p2 is true if and only if 0 ==
$heap<sub>724,1;747,8</sub>.p2]
[1.76] (0 == $heap<sub>724,1:747,8</sub>.p3) \vee (-1 < -$heap<sub>724,1:747,8</sub>.p1) \vee (0 ==
\text{$heap}_{724,1:747,8.p2}) \lor (30268 < \text{$heap}_{724,1:748,8.p1}) \lor (30306 <
\$heap_{724,1;748,8}.p2) \lor (30322 < \$heap_{724,1;748,8}.p3)
\rightarrow [from term 117.0, $heap<sub>724,1:748,8</sub> is equal to $heap<sub>724,1:747,8</sub>._replace(p2 \rightarrow
$heap<sub>724.1:747.8</sub>.p2)]
[1.77] (0 == $heap<sub>724,1;747,8</sub>.p3) \vee (-1 < -$heap<sub>724,1;747,8</sub>.p1) \vee (0 ==
\text{Sheap}_{724.1:747.8}.\text{p2}) \lor (30268 < \text{Sheap}_{724.1:747.8}.\text{-replace}(\text{p2} \rightarrow
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\text{Sheap}_{724,1:747,8}.\text{p2}).\text{p1}) \lor (30306 < \text{Sheap}_{724,1:748,8}.\text{p2}) \lor (30322 <
$heap<sub>724,1:748,8</sub>.p3)
\rightarrow [simplify]
[1.78] (0 == $heap<sub>724,1;747,8</sub>.p3) \vee (-1 < -$heap<sub>724,1;747,8</sub>.p1) \vee (0 ==
\text{$heap}_{724,1;747,8}.\text{p2}) \lor (30268 < \text{$heap}_{724,1;747,8}.\text{p1}) \lor (30306 <
\text{heap}_{724,1;748,8}.\text{p2}) \lor (30322 < \text{heap}_{724,1;748,8}.\text{p3})
\rightarrow [from term 117.0, $heap<sub>724,1;748,8</sub> is equal to $heap<sub>724,1;747,8</sub>._replace(p2 \rightarrow
heap_{724,1;747,8}.p2)
[1.79] (0 == $heap<sub>724.1:747.8</sub>.p3) \vee (-1 < -$heap<sub>724.1:747.8</sub>.p1) \vee (0 ==
\text{heap}_{724,1:747,8}.\text{p2}) \lor (30268 < \text{heap}_{724,1:747,8}.\text{p1}) \lor (30306 <
\text{heap}_{724,1:747,8}. replace(p2 \rightarrow \text{heap}_{724,1:747,8}.p2).p2) \vee (30322 <
$heap<sub>724,1;748,8</sub>.p3)
\rightarrow [simplify]
[1.80] (0 == $\text{heap}_{724.1:747.8}.p3) \times (-1 < -\text{$heap}_{724.1:747.8}.p1) \times (0 ==
\text{Sheap}_{724,1;747,8}.\text{p2}) \lor (30268 < \text{Sheap}_{724,1;747,8}.\text{p1}) \lor (30306 <
\text{$heap}_{724,1;747,8}.\text{p2}) \lor (30322 < \text{$heap}_{724,1;748,8}.\text{p3})
\rightarrow [from term 117.0, $heap<sub>724,1;748,8</sub> is equal to $heap<sub>724,1;747,8</sub>._replace(p2 \rightarrow
heap_{724,1;747,8}.p2)
[1.81] (0 == $\text{heap}_{724.1:747.8}.p3) \times (-1 < -\text{$heap}_{724.1:747.8}.p1) \times (0 ==
\text{$heap}_{724,1;747,8}.\text{p2}) \lor (30268 < \text{$heap}_{724,1;747,8}.\text{p1}) \lor (30306 <
\text{heap}_{724.1:747.8}.\text{p2}) \lor (30322 < \text{heap}_{724.1:747.8}.\text{-replace}(\text{p2} \rightarrow
$heap<sub>724.1:747.8</sub>.p2).p3)
\rightarrow [simplify]
[1.82] (0 == $\text{heap}_{724.1:747.8}.p3) \times (-1 < -\text{$heap}_{724.1:747.8}.p1) \times (0 ==
\text{heap}_{724.1:747.8.p2}) \lor (30268 < \text{heap}_{724.1:747.8.p1}) \lor (30306 <
\text{$heap}_{724,1;747,8.p2}) \lor (30322 < \text{$heap}_{724,1;747,8.p3})
\rightarrow [from term 124.0, $heap<sub>724,1;747,8</sub> is equal to
heap_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 * div(heapIs $heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1}.p1, 177).quot) + (171 * div(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
heap_{funcstart\_724,1}.p1, 177).rem))).\_replace(p2 \rightarrow ((-35 * div(heapIs))).\_replace(p2 \rightarrow ((-35 * div(heapIs)))))._replace(p2 \rightarrow ((-35 * div(heapIs)))))
heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p2, 176).quot) + (172 * div(heapIs)
\theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}
 * div(\mathbf{heapIs} \ \$heap_{funcstart\_724,1}, \ \$heap_{funcstart\_724,1}.p3, \ 178).quot) + (170 \ *
div(\mathbf{heapIs} \ \$heap_{funcstart\_724,1}, \ \$heap_{funcstart\_724,1}.p3,
178).rem)))._replace(p1 \rightarrow (-2 * div(\mathbf{heapIs} \$heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1}.\text{p1}, 177).\text{quot} + (171 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
heap_{funcstart_{-724,1}.p1, 177).rem}
[1.83] (0 == \text{heap}_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 * div(heapIs
\theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}.p1, 177).quot) + (171 * div(heapIs
\rho_{funcstart\_724,1}, \rho_{func
* \operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p2, \ 176).quot) + (172 \ \text{*}
```

```
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.p2,
176).rem)))._replace(p3 \rightarrow ((-63 * div(heapIs $heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1}.\text{p3}, 178).\text{quot}) + (170 * \text{div}(\text{heapIs} \text{Sheap}_{funcstart\_724,1},
\rho_{funcstart\_724,1.p3}, 178).rem)._replace(p1 \rightarrow ((-2 * div(heapIs))
\theta_{funcstart_{724,1}}, \theta_{funcstart_{724,1},p1, 177}.quot + (171 * div(heapIs))
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.p1, 177).rem))).p2) \lor (0 ==
heap_{724,1;747,8}.p3) \lor (-1 < -heap_{724,1;747,8}.p1) \lor (30268 < -heap_{724,1;747,8}.p3)
\text{heap}_{724,1;747,8}.\text{p1}) \lor (30306 < \text{heap}_{724,1;747,8}.\text{p2}) \lor (30322 <
$heap<sub>724,1;747,8</sub>.p3)
\rightarrow [simplify]
[1.86] \ (0 == ((-35 * div(\mathbf{heapIs} \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p2,
176).quot) + (172 * div(heapIs \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}.p2,
(176).rem)) \lor (0 == \$heap_{724,1;747,8}.p3) \lor (-1 < -\$heap_{724,1;747,8}.p1) \lor
(30268 < \text{$heap}_{724,1;747,8}.\text{p1}) \lor (30306 < \text{$heap}_{724,1;747,8}.\text{p2}) \lor (30322 < \text{$heap}_{724,1;747,8}.\text{p2}) \lor (30322 < \text{$heap}_{724,1;747,8}.\text{p2})
heap_{724,1;747,8}.p3
\rightarrow [from term 59.3, 0 == ((-35 * div(heapIs $heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1}.\text{p2},\ 176).\text{quot}) + (172 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
heap_{funcstart\_724,1}.p2, 176).rem) is false
[1.87] false \vee (0 == $heap<sub>724,1:747,8</sub>.p3) \vee (-1 < -$heap<sub>724,1:747,8</sub>.p1) \vee
(30268 < \text{heap}_{724,1;747,8}.\text{p1}) \lor (30306 < \text{heap}_{724,1;747,8}.\text{p2}) \lor (30322 < \text{p2})
$heap<sub>724,1;747,8</sub>.p3)
\rightarrow [from term 124.0, $heap<sub>724,1;747,8</sub> is equal to
heap_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 * div(heapIs *heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1}.\text{p1}, 177).\text{quot} + (171 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
\rho_{uncstart\_724,1}.p1, 177).rem))).\_replace(p2 \rightarrow ((-35 * div(heapIs))).\_replace(p2 \rightarrow ((-35 * div(heapIs)))).\_replace(p2 \rightarrow ((-35 * div(heapIs)))))
heap_{funcstart\_724,1}, p_{funcstart\_724,1}, p_{funcstart\_724,1}, p_{funcstart\_724,1}, p_{funcstart\_724,1}
heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p2, 176).rem)))._replace(p3 \rightarrow ((-63)
 * div(heapIs heap_{funcstart_{-724,1}}, heap_{funcstart_{-724,1}}, p_{3,178}).quot) + (170 *
div(\textbf{heapIs}~\$heap_{funcstart\_724,1},~\$heap_{funcstart\_724,1}.p3,
178).rem))). replace(p1 \rightarrow (-2 * div(heapIs $heap_{funcstart\_724,1},
heap_{funcstart_{724,1},p1, 177}, quot) + (171 * div(heapIs p_{funcstart_{724,1},p1, 177}).
heap_{funcstart_{-724,1}}.p1, 177).rem)
[1.88] false \vee (0 == $heap_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 * div(heapIs
\$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p1, 177).quot) + (171 * div(\mathbf{heapIs})
\rho_{funcstart\_724,1}, \rho_{funcstart\_724,1}
* div(heapIs heap_{funcstart_{-724.1}}, heap_{funcstart_{-724.1}}, p2, 176).quot) + (172 *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.\operatorname{p2},
176).rem)))._replace(p3 \rightarrow ((-63 * div(heapIs $heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1}.\text{p3}, 178).\text{quot} + (170 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
\rho_{funcstart\_724,1.p3, 178}.rem)._replace(p1 \rightarrow ((-2 * div(heapIs
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.p1, 177).quot) + (171 * div(heapIs)
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.p1, 177).rem))).p3) \lor (-1 <
-\$heap_{724,1:747,8}.p1) \lor (30268 < \$heap_{724,1:747,8}.p1) \lor (30306 < \$heap_{724,1:747,8}.p1)
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\text{heap}_{724,1:747,8}.\text{p2}) \lor (30322 < \text{heap}_{724,1:747,8}.\text{p3})
\rightarrow [simplify]
[1.90] false \vee (0 == ((-63 * div(heapIs $heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1}.\text{p3}, 178).\text{quot} + (170 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1.p3}, 178).rem))) \lor (-1 < -\text{Sheap}_{724,1;747,8.p1}) \lor (30268 < -\text{Sheap}_{724,1;747,8.p1}) \lor (30268 < -\text{Sheap}_{724,1;747,8.p1})
\text{$heap}_{724,1;747,8}.\text{p1}) \lor (30306 < \text{$heap}_{724,1;747,8}.\text{p2}) \lor (30322 <
$heap<sub>724,1;747,8</sub>.p3)
\rightarrow [from term 63.3, 0 == ((-63 * div(heapIs $heap_{funcstart\_724,1},
heap_{funcstart-724,1}.p3, 178).quot + (170 * div(heapIs $heap_{funcstart-724,1}),
heap_{funcstart\_724,1}.p3, 178).rem) is false
[1.91] false \vee false \vee (-1 < -\$heap_{724,1;747,8}.p1) \vee (30268 <
\text{heap}_{724,1:747.8}.\text{p1}) \lor (30306 < \text{heap}_{724,1:747.8}.\text{p2}) \lor (30322 <
heap_{724,1;747,8}.p3
\rightarrow [from term 124.0, $heap<sub>724,1;747,8</sub> is equal to
heap_{funcstart\_724.1}._replace(p1 \rightarrow ((-2 * div(heapIs heap_{funcstart\_724.1}),
heap_{funcstart_{-724,1},p1, 177}, quot) + (171 * div(heapIs heap_{funcstart_{-724,1},p1, 177})
\rho_{tuncstart\_724.1.p1, 177).rem}))._replace(p2 \rightarrow ((-35 * div(heapIs
heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p2, 176).quot) + (172 * div(heapIs)
\theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}. P2, 176).rem)))._replace(p3 \theta_{funcstart\_724,1}
* div(heapIs heap_{funcstart\_724.1}, heap_{funcstart\_724.1}, p_{funcstart\_724.1}), quot) + (170 *
div(\mathbf{heapIs} \ \$heap_{funcstart\_724,1}, \ \$heap_{funcstart\_724,1}.p3,
178).rem)))._replace(p1 \rightarrow (-2 * div(\mathbf{heapIs} \$heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1}.\text{p1}, 177).\text{quot} + (171 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
heap_{funcstart_{-724,1}.p1, 177).rem}
[1.92] false \vee false \vee (-1 < -$heap<sub>funcstart_724,1</sub>._replace(p1 \rightarrow ((-2 *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.p1, \ 177).\operatorname{quot}) + (171 \ *
\operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724,1}, \$ \operatorname{heap}_{funcstart\_724,1}.p1,
177).rem)))._replace(p2 \rightarrow ((-35 * div(heapIs $heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1}.\text{p2}, 176).\text{quot} + (172 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
\rho_{funcstart\_724,1.p2, 176}.rem))._replace(p3 \rightarrow ((-63 * div(heapIs
\text{Sheap}_{funcstart\_724.1}, \text{Sheap}_{funcstart\_724.1}.p3, 178).quot) + (170 * div(heapIs)
\rho_{funcstart\_724.1}, \rho_{funcstart\_724.1}, \rho_{funcstart\_724.1}, \rho_{funcstart\_724.1}, \rho_{funcstart\_724.1}
div(\mathbf{heapIs} \ \text{$heap}_{funcstart\_724,1}, \ \text{$heap}_{funcstart\_724,1}.p1, \ 177).quot) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \text{\$heap}_{funcstart\_724,1}, \ \text{\$heap}_{funcstart\_724,1}.p1, \ 177).rem))).p1) \lor
(30268 < \text{$heap}_{724,1;747,8}.\text{p1}) \lor (30306 < \text{$heap}_{724,1;747,8}.\text{p2}) \lor (30322 < \text{$heap}_{724,1;747,8}.\text{p2}) \lor (30322 < \text{$heap}_{724,1;747,8}.\text{p2})
$heap<sub>724.1:747.8</sub>.p3)
\rightarrow [simplify]
[1.96] false \vee false \vee (-1 < ((2 * div(heapIs $heap_{funcstart\_724.1},
\text{Sheap}_{funcstart\_724,1}.\text{p1}, 177).\text{quot} + (-171 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
\{\text{heap}_{funcstart\_724,1}.\text{p1}, 177\}.\text{rem}\} \forall (30268 < \{\text{heap}_{724,1;747,8}.\text{p1}\} \lor (30306 < \text{heap}_{724,1;747,8}.\text{p1})
\text{heap}_{724,1;747,8}.\text{p2}) \lor (30322 < \text{heap}_{724,1;747,8}.\text{p3})
\rightarrow [from term 125.0, literala < ((-171 * div(heapIs $heap_{funcstart\_724.1},
```

```
heap_{funcstart_{-724,1}}.p1, 177).quot) is false whenever -2 < (0 + literala)
       Proof of rule precondition:
       [1.96.0] - 2 < (-1 + 0)
       \rightarrow [simplify]
       [1.96.2] true
[1.97] false \vee false \vee false \vee (30268 < \text{$heap}_{724,1:747,8}.\text{p1}) <math>\vee (30306 <
\text{heap}_{724,1:747,8}.\text{p2}) \lor (30322 < \text{heap}_{724,1:747,8}.\text{p3})
\rightarrow [from term 124.0, $heap_{724,1;747,8}$ is equal to
heap_{funcstart\_724.1}._replace(p1 \rightarrow ((-2 * div(heapIs $heap_{funcstart\_724.1},
heap_{funcstart\_724.1.p1}, 177).quot + (171 * div(heapIs $heap_{funcstart\_724.1}, 177).quot) + (171 * div(heapIs $heap_{funcstart\_724.1}, 17
\rho_{funcstart\_724.1.p1, 177).rem}))._replace\rho_{funcstart\_724.1.p1, 177).rem})
heap_{funcstart\_724.1}, heap_{funcstart\_724.1}.p2, 176).quot) + (172 * div(heapIs)
heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p2, 176).rem)))._replace(p3 \rightarrow ((-63)
 * div(\mathbf{heapIs} \ \$heap_{funcstart\_724,1}, \ \$heap_{funcstart\_724,1}.p3, \ 178).quot) + (170 \ *
div(\mathbf{heapIs} \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p3,
 178).rem)))._replace(p1 \rightarrow (-2 * div(\mathbf{heapIs} \$heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1}.\text{p1}, 177).\text{quot} + (171 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
heap_{funcstart_{-724,1}.p1, 177).rem}
| 1.98| false \vee false \vee false \vee (30268 < $heap_{funcstart\_724,1}._replace(p1 \rightarrow
((-2*\operatorname{div}(\mathbf{heapIs}\ \$\operatorname{heap}_{funcstart\_724,1},\ \$\operatorname{heap}_{funcstart\_724,1}.\operatorname{p1},\ 177).\operatorname{quot})\ +
(171 * \text{div}(\text{heapIs } \text{\$heap}_{funcstart\_724,1}, \text{\$heap}_{funcstart\_724,1}.\text{p1},
177).rem)))._replace(p2 \rightarrow ((-35 * div(heapIs $heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1}.\text{p2}, 176).\text{quot} + (172 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
\rho_{funcstart\_724,1.p2, 176}.rem))._replace(p3 \rightarrow ((-63 * div(heapIs
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.\text{p3}, 178).\text{quot}) + (170 * \text{div}(\text{heapIs}))
\theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}, \theta_{funcstart\_724,1}
\operatorname{div}(\mathbf{heapIs} \ \operatorname{\$heap}_{funcstart\_724,1}, \ \operatorname{\$heap}_{funcstart\_724,1}.\operatorname{p1}, \ 177).\operatorname{quot}) + (171 *
\operatorname{div}(\mathbf{heapIs} \ \text{$heap}_{funcstart\_724.1}, \ \text{$heap}_{funcstart\_724.1}.p1, \ 177).rem))).p1) \lor
(30306 < \text{$heap}_{724,1;747,8}.\text{p2}) \lor (30322 < \text{$heap}_{724,1;747,8}.\text{p3})
\rightarrow [simplify]
[1.99] false \vee false \vee false \vee (30268 < ((-2 * div(heapIs $heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1}.\text{p1}, 177).\text{quot} + (171 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1}.\text{p1}, 177).\text{rem}))) \lor (30306 < \text{Sheap}_{724,1;747,8}.\text{p2}) \lor (30322 <
$heap<sub>724,1;747,8</sub>.p3)
\rightarrow [from term 56.17, literala < ((-2 * div(heapIs $heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1}.\text{p1}, 177).\text{quot} + (171 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
heap_{funcstart\_724,1}.p1, 177).rem) is false whenever -2 < (-30269 + literala)
       Proof of rule precondition:
```

 $\text{Sheap}_{funcstart\_724,1}.p1, 177).rem) + (2 * div(\text{heapIs } \text{Sheap}_{funcstart\_724,1},$ 

[1.99.0] - 2 < (-30269 + 30268)

```
\rightarrow [simplify]
     [1.99.2] true
[1.100] false \vee false \vee false \vee false \vee (30306 < \text{$heap}_{724.1:747.8}.\text{p2}) <math>\vee (30322)
< \text{$heap}_{724,1;747,8}.p3)
\rightarrow [from term 124.0, $heap<sub>724,1;747,8</sub> is equal to
heap_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 * div(heapIs $heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1}.p1, 177).quot) + (171 * div(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p2, 176).quot) + (172 * div(heapIs)
heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p2, 176).rem)))._replace(p3 \rightarrow ((-63)
* \operatorname{div}(\mathbf{heapIs} \ \$ heap_{funcstart\_724,1}, \ \$ heap_{funcstart\_724,1}.p3, \ 178).quot) + (170 \ *
div(\mathbf{heapIs} \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p3,
178).rem)))._replace(p1 \rightarrow (-2 * div(\mathbf{heapIs} \$heap_{funcstart\_724.1},
heap_{funcstart_{724,1},p1, 177}, quot) + (171 * div(heapIs p_{funcstart_{724,1},p1, 177}), quot)
heap_{funcstart_{-724,1},p1, 177,rem}
[1.101] false \vee false \vee false \vee false \vee (30306 <
\text{Sheap}_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 * div(heapIs \text{Sheap}_{funcstart\_724,1},
heap_{funcstart\_724,1}.p1, 177).quot + (171 * div(heapIs p_{funcstart\_724,1})
\rho_{tuncstart_{724,1},p1,177,rem})._replace(p2 \rightarrow ((-35 * div(heapIs
\theta_{funcstart_{-724,1}}, \theta_{funcstart_{-724,1}}, \theta_{funcstart_{-724,1}}, \theta_{funcstart_{-724,1}}, \theta_{funcstart_{-724,1}}
\rho_{tuncstart\_724,1}, \rho_{tuncstart\_724,1}, \rho_{tuncstart\_724,1}, \rho_{tuncstart\_724,1}, \rho_{tuncstart\_724,1}, \rho_{tuncstart\_724,1}
* div(heapIs heap_{funcstart_{-724,1}}, heap_{funcstart_{-724,1}}, p3, 178).quot) + (170 *
\operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724.1}, \$ \operatorname{heap}_{funcstart\_724.1}.p3,
178).rem)))._replace(p1 \rightarrow ((-2 * div(heapIs $heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1}.\text{p1}, 177).\text{quot} + (171 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1}.\text{p1}, 177).\text{rem})).\text{p2}) \lor (30322 < \text{Sheap}_{724,1;747,8}.\text{p3})
\rightarrow [simplify]
[1.104] false \vee false \vee false \vee false \vee (30306 < ((-35 * div(heapIs
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.p2, 176).quot) + (172 * div(heapIs)
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.p2, 176).rem))) \lor (30322 <
$heap<sub>724.1:747.8</sub>.p3)
\rightarrow [from term 60.18, literala < ((-35 * div(heapIs $heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1}.p2, 176).quot) + (172 * div(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
heap_{funcstart_{-724,1}.p2, 176}.rem) is false whenever -2 < (-30307 + literala)
     Proof of rule precondition:
     [1.104.0] - 2 < (-30307 + 30306)
     \rightarrow [simplify]
     [1.104.2] true
[1.105] false \vee false \vee false \vee false \vee false \vee (30322 < $heap<sub>724,1:747,8</sub>.p3)
\rightarrow [from term 124.0, $heap<sub>724,1;747,8</sub> is equal to
```

```
heap_{funcstart\_724,1}._replace(p1 \rightarrow ((-2 * div(heapIs $heap_{funcstart\_724,1},
heap_{funcstart_{724,1},p1, 177}, quot) + (171 * div(heapIs heap_{funcstart_{724,1},p1, 177})
\rho_{1.5}(p_1, p_1, p_2, p_3, p_4, p_5)._replace(p_2 \rightarrow ((-35 * div(\mathbf{heapIs})))._replace(p_3, p_4, p_4, p_5)
heap_{funcstart\_724,1}, heap_{funcstart\_724,1}.p2, 176).quot) + (172 * div(heapIs)
\rho_{funcstart\_724,1}, \rho_{funcstart\_724,1}, \rho_{funcstart\_724,1}, \rho_{funcstart\_724,1}, \rho_{funcstart\_724,1}, \rho_{funcstart\_724,1}
 * div(heapIs heap_{funcstart_{-724,1}}, heap_{funcstart_{-724,1}}, 178).quot) + (170 *
div(\mathbf{heapIs} \$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p3,
178).rem)))._replace(p1 \rightarrow (-2 * div(\textbf{heapIs } \$heap_{funcstart\_724,1},
heap_{funcstart_{724,1},p1, 177}, quot) + (171 * div(heapIs p_{funcstart_{724,1},p1, 177}).
heap_{funcstart_{-724,1}}.p1, 177).rem)
[1.106] false \vee false \vee false \vee false \vee false \vee (30322 <
\text{Sheap}_{funcstart\_724.1}._replace(p1 \rightarrow ((-2 * div(heapIs \text{Sheap}_{funcstart\_724.1}),
\text{Sheap}_{funcstart_{-724,1},p1, 177}.\text{quot}) + (171 * \text{div}(\text{heapIs } \text{Sheap}_{funcstart_{-724,1}},
\rho_{funcstart\_724,1.p1, 177}.rem)._replace(p2 \rightarrow ((-35 * div(heapIs
\$heap_{funcstart\_724,1}, \$heap_{funcstart\_724,1}.p2, 176).quot) + (172 * div(\textbf{heapIs}) + (172 * div(\textbf{heapIs})) + (172
\rho_{funcstart\_724,1}, \rho_{funcstart\_724,1}, \rho_{funcstart\_724,1}, \rho_{funcstart\_724,1}, \rho_{funcstart\_724,1}, \rho_{funcstart\_724,1}
* div(heapIs heap_{funcstart_{-724,1}}, heap_{funcstart_{-724,1}}, 178).quot) + (170 *
\operatorname{div}(\mathbf{heapIs} \ \$ \operatorname{heap}_{funcstart\_724,1}, \ \$ \operatorname{heap}_{funcstart\_724,1}.p3,
178).rem))). replace(p1 \rightarrow ((-2 * div(heapIs $heap_{funcstart\_724,1},
heap_{funcstart\_724,1}.p1, 177).quot + (171 * div(heapIs p_{funcstart\_724,1})
heap_{funcstart_{-724,1}.p1, 177).rem})).p3)
\rightarrow [simplify]
[1.108] false \vee false \vee false \vee false \vee false \vee (30322 < ((-63 * div(heapIs
\text{Sheap}_{funcstart\_724,1}, \text{Sheap}_{funcstart\_724,1}.p3, 178).quot) + (170 * div(heapIs)
heap_{funcstart_{724,1}}, heap_{funcstart_{724,1}}, 178).rem))
\rightarrow [from term 64.19, literala < ((-63 * div(heapIs $heap_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1}.p3, 178).quot) + (170 * div(\text{heapIs } \text{Sheap}_{funcstart\_724,1},
\text{Sheap}_{funcstart\_724,1}.p3, 178).rem) is false whenever -2 < (-30323 + \text{literala})
        Proof of rule precondition:
        [1.108.0] - 2 < (-30323 + 30322)
        \rightarrow [simplify]
        [1.108.2] true
[1.109] false \lor false \lor false \lor false \lor false
\rightarrow [simplify]
[1.110] false
```

Proof of verification condition: Precondition of 'operator /' satisfied Condition generated at: C:\Escher\Customers\prang\prang.c (75,34) Condition defined at: built in declaration

```
To prove: !(0.0 ==
asType < double > (static\_cast < real > ($heap_{funcend\_724,1}.M1)))
Given:
heap_{init}.LIMIT == (int)80
\theta
\theta_{init}.r1 == asType < short int > ((int)171)
\theta
\theta = asType < short int > ((int)2)
heap_{init}.M2 == asType < short int > ((int)30307)
\theta
heap_{init}.a2 == asType < short int > ((int)176)
\theta sheap<sub>init</sub>.b2 == asType<short int>((int)35)
heap_{init}.M3 == asType < short int > ((int)30323)
heap_{init}.r3 == asType < short int > ((int)170)
heap_{init}.a3 == asType < short int > ((int)178)
\theta = asType < short int > ((int)63)
\theta = asType < short int > ((int)1)
\theta
\theta = asType < short int > ((int)3)
invariant1(heapIs heap_{funcstart\_724,1})
\operatorname{div1} == \operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724,1},
asType < int > (\$heap_{funcstart\_724,1}.p1),
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{a1}))
(\mathbf{asType}{<}\mathbf{integer}{>}(\mathbf{asType}{<}\mathbf{int}{>}(\$\mathbf{heap}_{funcstart\_724,1}.\mathbf{p1})) \ / \\
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a1))) = =
asType<integer>(div1.quot)
(\mathbf{asType}{<}\mathbf{int}{>}(\mathbf{asType}{<}\mathbf{int}{>}(\$\mathbf{heap}_{funcstart\_724,1}.\mathbf{p1}))~\%
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a1))) = =
asType<integer>(div1.rem)
!(0 == asType < integer > (div1.rem)) || !(0 ==
asType<integer>(div1.quot))
div2 == div(\mathbf{heapIs} \$ heap_{funcstart\_724,1},
asType < int > (\$heap_{funcstart\_724,1}.p2),
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{a2}))
(asType<integer>(asType<int>($heap_{tuncstart\_724,1}.p2)) /
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a2))) = =
```

```
asType<integer>(div2.quot)
(asType < int > (asType < int > (\$heap_{funcstart\_724,1}.p2)) \%
\mathbf{asType}{<}\mathbf{integer}{>}(\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{a2}))) ==
asType<integer>(div2.rem)
!(0 == asType < integer > (div2.rem)) || !(0 ==
asType<integer>(div2.quot))
div3 == div(\mathbf{heapIs} \$ heap_{funcstart\_724,1},
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{p3}),
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{a3}))
(asType<int>(asType<int>($heap_{tuncstart\_724.1}.p3)) /
asType < integer > (asType < int > (\$heap_{funcstart\_724.1}.a3))) = =
asType<integer>(div3.quot)
(asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.p3)) \%
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a3))) = =
asType<integer>(div3.rem)
!(0 == asType < integer > (div3.rem)) || !(0 ==
asType<integer>(div3.quot))
\rho_{174,1740,8} == \rho_{174,174
int>((asType<int>(asType<short int>(div1.rem)) *
asType < int > (\$heap_{funcstart-724,1}.r1)) - (asType < int > (asType < short)
int>(div1.quot)) * asType< int>($heap_{funcstart\_724,1}.b1))))
-asType < integer\ const > (\$heap_{724,1;740,8}.M1) < 
asType<integer>($heap<sub>724.1:740.8</sub>.p1)
!(0 == asType < integer > (\$heap_{724,1:740,8}.p1))
asType<integer>($heap<sub>724.1:740.8</sub>.p1) <
asType<integer>($heap<sub>724,1:740,8</sub>.M1)
heap_{724,1:742,8} == heap_{724,1:740,8}.replace(p2 \rightarrow asType<short
int>((asType<int>(asType<short int>(div2.rem)) *
asType < int > (\$heap_{724,1:740.8}.r2)) - (asType < int > (asType < short)
int > (div2.quot)) * asType < int > ($heap_{724,1:740.8}.b2))))
-asType < integer\ const > (\$heap_{724,1;742,8}.M2) < 
asType<integer>($heap<sub>724.1:742.8</sub>.p2)
!(0 == asType < integer > (\$heap_{724,1:742.8}.p2))
asType < integer > (\$heap_{724,1;742,8}.p2) <
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathrm{heap}_{724,1;742,8}.\mathrm{M2})
\text{sheap}_{724,1;744,8} == \text{sheap}_{724,1;742,8}.\_\text{replace}(p3 \to asType < short)
int>((asType<int>(asType<short int>(div3.rem)) *
asType < int > (\$heap_{724,1:742.8}.r3)) - (asType < int > (asType < short)
int>(div3.quot)) * asType<int>($heap<sub>724,1:742,8</sub>.b3))))
```

```
-asType < integer const > (\$heap_{724,1:744.8}.M3) < 
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathrm{heap}_{724,1;744,8}.\mathrm{p3})
!(0 == asType < integer > (\$heap_{724,1:744.8}.p3))
asType<integer>($heap<sub>724,1;744,8</sub>.p3) <
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathrm{heap}_{724,1;744,8}.\mathrm{M3})
heap_{724,1:747,8} == heap_{724,1:744,8}.replace(p1 \rightarrow asType<short
int>((asType< int>(\$heap_{724,1;744,8}.M1) *
asType<int>(static_cast<integer>(asType<int>($heap_{724,1:744,8}.p1) <
(int)(0)) + asType < int > ($heap_{724,1;744,8}.p1)))
\$ heap_{724,1;748,8} == \$ heap_{724,1;747,8}. \textbf{\_replace} (p2 \rightarrow \textbf{asType} < \textbf{short}
int>((asType<int>($heap<sub>724.1:747.8</sub>.M2) *
asType<int>(static_cast<integer>(asType<int>($heap<sub>724.1:747.8</sub>.p2) <
(int)(0) + asType < int > ($heap_{724,1:747,8}.p2)))
\theta_{funcend\_724,1} == \theta_{724,1:748,8}.\_replace(p3 \rightarrow asType < short)
int>((asType<int>($heap<sub>724.1:748.8</sub>.M3) *
asType<int>(static_cast<integer>(asType<int>($heap_{724.1:748.8}.p3) <
(int)(0) + asType<int>($heap<sub>724.1:748.8</sub>.p3)))
invariant1(heapIs heap_{funcend\_724,1})
Proof:
[Take goal term]
[1.0]!(0.0 ==
asType < double > (static\_cast < real > ($heap_{funcend\_724,1}.M1)))
\rightarrow [const static or extern object]
[1.1]!(0.0 == asType < double > (static\_cast < real > (\$heap_{init}.M1)))
\rightarrow [expand definition of constant 'M1' at prang.c (14,20)]
[1.2] !(0.0 == asType<double>(static_cast<real>(asType<short
int>((int)30269))))
\rightarrow [simplify]
[1.9] true
Proof of verification condition: Precondition of 'operator /' satisfied
Condition generated at: C:\Escher\Customers\prang\prang.c (76,34)
Condition defined at: built in declaration
To prove: !(0.0 ==
asType < double > (static\_cast < real > ($heap_{funcend\_724,1}.M2)))
Given:
heap_{init}.LIMIT == (int)80
```

```
heap_{init}.M1 == asType < short int > ((int)30269)
\theta_{init}.r1 == asType < short int > ((int)171)
heap_{init}.a1 == asType < short int > ((int)177)
\theta = asType < short int > ((int)2)
\theta sheap<sub>init</sub>.M2 == asType<short int>((int)30307)
\theta_{init}.r2 == asType < short int > ((int)172)
heap_{init}.a2 == asType < short int > ((int)176)
\theta = asType < short int > ((int)35)
\theta = asType < short int > ((int)30323)
heap_{init}.r3 == asType < short int > ((int)170)
heap_{init}.a3 == asType < short int > ((int)178)
\theta = asType < short int > ((int)63)
\theta = asType < short int > ((int)1)
\theta
\theta = asType < short int > ((int)3)
invariant1(heapIs heap_{funcstart_{-724,1}})
\operatorname{div1} == \operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724,1},
asType < int > (\$heap_{funcstart\_724.1}.p1),
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{a1}))
(\mathbf{asType}{<}\mathbf{integer}{>}(\mathbf{asType}{<}\mathbf{int}{>}(\$\mathbf{heap}_{funcstart\_724,1}.\mathbf{p1})) \ / \\
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a1))) = =
asType<integer>(div1.quot)
(asType < int > (asType < int > (\$heap_{funcstart\_724,1}.p1)) \%
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a1))) = =
asType<integer>(div1.rem)
!(0 == asType < integer > (div1.rem)) || !(0 ==
\mathbf{asType}{<}\mathbf{integer}{>}(\mathbf{div1}.\mathbf{quot}))
div2 == div(\mathbf{heapIs} \$heap_{funcstart\_724,1},
asType < int > (\$heap_{funcstart\_724.1}.p2),
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{a2}))
(\mathbf{asType} < \mathbf{integer} > (\mathbf{asType} < \mathbf{int} > (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p2})) \ / \\
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a2))) = =
asType<integer>(div2.quot)
(asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.p2)) \%
asType < integer > (asType < int > (\$heap_{funcstart\_724.1}.a2))) = =
asType<integer>(div2.rem)
```

```
!(0 == asType < integer > (div2.rem)) || !(0 ==
asType<integer>(div2.quot))
\label{eq:div3} \text{div3} == \text{div}(\mathbf{heapIs} \ \$ \text{heap}_{funcstart\_724,1},
\mathbf{asType} < \mathbf{int} > (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p3}),
asType < int > (\$heap_{funcstart\_724.1}.a3))
(asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.p3)) /
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a3))) = =
asType<integer>(div3.quot)
(asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.p3)) \%
\mathbf{asType}{<}\mathbf{integer}{>}(\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{a3}))) ==
asType<integer>(div3.rem)
!(0 == asType < integer > (div3.rem)) || !(0 ==
asType<integer>(div3.quot))
\$heap_{724,1;740,8} == \$heap_{funcstart\_724,1}.\_\mathbf{replace}(p1 \to \mathbf{asType} < \mathbf{short}
int>((asType<int>(asType<short int>(div1.rem)) *
asType < int > (\$heap_{funcstart\_724,1}.r1)) - (asType < int > (asType < short)
int>(div1.quot)) * asType< int>($heap_{funcstart\_724,1}.b1))))
-asType < integer const > (\$heap_{724,1:740.8}.M1) < 
asType<integer>($heap<sub>724,1;740,8</sub>.p1)
!(0 == asType < integer > (\$heap_{724,1;740,8}.p1))
asType<integer>($heap<sub>724.1:740.8</sub>.p1) <
asType<integer>($heap<sub>724,1:740,8</sub>.M1)
heap_{724,1:742,8} == heap_{724,1:740,8}.replace(p2 \rightarrow asType<short
int>((asType<int>(asType<short int>(div2.rem)) *
asType < int > (\$heap_{724,1:740,8}.r2)) - (asType < int > (asType < short)
int>(div2.quot)) * asType< int>($heap_{724,1;740,8}.b2))))
-asType<integer const>($heap<sub>724.1:742.8</sub>.M2) <
asType<integer>($heap<sub>724.1:742.8</sub>.p2)
!(0 == asType < integer > (\$heap_{724,1:742.8}.p2))
asType<integer>($heap<sub>724.1:742.8</sub>.p2) <
asType<integer>($heap<sub>724.1:742.8</sub>.M2)
heap_{724,1:744,8} == heap_{724,1:742,8}.replace(p3 \rightarrow asType<short
int>((asType<int>(asType<short int>(div3.rem)) *
\mathbf{asType} < \mathbf{int} > (\$ \mathrm{heap}_{724,1;742,8}.\mathrm{r3})) - (\mathbf{asType} < \mathbf{int} > (\mathbf{asType} < \mathbf{short}))
int>(div3.quot)) * asType< int>($heap_{724.1:742.8}.b3))))
-asType<integer const>($heap<sub>724 1.744 8.</sub>M3) <
asType<integer>($heap<sub>724 1.744 8.</sub>p3)
!(0 == asType < integer > (\$heap_{724,1:744.8}.p3))
asType<integer>($heap<sub>724.1:744.8</sub>.p3) <
```

```
asType<integer>($heap<sub>724.1:744.8</sub>.M3)
heap_{724,1:747,8} == heap_{724,1:744,8}._replace(p1 \rightarrow asType<short
int>((asType<int>($heap<sub>724,1:744,8</sub>.M1) *
asType<int>(static_cast<integer>(asType<int>($heap_{724.1:744.8}.p1) <
(int)(0) + asType<int>($heap<sub>724.1:744.8</sub>.p1)))
\text{$heap}_{724,1;748,8} == \text{$heap}_{724,1;747,8}.\_\textbf{replace}(p2 \to \textbf{asType} < \textbf{short}
int>((asType<int>($heap<sub>724,1:747,8</sub>.M2) *
asType<int>(static_cast<integer>(asType<int>($heap_{724,1:747,8}.p2) <
(int)(0) + asType < int > (\$heap_{724,1:747,8}.p2))
heap_{funcend\_724,1} == heap_{724,1;748,8}.\_replace(p3 \rightarrow asType < short)
int>((asType<int>($heap<sub>724.1:748.8</sub>.M3) *
asType<int>(static_cast<integer>(asType<int>($heap_{724.1:748.8}.p3) <
(int)(0) + asType < int > ($heap_{724,1:748,8}.p3))
invariant
1(heap<br/>Is \theta_{funcend\_724,1}
raux1 == asType<double>(static_cast<real>($heap_{funcend_724.1}.p1)) /
asType<double>(static_cast<real>($heap_{funcend\_724.1}.M1))
Proof:
[Take goal term]
[1.0]!(0.0 ==
asType < double > (static\_cast < real > (\$heap_{funcend\_724,1}.M2)))
\rightarrow [const static or extern object]
[1.1]!(0.0 == asType < double > (static\_cast < real > ($heap_{init}.M2)))
\rightarrow [expand definition of constant 'M2' at prang.c (19,20)]
[1.2] !(0.0 == asType<double>(static_cast<real>(asType<short
int > ((int)30307)))
\rightarrow [simplify]
[1.9] true
Proof of verification condition: Precondition of 'operator /' satisfied
Condition generated at: C:\Escher\Customers\prang\prang.c (77,34)
Condition defined at: built in declaration
To prove: !(0.0 ==
asType < double > (static\_cast < real > ($heap_{funcend\_724,1}.M3)))
Given:
heap_{init}.LIMIT == (int)80
\theta sheap<sub>init</sub>.M1 == asType<short int>((int)30269)
```

```
\rho_{init}.r1 == asType < short int > ((int)171)
heap_{init}.a1 == asType < short int > ((int)177)
heap_{init}.M2 == asType < short int > ((int)30307)
\theta_{init}.r2 == asType<short int>((int)172)
heap_{init}.a2 == asType < short int > ((int)176)
\theta = asType < short int > ((int)35)
heap_{init}.M3 == asType < short int > ((int)30323)
\theta_{init}.r3 == asType<short int>((int)170)
heap_{init}.a3 == asType<short int>((int)178)
\theta = asType < short int > ((int)63)
\theta = asType < short int > ((int)1)
\theta
\theta = asType < short int > ((int)3)
invariant1(heapIs heap_{funcstart_{724.1}})
div1 == div(\mathbf{heapIs} \$heap_{funcstart\_724,1},
\mathbf{asType} < \mathbf{int} > (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p1}),
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{a1}))
(asType<integer>(asType<int>($heap_{tuncstart\_724.1}.p1)) /
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a1))) = =
asType<integer>(div1.quot)
(\mathbf{asType} {<} \mathbf{integer} {>} (\mathbf{asType} {<} \mathbf{int} {>} (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p1})) \ \%
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a1))) = =
asType<integer>(div1.rem)
!(0 == asType < integer > (div1.rem)) || !(0 ==
asType<integer>(div1.quot))
div2 == div(\mathbf{heapIs} \$heap_{funcstart\_724,1},
asType < int > ($heap_{funcstart\_724,1}.p2),
asType < int > (\$heap_{funcstart\_724,1}.a2))
(asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.p2)) /
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a2))) = =
asType<integer>(div2.quot)
(\mathbf{asType} {<} \mathbf{int} {>} (\mathbf{asType} {<} \mathbf{int} {>} (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p2})) \ \%
asType < integer > (asType < int > (\$heap_{funcstart, 724,1}.a2))) = =
asType<integer>(div2.rem)
!(0 == asType < integer > (div2.rem)) || !(0 ==
```

```
asType<integer>(div2.quot))
div3 == div(\mathbf{heapIs} \$ heap_{funcstart\_724,1},
asType < int > (\$heap_{funcstart\_724,1}.p3),
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{a3}))
(asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.p3)) /
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a3))) = =
asType<integer>(div3.quot)
(\mathbf{asType} {<} \mathbf{integer} {>} (\mathbf{asType} {<} \mathbf{int} {>} (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p3})) \ \%
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a3))) = =
asType<integer>(div3.rem)
!(0 == asType < integer > (div3.rem)) || !(0 ==
asType<integer>(div3.quot))
\$heap_{724,1;740,8} == \$heap_{funcstart\_724,1}.\_\mathbf{replace}(p1 \to \mathbf{asType} < \mathbf{short}
int>((asType<int>(asType<short int>(div1.rem)) *
asType < int > (\$heap_{funcstart\_724,1}.r1)) - (asType < int > (asType < short)
int>(div1.quot)) * asType< int>($heap_{tuncstart\_724.1}.b1))))
-asType < integer const > (\$heap_{724.1:740.8}.M1) < 
asType<integer>($heap<sub>724,1:740,8</sub>.p1)
!(0 == asType < integer > (\$heap_{724,1:740.8}.p1))
asType<integer>($heap<sub>724.1:740.8</sub>.p1) <
asType<integer>($heap<sub>724.1:740.8</sub>.M1)
heap_{724,1:742,8} == heap_{724,1:740,8}.replace(p2 \rightarrow asType<short
int>((asType<int>(asType<short int>(div2.rem)) *
asType < int > (\$heap_{724,1:740.8}.r2)) - (asType < int > (asType < short)
int>(div2.quot)) * asType< int>($heap_{724,1;740,8}.b2))))
-\mathbf{asType} < \mathbf{integer\ const} > (\$ \mathrm{heap}_{724,1;742,8}.\mathrm{M2}) <
asType<integer>($heap<sub>724.1:742.8</sub>.p2)
!(0 == asType < integer > (\$heap_{724,1:742.8}.p2))
asType<integer>($heap<sub>724,1;742,8</sub>.p2) <
asType<integer>($heap<sub>724.1:742.8</sub>.M2)
\text{heap}_{724.1:744.8} == \text{heap}_{724.1:742.8}._replace(p3 \rightarrow asType<short)
int>((asType<int>(asType<short int>(div3.rem)) *
asType < int > (\$heap_{724,1:742,8}.r3)) - (asType < int > (asType < short)
int>(div3.quot)) * asType< int>($heap_{724,1;742.8}.b3))))
-asType<integer const>($heap<sub>724.1:744.8</sub>.M3) <
asType < integer > ($heap_{724,1;744,8}.p3)
!(0 == asType < integer > (\$heap_{724,1;744,8}.p3))
asType<integer>($heap<sub>724,1.744,8.</sub>p3) <
asType<integer>($heap<sub>724.1:744.8</sub>.M3)
```

```
heap_{724,1;747,8} == heap_{724,1;744,8}._replace(p1 \rightarrow asType<short
int>((asType< int>(\$heap_{724,1;744,8}.M1) *
asType<int>(static_cast<integer>(asType<int>($heap_{724,1:744,8}.p1) <
(int)(0) + asType<int>($heap<sub>724,1:744,8</sub>.p1)))
\text{heap}_{724.1;748.8} == \text{heap}_{724.1;747.8}._replace(p2 \rightarrow asType<short)
int>((asType<int>($heap<sub>724.1:747.8</sub>.M2) *
asType<int>(static_cast<integer>(asType<int>($heap<sub>724.1:747.8</sub>.p2) <
(int)(0)) + asType < int > (\$heap_{724,1;747,8}.p2)))
\rho_{1724,1} == \rho_{1724,1;748.8}-replace \rho_{1724,1} == \rho_{1724,1;748.8}-replace
int>((asType<int>($heap<sub>724.1:748.8</sub>.M3) *
asType<int>(static_cast<integer>(asType<int>($heap<sub>724.1:748.8</sub>.p3) <
(int)(0) + asType<int>($heap<sub>724,1:748,8</sub>.p3)))
invariant1(heapIs $heap_{funcend_724.1})
raux1 == asType < double > (static\_cast < real > ($heap_{funcend\_724,1}.p1)) /
asType < double > (static\_cast < real > ($heap_{funcend\_724,1}.M1))
asType<double>(static_cast<real>($heap_{funcend\_724.1}.M2))
Proof:
[Take goal term]
asType<double>(static_cast<real>($heap_{funcend\_724.1}.M3)))
\rightarrow [const static or extern object]
[1.1]!(0.0 == asType < double > (static\_cast < real > ($heap_{init}.M3)))
\rightarrow [expand definition of constant 'M3' at prang.c (24,20)]
[1.2] !(0.0 == asType<double>(static_cast<real>(asType<short
int > ((int)30323))))
\rightarrow [simplify]
[1.9] true
Proof of verification condition: Assertion valid
Condition generated at: C:\Escher\Customers\prang\prang.c (81,30)
To prove: asType<real>((double)0.0) < ((asType<real>(raux2) +
asType<real>(raux1)) + asType<real>(raux3))
Given:
heap_{init}.LIMIT == (int)80
heap_{init}.M1 == asType < short int > ((int)30269)
\theta_{init}.r1 == asType < short int > ((int)171)
```

```
heap_{init}.a1 == asType < short int > ((int)177)
\theta = asType < short int > ((int)2)
\theta sheap<sub>init</sub>.M2 == asType<short int>((int)30307)
\theta_{init}.r2 == asType < short int > ((int)172)
\theta_{init}.a2 == asType<short int>((int)176)
heap_{init}.b2 == asType<short int>((int)35)
\theta = asType < short int > ((int)30323)
heap_{init}.r3 == asType < short int > ((int)170)
heap_{init}.a3 == asType < short int > ((int)178)
\theta = asType < short int > ((int)63)
\theta
\theta
\theta = asType < short int > ((int)3)
invariant
1(heap<br/>Is \rho_{funcstart\_724,1}
\operatorname{div1} == \operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724,1},
asType < int > (\$heap_{funcstart\_724,1}.p1),
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{a1}))
(asType<integer>(asType<int>($heap_{funcstart\_724,1}.p1)) /
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a1))) = =
asType<integer>(div1.quot)
(\mathbf{asType} < \mathbf{integer} > (\mathbf{asType} < \mathbf{int} > (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p1})) \%
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a1))) = =
asType<integer>(div1.rem)
!(0 == asType < integer > (div1.rem)) || !(0 ==
asType<integer>(div1.quot))
div2 == div(\mathbf{heapIs} \$ heap_{funcstart\_724.1},
asType < int > (\$heap_{funcstart\_724.1}.p2),
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{a2}))
(asType<integer>(asType<int>($heap_{funcstart\_724,1}.p2)) /
\mathbf{asType}{<}\mathbf{integer}{>}(\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{a2}))) ==
asType<integer>(div2.quot)
(\mathbf{asType}{<}\mathbf{integer}{>}(\mathbf{asType}{<}\mathbf{int}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathsf{p2}))\ \%
asType < integer > (asType < int > (\$heap_{funcstart\_724.1}.a2))) = =
asType<integer>(div2.rem)
!(0 == asTvpe < integer > (div2.rem)) || !(0 ==
asType<integer>(div2.quot))
```

```
div3 == div(\mathbf{heapIs} \$heap_{funcstart\_724,1},
asType < int > (\$heap_{funcstart\_724,1}.p3),
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{a3}))
(asType<int>(asType<int>($heap_{tuncstart\_724.1}.p3)) /
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a3))) = =
asType<integer>(div3.quot)
(asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.p3)) \%
\mathbf{asType}{<}\mathbf{integer}{>}(\mathbf{asType}{<}\mathbf{int}{>}(\$\mathsf{heap}_{funcstart\_724,1}.\mathtt{a3}))) ==
asType<integer>(div3.rem)
!(0 == asType < integer > (div3.rem)) || !(0 ==
asType<integer>(div3.quot))
$heap_{724,1;740,8} == $heap_{funcstart\_724,1}.\_replace(p1 \rightarrow asType < short)
int>((asType<int>(asType<short int>(div1.rem)) *
asType < int > (\$heap_{funcstart\_724,1}.r1)) - (asType < int > (asType < short)
int>(div1.quot)) * asType< int>($heap_{funcstart\_724,1}.b1))))
-asType < integer\ const > (\$heap_{724,1;740,8}.M1) < 
asType<integer>($heap<sub>724.1:740.8</sub>.p1)
!(0 == asType < integer > (\$heap_{724,1;740,8}.p1))
asType<integer>($heap<sub>724,1:740,8</sub>.p1) <
asType<integer>($heap<sub>724,1:740,8</sub>.M1)
\rho_{724,1:742.8} == \rho_{724,1:740.8}._replace(p2 \rightarrow asType<short
int>((asType<int>(asType<short int>(div2.rem)) *
asType < int > (\$heap_{724.1:740.8}.r2)) - (asType < int > (asType < short)
int>(div2.quot)) * asType<int>($heap<sub>724.1:740.8</sub>.b2))))
-asType<integer const>($heap<sub>724,1:742,8</sub>.M2) <
\mathbf{asType} {<} \mathbf{integer} {>} (\$ \mathrm{heap}_{724,1;742,8}.\mathrm{p2})
!(0 == asType < integer > (\$heap_{724,1:742.8}.p2))
asType<integer>($heap<sub>724.1:742.8</sub>.p2) <
asType<integer>($heap<sub>724.1:742.8</sub>.M2)
\text{sheap}_{724,1:744.8} == \text{sheap}_{724,1:742.8}._replace(p3 \rightarrow asType<short
int>((asType<int>(asType<short int>(div3.rem))
\mathbf{asType} < \mathbf{int} > (\$ \mathrm{heap}_{724,1;742,8}.\mathrm{r3})) - (\mathbf{asType} < \mathbf{int} > (\mathbf{asType} < \mathbf{short}))
int>(div3.quot)) * asType<int>($heap<sub>724.1:742.8</sub>.b3))))
-asType<integer const>($heap<sub>724,1:744,8</sub>.M3) <
asType<integer>($heap<sub>724.1:744.8</sub>.p3)
!(0 == asType < integer > (\$heap_{724.1:744.8}.p3))
asType<integer>($heap<sub>724,1:744,8</sub>.p3) <
asType<integer>($heap<sub>724,1;744,8</sub>.M3)
heap_{724,1;747,8} == heap_{724,1;744,8}.replace(p1 \rightarrow asType<short
```

```
int>((asType<int>($heap<sub>724.1:744.8</sub>.M1) *
\mathbf{asType} < \mathbf{int} > (\mathbf{static\_cast} < \mathbf{integer} > (\mathbf{asType} < \mathbf{int} > (\$ \mathrm{heap}_{724,1;744,8}.\mathrm{p1}) < \mathsf{nt}) < \mathsf{nt} > \mathsf{nt} >
(int)(0)) + asType < int > (\$heap_{724,1:744,8}.p1)))
\$heap_{724,1;748,8} == \$heap_{724,1;747,8}.\_\mathbf{replace}(p2 \to \mathbf{asType} {<} \mathbf{short}
int>((asType<int>($heap<sub>724.1:747.8</sub>.M2) *
asType<int>(static_cast<integer>(asType<int>($heap<sub>724.1:747.8</sub>.p2) <
(\mathbf{int})0))) + \mathbf{asType} < \mathbf{int} > (\$ \mathrm{heap}_{724,1;747,8}.\mathrm{p2})))
\theta_{1:748,8}. replace(p3 \rightarrow asType<short
int>((asType<int>($heap<sub>724.1:748.8</sub>.M3) *
asType<int>(static_cast<integer>(asType<int>($heap<sub>724.1:748.8</sub>.p3) <
(int)(0)) + asType < int > ($heap_{724,1:748,8}.p3)))
invariant1(heapIs $heap_{funcend_724.1})
raux1 == asType < double > (static\_cast < real > ($heap_{funcend\_724,1}.p1)) /
asType<double>(static_cast<real>($heap_{funcend\_724,1}.M1))
\mathbf{asType} \small{<} \mathbf{double} \small{>} (\mathbf{static\_cast} \small{<} \mathbf{real} \small{>} (\$ \mathbf{heap}_{funcend\_724,1}.\mathbf{M2}))
raux3 == asType < double > (static\_cast < real > ($heap_{funcend\_724,1}.p3)) / 
\mathbf{asType}{<}\mathbf{double}{>}(\mathbf{static\_cast}{<}\mathbf{real}{>}(\$\mathbf{heap}_{funcend\_724,1}.\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)
Proof:
[Take given term]
[78.0] \ (\mathbf{asType} < \mathbf{double} > (\mathbf{static\_cast} < \mathbf{real} > (\$ \mathrm{heap}_{funcend\_724,1}.\mathrm{p1})) \ / \\
\mathbf{asType} < \mathbf{double} > (\mathbf{static\_cast} < \mathbf{real} > (\$ \operatorname{heap}_{funcend\_724,1}.\mathrm{M1}))) == \operatorname{raux1}
\rightarrow [simplify]
[78.2] (\mathbf{real}(\mathbf{\$}heap_{funcend\_724,1}.p1) /
asType < double > (static\_cast < real > (\$heap_{funcend\_724,1}.M1))) == raux1
\rightarrow [const static or extern object]
[78.3] (real(heap_{funcend\_724,1.p1}) /
asType < double > (static\_cast < real > (\$heap_{init}.M1))) == raux1
\rightarrow [expand definition of constant 'M1' at prang.c (14,20)]
[78.4] (\mathbf{real}(\$heap_{funcend\_724,1}.p1) /
asType < double > (static\_cast < real > (asType < short int > ((int)30269))))
== raux1
\rightarrow [simplify]
[78.10] \ 0.0 == (-\text{raux1} + (\text{real}(\$\text{heap}_{funcend\_724,1}.\text{p1}) / 30269.0))
```

```
[Take given term]
[79.0] (asType<double>(static_cast<real>(\ensuremath{$^{\circ}$}heap_{funcend\_724,1}.p2)) /
asType < double > (static\_cast < real > (\$heap_{funcend\_724,1}.M2))) == raux2
\rightarrow [simplify]
[79.2] (\mathbf{real}(\hat{\mathbf{s}}_{heap_{funcend\_724,1}}.p2) /
\mathbf{asType} < \mathbf{double} > (\mathbf{static\_cast} < \mathbf{real} > (\$ \operatorname{heap}_{funcend\_724,1}.\mathrm{M2}))) == \operatorname{raux2}
\rightarrow [const static or extern object]
[79.3] (real($heap_{funcend_724,1}.p2) /
asType < double > (static\_cast < real > (\$heap_{init}.M2))) == raux2
\rightarrow [expand definition of constant 'M2' at prang.c (19,20)]
[79.4] (real(heap_{funcend_{-724,1}}.p2) /
asType<double>(static_cast<real>(asType<short int>((int)30307))))
== raux2
\rightarrow [simplify]
[79.10] 0.0 == (-\text{raux}2 + (\text{real}(\$\text{heap}_{funcend\_724,1}.\text{p2}) / 30307.0))
[Take given term]
[80.0] (asType<double>(static_cast<real>($heap_{tuncend\_724.1}.p3)) /
asType<double>(static_cast<real>($heap_{funcend\_724.1}.M3))) == raux3
\rightarrow [simplify]
[80.2] (real($heap_funcend_724,1.p3) /
\mathbf{asType} < \mathbf{double} > (\mathbf{static\_cast} < \mathbf{real} > (\$ \operatorname{heap}_{funcend\_724,1}.\mathrm{M3}))) == \operatorname{raux3}
\rightarrow [const static or extern object]
[80.3] (real(heap_{funcend\_724,1}.p3) /
asType < double > (static\_cast < real > (\$heap_{init}.M3))) == raux3
\rightarrow [expand definition of constant 'M3' at prang.c (24,20)]
[80.4] (real($heap<sub>funcend_724,1</sub>.p3) /
asType<double>(static_cast<real>(asType<short int>((int)30323))))
== raux3
\rightarrow [simplify]
[80.10] \ 0.0 == (-\text{raux3} + (\text{real}(\text{\$heap}_{funcend\_724,1}.\text{p3}) / 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 79.10, raux2 is equal to \mathbf{real}(\$heap_{funcend\_724,1}.p2) / 30307.0]
[1.3] 0.0 < ((asType < real > (real (\$heap_{funcend\_724,1}.p2) / 30307.0) +
asType<real>(raux1)) + asType<real>(raux3))
\rightarrow [simplify]
[1.4] 0.0 < (((real(\$heap_{funcend\_724,1}.p2) / 30307.0) +
\mathbf{asType} {<} \mathbf{real} {>} (\mathrm{raux1})) + \mathbf{asType} {<} \mathbf{real} {>} (\mathrm{raux3}))
\rightarrow [from term 78.10, raux1 is equal to real($heap_{funcend\_724,1}.p1) / 30269.0]
[1.5] 0.0 < (((real(\$heap_{funcend\_724,1}.p2) / 30307.0) +
asType < real > (real(\$heap_{funcend\_724,1}.p1) / 30269.0)) +
asType<real>(raux3))
\rightarrow [simplify]
[1.6] \ 0.0 < (((\mathbf{real}(\$heap_{funcend\_724,1}.p2) \ / \ 30307.0) \ +
(\mathbf{real}(\theta_{124,1}.p1) / 30269.0)) + \mathbf{asType} < \mathbf{real} > (\mathbf{raux3}))
\rightarrow [from term 80.10, raux3 is equal to \mathbf{real}(\$heap_{funcend\_724,1}.p3) \; / \; 30323.0]
[1.7] 0.0 < (((\mathbf{real}(\hat{\mathbf{s}}_{1.724,1.p1}) / 30269.0) + ((\mathbf{real}(\hat{\mathbf{s}}_{1.724,1.p1}) / 30269.0) + ((\mathbf{re
(real(\text{$heap}_{funcend=724.1.p2}) / 30307.0)) +
asType < real > (real(\$heap_{funcend\_724,1}.p3) / 30323.0))
\rightarrow [simplify]
[1.9] 0.0 < ((real(\$heap_{funcend\_724,1}.p3) / 30323.0) +
(real(\$heap_{funcend\_724,1}.p1) / 30269.0) + (real(\$heap_{funcend\_724,1}.p2) / (real(\$heap_{funcend\_724,1}.p2)) / (real
30307.0))
\rightarrow [negate goal and search for contradiction]
[1.10]!(0.0 < ((real(\$heap_{funcend\_724,1}.p3) / 30323.0) +
(real(\$heap_{funcend\_724,1}.p1) / 30269.0) + (real(\$heap_{funcend\_724,1}.p2) / (real(\$heap_{funcend\_724,1}.p2)) / (real
30307.0)))
\rightarrow [simplify]
[1.17] 0.0 \le (-(\mathbf{real}(\$heap_{funcend\_724,1}.p3) / 30323.0) +
 30269.0))
[Take given term]
[81.0] asType<real>((double)0.0) < asType<real>(raux1)
\rightarrow [simplify]
[81.2] 0.0 < asType < real > (raux1)
\rightarrow [from term 78.10, raux1 is equal to real($heap_{funcend\_724,1}.p1) / 30269.0]
[81.3] \ 0.0 < asType < real > (real(\$heap_{funcend\_724,1}.p1) / 30269.0)
\rightarrow [simplify]
```

```
[81.4] \ 0.0 < (real(\$heap_{funcend\_724,1}.p1) / 30269.0)
[Take given term]
[82.0] asType<real>((double)0.0) < asType<real>(raux2)
\rightarrow [simplify]
[82.2] 0.0 < asType < real > (raux2)
\rightarrow [from term 79.10, raux2 is equal to \mathbf{real}(\$heap_{funcend\_724,1}.p2) / 30307.0]
[82.3] \ 0.0 < asType < real > (real(\$heap_{funcend\_724,1}.p2) / 30307.0)
\rightarrow [simplify]
[82.4] 0.0 < (real(\text{$heap_{funcend\_724,1.p2}}) / 30307.0)
[Take given term]
[83.0] asType<real>((double)0.0) < asType<real>(raux3)
\rightarrow [simplify]
[83.2] 0.0 < asType < real > (raux3)
\rightarrow [from term 80.10, raux3 is equal to real($heap_{funcend\_724,1}.p3) / 30323.0]
[83.3] 0.0 < asType < real > (real(\$heap_{funcend\_724,1}.p3) / 30323.0)
\rightarrow [simplify]
[83.4] 0.0 < (real(\$heap_{funcend\_724,1}.p3) / 30323.0)
[Create new term from terms 1.17, 83.4 using rule: transitivity 2b]
[140.0] (0.0 + 0.0) < (-(real(\$heap_{funcend\_724,1}.p2) / 30307.0) +
\rightarrow [simplify]
-(\mathbf{real}(\hat{p}_{funcend\_724,1}.p1) / 30269.0))
[Create new term from terms 140.1, 82.4 using rule: transitivity 2a]
[150.0] (0.0 + 0.0) < -(\text{real}(\text{\$heap}_{funcend\_724,1}.\text{p1}) / 30269.0)
\rightarrow [simplify]
[150.1] 0.0 < -(\text{real}(\text{\$heap}_{funcend\_724,1}.\text{p1}) / 30269.0)
\rightarrow [from term 81.4, literala < -(\text{real}(\text{\$heap}_{funcend\_724,1}.p1) / 30269.0) is false
whenever -0.0 \le literala
   Proof of rule precondition:
   [150.1.0] - 0.0 \le 0.0
   \rightarrow [simplify]
   [150.1.1] true
```

## [150.2] **false**

```
Proof of verification condition: Precondition of 'fmod' satisfied
Condition generated at: C:\Escher\Customers\prang\prang.c (82,25)
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}.M1 == asType < short int > ((int)30269)
\theta_{init}.r1 == asType < short int > ((int)171)
heap_{init}.a1 == asType < short int > ((int)177)
\theta
heap_{init}.M2 == asType < short int > ((int)30307)
\rho_{init}.r2 == asType < short int > ((int)172)
heap_{init}.a2 == asType < short int > ((int)176)
\theta
\theta sheap<sub>init</sub>.M3 == asType<short int>((int)30323)
\theta
\theta
heap_{init}.b3 == asType < short int > ((int)63)
\theta
\theta
\theta = asType < short int > ((int)3)
invariant1(heapIs heap_{funcstart_{724,1}})
\operatorname{div1} == \operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724,1},
\mathbf{asType} < \mathbf{int} > (\$ \mathrm{heap}_{funcstart\_724,1}.\mathrm{p1}),
asType < int > (\$heap_{funcstart_{-724,1}}.a1))
(asType<integer>(asType<int>($heap_{tuncstart}, 724,1.p1)) /
\mathbf{asType} < \mathbf{integer} > (\mathbf{asType} < \mathbf{int} > (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{a1}))) = =
asType<integer>(div1.quot)
(asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.p1)) \%
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a1))) = =
asType<integer>(div1.rem)
!(0 == asType < integer > (div1.rem)) || !(0 ==
```

```
asType<integer>(div1.quot))
div2 == div(\mathbf{heapIs} \$ heap_{funcstart\_724,1},
asType < int > (\$heap_{funcstart\_724,1}.p2),
\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{a2}))
(asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.p2)) /
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a2))) = =
asType<integer>(div2.quot)
(\mathbf{asType} {<} \mathbf{integer} {>} (\mathbf{asType} {<} \mathbf{int} {>} (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p2})) \ \%
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a2))) = =
asType<integer>(div2.rem)
!(0 == asType < integer > (div2.rem)) || !(0 ==
asType<integer>(div2.quot))
div3 == div(\mathbf{heapIs} \$ heap_{funcstart\_724,1},
asType < int > (\$heap_{funcstart\_724,1}.p3),
asType < int > (\$heap_{funcstart\_724,1}.a3))
(asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.p3)) /
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a3))) = =
asType<integer>(div3.quot)
(\mathbf{asType} < \mathbf{integer} > (\mathbf{asType} < \mathbf{int} > (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p3})) \ \%
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a3))) = =
asType<integer>(div3.rem)
!(0 == asType < integer > (div3.rem)) || !(0 ==
asType<integer>(div3.quot))
\text{Sheap}_{724,1;740,8} == \text{Sheap}_{funcstart\_724,1}.\_\mathbf{replace}(\text{p1} \to \mathbf{asType} < \mathbf{short})
int>((asType<int>(asType<short int>(div1.rem)) *
asType < int > (\$heap_{funcstart\_724,1}.r1)) - (asType < int > (asType < short)
int>(div1.quot)) * asType<int>($heap_{funcstart\_724,1}.b1)))
-asType < integer const > (\$heap_{724.1:740.8}.M1) < 
asType<integer>($heap<sub>724,1:740,8</sub>.p1)
!(0 == \mathbf{asType} {<} \mathbf{integer} {>} (\$ \mathrm{heap}_{724,1;740,8}.\mathrm{p1}))
asType<integer>($heap<sub>724.1:740.8</sub>.p1) <
\mathbf{asType} < \mathbf{integer} > (\$ \mathrm{heap}_{724,1;740,8}.\mathrm{M1})
heap_{724,1:742,8} == heap_{724,1:740,8}.replace(p2 \rightarrow asType<short
int>((asType<int>(asType<short int>(div2.rem)) *
asType < int > (\$heap_{724.1:740.8}.r2)) - (asType < int > (asType < short)
int > (div2.quot)) * asType < int > ($heap_{724,1:740.8}.b2))))
-asType<integer const>($heap<sub>724.1:742.8</sub>.M2) <
asType<integer>($heap<sub>724.1:742.8</sub>.p2)
!(0 == asType < integer > (\$heap_{724,1:742,8}.p2))
```

```
asType < integer > (\$heap_{724,1;742,8}.p2) <
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathrm{heap}_{724,1;742,8}.\mathrm{M2})
heap_{724,1:744,8} == heap_{724,1:742,8}.replace(p3 \rightarrow asType<short
int>((asType<int>(asType<short int>(div3.rem)) *
asType < int > (\$heap_{724.1:742.8}.r3)) - (asType < int > (asType < short)
int>(div3.quot)) * asType<int>($heap<sub>724.1:742.8</sub>.b3))))
 -asType < integer const > (\$heap_{724,1;744,8}.M3) < 
asType<integer>($heap<sub>724.1:744.8</sub>.p3)
!(0 == asType < integer > (\$heap_{724,1:744.8}.p3))
asType<integer>($heap<sub>724.1:744.8</sub>.p3) <
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathrm{heap}_{724,1;744,8}.\mathrm{M3})
\text{Sheap}_{724,1;747,8} == \text{Sheap}_{724,1;744,8}. \text{replace}(\text{p1} \to \text{asType} < \text{short})
int>((asType<int>($heap<sub>724,1:744,8</sub>.M1) *
\mathbf{asType}{<}\mathbf{int}{>}(\mathbf{static\_cast}{<}\mathbf{integer}{>}(\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{724,1;744,8}.\mathrm{p1})<
(int)(0) + asType<int>($heap<sub>724.1:744.8</sub>.p1)))
heap_{724,1;748,8} == heap_{724,1;747,8}.replace(p2 \rightarrow asType<short
int>((asType<int>($heap<sub>724.1:747.8</sub>.M2) *
asType < int > (static\_cast < integer > (asType < int > (\$heap_{724,1:747,8}.p2) < int > (\$heap_{
(int)(0) + asType < int > (\$heap_{724,1:747,8}.p2))
\theta_{funcend\_724,1} == \theta_{724,1:748,8}.\_replace(p3 \rightarrow asType < short)
int>((asType<int>($heap<sub>724.1:748.8</sub>.M3) *
asType<int>(static_cast<integer>(asType<int>($heap<sub>724.1:748.8</sub>.p3) <
(int)(0) + asType<int>($heap<sub>724.1:748.8</sub>.p3)))
invariant1(heapIs heap_{funcend\_724,1})
raux1 == asType < double > (static\_cast < real > (\$heap_{funcend\_724,1}.p1)) / 
asType < double > (static\_cast < real > ($heap_{funcend\_724,1}.M1))
raux2 == asType < double > (static\_cast < real > ($heap_{funcend\_724,1}.p2)) /
asType<double>(static_cast<real>($heap_{funcend\_724.1}.M2))
raux3 == asType < double > (static\_cast < real > (\$heap_{funcend\_724,1}.p3)) / (
\mathbf{asType} \small{<} \mathbf{double} \small{>} (\mathbf{static\_cast} \small{<} \mathbf{real} \small{>} (\$ \mathbf{heap}_{funcend\_724,1}.\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
'WHprang' returns
Condition generated at: C:\Escher\Customers\prang\prang.c (84,9)
Condition defined at: C:\Escher\Customers\prang\prang.c (43,25)
To prove: asType<real>(result) < asType<real>((double)1.0)
Given:
heap_{init}.LIMIT == (int)80
heap_{init}.M1 == asType < short int > ((int)30269)
\theta_{init}.r1 == asType < short int > ((int)171)
heap_{init}.a1 == asType < short int > ((int)177)
\theta
heap_{init}.M2 == asType < short int > ((int)30307)
\theta_{init}.r2 == asType < short int > ((int)172)
heap_{init}.a2 == asType < short int > ((int)176)
\theta == asType<short int>((int)35)
\theta sheap<sub>init</sub>.M3 == asType<short int>((int)30323)
\theta_{init}.r3 == asType < short int > ((int)170)
heap_{init}.a3 == asType < short int > ((int)178)
heap_{init}.b3 == asType < short int > ((int)63)
\theta = asType < short int > ((int)1)
\theta
\theta = asType < short int > ((int)3)
invariant1(heapIs heap_{funcstart_{-724,1}})
\operatorname{div1} == \operatorname{div}(\mathbf{heapIs} \$ \operatorname{heap}_{funcstart\_724,1},
asType < int > (\$heap_{funcstart\_724.1}.p1),
asType < int > (\$heap_{funcstart\_724,1}.a1))
(asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.p1)) /
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a1))) = =
asType<integer>(div1.quot)
(\mathbf{asType}{<}\mathbf{int}{>}(\mathbf{asType}{<}\mathbf{int}{>}(\$\mathbf{heap}_{funcstart\_724,1}.\mathbf{p1}))~\%
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a1))) = =
asType<integer>(div1.rem)
```

```
!(0 == asType < integer > (div1.rem)) || !(0 ==
asType<integer>(div1.quot))
\label{eq:div2} \text{div2} == \text{div}(\mathbf{heapIs} \ \$ \text{heap}_{funcstart\_724,1},
\mathbf{asType} < \mathbf{int} > (\$ \mathbf{heap}_{funcstart\_724,1}.\mathbf{p2}),
asType < int > (\$heap_{funcstart\_724.1}.a2))
(asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.p2)) /
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a2))) = =
asType<integer>(div2.quot)
(asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.p2)) \%
\mathbf{asType}{<}\mathbf{integer}{>}(\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{a2}))) ==
asType<integer>(div2.rem)
!(0 == asType < integer > (div2.rem)) || !(0 ==
asType<integer>(div2.quot))
\label{eq:div3} \text{div3} == \text{div}(\mathbf{heapIs} \ \$ \text{heap}_{funcstart\_724,1},
\mathbf{asType} < \mathbf{int} > (\$ \mathrm{heap}_{funcstart\_724,1}.\mathrm{p3}),
asType < int > (\$heap_{funcstart\_724.1}.a3))
(asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.p3)) /
asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.a3))) = =
asType<integer>(div3.quot)
(asType < integer > (asType < int > (\$heap_{funcstart\_724,1}.p3)) \%
\mathbf{asType}{<}\mathbf{integer}{>}(\mathbf{asType}{<}\mathbf{int}{>}(\$\mathrm{heap}_{funcstart\_724,1}.\mathrm{a3}))) ==
asType<integer>(div3.rem)
!(0 == asType < integer > (div3.rem)) || !(0 ==
asType<integer>(div3.quot))
heap_{724,1;740,8} == heap_{funcstart\_724,1}._replace(p1 \rightarrow asType<short
int>((asType<int>(asType<short int>(div1.rem)) *
asType < int > (\$heap_{funcstart\_724.1}.r1)) - (asType < int > (asType < short)
int>(div1.quot)) * asType< int>($heap_{tuncstart\_724.1}.b1))))
-asType < integer const > (\$heap_{724,1:740.8}.M1) < 
asType<integer>($heap<sub>724,1:740,8</sub>.p1)
!(0 == \mathbf{asType} {<} \mathbf{integer} {>} (\$ \mathrm{heap}_{724,1;740,8}.\mathrm{p1}))
asType < integer > (\$heap_{724,1;740,8}.p1) <
asType<integer>($heap<sub>724,1:740,8</sub>.M1)
\text{sheap}_{724,1;742,8} == \text{sheap}_{724,1;740,8}.\text{replace}(p2 \to asType < short)
int>((asType<int>(asType<short int>(div2.rem)) *
asType < int > (\$heap_{724,1;740,8}.r2)) - (asType < int > (asType < short)
int>(div2.quot)) * asType< int>($heap_{724,1;740,8}.b2))))
-asType<integer const>($heap<sub>724.1:742.8</sub>.M2) <
asType<integer>($heap<sub>724.1:742.8</sub>.p2)
```

```
!(0 == asType < integer > ($heap_{724, 1.742, 8.p2}))
asType<integer>($heap<sub>724.1:742.8</sub>.p2) <
\mathbf{asType}{<}\mathbf{integer}{>}(\$\mathrm{heap}_{724,1;742,8}.\mathrm{M2})
heap_{724,1;744,8} == heap_{724,1;742,8}.replace(p3 \rightarrow asType<short
int>((asType<int>(asType<short int>(div3.rem)) *
asType < int > (\$heap_{724.1:742.8}.r3)) - (asType < int > (asType < short)
int>(div3.quot)) * asType<int>($heap<sub>724,1:742,8</sub>.b3))))
-asType<integer const>($heap<sub>724,1:744,8</sub>.M3) <
asType<integer>($heap<sub>724,1:744,8</sub>.p3)
!(0 == asType < integer > (\$heap_{724,1;744,8}.p3))
asType<integer>($heap<sub>724,1:744,8</sub>.p3) <
asType<integer>($heap<sub>724,1:744,8</sub>.M3)
\text{heap}_{724.1:747.8} == \text{heap}_{724.1:744.8}._replace(p1 \rightarrow asType<short)
int>((asType<int>($heap<sub>724.1:744.8</sub>.M1) *
asType<int>(static_cast<integer>(asType<int>($heap<sub>724.1:744.8</sub>.p1) <
(\mathbf{int})0))) + \mathbf{asType} < \mathbf{int} > (\$ \mathrm{heap}_{724,1;744,8}.\mathrm{p1})))
heap_{724,1:748,8} == heap_{724,1:747,8}.replace(p2 \rightarrow asType<short
int>((asType<int>($heap<sub>724.1:747.8</sub>.M2) *
asType<int>(static_cast<integer>(asType<int>($heap_{724,1:747,8}.p2) <
(int)(0) + asType < int > (\$heap_{724,1:747,8}.p2))
\theta_{funcend\_724,1} == \theta_{724,1;748,8}.\_replace(p3 \rightarrow asType < short)
int>((asType<int>($heap<sub>724.1:748.8</sub>.M3) *
asType<int>(static_cast<integer>(asType<int>($heap<sub>724,1:748.8.p3</sub>) <
(int)(0)) + asType < int > ($heap_{724,1;748,8}.p3)))
invariant
1<br/>(\mathbf{heapIs}\ \$\mathrm{heap}_{funcend\_724,1})
\mathbf{asType} \small{<} \mathbf{double} \small{>} (\mathbf{static\_cast} \small{<} \mathbf{real} \small{>} (\$ \mathbf{heap}_{funcend\_724,1}.\mathbf{M1}))
raux2 == asType < double > (static\_cast < real > (\$heap_{funcend\_724,1}.p2)) / (
\mathbf{asType}{<}\mathbf{double}{>}(\mathbf{static\_cast}{<}\mathbf{real}{>}(\$\mathbf{heap}_{funcend\_724,1}.\mathbf{M2}))
\mathbf{asType} < \mathbf{double} > (\mathbf{static\_cast} < \mathbf{real} > (\$ \mathbf{heap}_{funcend\_724,1}.\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) + real > (raux
asType<real>(raux1)) + asType<real>(raux3))
result == \operatorname{fmod}(\mathbf{heapIs} \$ \operatorname{heap}_{funcend\_724,1}, (\operatorname{raux}1 + \operatorname{raux}2) + \operatorname{raux}3,
(double)1.0)
```

```
((asType < real > ((double)0.0) < asType < real > ((raux1 + raux2) + raux2))
raux3)) \ \&\& \ (\mathbf{asType} < \mathbf{real} > ((\mathbf{double})0.0) \le \mathbf{asType} < \mathbf{real} > ((\mathbf{double})1.0)))
=>((asType < real > ((double)0.0) \le asType < real > (result)) \&\&
(asType < real > (result) < asType < real > ((double)1.0)))
Proof:
[Take given term]
[78.0] (asType<double>(static_cast<real>($heap<sub>funcend_724,1.</sub>p1)) /
asType < double > (static\_cast < real > (\$heap_{funcend\_724,1}.M1))) == raux1
\rightarrow [simplify]
[78.2] (\mathbf{real}(\mathbf{\$}heap_{funcend\_724,1}.p1) /
\mathbf{asType} {<} \mathbf{double} {>} (\mathbf{static\_cast} {<} \mathbf{real} {>} (\$ \mathbf{heap}_{funcend\_724,1}.\mathbf{M1}))) == \mathbf{raux1}
\rightarrow [const static or extern object]
[78.3] (real($heap_{funcend\_724,1}.p1) /
asType < double > (static\_cast < real > (\$heap_{init}.M1))) == raux1
\rightarrow [expand definition of constant 'M1' at prang.c (14,20)]
[78.4] (real(heap_{funcend}_{-724.1}.p1) /
asType<double>(static_cast<real>(asType<short int>((int)30269))))
== raux1
\rightarrow [simplify]
[78.10] \ 0.0 == (-\text{raux1} + (\text{real}(\text{\$heap}_{funcend\_724,1}.\text{p1}) \ / \ 30269.0))
[Take given term]
[79.0] (asType<double>(static_cast<real>(part = 1.00) /
asType < double > (static\_cast < real > (\$heap_{funcend\_724.1}.M2))) == raux2
\rightarrow [simplify]
[79.2] (real(heap_{funcend\_724,1}.p2) /
asType < double > (static\_cast < real > (\$heap_{funcend\_724,1}.M2))) == raux2
\rightarrow [const static or extern object]
[79.3] (real(heap_{funcend\_724,1}.p2) /
asType < double > (static\_cast < real > (\$heap_{init}.M2))) == raux2
\rightarrow [expand definition of constant 'M2' at prang.c (19,20)]
[79.4] (real(heap_{funcend\_724,1}.p2) /
asType<double>(static_cast<real>(asType<short int>((int)30307))))
== raux2
\rightarrow [simplify]
[79.10] \ 0.0 == (-\text{raux}2 + (\text{real}(\text{\$heap}_{funcend\_724,1}.\text{p2}) / 30307.0))
[Take given term]
```

```
[80.0] (asType<double>(static_cast<real>($heap_{funcend\_724.1}.p3)) /
\mathbf{asType} < \mathbf{double} > (\mathbf{static\_cast} < \mathbf{real} > (\$ \operatorname{heap}_{funcend\_724,1}.\mathrm{M3}))) == \operatorname{raux3}
\rightarrow [simplify]
asType < double > (static\_cast < real > (\$heap_{funcend\_724,1}.M3))) == raux3
\rightarrow [const static or extern object]
[80.3] (\mathbf{real}(\mathbf{\$}heap_{funcend\_724,1}.p3) /
asType < double > (static\_cast < real > (\$heap_{init}.M3))) == raux3
\rightarrow [expand definition of constant 'M3' at prang.c (24,20)]
[80.4] (real($heap_{funcend_724.1}.p3) /
asType<double>(static_cast<real>(asType<short int>((int)30323))))
== raux3
\rightarrow [simplify]
[80.10] \ 0.0 == (-\text{raux}3 + (\text{real}(\text{\$heap}_{funcend\_724.1}.\text{p3}) / 30323.0))
[Take given term]
[84.0] asType<real>((double)0.0) < ((asType<real>(raux2) + 
asType<real>(raux1)) + asType<real>(raux3))
\rightarrow [simplify]
[84.2] 0.0 < ((asType < real > (raux2) + asType < real > (raux1)) +
asType<real>(raux3))
\rightarrow [from term 79.10, raux2 is equal to real($heap_{funcend\_724,1}.p2) / 30307.0]
[84.3] 0.0 < ((asType<real>(real($heap_{funcend\_724,1}.p2) / 30307.0) +
asType<real>(raux1)) + asType<real>(raux3))
\rightarrow [simplify]
asType<real>(raux1)) + asType<real>(raux3))
\rightarrow [from term 78.10, raux1 is equal to real($heap_{funcend\_724,1}.p1) / 30269.0]
[84.5] \ 0.0 < (((real(\$heap_{funcend\_724.1}.p2) \ / \ 30307.0) +
asType < real > (real(\$heap_{funcend\_724,1}.p1) / 30269.0)) +
asType < real > (raux3))
\rightarrow [simplify]
(real(\text{$heap}_{funcend\_724,1}.p1) / 30269.0)) + asType < real > (raux3))
\rightarrow [from term 80.10, raux3 is equal to real($heap_{funcend\_724,1}.p3) / 30323.0]
```

```
asType < real > (real(\$heap_{funcend\_724.1}.p3) / 30323.0))
\rightarrow [simplify]
[84.9] \ 0.0 < ((real(\$heap_{funcend\_724,1}.p3) / 30323.0) +
(real(\$heap_{funcend\_724,1}.p1) / 30269.0) + (real(\$heap_{funcend\_724,1}.p2) / (real(\$heap_{funcend\_724,1}.p2)) / (real
30307.0))
[Take given term]
[85.0] result == fmod(heapIs heap_{funcend\_724,1}, (raux1 + raux2) + raux3,
(double)1.0)
\rightarrow [from term 78.10, raux1 is equal to real($heap_{funcend\_724,1.p1}) / 30269.0]
[85.1] result == fmod(heapIs heap_{funcend\_724,1},
((real(\$heap_{funcend\_724,1}.p1) / 30269.0) + raux2) + raux3, (double)1.0)
\rightarrow [from term 79.10, raux2 is equal to real($heap_{funcend\_724,1}.p2) / 30307.0]
[85.2] result == fmod(heapIs \theta_{funcend_{-724,1}}, ((real(\theta_{funcend_{-724,1}}))
/30269.0) + (real(\text{$heap_{funcend\_724,1.p2})} / 30307.0)) + raux3, (double)1.0)
\rightarrow [from term 80.10, raux3 is equal to real($heap_{funcend\_724,1}.p3) / 30323.0]
[85.3] result == fmod(heapIs heap_{funcend\_724,1},
((real(\$heap_{funcend\_724,1}.p2) / 30307.0) + (real(\$heap_{funcend\_724,1}.p1) / (real(\$heap_{funcend\_724,1
30269.0)) + (real($heap_{funcend_724,1}.p3) / 30323.0), (double)1.0)
\rightarrow [simplify]
[85.6] \ 0.0 == (-\mathrm{fmod}(\mathbf{heapIs} \ \$ \mathrm{heap}_{funcend\_724,1}, \ (\mathbf{real}(\$ \mathrm{heap}_{funcend\_724,1}.\mathrm{p3}))))
/30323.0) + (real(\$heap_{funcend\_724,1}.p2) / 30307.0) +
(real(\$heap_{funcend\_724,1}.p1) / 30269.0), 1.0) + result)
[Assume known post-assertion, class invariant or type constraint for term 85.6]
[88.0] ((asType<real>((double)0.0) \leq
asType < real > ((real(\$heap_{funcend\_724,1}.p3) / 30323.0) +
(real(\$heap_{funcend\_724,1}.p2) / 30307.0) + (real(\$heap_{funcend\_724,1}.p1) / (real(\$heap_{funcend\_724,1}.p1)) / (real
30269.0)) && (asType<real>((double)0.0) \le asType<real>(1.0))) =>
((asType < real > ((double)0.0) \le asType < real > (fmod(heapIs)))
\theta_{funcend\_724,1}, (real(\theta_{funcend\_724,1}.p3) / 30323.0) +
(real(\$heap_{funcend\_724,1}.p2) / 30307.0) + (real(\$heap_{funcend\_724,1}.p1) / (real(\$heap_{funcend\_724,1}.p1)) / (real
30269.0), 1.0))) && (asType<real>(fmod(heapIs $heap_{funcend\_724,1},
(real(\text{sheap}_{funcend\_724.1}.p3) / 30323.0) + (real(\text{sheap}_{funcend\_724.1}.p2) / (real(\text{sheap}_{funcend\_724.1}.p3) / (real(\text{sheap}_{funcend\_724.1}.p3)))
30307.0) + (real($heap_{funcend\_724,1}.p1) / 30269.0), 1.0)) <
asType < real > (1.0)))
\rightarrow [simplify]
[88.3] ((0.0 \leq ((real($heap_{funcend_{-724,1}}.p3) / 30323.0) +
(real(\$heap_{funcend\_724,1}.p2) / 30307.0) + (real(\$heap_{funcend\_724,1}.p1) / (real(\$heap_{funcend\_724,1}.p1)) / (real
30269.0)) && (asType<real>((double)0.0) < asType<real>(1.0))) =>
((asType < real > ((double)0.0) \le asType < real > (fmod(heapIs)))
```

```
heap_{funcend-724,1}, (real(heap_{funcend-724,1}.p3) / 30323.0) +
(real(\$heap_{funcend\_724,1}.p2) / 30307.0) + (real(\$heap_{funcend\_724,1}.p1) / (real(\$heap_{funcend\_724,1}.p1))
30269.0), 1.0))) && (asType<real>(fmod(heapIs $heap_{funcend\_724.1},
 (real(\$heap_{funcend\_724,1}.p3) / 30323.0) + (real(\$heap_{funcend\_724,1}.p2) / (real(\$heap_{funcend\_724,1}.p3) / (real(\$heap_{funcend\_724,1}.p3)))
30307.0) + (real($heap_{funcend\_724,1}.p1) / 30269.0), 1.0)) <
asType < real > (1.0))
 \rightarrow [from term 84.9, literala \leq ((real($heap_{funcend\_724,1}.p3) / 30323.0) +
 (real(\$heap_{funcend\_724,1}.p1) / 30269.0) + (real(\$heap_{funcend\_724,1}.p2) / (real(\$heap_{funcend\_724,1}.p2)) / (real
30307.0)) is true whenever literala \leq 0.0]
                   Proof of rule precondition:
                   [88.3.0] \ 0.0 \le 0.0
                   \rightarrow [simplify]
                   [88.3.1] true
 [88.4] (true && (asType<real>((double)0.0) < asType<real>(1.0))) =>
 ((asType < real > ((double)0.0) \le asType < real > (fmod(heapIs)))
\text{Sheap}_{funcend\_724,1}, (\text{real}(\text{Sheap}_{funcend\_724,1}.\text{p3}) / 30323.0) +
 (real(\$heap_{funcend\_724,1}.p2) / 30307.0) + (real(\$heap_{funcend\_724,1}.p1) / (real(\$heap_{funcend\_724,1}.p1)) / (real
30269.0, 1.0))) && (asType<real>(fmod(heapIs $heap_{funcend\_724,1},
 (real(\$heap_{funcend\_724,1}.p3) / 30323.0) + (real(\$heap_{funcend\_724,1}.p2) / (real(\$heap_{funcend\_724,1}.p3)) / (real
30307.0) + (real($heap_{funcend\_724,1}.p1) / 30269.0), 1.0)) <
asType < real > (1.0))
 \rightarrow [simplify]
 [88.21] (-1.0 < -\text{fmod}(\text{heapIs }\text{\$heap}_{funcend\_724,1}, (\text{real}(\text{\$heap}_{funcend\_724,1}.p3))
  /30323.0) + (real(\$heap_{funcend\_724,1}.p2) / 30307.0) +
 (real(heap_{funcend\_724,1}.p1) / 30269.0), 1.0)) \land (0.0 \le fmod(heapIs)
\text{heap}_{funcend\_724,1}, (\text{real}(\text{heap}_{funcend\_724,1}.\text{p3}) / 30323.0) +
 (real(\$heap_{funcend\_724,1}.p2) / 30307.0) + (real(\$heap_{funcend\_724,1}.p1) / (real(\$heap_{funcend\_724,1}.p2) / 30307.0))
30269.0), 1.0))
 → [separate conjunction and work on first sub-term]
 [88.22] \text{ -}1.0 < -\text{fmod}(\mathbf{heapIs} \$ \text{heap}_{funcend\_724,1}, (\mathbf{real}(\$ \text{heap}_{funcend\_724,1}.\text{p3})))))
 /30323.0) + (real(\$heap_{funcend\_724,1}.p2) / 30307.0) +
 (real(\text{$heap}_{funcend\_724,1}.p1) / 30269.0), 1.0)
 [Take goal term]
 [1.0] asType<real>(result) < asType<real>((double)1.0)
 \rightarrow [from term 85.6, result is equal to fmod(heapIs $heap_{funcend_{724,1}},
 (real(\$heap_{funcend\_724,1}.p3) / 30323.0) + (real(\$heap_{funcend\_724,1}.p2) / (real(\$heap_{funcend\_724,1}.p3)) / (real
30307.0) + (real($heap_{funcend_{724,1}}.p1) / 30269.0), 1.0)]
 [1.1] asType < real > (fmod(heapIs $heap_{funcend\_724,1},
 (real(\text{sheap}_{funcend\_724.1.p3}) / 30323.0) + (real(\text{sheap}_{funcend\_724.1.p2}) / (real(\text{sheap}_{funcend\_724.1.p3}) / (real(\text{sheap}_{funcend\_724.1.p3})) / (real(\text{sheap}_{funcen
30307.0) + (real($heap_{funcend_724,1}.p1) / 30269.0), 1.0)) <
```

```
\rightarrow [simplify]
[1.7] -1.0 < -\text{fmod}(\text{heapIs }\text{\$heap}_{funcend\_724,1}, (\text{real}(\text{\$heap}_{funcend\_724,1}.\text{p3}))
30323.0) + (real($heap_{funcend\_724,1}.p2) / 30307.0) +
(real(\theta_{10}, 1.0) / 30269.0), 1.0)
\rightarrow [from term 88.22, literala < -fmod(heapIs $heap_{funcend\_724,1},
(real(\$heap_{funcend\_724,1}.p3) / 30323.0) + (real(\$heap_{funcend\_724,1}.p2) / (real(\$heap_{funcend\_724,1}.p3)) / (real
30307.0) + (real(\$heap_{funcend\_724,1}.p1) / 30269.0), 1.0) is true whenever
literala \leq -1.0
       Proof of rule precondition:
       [1.7.0] - 1.0 \le -1.0
       \rightarrow [simplify]
       [1.7.1] true
[1.8] true
Proof of verification condition: Loop initialisation establishes end
condition or a valid variant
Condition generated at: C:\Escher\Customers\prang\prang.c (101,5)
Condition defined at: C:\Escher\Customers\prang\prang.c (103,20)
To prove: 0 \le (asType < integer const > (limit) - limit)
asType<integer>(count))
Given:
heap_{init}.LIMIT == (int)80
heap_{init}.M1 == asType < short int > ((int)30269)
\theta_{init}.r1 == asType < short int > ((int)171)
\theta
\theta
\theta sheap<sub>init</sub>.M2 == asType<short int>((int)30307)
\rho_{init}.r2 == asType < short int > ((int)172)
heap_{init}.a2 == asType < short int > ((int)176)
\theta sheap<sub>init</sub>.b2 == asType<short int>((int)35)
heap_{init}.M3 == asType < short int > ((int)30323)
heap_{init}.r3 == asType < short int > ((int)170)
heap_{init}.a3 == asType < short int > ((int)178)
\theta = asType < short int > ((int)63)
```

asType<real>((double)1.0)

```
\theta
\theta
\theta = asType < short int > ((int)3)
limit == \$heap_{funcstart\_775,1}.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_{775,1;780,5} ==
\rho_{funcstart\_775,1}.-\text{replace}((\&\rho_{funcstart\_775,1}.-\text{ecv\_files}[1]).\
writes_780_5
count < limit
Proof:
[Take given term]
[5.0] heap_{funcstart\_775,1}.LIMIT == limit
\rightarrow [const static or extern object]
[5.1] $heap<sub>init</sub>.LIMIT == limit
\rightarrow [expand definition of constant 'LIMIT' at prang.c (12,18)]
[5.2] (int)80 == limit
\rightarrow [simplify]
[5.3] 80 == limit
[Take given term]
[6.0] (int)0 == count
\rightarrow [simplify]
[6.1] 0 == count
[Take goal term]
[1.0] 0 \leq (asType<integer const>(limit) - asType<integer>(count))
\rightarrow [from term 5.3, limit is equal to 80]
[1.1] 0 \le (asType < integer const > (80) - asType < integer > (count))
\rightarrow [simplify]
[1.2] 0 \le (80 - asType < integer > (count))
\rightarrow [from term 6.1, count is equal to 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\prang.c (104,5)
Condition defined at: C:\Escher\Customers\prang\prang.c (103,5)
To prove: (asType<integer const>(limit) -
asType < integer > (count_{loopend})) < (asType < integer const > (limit) - limit) = limit > (limit) > (limit) = limit > (limit) > (limi
\mathbf{asType}{<}\mathbf{integer}{>}(\mathrm{count}_{loopstart\_782,5}))
Given:
heap_{init}.LIMIT == (int)80
\theta sheap<sub>init</sub>.M1 == asType<short int>((int)30269)
\theta_{init}.r1 == asType < short int > ((int)171)
\theta
\theta
heap_{init}.M2 == asType < short int > ((int)30307)
\rho_{init}.r2 == asType < short int > ((int)172)
heap_{init}.a2 == asType < short int > ((int)176)
\theta = asType < short int > ((int)35)
\theta = asType < short int > ((int)30323)
\theta_{init}.r3 == asType<short int>((int)170)
heap_{init}.a3 == asType<short int>((int)178)
\theta = asType < short int > ((int)63)
\theta = asType < short int > ((int)1)
\theta
\theta = asType < short int > ((int)3)
limit == \$heap_{funcstart\_775,1}.LIMIT
minof(int const) \le limit
limit < maxof(int const)</pre>
count == (int)0
minof(int) < count
```

 $[1.3] 0 \le (80 - asType < integer > (0))$ 

```
count < maxof(int)
heap_{775,1;780,5} ==
\$ heap_{funcstart\_775,1}.\_\textbf{replace}((\&\$ heap_{funcstart\_775,1}.\_ecv\_files[1]).\$ r \rightarrow \texttt{prop}(\texttt{prop}(\texttt{prop}(\texttt{prop}(\texttt{prop}(\texttt{prop}(\texttt{prop}(\texttt{prop}(\texttt{prop}(\texttt{prop}(\texttt{prop}(\texttt{prop}(\texttt{prop}(\texttt{prop}(\texttt{prop}(\texttt{prop}(\texttt{prop}(\texttt{prop}(\texttt{prop}(\texttt{prop}(\texttt{prop}(\texttt{prop}(\texttt{prop}(\texttt{prop}(\texttt{prop}(\texttt{prop}(\texttt{prop}(\texttt{prop}(\texttt{prop}(\texttt{prop}(\texttt{prop}(\texttt{prop}(\texttt{prop}(\texttt{prop}(\texttt{prop}(\texttt{prop}(\texttt{prop}(\texttt{prop}(\texttt{prop}(\texttt{prop}(\texttt{prop}(\texttt{prop}(\texttt{prop}(\texttt{prop}(\texttt{prop}(\texttt{prop}(\texttt{prop}(\texttt{prop}(\texttt{prop}(\texttt{prop}(\texttt{prop}(\texttt{prop}(\texttt{prop}(\texttt{prop}(\texttt{prop}(\texttt{prop}(\texttt{prop}(\texttt{prop}(\texttt{prop}(\texttt{prop}(\texttt{prop}(\texttt{prop}(\texttt{prop}(\texttt{prop}(\texttt{prop}(\texttt{prop}(\texttt{prop}(\texttt{prop}(\texttt{prop}(\texttt{prop}(\texttt{prop}(\texttt{prop}(\texttt{prop}(\texttt{prop}(\texttt{prop}(\texttt{prop}(\texttt{prop}(\texttt{prop}(\texttt{prop}(\texttt{prop}(\texttt{prop}(\texttt{prop}(\texttt{prop}(\texttt{prop}(\texttt{prop}(\texttt{prop}(\texttt{prop}(\texttt{prop}(\texttt{prop}(\texttt{prop}(\texttt{prop}(\texttt{prop}(\texttt{prop}(\texttt{prop}(\texttt{prop}(\texttt{prop}(\texttt{prop}(\texttt{prop}(\texttt{prop}(\texttt{prop}(\texttt{prop}(\texttt{prop}(\texttt{prop}(\texttt{prop}(\texttt{prop}(\texttt{prop}(\texttt{prop}(\texttt{prop}(\texttt{prop}(\texttt{prop}(\texttt{prop}(\texttt{prop}(\texttt{prop}(\texttt{prop}(\texttt{prop}(\texttt{prop}(\texttt{prop}(\texttt{prop}(\texttt{prop}(\texttt{prop}(\texttt{prop}(\texttt{prop}(\texttt{prop}(\texttt{prop}(\texttt{prop}(\texttt{prop}(\texttt{prop}(\texttt{prop}(\texttt{prop}(\texttt{prop}(\texttt{prop}(\texttt{prop}(\texttt{prop}(\texttt{prop}(\texttt{prop}(\texttt{prop}(\texttt{prop}(\texttt{prop}(\texttt{prop}(\texttt{prop}(\texttt{prop}(\texttt{prop}(\texttt{prop}(\texttt{prop}(\texttt{prop}(\texttt{prop}(\texttt{prop}(\texttt{prop}(\texttt{prop}(\texttt{prop}(\texttt{prop}(\texttt{prop}(\texttt{prop}(\texttt{prop}(\texttt{prop}(\texttt{prop}(\texttt{prop}(\texttt{prop}(\texttt{prop}(\texttt{prop}(\texttt{prop}(\texttt{prop}(\texttt{prop}(\texttt{prop}(\texttt{prop}(\texttt{prop}(\texttt{prop}(\texttt{prop}(\texttt{prop}(\texttt{prop}(\texttt{prop}(\texttt{prop}(\texttt{prop}(\texttt{prop}(\texttt{prop}(\texttt{prop}(\texttt{prop}(\texttt{prop}(\texttt{prop}(\texttt{prop}(\texttt{prop}(\texttt{prop}(\texttt{prop}(\texttt{prop}(\texttt{prop}(\texttt{prop}(\texttt{prop}(\texttt{prop}(\texttt{prop}(\texttt{prop}(\texttt{prop}(\texttt{prop}(\texttt{prop}(\texttt{prop}(\texttt{prop}(\texttt{prop}(\texttt{prop}(\texttt{prop}(\texttt{prop}(\texttt{prop}(\texttt{prop}(\texttt{prop}(\texttt{prop}(\texttt{prop}(\texttt{prop}(\texttt{prop}(\texttt{prop}(\texttt{prop}(\texttt{prop}(\texttt{prop}(\texttt{prop}(\texttt{prop}(\texttt{prop}(\texttt{prop}(\texttt{prop}(\texttt{prop}(\texttt{prop}(\texttt{prop}(\texttt{prop}(\texttt{prop}(\texttt{prop}(\texttt{prop}(\texttt{prop}(\texttt{prop}(\texttt{prop}(\texttt{prop}(\texttt{prop}(\texttt{prop}(\texttt{prop}(\texttt{prop}(\texttt{prop}(\texttt{prop}(\texttt{prop}(\texttt{prop}(\texttt{prop}(\texttt{prop}(\texttt{prop}(\texttt{prop}(\texttt{prop}(\texttt{prop}(\texttt{prop}(\texttt{prop}(\texttt{prop}(\texttt{prop}(\texttt{prop}
writes_780_5)
\text{Sheap}_{loopstart\_782,5} == \text{Sheap}_{775,1;780,5}.replace(p1 \rightarrow
writes_783_12)._replace(p2 \rightarrow writes_783_12)._replace(p3 \rightarrow
writes_783_12)._replace(\_ecv\_files \rightarrow writes\_783\_12)
\#writes_783_12 == \#$heap<sub>775,1:780,5</sub>._ecv_files
minof(int) \leq count_{loopstart\_782,5}
\operatorname{count}_{loopstart\_782,5} \leq \operatorname{maxof}(\operatorname{int})
count_{loopstart\_782,5} < limit
0 \le (asType < integer const > (limit) -
asType < integer > (count_{loopstart\_782,5}))
(asType < integer const > (limit) - asType < integer > (count_{loopstart\_782,5}))
\leq (asType < integer const > (limit) - asType < integer > (count))
(++\text{count}_{loopstart\_782,5} == \text{count}_{loopend}) \land (\$\text{heap}_{786,16} ==
\theta_{loopstart\_782.5}._replace(p1 \rightarrow writes_786_25)._replace(p2 \rightarrow
writes_786_25)._replace(p3 \rightarrow writes_786_25)) \land ($heap<sub>loopend</sub> ==
\theta_{786,16}.\_replace((\&\theta_{786,16}.\_ecv\_files[1]).$r \rightarrow writes\_786\_9)) \land
(asType < real > ((double)0.0) < asType < real > (\$result_786_25)) \land
(asType < real > (\$result\_786\_25) < asType < real > ((double)1.0))
count_{loopend} < limit
Proof:
[Take given term]
[5.0] heap_{funcstart\_775,1}.LIMIT == limit
\rightarrow [const static or extern object]
[5.1] heap_{init}.LIMIT == limit
\rightarrow [expand definition of constant 'LIMIT' at prang.c (12,18)]
[5.2] (int)80 == limit
\rightarrow [simplify]
[5.3] 80 == limit
[Take given term]
[7.0] $heap<sub>775.1:780.5</sub> ==
heap_{funcstart\_775,1}._replace((&heap_{funcstart\_775,1}._ecv_files[1]).$r \rightarrow
writes_780_5)
\rightarrow [simplify]
```

```
[7.1] heap_{775,1;780,5} == heap_{funcstart\_775,1}._replace((&$heap._ecv_files[1]).$r
\rightarrow writes_780_5)
→ [attribute value is known from postcondition]
[7.2] heap_{775,1;780,5} == heap_{funcstart\_775,1}.replace(&heap._ecv_files[1] \rightarrow
writes_780_5)
[Take given term]
[8.0] $\text{heap}_{loopstart_782,5} == \text{$heap}_{775,1;780,5}._\text{replace}(p1 \rightarrow 1.00)
writes_783_12)._replace(p2 \rightarrow writes_783_12)._replace(p3 \rightarrow
writes_783_12)._replace(\_ecv\_files \rightarrow writes\_783\_12)
\rightarrow [from term 7.2, $heap_{775,1;780,5}$ is equal to
heap_{funcstart\_775,1}._replace(&\heap._ecv_files[1] \rightarrow writes_780_5)]
[8.1] $heap<sub>loopstart_782,5</sub> ==
\text{heap}_{funcstart\_775.1}.\text{replace}((\&\text{heap}.\text{lecv\_files}[1]) \rightarrow
writes_780_5)._replace(p1 \rightarrow writes_783_12)._replace(p2 \rightarrow
writes_783_12)._replace(p3 \rightarrow writes_783_12)._replace(_ecv_files \rightarrow
writes_783_12)
[Take given term]
[20.0] (++\text{count}_{loopstart\_782,5} == \text{count}_{loopend}) \land (\$\text{heap}_{786,16} ==
\text{heap}_{loopstart\_782.5}._replace(p1 \rightarrow writes_786_25)._replace(p2 \rightarrow
writes_786_25)._replace(p3 \rightarrow writes_786_25)) \land ($heap<sub>loopend</sub> ==
\$heap_{786,16}.\_\textbf{replace}((\&\$heap_{786,16}.\_ecv\_files[1]).\$r \rightarrow writes\_786\_9)) \land \\
(asType < real > ((double)0.0) < asType < real > (\$result_786\_25)) \land
(asType < real > (\$result_786\_25) < asType < real > ((double)1.0))
\rightarrow [simplify]
[20.8] (1 == (count_{loopend} + -count_{loopstart\_782,5})) \land (\$heap_{786,16} ==
\theta_{loopstart\_782,5}._replace(p1 \rightarrow writes_786_25)._replace(p2 \rightarrow
writes_786_25)._replace(p3 \rightarrow writes_786_25)) \land ($heap<sub>loopend</sub> ==
\rho_{86.16}. replace((&\pi_{86.16}. ecv_files[1]).\Pi_r \rightarrow writes_786_9)) \lambda
(asType < real > ((double)0.0) < asType < real > (\$result_786_25)) \land
(asType < real > (\$result_786\_25) < asType < real > ((double)1.0))
\rightarrow [from term 8.1, \rho_{loopstart\_782,5} is equal to
heap_{funcstart\_775,1}._replace((&$heap._ecv_files[1]) \rightarrow
writes_780_5)._replace(p1 \rightarrow writes_783_12)._replace(p2 \rightarrow
writes_783_12)._replace(p3 \rightarrow writes_783_12)._replace(_ecv_files \rightarrow
writes_783_12)]
[20.9] (1 == (-\text{count}_{loopstart\_782,5} + \text{count}_{loopend})) \land (\$\text{heap}_{786,16} ==
\text{heap}_{funcstart\_775,1}.\text{-replace}((\&\text{heap}.\text{-ecv\_files}[1]) \rightarrow
writes_780_5)._replace(p1 \rightarrow writes_783_12)._replace(p2 \rightarrow
writes_783_12)._replace(p3 \rightarrow writes_783_12)._replace(_ecv_files \rightarrow
writes_783_12)._replace(p1 \rightarrow writes_786_25)._replace(p2 \rightarrow
writes_786_25)._replace(p3 \rightarrow writes_786_25)) \land ($heap<sub>loopend</sub> ==
```

```
\rho_{86.16}. replace((&\pi_{86.16}. ecv_files[1]).\Pi_r \rightarrow writes_786_9)) \lambda
(asType < real > ((double)0.0) < asType < real > (\$result_786_25)) \land
(asType < real > (\$result\_786\_25) < asType < real > ((double)1.0))
\rightarrow [simplify]
[20.10] (1 == (-\text{count}_{loopstart\_782,5} + \text{count}_{loopend})) \land (\$\text{heap}_{786,16} ==
\text{heap}_{funcstart\_775,1}.\text{-replace}((\&\text{heap}.\text{-ecv\_files}[1]) \rightarrow
writes_780_5)._replace(p1 \rightarrow writes_783_12)._replace(p2 \rightarrow
writes_783_12)._replace(p3 \rightarrow writes_783_12)._replace(_ecv_files \rightarrow
writes_783_12)._replace(p1 \rightarrow writes_786_25)._replace(p2 \rightarrow
writes_786_25)._replace(p3 \rightarrow writes_786_25)) \land ($heap<sub>loopend</sub> ==
\rho_{86.16.}-replace((&\pi_eap._ecv_files[1]).\pi_r \rightarrow writes_786_9)) \lambda
(asType < real > ((double)0.0) < asType < real > (\$result_786\_25)) \land
(asType < real > (\$result\_786\_25) < asType < real > ((double)1.0))
→ [attribute value is known from postcondition]
[20.11] (1 == (-\text{count}_{loopstart\_782.5} + \text{count}_{loopend})) \land (\$\text{heap}_{786.16} ==
\$heap_{funcstart\_775,1}.\_\textbf{replace}((\&\$heap.\_ecv\_files[1]) \rightarrow
writes_780_5)._replace(p1 \rightarrow writes_783_12)._replace(p2 \rightarrow
writes_783_12)._replace(p3 \rightarrow writes_783_12)._replace(_ecv_files \rightarrow
writes_783_12)._replace(p1 \rightarrow writes_786_25)._replace(p2 \rightarrow
writes_786_25)._replace(p3 \rightarrow writes_786_25)) \land ($heap<sub>loopend</sub> ==
heap_{786,16}._replace(&\heap._ecv_files[1] \rightarrow writes_786_9)) \land
(asType < real > ((double)0.0) < asType < real > (\$result_786_25)) \land
(asType < real > (\$result_786\_25) < asType < real > ((double)1.0))
\rightarrow [simplify]
[20.20] (1 == (-\text{count}_{loopstart\_782.5} + \text{count}_{loopend})) \land (\$\text{heap}_{786.16} ==
\text{Sheap}_{funcstart\_775,1}.\_\mathbf{replace}((\&\text{Sheap}.\_ecv\_files[1]) \rightarrow
writes_780_5)._replace(p1 \rightarrow writes_783_12)._replace(p2 \rightarrow
writes_783_12)._replace(p3 \rightarrow writes_783_12)._replace(_ecv_files \rightarrow
writes_783_12)._replace(p1 \rightarrow writes_786_25)._replace(p2 \rightarrow
writes_786_25)._replace(p3 \rightarrow writes_786_25)) \land ($heap<sub>loopend</sub> ==
\rho_{786,16}._replace(&\pi_exp_exv_files[1] \rightarrow writes_786_9)) \wedge (0.0 <
\text{sresult}_{786-25} \land (-1.0 < -\text{sresult}_{786-25})
\rightarrow [separate conjunction and work on first sub-term]
[20.21] 1 == (-\text{count}_{loopstart\_782.5} + \text{count}_{loopend})
[Take goal term]
[1.0] (asType<integer const>(limit) - asType<integer>(count_loopend)) <
(asType < integer const > (limit) - asType < integer > (count_{loopstart\_782.5}))
\rightarrow [from term 5.3, limit is equal to 80]
[1.1] (asType<integer const>(80) - asType<integer>(count<sub>loopend</sub>)) <
(asType < integer const > (limit) - asType < integer > (count_{loopstart\_782.5}))
```

```
\rightarrow [simplify]
[1.2] (80 - asType<integer>(count<sub>loopend</sub>)) < (asType<integer
const>(limit) - asType < integer>(count_{loopstart\_782,5}))
\rightarrow [from term 20.21, count<sub>loopend</sub> is equal to 1 + count<sub>loopstart_782,5</sub>]
[1.3] \; (80 - \mathbf{asType} < \mathbf{integer} > (1 + \mathbf{count}_{loopstart\_782,5})) < (\mathbf{asType} < \mathbf{integer})
const>(limit) - asType < integer>(count_{loopstart\_782.5}))
\rightarrow [simplify]
[1.9] (79 + -count<sub>loopstart_782,5</sub>) < (asType<integer const>(limit) -
\mathbf{asType}{<}\mathbf{integer}{>}(\mathtt{count}_{loopstart\_782,5}))
\rightarrow [from term 5.3, limit is equal to 80]
[1.10] (79 + -\text{count}_{loopstart\_782,5}) < (\mathbf{asType} < \mathbf{integer\ const} > (80) - (80) + (80) + (80) + (80) + (80) + (80) + (80) + (80) + (80) + (80) + (80) + (80) + (80) + (80) + (80) + (80) + (80) + (80) + (80) + (80) + (80) + (80) + (80) + (80) + (80) + (80) + (80) + (80) + (80) + (80) + (80) + (80) + (80) + (80) + (80) + (80) + (80) + (80) + (80) + (80) + (80) + (80) + (80) + (80) + (80) + (80) + (80) + (80) + (80) + (80) + (80) + (80) + (80) + (80) + (80) + (80) + (80) + (80) + (80) + (80) + (80) + (80) + (80) + (80) + (80) + (80) + (80) + (80) + (80) + (80) + (80) + (80) + (80) + (80) + (80) + (80) + (80) + (80) + (80) + (80) + (80) + (80) + (80) + (80) + (80) + (80) + (80) + (80) + (80) + (80) + (80) + (80) + (80) + (80) + (80) + (80) + (80) + (80) + (80) + (80) + (80) + (80) + (80) + (80) + (80) + (80) + (80) + (80) + (80) + (80) + (80) + (80) + (80) + (80) + (80) + (80) + (80) + (80) + (80) + (80) + (80) + (80) + (80) + (80) + (80) + (80) + (80) + (80) + (80) + (80) + (80) + (80) + (80) + (80) + (80) + (80) + (80) + (80) + (80) + (80) + (80) + (80) + (80) + (80) + (80) + (80) + (80) + (80) + (80) + (80) + (80) + (80) + (80) + (80) + (80) + (80) + (80) + (80) + (80) + (80) + (80) + (80) + (80) + (80) + (80) + (80) + (80) + (80) + (80) + (80) + (80) + (80) + (80) + (80) + (80) + (80) + (80) + (80) + (80) + (80) + (80) + (80) + (80) + (80) + (80) + (80) + (80) + (80) + (80) + (80) + (80) + (80) + (80) + (80) + (80) + (80) + (80) + (80) + (80) + (80) + (80) + (80) + (80) + (80) + (80) + (80) + (80) + (80) + (80) + (80) + (80) + (80) + (80) + (80) + (80) + (80) + (80) + (80) + (80) + (80) + (80) + (80) + (80) + (80) + (80) + (80) + (80) + (80) + (80) + (80) + (80) + (80) + (80) + (80) + (80) + (80) + (80) + (80) + (80) + (80) + (80) + (80) + (80) + (80) + (80) + (80) + (80) + (80) + (80) + (80) + (80) + (80) + (80) + (80) + (80) + (80) + (80) + (80) + (80) + (80) + (80) + (80) + (80) + (80) + (80) + (80) + (80) + (80) + (80) + (80) + (80) + (80) + (80) + (80) + (80) + (80) + (80) + (80) + (80) + (80) + 
asType < integer > (count_{loopstart\_782,5}))
\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\prang.c (104,5)
Condition defined at: C:\Escher\Customers\prang\prang.c (103,20)
To prove: 0 < (asType < integer const > (limit) - limit)
asType < integer > (count_{loopend}))
Given:
heap_{init}.LIMIT == (int)80
\theta
\theta_{init}.r1 == asType < short int > ((int)171)
heap_{init}.a1 == asType < short int > ((int)177)
\theta
heap_{init}.M2 == asType < short int > ((int)30307)
\theta_{init}.r2 == asType<short int>((int)172)
heap_{init}.a2 == asType < short int > ((int)176)
\theta = asType < short int > ((int)35)
\theta = asType < short int > ((int)30323)
\theta
heap_{init}.a3 == asType<short int>((int)178)
```

```
\theta = asType < short int > ((int)63)
\theta = asType < short int > ((int)1)
\theta
\theta = asType < short int > ((int)3)
limit == \$heap_{funcstart\_775,1}.LIMIT
minof(int const) \le limit
limit \leq maxof(int const)
count == (int)0
minof(int) \le count
count < maxof(int)
heap_{775,1;780,5} ==
\text{Sheap}_{funcstart\_775,1}.\_\mathbf{replace}((\&\text{Sheap}_{funcstart\_775,1}.\_\mathbf{ecv\_files}[1]).\$r \rightarrow
writes_780_5)
\text{Sheap}_{loopstart\_782,5} == \text{Sheap}_{775,1;780,5}.\_\mathbf{replace}(p1 \rightarrow
writes_783_12)._replace(p2 \rightarrow writes_783_12)._replace(p3 \rightarrow
writes_783_12)._replace(_ecv_files \rightarrow writes_783_12)
\#writes_783_12 == \#$heap<sub>775,1:780,5</sub>._ecv_files
minof(int) \leq count_{loopstart\_782,5}
count_{loopstart\_782,5} \le maxof(int)
count_{loopstart\_782,5} < limit
0 \le (asType < integer const > (limit) -
asType < integer > (count_{loopstart\_782,5}))
(asType < integer const > (limit) - asType < integer > (count_{loopstart\_782.5}))
\leq (asType<integer const>(limit) - asType<integer>(count))
(++\text{count}_{loopstart\_782,5} == \text{count}_{loopend}) \land (\$\text{heap}_{786,16} ==
\theta_{loopstart\_782.5}. replace(p1 \rightarrow writes\_786\_25). replace(p2 \rightarrow writes\_786\_25)
writes_786_25)._replace(p3 \rightarrow writes_786_25)) \land ($heap<sub>loopend</sub> ==
\rho_{86.16}.\mathbf{replace}((\&\rho_{86.16}.\mathbf{ecv}_{10}).\$r \rightarrow \text{writes}_{786.9})) \land
(asType < real > ((double)0.0) < asType < real > (\$result_786\_25)) \land
(asType < real > (\$result\_786\_25) < asType < real > ((double)1.0))
count_{loopend} < limit
Proof:
[Take given term]
[5.0] heap_{funcstart\_775,1}.LIMIT == limit
\rightarrow [const static or extern object]
[5.1] $heap<sub>init</sub>.LIMIT == limit
```

```
\rightarrow [expand definition of constant 'LIMIT' at prang.c (12,18)]
[5.2] (int)80 == limit
\rightarrow [simplify]
[5.3] 80 == limit
[Take given term]
[7.0] $heap<sub>775,1;780,5</sub> ==
\rho_{tuncstart\_775,1}.\_replace((\&\rho_{tuncstart\_775,1}.\_ecv\_files[1]).r \rightarrow \rho_{tuncstart\_775,1}.\_ecv\_files[1]).replace((\&\rho_{tuncstart\_775,1}.\_ecv\_files[1]).replace((\&\rho_{tuncstart\_775,1}.\_ecv\_files[1]).replace((\&\rho_{tuncstart\_775,1}.\_ecv\_files[1]).replace((\&\rho_{tuncstart\_775,1}.\_ecv\_files[1]).replace((\&\rho_{tuncstart\_775,1}.\_ecv\_files[1]).replace((\&\rho_{tuncstart\_775,1}.\_ecv\_files[1]).replace((\&\rho_{tuncstart\_775,1}.\_ecv\_files[1]).replace((\&\rho_{tuncstart\_775,1}.\_ecv\_files[1]).replace((\&\rho_{tuncstart\_775,1}.\_ecv\_files[1]).replace((\&\rho_{tuncstart\_775,1}.\_ecv\_files[1]).replace((\&\rho_{tuncstart\_775,1}.\_ecv\_files[1]).replace((\&\rho_{tuncstart\_775,1}.\_ecv\_files[1]).replace((\&\rho_{tuncstart\_775,1}.\_ecv\_files[1]).replace((\&\rho_{tuncstart\_775,1}.\_ecv\_files[1]).replace((\&\rho_{tuncstart\_775,1}.\_ecv\_files[1]).replace((\&\rho_{tuncstart\_775,1}.\_ecv\_files[1]).replace((\&\rho_{tuncstart\_775,1}.\_ecv\_files[1]).replace((\&\rho_{tuncstart\_775,1}.\_ecv\_files[1]).replace((\&\rho_{tuncstart\_775,1}.\_ecv\_files[1]).replace((\&\rho_{tuncstart\_775,1}.\_ecv\_files[1]).replace((\&\rho_{tuncstart\_775,1}.\_ecv\_files[1]).replace((\&\rho_{tuncstart\_775,1}.\_ecv\_files[1]).replace((\&\rho_{tuncstart\_775,1}.\_ecv\_files[1]).replace((\&\rho_{tuncstart\_775,1}.\_ecv\_files[1]).replace((\&\rho_{tuncstart\_775,1}.\_ecv\_files[1]).replace((\&\rho_{tuncstart\_775,1}.\_ecv\_files[1]).replace((\&\rho_{tuncstart\_775,1}.\_ecv\_files[1]).replace((\&\rho_{tuncstart\_775,1}.\_ecv\_files[1]).replace((\&\rho_{tuncstart\_775,1}.\_ecv\_files[1]).replace((\&\rho_{tuncstart\_775,1}.\_ecv\_files[1]).replace((\&\rho_{tuncstart\_775,1}.\_ecv\_files[1]).replace((\&\rho_{tuncstart\_775,1}.\_ecv\_files[1]).replace((\&\rho_{tuncstart\_775,1}.\_ecv\_files[1]).replace((\&\rho_{tuncstart\_775,1}.\_ecv\_files[1]).replace((\&\rho_{tuncstart\_775,1}.\_ecv\_files[1]).replace((\&\rho_{tuncstart\_775,1}.\_ecv\_files[1]).replace((\&\rho_{tuncstart\_775,1}.\_ecv\_files[1]).replace((\&\rho_{tuncstart\_775,1}.\_ecv\_files[1]).replace((\&\rho_{tuncstart\_775,1}.\_ecv\_files[1]).replace((\&\rho_{tuncstart\_775,1}.\_ecv\_files[1]).replace((\&\rho_{tuncstart\_775,1}.\_ecv\_files[1]).replace((\&\rho_{tuncstart\_775,1}.\_ecv\_files[1]).replace((\&\rho_{tuncstart\_775,1}.\_ecv\_files[1]).repl
writes_780_5
\rightarrow [simplify]
[7.1] heap_{775,1;780,5} == heap_{funcstart\_775,1}._replace((&$heap._ecv_files[1]).$r
\rightarrow writes_780_5)
→ [attribute value is known from postcondition]
[7.2] heap_{775,1;780,5} == heap_{funcstart\_775,1}.replace(&heap._ecv_files[1] \rightarrow
writes_780_5)
[Take given term]
[8.0] $\text{heap}_{loopstart_782,5} == \text{$heap}_{775,1;780,5}._\text{replace}(p1 \rightarrow 1.00)
writes_783_12)._replace(p2 \rightarrow writes_783_12)._replace(p3 \rightarrow
writes_783_12)._replace(\_ecv\_files \rightarrow writes\_783\_12)
\rightarrow [from term 7.2, $heap<sub>775,1:780,5</sub> is equal to
heap_{funcstart\_775,1}._replace(&\heap._ecv_files[1] \rightarrow writes_780_5)]
[8.1] $heap<sub>loopstart_782,5</sub> ==
\text{heap}_{funcstart\_775,1}.replace((&\text{heap}._ecv_files[1]) \rightarrow
writes_780_5)._replace(p1 \rightarrow writes_783_12)._replace(p2 \rightarrow
writes_783_12)._replace(p3 \rightarrow writes_783_12)._replace(_ecv_files \rightarrow
writes_783_12)
[Take given term]
[20.0] (++count<sub>loopstart_782,5</sub> == count<sub>loopend</sub>) \land ($heap<sub>786,16</sub> ==
\theta_{loopstart\_782,5}._replace(p1 \rightarrow writes_786_25)._replace(p2 \rightarrow
writes_786_25)._replace(p3 \rightarrow writes_786_25)) \land ($heap<sub>loopend</sub> ==
\theta_{786,16}.\mathbf{replace}((\$\theta_{786,16}.\mathbf{ecv}_{11}).\$r \rightarrow \mathbf{writes}_{786,9})) \land \theta_{786,16}.\mathbf{replace}((\$\theta_{786,16}.\mathbf{ecv}_{11}).\$r \rightarrow \mathbf{writes}_{11})
(asType < real > ((double)0.0) < asType < real > (\$result_786_25)) \land
(asType < real > (\$result_786\_25) < asType < real > ((double)1.0))
\rightarrow [simplify]
[20.8] (1 == (count_{loopend} + -count_{loopstart\_782,5})) \land (\$heap_{786,16} ==
\$heap_{loopstart\_782,5}.\mathbf{replace}(p1 \rightarrow writes\_786\_25).\mathbf{\_replace}(p2 \rightarrow
writes_786_25)._replace(p3 \rightarrow writes_786_25)) \land ($heap<sub>loopend</sub> ==
\theta_{786,16}.\_replace((\&\theta_{786,16}.\_ecv\_files[1]).$r \rightarrow writes\_786\_9)) \land
(asType < real > ((double)0.0) < asType < real > (\$result_786_25)) \land
```

```
(asType<real>($result_786_25) < asType<real>((double)1.0))
\rightarrow [from term 8.1, $heap_{loopstart_782,5}$ is equal to
\theta_{funcstart\_775,1}._replace((&\partial_ev_files[1]) \rightarrow
writes_780_5)._replace(p1 \rightarrow writes_783_12)._replace(p2 \rightarrow
writes_783_12)._replace(p3 \rightarrow writes_783_12)._replace(_ecv_files \rightarrow
writes_783_12)]
[20.9] (1 == (-\text{count}_{loopstart\_782,5} + \text{count}_{loopend})) \land (\$\text{heap}_{786,16} ==
heap_{funcstart\_775,1}._replace((&\heap._ecv_files[1]) \rightarrow
writes_780_5)._replace(p1 \rightarrow writes_783_12)._replace(p2 \rightarrow
writes_783_12)._replace(p3 \rightarrow writes_783_12)._replace(_ecv_files \rightarrow
writes_783_12)._replace(p1 \rightarrow writes_786_25)._replace(p2 \rightarrow
writes_786_25)._replace(p3 \rightarrow writes_786_25)) \land ($heap<sub>loopend</sub> ==
\text{heap}_{786,16}.\text{-replace}((\&\text{heap}_{786,16}.\text{-ecv\_files}[1]).\$r \rightarrow \text{writes}\_786\_9)) \land
(asType < real > ((double)0.0) < asType < real > (\$result_786_25)) \land
(asType < real > (\$result_786\_25) < asType < real > ((double)1.0))
\rightarrow [simplify]
[20.10] (1 == (-\text{count}_{loopstart\_782,5} + \text{count}_{loopend})) \land (\$\text{heap}_{786,16} ==
\theta_{funcstart\_775,1}._replace((&\heap._ecv_files[1]) \to
writes_780_5)._replace(p1 \rightarrow writes_783_12)._replace(p2 \rightarrow
writes_783_12)._replace(p3 \rightarrow writes_783_12)._replace(_ecv_files \rightarrow
writes_783_12)._replace(p1 \rightarrow writes_786_25)._replace(p2 \rightarrow
writes_786_25)._replace(p3 \rightarrow writes_786_25)) \land ($heap<sub>loopend</sub> ==
heap_{786.16}._replace((&\hat{heap}._ecv_files[1]).\hat{r} \rightarrow writes_786_9)) \lambda
(asType < real > ((double)0.0) < asType < real > (\$result_786_25)) \land
(asType < real > (\$result_786\_25) < asType < real > ((double)1.0))
\rightarrow [attribute value is known from postcondition]
[20.11] (1 == (-\text{count}_{loopstart\_782,5} + \text{count}_{loopend})) \land (\$\text{heap}_{786,16} ==
heap_{funcstart\_775,1}._replace((&$heap._ecv_files[1]) \rightarrow
writes_780_5)._replace(p1 \rightarrow writes_783_12)._replace(p2 \rightarrow
writes_783_12)._replace(p3 \rightarrow writes_783_12)._replace(_ecv_files \rightarrow
writes_783_12)._replace(p1 \rightarrow writes_786_25)._replace(p2 \rightarrow
writes_786_25)._replace(p3 \rightarrow writes_786_25)) \land ($heap<sub>loopend</sub> ==
\theta_{16}. \mathbf{replace}(\$ \theta_{16}. \mathbf{replace}(\$ \theta_{16}. \mathbf{replace}(\$ \theta_{16}. \mathbf{replace})) \land
(asType < real > ((double)0.0) < asType < real > (\$result_786\_25)) \land
(asType < real > (\$result_786\_25) < asType < real > ((double)1.0))
\rightarrow [simplify]
[20.20] (1 == (-\text{count}_{loopstart\_782,5} + \text{count}_{loopend})) \land (\$\text{heap}_{786,16} ==
\text{heap}_{funcstart\_775,1}.\_\mathbf{replace}((\&\text{heap}.\_ecv\_files[1]) \rightarrow
writes_780_5)._replace(p1 \rightarrow writes_783_12)._replace(p2 \rightarrow
writes_783_12)._replace(p3 \rightarrow writes_783_12)._replace(_ecv_files \rightarrow
writes_783_12)._replace(p1 \rightarrow writes_786_25)._replace(p2 \rightarrow
writes_786_25)._replace(p3 \rightarrow writes_786_25)) \land ($heap<sub>loopend</sub> ==
```

```
\text{heap}_{786.16}.\text{-replace}(\text{\$heap}.\text{-ecv\_files}[1] \rightarrow \text{writes}.786.9)) \land (0.0 <
result_786_25) \land (-1.0 < -result_786_25)
\rightarrow [separate conjunction and work on first sub-term]
[20.21] 1 == (-\operatorname{count}_{loopstart\_782,5} + \operatorname{count}_{loopend})
[Take given term]
[33.0] count<sub>loopend</sub> < limit
\rightarrow [from term 20.21, count_{loopend} is equal to 1 + count_{loopstart\_782,5}]
[33.1] (1 + count<sub>loopstart_782,5</sub>) < limit
\rightarrow [from term 5.3, limit is equal to 80]
[33.2] (1 + count_{loopstart\_782,5}) < 80
\rightarrow [simplify]
[33.9] \ \hbox{--} respectively -79 < -count_{loop start\_782,5}
[Take goal term]
[1.0] 0 \leq (asType<integer const>(limit) -
asType<integer>(count<sub>loopend</sub>))
\rightarrow [from term 5.3, 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 20.21, count<sub>loopend</sub> is equal to 1 + count<sub>loopstart_782,5</sub>]
[1.3] 0 \le (80 - \text{asType} < \text{integer} > (1 + \text{count}_{loopstart\_782,5}))
\rightarrow [simplify]
\textit{[1.13]} \text{ -80} < -\text{count}_{loopstart\_782,5}
\rightarrow [from term 33.9, literala <-count_{loopstart\_782,5} 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\prang.c (106,9)

```
Condition defined at:
To prove: minof(int) \le ++count_{loopstart\_782,5}
Given:
heap_{init}.LIMIT == (int)80
\theta sheap<sub>init</sub>.M1 == asType<short int>((int)30269)
\theta_{init}.r1 == asType < short int > ((int)171)
\theta
\theta
\theta sheap<sub>init</sub>.M2 == asType<short int>((int)30307)
\rho_{init}.r2 == asType < short int > ((int)172)
\theta sheap<sub>init</sub>.a2 == asType<short int>((int)176)
\theta = asType < short int > ((int)35)
heap_{init}.M3 == asType < short int > ((int)30323)
\theta_{init}.r3 == asType<short int>((int)170)
heap_{init}.a3 == asType<short int>((int)178)
\theta = asType < short int > ((int)63)
\theta = asType < short int > ((int)1)
\theta
\theta = asType < short int > ((int)3)
limit == \$heap_{funcstart\_775,1}.LIMIT
\mathbf{minof}(\mathbf{int}\ \mathbf{const}) \leq \mathbf{limit}
limit \leq maxof(int const)
count == (int)0
minof(int) \le count
count \leq maxof(int)
heap_{775,1:780,5} ==
\rho_{funcstart\_775,1}.replace((&$heap_{funcstart\_775,1}.ecv_files[1]).$r \rightarrow
writes_780_5
\theta_{loopstart\_782,5} == \theta_{1775,1;780,5}. replace(p1 \rightarrow
writes_783_12)._replace(p2 \rightarrow writes_783_12)._replace(p3 \rightarrow
writes_783_12)._replace(\_ecv\_files \rightarrow writes\_783\_12)
\#writes_783_12 == \#$heap<sub>775,1:780,5</sub>._ecv_files
minof(int) \leq count_{loopstart\_782,5}
```

```
\operatorname{count}_{loopstart\_782,5} \leq \operatorname{maxof}(\operatorname{int})
count_{loopstart\_782,5} < limit
0 \le (asType < integer const > (limit) -
asType < integer > (count_{loopstart\_782,5}))
(asType < integer const > (limit) - asType < integer > (count_{loopstart\_782.5}))
\leq (asType < integer const > (limit) - asType < integer > (count))
heap_{786,16} == heap_{loopstart\_782,5}.replace(p1 \rightarrow writes_786_25)._replace(p2
\rightarrow writes_786_25)._replace(p3 \rightarrow writes_786_25)
\theta_{loopend} == \theta_{r86,16}. \mathbf{replace}((\theta_{r86,16}. \mathbf{lecv_files}[1]). \mathbf{r} \rightarrow \theta_{r86,16}. \mathbf{lecv_files}[1])
writes_786_9)
asType < real > ((double)0.0) < asType < real > ($result_786_25)
asType<real>($result_786_25) < asType<real>((double)1.0)
Proof:
[Take given term]
[5.0] \; \$ \mathrm{heap}_{funcstart\_775,1}.\mathrm{LIMIT} == \mathrm{limit}
\rightarrow [const static or extern object]
[5.1] $heap<sub>init</sub>.LIMIT == limit
\rightarrow [expand definition of constant 'LIMIT' at prang.c (12,18)]
[5.2] (int)80 == limit
\rightarrow [simplify]
[5.3] 80 == limit
[Take given term]
[6.0] (int)0 == count
\rightarrow [simplify]
[6.1] 0 == count
[Take given term]
[19.0] (asType<integer const>(limit) -
asType < integer > (count_{loopstart\_782.5})) \le (asType < integer const > (limit)
- asType<integer>(count))
\rightarrow [from term 5.3, limit is equal to 80]
[19.1] (asType<integer const>(80) -
asType < integer > (count_{loopstart\_782.5})) \le (asType < integer const > (limit)
- asType<integer>(count))
\rightarrow [simplify]
[19.4] (80 + -count<sub>loopstart_782.5</sub>) \leq (asType<integer const>(limit) -
```

```
asType<integer>(count))
\rightarrow [from term 5.3, limit is equal to 80]
[19.5] (80 + -\text{count}_{loopstart\_782,5}) \le (asType < integer const > (80) - (80)
asType<integer>(count))
\rightarrow [simplify]
[19.6] (80 + -\text{count}_{loopstart\_782,5}) \le (80 - \text{asType} < \text{integer} > (\text{count}))
\rightarrow [from term 6.1, count is equal to 0]
[19.7] (80 + -count<sub>loopstart_782,5</sub>) \leq (80 - asType<integer>(0))
\rightarrow [simplify]
\textit{[19.20]} \text{--}1 < \text{count}_{loopstart\_782,5}
[Take goal term]
[1.0] minof(int) \leq ++count<sub>loopstart_782.5</sub>
\rightarrow [simplify]
[1.6] -32770 < count<sub>loopstart_782,5</sub>
\rightarrow [from term 19.20, literala < count_{loopstart\_782,5} 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\prang.c (106,9)
Condition defined at:
To prove: ++\text{count}_{loopstart\_782,5} \leq \text{maxof}(\text{int})
Given:
heap_{init}.LIMIT == (int)80
\theta sheap<sub>init</sub>.M1 == asType<short int>((int)30269)
\theta_{init}.r1 == asType < short int > ((int)171)
\theta
\theta
```

```
\theta sheap<sub>init</sub>.M2 == asType<short int>((int)30307)
\theta_{init}.r2 == asType < short int > ((int)172)
\theta_{init}.a2 == asType<short int>((int)176)
heap_{init}.b2 == asType<short int>((int)35)
heap_{init}.M3 == asType < short int > ((int)30323)
heap_{init}.r3 == asType < short int > ((int)170)
heap_{init}.a3 == asType < short int > ((int)178)
\theta = asType < short int > ((int)63)
\theta = asType < short int > ((int)1)
\theta
\rho = asType < short int > ((int)3)
limit == \$heap_{funcstart\_775,1}.LIMIT
minof(int const) < limit</pre>
limit \leq maxof(int const)
count == (int)0
minof(int) \le count
count \le maxof(int)
heap_{775,1;780,5} ==
heap_{funcstart\_775,1}.replace((&place(flex)).$r \rightarrow
writes_780_5)
heap_{loopstart_{-782,5}} == heap_{775,1;780,5}._replace(p1 \rightarrow
writes_783_12)._replace(p2 \rightarrow writes_783_12)._replace(p3 \rightarrow
writes_783_12)._replace(\_ecv\_files \rightarrow writes\_783\_12)
\#writes_783_12 == \#$heap<sub>775,1:780,5</sub>._ecv_files
minof(int) \leq count_{loopstart\_782,5}
\operatorname{count}_{loopstart\_782,5} \leq \operatorname{maxof}(\operatorname{int})
count_{loopstart\_782,5} < limit
0 \le (asType < integer const > (limit) -
\mathbf{asType}{<}\mathbf{integer}{>}(\mathtt{count}_{loopstart\_782,5}))
(\mathbf{asType} < \mathbf{integer\ const} > (\mathbf{limit}) - \mathbf{asType} < \mathbf{integer} > (\mathbf{count}_{loopstart\_782,5}))
\leq (asType < integer const > (limit) - asType < integer > (count))
$heap_{786,16} == $heap_{loopstart\_782,5}.\_replace(p1 \rightarrow writes\_786\_25).\_replace(p2)
\rightarrow writes_786_25)._replace(p3 \rightarrow writes_786_25)
heap_{loopend} == heap_{786.16}.-replace((&heap_{786.16}.-ecv_files[1]).r \rightarrow
writes_786_9)
```

```
asType < real > ((double)0.0) < asType < real > ($result_786_25)
asType<real>($result_786_25) < asType<real>((double)1.0)
Proof:
[Take given term]
[5.0] heap_{funcstart\_775,1}.LIMIT == limit
\rightarrow [const static or extern object]
[5.1] $heap<sub>init</sub>.LIMIT == limit
\rightarrow [expand definition of constant 'LIMIT' at prang.c (12,18)]
[5.2] (int)80 == limit
\rightarrow [simplify]
[5.3] 80 == limit
[Take given term]
[18.0] \operatorname{count}_{loopstart\_782,5} < \operatorname{limit}
\rightarrow [from term 5.3, limit is equal to 80]
[18.1] \operatorname{count}_{loopstart\_782,5} < 80
\rightarrow [simplify]
[18.4] - 80 < -\text{count}_{loopstart\_782,5}
[Take goal term]
[1.0] ++count<sub>loopstart_782,5</sub> \leq maxof(int)
\rightarrow [simplify]
\textit{[1.9]} \ \texttt{-32767} < -\text{count}_{loopstart\_782,5}
\rightarrow [from term 18.4, literala < -count_{loopstart\_782.5} 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
```

Condition generated at: C:\Escher\Customers\prang\prang.c (31,19) Condition defined at:

```
To prove: minof(short int) \le (int)3
Given:
heap_{init}.LIMIT == (int)80
heap_{init}.M1 == asType < short int > ((int)30269)
\theta_{init}.r1 == asType < short int > ((int)171)
heap_{init}.a1 == asType < short int > ((int)177)
\theta
heap_{init}.M2 == asType < short int > ((int)30307)
\theta_{init}.r2 == asType < short int > ((int)172)
heap_{init}.a2 == asType < short int > ((int)176)
\theta == asType<short int>((int)35)
heap_{init}.M3 == asType < short int > ((int)30323)
heap_{init}.r3 == asType < short int > ((int)170)
heap_{init}.a3 == asType < short int > ((int)178)
\theta = asType < short int > ((int)63)
\theta = asType < short int > ((int)1)
\theta
Proof:
[Take goal term]
[1.0] minof(short int) \le (int)3
\rightarrow [simplify]
[1.3] true
Proof of verification condition: Type constraint satisfied in explicit
conversion from 'int' to 'short int'
Condition generated at: C:\Escher\Customers\prang\prang.c (31,19)
Condition defined at:
To prove: (int)3 \le maxof(short\ int)
Given:
heap_{init}.LIMIT == (int)80
heap_{init}.M1 == asType < short int > ((int)30269)
\theta_{init}.r1 == asType < short int > ((int)171)
\theta sheap<sub>init</sub>.a1 == asType<short int>((int)177)
```

```
heap_{init}.M2 == asType < short int > ((int)30307)
\theta
heap_{init}.a2 == asType < short int > ((int)176)
heap_{init}.b2 == asType < short int > ((int)35)
heap_{init}.M3 == asType < short int > ((int)30323)
\theta_{init}.r3 == asType<short int>((int)170)
heap_{init}.a3 == asType<short int>((int)178)
\theta = asType < short int > ((int)63)
\theta
\rho = asType < short int > ((int)2)
Proof:
[Take goal term]
[1.0] (int)3 \le \max(\text{short int})
\rightarrow [simplify]
[1.3] true
Proof of verification condition: Type constraint satisfied in explicit
conversion from 'int' to 'short int'
Condition generated at: C:\Escher\Customers\prang\prang.c (30,19)
Condition defined at:
To prove: minof(short int) < (int)2
Given:
heap_{init}.LIMIT == (int)80
\theta sheap<sub>init</sub>.M1 == asType<short int>((int)30269)
heap_{init}.r1 == asType < short int > ((int)171)
\theta
\theta
\theta sheap<sub>init</sub>.M2 == asType<short int>((int)30307)
\theta_{init}.r2 == asType<short int>((int)172)
heap_{init}.a2 == asType < short int > ((int)176)
\theta = asType < short int > ((int)35)
heap_{init}.M3 == asType < short int > ((int)30323)
```

```
\theta_{init}.r3 == asType<short int>((int)170)
heap_{init}.a3 == asType<short int>((int)178)
\theta = asType < short int > ((int)63)
\theta
Proof:
[Take goal term]
[1.0] minof(short int) \leq (int)2
\rightarrow [simplify]
[1.3] true
Proof of verification condition: Type constraint satisfied in explicit
conversion from 'int' to 'short int'
Condition generated at: C:\Escher\Customers\prang\prang.c (30,19)
Condition defined at:
To prove: (int)2 < maxof(short int)
Given:
heap_{init}.LIMIT == (int)80
\theta
\theta
heap_{init}.a1 == asType<short int>((int)177)
\theta
heap_{init}.M2 == asType < short int > ((int)30307)
\theta_{init}.r2 == asType<short int>((int)172)
heap_{init}.a2 == asType < short int > ((int)176)
\theta = asType < short int > ((int)35)
\theta sheap<sub>init</sub>.M3 == asType<short int>((int)30323)
\theta
heap_{init}.a3 == asType < short int > ((int)178)
\theta = asType < short int > ((int)63)
\theta = asType < short int > ((int)1)
Proof:
[Take goal term]
[1.0] (int)2 \leq maxof(short int)
```

```
\rightarrow [simplify]
[1.3] true
Proof of verification condition: Type constraint satisfied in explicit
conversion from 'int' to 'short int'
Condition generated at: C:\Escher\Customers\prang\prang.c (29,19)
Condition defined at:
To prove: minof(short int) \le (int)1
Given:
heap_{init}.LIMIT == (int)80
heap_{init}.M1 == asType < short int > ((int)30269)
\theta_{init}.r1 == asType < short int > ((int)171)
heap_{init}.a1 == asType < short int > ((int)177)
\theta
heap_{init}.M2 == asType < short int > ((int)30307)
\label{eq:short_int} $$ $ = asType < short int > ((int)172) $$
\label{eq:asType} $$  \  = asType < short int > ((int)176)$  
\theta = asType < short int > ((int)35)
heap_{init}.M3 == asType < short int > ((int)30323)
heap_{init}.r3 == asType < short int > ((int)170)
heap_{init}.a3 == asType < short int > ((int)178)
\theta = asType < short int > ((int)63)
Proof:
[Take goal term]
[1.0] minof(short int) \leq (int)1
\rightarrow [\text{simplify}]
[1.3] true
Proof of verification condition: Type constraint satisfied in explicit
conversion from 'int' to 'short int'
Condition generated at: C:\Escher\Customers\prang\prang.c (29,19)
```

Condition defined at:

To prove: (int)1 < maxof(short int)

#### Given:

```
heap_{init}.LIMIT == (int)80
\theta
\theta_{init}.r1 == asType < short int > ((int)171)
heap_{init}.a1 == asType < short int > ((int)177)
\theta = asType < short int > ((int)2)
heap_{init}.M2 == asType < short int > ((int)30307)
\theta_{init}.r2 == asType < short int > ((int)172)
heap_{init}.a2 == asType < short int > ((int)176)
\theta = asType < short int > ((int)35)
heap_{init}.M3 == asType < short int > ((int)30323)
\theta_{init}.r3 == asType<short int>((int)170)
heap_{init}.a3 == asType<short int>((int)178)
\theta = asType < short int > ((int)63)
Proof:
[Take goal term]
[1.0] (int)1 \leq maxof(short int)
\rightarrow [simplify]
[1.3] true
Proof of verification condition: Type constraint satisfied in explicit
conversion from 'int' to 'short int'
Condition generated at: C:\Escher\Customers\prang\prang.c (27,29)
Condition defined at:
To prove: minof(short int) \le (int)63
Given:
heap_{init}.LIMIT == (int)80
\theta sheap<sub>init</sub>.M1 == asType<short int>((int)30269)
\theta
\theta
\theta
heap_{init}.M2 == asType < short int > ((int)30307)
heap_{init}.r2 == asType < short int > ((int)172)
```

```
heap_{init}.a2 == asType < short int > ((int)176)
\theta
heap_{init}.M3 == asType < short int > ((int)30323)
heap_{init}.r3 == asType < short int > ((int)170)
heap_{init}.a3 == asType < short int > ((int)178)
Proof:
[Take goal term]
[1.0] minof(short int) \leq (int)63
\rightarrow [simplify]
[1.3] true
Proof of verification condition: Type constraint satisfied in explicit
conversion from 'int' to 'short int'
Condition generated at: C:\Escher\Customers\prang\prang.c (27,29)
Condition defined at:
To prove: (int)63 \le maxof(short\ int)
Given:
heap_{init}.LIMIT == (int)80
\theta
heap_{init}.r1 == asType < short int > ((int)171)
\theta
\theta
heap_{init}.M2 == asType < short int > ((int)30307)
\theta_{init}.r2 == asType < short int > ((int)172)
heap_{init}.a2 == asType < short int > ((int)176)
\theta == asType<short int>((int)35)
\theta sheap<sub>init</sub>.M3 == asType<short int>((int)30323)
\theta_{init}.r3 == asType<short int>((int)170)
\theta == asType<short int>((int)178)
Proof:
[Take goal term]
[1.0] (int)63 \leq maxof(short int)
\rightarrow [simplify]
```

```
[1.3] true
```

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

Condition generated at: C:\Escher\Customers\prang\prang.c (26,29)

Condition defined at:

To prove:  $minof(short int) \le (int)178$ 

#### Given:

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

 $heap_{init}.M1 == asType < short int > ((int)30269)$ 

 $\theta$ 

 $heap_{init}.a1 == asType < short int > ((int)177)$ 

 $\theta$ 

 $\theta$  sheap<sub>init</sub>.M2 == asType<short int>((int)30307)

 $\theta_{init}.r2 == asType < short int > ((int)172)$ 

 $\theta$ 

 $\theta$ 

 $\theta$  == asType<short int>((int)30323)

 $\theta$ 

# **Proof:**

[Take goal term]

[1.0] minof(short int)  $\leq$  (int)178

 $\rightarrow$  [simplify]

[1.3] **true** 

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

Condition generated at: C:\Escher\Customers\prang\prang.c (26,29)

#### Condition defined at:

To prove:  $(int)178 \le maxof(short\ int)$ 

### Given:

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

 $\theta$  sheap<sub>init</sub>.M1 == asType<short int>((int)30269)

```
\theta_{init}.r1 == asType < short int > ((int)171)
heap_{init}.a1 == asType < short int > ((int)177)
heap_{init}.M2 == asType < short int > ((int)30307)
\theta_{init}.r2 == asType<short int>((int)172)
heap_{init}.a2 == asType < short int > ((int)176)
\theta = asType < short int > ((int)35)
heap_{init}.M3 == asType < short int > ((int)30323)
\theta_{init}.r3 == asType<short int>((int)170)
Proof:
[Take goal term]
[1.0] (int)178 \leq maxof(short int)
\rightarrow [simplify]
[1.3] true
Proof of verification condition: Type constraint satisfied in explicit
conversion from 'int' to 'short int'
Condition generated at: C:\Escher\Customers\prang\prang.c (25,29)
Condition defined at:
To prove: minof(short int) \le (int)170
Given:
heap_{init}.LIMIT == (int)80
\theta sheap<sub>init</sub>.M1 == asType<short int>((int)30269)
\theta_{init}.r1 == asType < short int > ((int)171)
\theta
\theta
\theta sheap<sub>init</sub>.M2 == asType<short int>((int)30307)
\theta_{init}.r2 == asType<short int>((int)172)
\theta
\theta = asType < short int > ((int)35)
\label{eq:short_int} \$ \mathrm{heap}_{init}.\mathrm{M3} == \mathbf{asType} < \mathbf{short\ int} > ((\mathbf{int})30323)
Proof:
[Take goal term]
```

```
[1.0] minof(short int) \leq (int)170
\rightarrow [simplify]
[1.3] true
Proof of verification condition: Type constraint satisfied in explicit
conversion from 'int' to 'short int'
Condition generated at: C:\Escher\Customers\prang\prang.c (25,29)
Condition defined at:
To prove: (int)170 \le maxof(short\ int)
Given:
heap_{init}.LIMIT == (int)80
heap_{init}.M1 == asType < short int > ((int)30269)
heap_{init}.r1 == asType < short int > ((int)171)
heap_{init}.a1 == asType < short int > ((int)177)
\theta = asType < short int > ((int)2)
\theta_{init}.M2 == asType < short int > ((int)30307)
\theta_{init}.r2 == asType < short int > ((int)172)
\theta sheap<sub>init</sub>.a2 == asType<short int>((int)176)
\theta = asType < short int > ((int)35)
heap_{init}.M3 == asType < short int > ((int)30323)
Proof:
[Take goal term]
[1.0] (int)170 \leq maxof(short int)
\rightarrow [simplify]
[1.3] true
Proof of verification condition: Type constraint satisfied in explicit
conversion from 'int' to 'short int'
Condition generated at: C:\Escher\Customers\prang\prang.c (24,29)
Condition defined at:
To prove: minof(short int) \le (int)30323
```

Given:

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

```
\theta sheap<sub>init</sub>.M1 == asType<short int>((int)30269)
\theta_{init}.r1 == asType < short int > ((int)171)
\theta
\theta = asType < short int > ((int)2)
\theta sheap<sub>init</sub>.M2 == asType<short int>((int)30307)
\theta_{init}.r2 == asType < short int > ((int)172)
heap_{init}.a2 == asType < short int > ((int)176)
\theta = asType < short int > ((int)35)
Proof:
[Take goal term]
[1.0] minof(short int) \leq (int)30323
\rightarrow [simplify]
[1.3] true
Proof of verification condition: Type constraint satisfied in explicit
conversion from 'int' to 'short int'
Condition generated at: C:\Escher\Customers\prang\prang.c (24,29)
Condition defined at:
To prove: (int)30323 \le maxof(short\ int)
Given:
heap_{init}.LIMIT == (int)80
heap_{init}.M1 == asType < short int > ((int)30269)
\theta_{init}.r1 == asType < short int > ((int)171)
heap_{init}.a1 == asType < short int > ((int)177)
\theta
\theta sheap<sub>init</sub>.M2 == asType<short int>((int)30307)
\theta
heap_{init}.a2 == asType < short int > ((int)176)
\theta
Proof:
[Take goal term]
[1.0] (int)30323 \leq maxof(short int)
\rightarrow [simplify]
```

```
[1.3] true
```

```
Proof of verification condition: Type constraint satisfied in explicit conversion from 'int' to 'short int' 
Condition generated at: C:\Escher\Customers\prang\prang.c (22,29) 
Condition defined at: 
To prove: minof(short\ int) \leq (int)35 
Given: 
sheap_{init}.LIMIT == (int)80
```

 $$heap_{init}.r1 == asType < short int > ((int)171)$   $$heap_{init}.a1 == asType < short int > ((int)177)$  $$heap_{init}.b1 == asType < short int > ((int)2)$ 

 $heap_{init}.M1 == asType < short int > ((int)30269)$ 

 $\label{eq:heapinit} \$ \mathrm{heap}_{init}.\mathrm{M2} == \mathbf{asType} < \mathbf{short\ int} > ((\mathbf{int})30307)$ 

 $\label{eq:short_int} $$ $ = asType < short int > ((int)172) $$$ 

 $\theta$ 

#### **Proof:**

[Take goal term]
[1.0]  $minof(short int) \leq (int)35$   $\rightarrow [simplify]$ [1.3] true

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

Condition generated at: C:\Escher\Customers\prang\prang.c (22,29)

# Condition defined at:

To prove:  $(int)35 \le maxof(short\ int)$ 

## Given:

 $$heap_{init}.LIMIT == (int)80$$ $heap_{init}.M1 == asType < short int > ((int)30269)$$ $heap_{init}.r1 == asType < short int > ((int)171)$$ $heap_{init}.a1 == asType < short int > ((int)177)$$ $heap_{init}.b1 == asType < short int > ((int)2)$$$ 

```
\theta sheap<sub>init</sub>.M2 == asType<short int>((int)30307)
\theta_{init}.r2 == asType < short int > ((int)172)
heap_{init}.a2 == asType < short int > ((int)176)
Proof:
[Take goal term]
[1.0] (int)35 \leq maxof(short int)
\rightarrow [simplify]
[1.3] true
Proof of verification condition: Type constraint satisfied in explicit
conversion from 'int' to 'short int'
Condition generated at: C:\Escher\Customers\prang\prang.c (21,29)
Condition defined at:
To prove: minof(short int) \le (int)176
Given:
heap_{init}.LIMIT == (int)80
\theta
\theta
heap_{init}.a1 == asType < short int > ((int)177)
\theta
heap_{init}.M2 == asType < short int > ((int)30307)
\rho_{init}.r2 == asType < short int > ((int)172)
Proof:
[Take goal term]
[1.0] minof(short int) \leq (int)176
\rightarrow [simplify]
[1.3] true
Proof of verification condition: Type constraint satisfied in explicit
conversion from 'int' to 'short int'
Condition generated at: C:\Escher\Customers\prang\prang.c (21,29)
Condition defined at:
```

To prove:  $(int)176 \le maxof(short\ int)$ 

```
Given:
heap_{init}.LIMIT == (int)80
heap_{init}.M1 == asType < short int > ((int)30269)
\theta_{init}.r1 == asType < short int > ((int)171)
heap_{init}.a1 == asType < short int > ((int)177)
\theta
\theta sheap<sub>init</sub>.M2 == asType<short int>((int)30307)
\rho_{init}.r2 == asType < short int > ((int)172)
Proof:
[Take goal term]
[1.0] (int)176 \leq maxof(short int)
\rightarrow [simplify]
[1.3] true
Proof of verification condition: Type constraint satisfied in explicit
conversion from 'int' to 'short int'
Condition generated at: C:\Escher\Customers\prang\prang.c (20,29)
Condition defined at:
To prove: minof(short int) \le (int)172
Given:
heap_{init}.LIMIT == (int)80
heap_{init}.M1 == asType < short int > ((int)30269)
\theta_{init}.r1 == asType < short int > ((int)171)
heap_{init}.a1 == asType < short int > ((int)177)
\theta
\theta sheap<sub>init</sub>.M2 == asType<short int>((int)30307)
Proof:
[Take goal term]
```

Proof of verification condition: Type constraint satisfied in explicit

[1.0] minof(short int)  $\leq$  (int)172

 $\rightarrow$  [simplify] [1.3] **true** 

```
Condition generated at: C:\Escher\Customers\prang\prang.c (20,29)
Condition defined at:
To prove: (int)172 \le maxof(short\ int)
Given:
heap_{init}.LIMIT == (int)80
\theta sheap<sub>init</sub>.M1 == asType<short int>((int)30269)
\theta_{init}.r1 == asType < short int > ((int)171)
\theta sheap<sub>init</sub>.a1 == asType<short int>((int)177)
\theta = asType < short int > ((int)2)
heap_{init}.M2 == asType < short int > ((int)30307)
Proof:
[Take goal term]
[1.0] (int)172 \leq \max(\text{short int})
\rightarrow [simplify]
[1.3] true
Proof of verification condition: Type constraint satisfied in explicit
conversion from 'int' to 'short int'
Condition generated at: C:\Escher\Customers\prang\prang.c (19,29)
Condition defined at:
To prove: minof(short int) \le (int)30307
Given:
heap_{init}.LIMIT == (int)80
\theta sheap<sub>init</sub>.M1 == asType<short int>((int)30269)
\theta
\theta
\theta = asType < short int > ((int)2)
Proof:
[Take goal term]
[1.0] minof(short int) \leq (int)30307
\rightarrow [simplify]
[1.3] true
```

conversion from 'int' to 'short int'

```
Proof of verification condition: Type constraint satisfied in explicit
conversion from 'int' to 'short int'
Condition generated at: C:\Escher\Customers\prang\prang.c (19,29)
Condition defined at:
To prove: (int)30307 \le maxof(short\ int)
Given:
heap_{init}.LIMIT == (int)80
\theta
\theta_{init}.r1 == asType < short int > ((int)171)
\theta sheap<sub>init</sub>.a1 == asType<short int>((int)177)
\theta = asType < short int > ((int)2)
Proof:
[Take goal term]
[1.0] (int)30307 \leq maxof(short int)
\rightarrow [simplify]
[1.3] true
Proof of verification condition: Type constraint satisfied in explicit
conversion from 'int' to 'short int'
Condition generated at: C:\Escher\Customers\prang\prang.c (17,29)
Condition defined at:
To prove: minof(short int) \le (int)2
Given:
heap_{init}.LIMIT == (int)80
\theta
\theta_{init}.r1 == asType < short int > ((int)171)
heap_{init}.a1 == asType < short int > ((int)177)
Proof:
[Take goal term]
[1.0] minof(short int) \leq (int)2
\rightarrow [simplify]
[1.3] true
```

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

Condition generated at: C:\Escher\Customers\prang\prang.c (17,29)

Condition defined at:
```

To prove:  $(int)2 \le maxof(short\ int)$ 

#### Given:

 $$heap_{init}.LIMIT == (int)80$$ $heap_{init}.M1 == asType < short int > ((int)30269)$$ $heap_{init}.r1 == asType < short int > ((int)171)$$ $heap_{init}.a1 == asType < short int > ((int)177)$$$ 

#### **Proof:**

[Take goal term]
[1.0] (int)2  $\leq$  maxof(short int)  $\rightarrow$  [simplify]
[1.3] true

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

Condition generated at: C:\Escher\Customers\prang\prang.c (16,29)

## Condition defined at:

To prove:  $minof(short int) \le (int)177$ 

### Given:

$$\label{eq:heapinit} \begin{split} &\text{$\text{heap}_{init}$.} \text{$\text{LIMIT} == (int)80$} \\ &\text{$\text{heap}_{init}$.} \text{$\text{M1} == asType} < \text{short int} > ((int)30269)$} \\ &\text{$\text{heap}_{init}$.} \text{$\text{r1} == asType} < \text{short int} > ((int)171)$} \end{split}$$

#### **Proof:**

[Take goal term]  $[1.0] \ \mathbf{minof(short\ int)} \leq (\mathbf{int}) 177 \\ \rightarrow [\mathbf{simplify}] \\ [1.3] \ \mathbf{true}$ 

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

Condition generated at: C:\Escher\Customers\prang\prang.c (16,29)

```
Condition defined at:
```

To prove:  $(int)177 \le maxof(short\ int)$ 

### Given:

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

 $\theta$ 

 $heap_{init}.r1 == asType < short int > ((int)171)$ 

### **Proof:**

[Take goal term]

[1.0] (int)177  $\leq$  maxof(short int)

 $\rightarrow$  [simplify]

[1.3] **true** 

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

Condition generated at: C:\Escher\Customers\prang\prang.c (15,29)

Condition defined at:

To prove:  $minof(short int) \le (int)171$ 

## Given:

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

 $\theta$  sheap<sub>init</sub>.M1 == asType<short int>((int)30269)

### **Proof:**

[Take goal term]

[1.0] minof(short int)  $\leq$  (int)171

 $\rightarrow$  [simplify]

[1.3] **true** 

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

Condition generated at: C:\Escher\Customers\prang\prang.c (15,29)

Condition defined at:

To prove:  $(int)171 \le maxof(short int)$ 

Given:

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

```
heap_{init}.M1 == asType < short int > ((int)30269)
Proof:
[Take goal term]
[1.0] (int)171 \leq maxof(short int)
\rightarrow [simplify]
[1.3] true
Proof of verification condition: Type constraint satisfied in explicit
conversion from 'int' to 'short int'
Condition generated at: C:\Escher\Customers\prang\prang.c (14,29)
Condition defined at:
To prove: minof(short int) \le (int)30269
Given:
heap_{init}.LIMIT == (int)80
Proof:
[Take goal term]
[1.0] minof(short int) \leq (int)30269
\rightarrow [simplify]
[1.3] true
Proof of verification condition: Type constraint satisfied in explicit
conversion from 'int' to 'short int'
Condition generated at: C:\Escher\Customers\prang\prang.c (14,29)
Condition defined at:
To prove: (int)30269 \le maxof(short\ int)
Given:
heap_{init}.LIMIT == (int)80
Proof:
[Take goal term]
[1.0] (int)30269 \leq maxof(short int)
\rightarrow [simplify]
[1.3] true
```

End of proofs for file C:\Escher\Customers\prang\prang.c