Proofs for file C:\Escher\Customers\prang\prang.c

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Escher Verification Studio file versions

EscherTool 7.00
ecv 7.00.00.00
rubric 7.00.00.01

Proved 143 of 143 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 (41,22)

Condition defined at:

To prove: minof(int) $\leq$ \$heap$_{funcstart\_719,1}$.p1

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)

\$heap$_{init}$.M2 $==$ **asType**<**short int**>((**int**)30307)

\$heap$_{init}$.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)

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

\$heap$_{init}$.a3 $==$ **asType**<**short int**>((**int**)178)

\$heap$_{init}$.b3 $==$ **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)

Proof:

[Take goal term]

[1.0] **minof(int)** $\leq$ \$heap$_{funcstart\_719,1}$.p1

$\rightarrow$ *[simplify]*

[1.3] -32769 < $\$\text{heap}_{funcstart\_719,1}.\text{p1}$

$\rightarrow$ *[negate goal and search for contradiction]*

[1.4] !(-32769 < $\$\text{heap}_{funcstart\_719,1}.\text{p1}$)

$\rightarrow$ *[simplify]*

[1.6] 32768 < $-\$\text{heap}_{funcstart\_719,1}.\text{p1}$

[Assume known post-assertion, class invariant or type constraint for term 1.6]

[5.0] **minof(short int)** $\leq \$\text{heap}_{funcstart\_719,1}.\text{p1}$

$\rightarrow$ *[simplify]*

[5.3] -32769 < $\$\text{heap}_{funcstart\_719,1}.\text{p1}$

$\rightarrow$ *[from term 1.6, literala < $\$\text{heap}_{funcstart\_719,1}.\text{p1}$ is false whenever -2 < (32768 + literala)]*

> **Proof of rule precondition:**
>
> *[5.3.0]* -2 < (-32769 + 32768)
>
> $\rightarrow$ *[simplify]*
>
> *[5.3.2]* **true**

[5.4] **false**

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

Condition generated at: C:\Escher\Customers\prang\prang.c (41,22)

Condition defined at:

To prove: $\$\text{heap}_{funcstart\_719,1}.\text{p1} \leq$ **maxof(int)**

Given:

$\$\text{heap}_{init}.\text{LIMIT} == (\textbf{int})80$

$\$\text{heap}_{init}.\text{M1} == \textbf{asType<short int>}((\textbf{int})30269)$

$\$\text{heap}_{init}.\text{r1} == \textbf{asType<short int>}((\textbf{int})171)$

$\$\text{heap}_{init}.\text{a1} == \textbf{asType<short int>}((\textbf{int})177)$

$\$\text{heap}_{init}.\text{b1} == \textbf{asType<short int>}((\textbf{int})2)$

$\$\text{heap}_{init}.\text{M2} == \textbf{asType<short int>}((\textbf{int})30307)$

$\$\text{heap}_{init}.\text{r2} == \textbf{asType<short int>}((\textbf{int})172)$

$\$\text{heap}_{init}.\text{a2} == \textbf{asType<short int>}((\textbf{int})176)$

$\$\text{heap}_{init}.\text{b2} == \textbf{asType<short int>}((\textbf{int})35)$

$\$heap_{init}$.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)

$\$heap_{init}$.p1 == **asType\<short int\>**((**int**)1)

$\$heap_{init}$.p2 == **asType\<short int\>**((**int**)2)

$\$heap_{init}$.p3 == **asType\<short int\>**((**int**)3)

Proof:

[Take goal term]

[1.0] $\$heap_{funcstart\_719,1}$.p1 $\leq$ **maxof**(**int**)

$\rightarrow$ *[simplify]*

[1.9] -32768 $< -\$heap_{funcstart\_719,1}$.p1

$\rightarrow$ *[negate goal and search for contradiction]*

[1.10] !(-32768 $< -\$heap_{funcstart\_719,1}$.p1)

$\rightarrow$ *[simplify]*

[1.13] 32767 $< \$heap_{funcstart\_719,1}$.p1

[Assume known post-assertion, class invariant or type constraint for term 1.13]

[5.0] $\$heap_{funcstart\_719,1}$.p1 $\leq$ **maxof**(**short int**)

$\rightarrow$ *[simplify]*

[5.9] -32768 $< -\$heap_{funcstart\_719,1}$.p1

$\rightarrow$ *[from term 1.13, literala $< -\$heap_{funcstart\_719,1}$.p1 is false whenever -2 < (32767 + literala)]*

   Proof of rule precondition:

   [5.9.0] -2 < (-32768 + 32767)

   $\rightarrow$ *[simplify]*

   [5.9.2] **true**

[5.10] **false**

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 (41,31)

Condition defined at:

To prove: minof(**int**) $\leq \$heap_{funcstart\_719,1}$.a1

Given:

$\$\text{heap}_{init}.\text{LIMIT} == (\textbf{int})80$

$\$\text{heap}_{init}.\text{M1} == \textbf{asType}<\textbf{short int}>((\textbf{int})30269)$

$\$\text{heap}_{init}.\text{r1} == \textbf{asType}<\textbf{short int}>((\textbf{int})171)$

$\$\text{heap}_{init}.\text{a1} == \textbf{asType}<\textbf{short int}>((\textbf{int})177)$

$\$\text{heap}_{init}.\text{b1} == \textbf{asType}<\textbf{short int}>((\textbf{int})2)$

$\$\text{heap}_{init}.\text{M2} == \textbf{asType}<\textbf{short int}>((\textbf{int})30307)$

$\$\text{heap}_{init}.\text{r2} == \textbf{asType}<\textbf{short int}>((\textbf{int})172)$

$\$\text{heap}_{init}.\text{a2} == \textbf{asType}<\textbf{short int}>((\textbf{int})176)$

$\$\text{heap}_{init}.\text{b2} == \textbf{asType}<\textbf{short int}>((\textbf{int})35)$

$\$\text{heap}_{init}.\text{M3} == \textbf{asType}<\textbf{short int}>((\textbf{int})30323)$

$\$\text{heap}_{init}.\text{r3} == \textbf{asType}<\textbf{short int}>((\textbf{int})170)$

$\$\text{heap}_{init}.\text{a3} == \textbf{asType}<\textbf{short int}>((\textbf{int})178)$

$\$\text{heap}_{init}.\text{b3} == \textbf{asType}<\textbf{short int}>((\textbf{int})63)$

$\$\text{heap}_{init}.\text{p1} == \textbf{asType}<\textbf{short int}>((\textbf{int})1)$

$\$\text{heap}_{init}.\text{p2} == \textbf{asType}<\textbf{short int}>((\textbf{int})2)$

$\$\text{heap}_{init}.\text{p3} == \textbf{asType}<\textbf{short int}>((\textbf{int})3)$

Proof:

[Take goal term]

[1.0] $\textbf{minof}(\textbf{int}) \leq \$\text{heap}_{funcstart\_719,1}.\text{a1}$

$\rightarrow$ *[simplify]*

[1.1] $-32768 \leq \$\text{heap}_{funcstart\_719,1}.\text{a1}$

$\rightarrow$ *[const static or extern object]*

[1.2] $-32768 \leq \$\text{heap}_{init}.\text{a1}$

$\rightarrow$ *[expand definition of constant 'a1' at prang.c (16,20)]*

[1.3] $-32768 \leq \textbf{asType}<\textbf{short int}>((\textbf{int})177)$

$\rightarrow$ *[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 (41,31)

Condition defined at:

To prove: $\$\text{heap}_{funcstart\_719,1}.a1 \leq \mathbf{maxof(int)}$

Given:

$\$\text{heap}_{init}.\text{LIMIT} == (\mathbf{int})80$

$\$\text{heap}_{init}.\text{M1} == \mathbf{asType<short\ int>}((\mathbf{int})30269)$

$\$\text{heap}_{init}.\text{r1} == \mathbf{asType<short\ int>}((\mathbf{int})171)$

$\$\text{heap}_{init}.\text{a1} == \mathbf{asType<short\ int>}((\mathbf{int})177)$

$\$\text{heap}_{init}.\text{b1} == \mathbf{asType<short\ int>}((\mathbf{int})2)$

$\$\text{heap}_{init}.\text{M2} == \mathbf{asType<short\ int>}((\mathbf{int})30307)$

$\$\text{heap}_{init}.\text{r2} == \mathbf{asType<short\ int>}((\mathbf{int})172)$

$\$\text{heap}_{init}.\text{a2} == \mathbf{asType<short\ int>}((\mathbf{int})176)$

$\$\text{heap}_{init}.\text{b2} == \mathbf{asType<short\ int>}((\mathbf{int})35)$

$\$\text{heap}_{init}.\text{M3} == \mathbf{asType<short\ int>}((\mathbf{int})30323)$

$\$\text{heap}_{init}.\text{r3} == \mathbf{asType<short\ int>}((\mathbf{int})170)$

$\$\text{heap}_{init}.\text{a3} == \mathbf{asType<short\ int>}((\mathbf{int})178)$

$\$\text{heap}_{init}.\text{b3} == \mathbf{asType<short\ int>}((\mathbf{int})63)$

$\$\text{heap}_{init}.\text{p1} == \mathbf{asType<short\ int>}((\mathbf{int})1)$

$\$\text{heap}_{init}.\text{p2} == \mathbf{asType<short\ int>}((\mathbf{int})2)$

$\$\text{heap}_{init}.\text{p3} == \mathbf{asType<short\ int>}((\mathbf{int})3)$

Proof:

[Take goal term]

[1.0] $\$\text{heap}_{funcstart\_719,1}.a1 \leq \mathbf{maxof(int)}$

$\rightarrow$ *[const static or extern object]*

[1.1] $\$\text{heap}_{init}.a1 \leq \mathbf{maxof(int)}$

$\rightarrow$ *[expand definition of constant 'a1' at prang.c (16,20)]*

[1.2] $\mathbf{asType<short\ int>}((\mathbf{int})177) \leq \mathbf{maxof(int)}$

$\rightarrow$ *[simplify]*

[1.6] **true**

Proof of verification condition: Precondition of 'div' satisfied

Condition generated at: C:\Escher\Customers\prang\prang.c (41,18)

Condition defined at: C:\Escher\ecv\standard\stdlib.h (94,10)

To prove: $0 < \mathbf{asType<integer>}(\mathbf{asType<int>}(\$\text{heap}_{funcstart\_719,1}.a1))$

Given:

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

$\$heap_{init}.\text{M1} == \textbf{asType<short int>}((\textbf{int})30269)$

$\$heap_{init}.\text{r1} == \textbf{asType<short int>}((\textbf{int})171)$

$\$heap_{init}.\text{a1} == \textbf{asType<short int>}((\textbf{int})177)$

$\$heap_{init}.\text{b1} == \textbf{asType<short int>}((\textbf{int})2)$

$\$heap_{init}.\text{M2} == \textbf{asType<short int>}((\textbf{int})30307)$

$\$heap_{init}.\text{r2} == \textbf{asType<short int>}((\textbf{int})172)$

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

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

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

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

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

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

$\$heap_{init}.\text{p1} == \textbf{asType<short int>}((\textbf{int})1)$

$\$heap_{init}.\text{p2} == \textbf{asType<short int>}((\textbf{int})2)$

$\$heap_{init}.\text{p3} == \textbf{asType<short int>}((\textbf{int})3)$

Proof:

[Take goal term]

[1.0] $0 < \textbf{asType<integer>}(\textbf{asType<int>}(\$heap_{funcstart\_719,1}.\text{a1}))$

$\rightarrow$ *[const static or extern object]*

[1.1] $0 < \textbf{asType<integer>}(\textbf{asType<int>}(\$heap_{init}.\text{a1}))$

$\rightarrow$ *[expand definition of constant 'a1' at prang.c (16,20)]*

[1.2] $0 < \textbf{asType<integer>}(\textbf{asType<int>}(\textbf{asType<short int>}((\textbf{int})177)))$

$\rightarrow$ *[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 (42,22)

Condition defined at:

To prove: minof(int) $\leq \$heap_{funcstart\_719,1}.\text{p2}$

Given:

$\$\text{heap}_{init}.\text{LIMIT} == (\textbf{int})80$

$\$\text{heap}_{init}.\text{M1} == \textbf{asType}<\textbf{short int}>((\textbf{int})30269)$

$\$\text{heap}_{init}.\text{r1} == \textbf{asType}<\textbf{short int}>((\textbf{int})171)$

$\$\text{heap}_{init}.\text{a1} == \textbf{asType}<\textbf{short int}>((\textbf{int})177)$

$\$\text{heap}_{init}.\text{b1} == \textbf{asType}<\textbf{short int}>((\textbf{int})2)$

$\$\text{heap}_{init}.\text{M2} == \textbf{asType}<\textbf{short int}>((\textbf{int})30307)$

$\$\text{heap}_{init}.\text{r2} == \textbf{asType}<\textbf{short int}>((\textbf{int})172)$

$\$\text{heap}_{init}.\text{a2} == \textbf{asType}<\textbf{short int}>((\textbf{int})176)$

$\$\text{heap}_{init}.\text{b2} == \textbf{asType}<\textbf{short int}>((\textbf{int})35)$

$\$\text{heap}_{init}.\text{M3} == \textbf{asType}<\textbf{short int}>((\textbf{int})30323)$

$\$\text{heap}_{init}.\text{r3} == \textbf{asType}<\textbf{short int}>((\textbf{int})170)$

$\$\text{heap}_{init}.\text{a3} == \textbf{asType}<\textbf{short int}>((\textbf{int})178)$

$\$\text{heap}_{init}.\text{b3} == \textbf{asType}<\textbf{short int}>((\textbf{int})63)$

$\$\text{heap}_{init}.\text{p1} == \textbf{asType}<\textbf{short int}>((\textbf{int})1)$

$\$\text{heap}_{init}.\text{p2} == \textbf{asType}<\textbf{short int}>((\textbf{int})2)$

$\$\text{heap}_{init}.\text{p3} == \textbf{asType}<\textbf{short int}>((\textbf{int})3)$

div1 == div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, **asType**$<\textbf{int}>(\$\text{heap}_{funcstart\_719,1}.\text{p1})$, **asType**$<\textbf{int}>(\$\text{heap}_{funcstart\_719,1}.\text{a1}))$

$(\textbf{asType}<\textbf{integer}>(\textbf{asType}<\textbf{int}>(\$\text{heap}_{funcstart\_719,1}.\text{p1}))$ / $\textbf{asType}<\textbf{integer}>(\textbf{asType}<\textbf{int}>(\$\text{heap}_{funcstart\_719,1}.\text{a1}))) == \textbf{asType}<\textbf{integer}>(\text{div1.quot})$

$(\textbf{asType}<\textbf{integer}>(\textbf{asType}<\textbf{int}>(\$\text{heap}_{funcstart\_719,1}.\text{p1}))$ % $\textbf{asType}<\textbf{integer}>(\textbf{asType}<\textbf{int}>(\$\text{heap}_{funcstart\_719,1}.\text{a1}))) == \textbf{asType}<\textbf{integer}>(\text{div1.rem})$

Proof:

[Take goal term]

[1.0] $\textbf{minof}(\textbf{int}) \leq \$\text{heap}_{funcstart\_719,1}.\text{p2}$

$\rightarrow$ *[simplify]*

[1.3] $-32769 < \$\text{heap}_{funcstart\_719,1}.\text{p2}$

$\rightarrow$ *[negate goal and search for contradiction]*

[1.4] $!(-32769 < \$\text{heap}_{funcstart\_719,1}.\text{p2})$

$\rightarrow$ *[simplify]*

[1.6] $32768 < -\$\text{heap}_{funcstart\_719,1}.\text{p2}$

[Assume known post-assertion, class invariant or type constraint for term 1.6]

[12.0] **minof(short int)** $\leq$ \$heap$_{funcstart\_719,1}$.p2

$\rightarrow$ *[simplify]*

[12.3] -32769 $<$ \$heap$_{funcstart\_719,1}$.p2

$\rightarrow$ *[from term 1.6, literala $<$ \$heap$_{funcstart\_719,1}$.p2 is false whenever -2 $<$ (32768 + literala)]*

    Proof of rule precondition:

    [12.3.0] -2 $<$ (-32769 + 32768)

    $\rightarrow$ *[simplify]*

    [12.3.2] **true**

[12.4] **false**

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

Condition generated at: C:\Escher\Customers\prang\prang.c (42,22)

Condition defined at:

To prove: \$heap$_{funcstart\_719,1}$.p2 $\leq$ **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)

\$heap$_{init}$.b1 == **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)

\$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)

\$heap$_{init}$.b3 == **asType**<**short int**>((**int**)63)

\$heap$_{init}$.p1 == **asType**<**short int**>((**int**)1)

\$heap$_{init}$.p2 == **asType**<**short int**>((**int**)2)

$\text{\$heap}_{init}.\text{p3} == \textbf{asType}\textbf{<short int>}((\textbf{int})3)$

div1 == div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$,
asType<int>($\text{\$heap}_{funcstart\_719,1}.\text{p1}$),
asType<int>($\text{\$heap}_{funcstart\_719,1}.\text{a1}$))

(**asType<integer>**(**asType<int>**($\text{\$heap}_{funcstart\_719,1}.\text{p1}$)) /
asType<integer>(**asType<int>**($\text{\$heap}_{funcstart\_719,1}.\text{a1}$))) ==
asType<integer>(div1.quot)

(**asType<integer>**(**asType<int>**($\text{\$heap}_{funcstart\_719,1}.\text{p1}$)) %
asType<integer>(**asType<int>**($\text{\$heap}_{funcstart\_719,1}.\text{a1}$))) ==
asType<integer>(div1.rem)

Proof:

[Take goal term]

[1.0] $\text{\$heap}_{funcstart\_719,1}.\text{p2} \leq$ **maxof(int**)

$\rightarrow$ *[simplify]*

[1.9] -32768 $< -\text{\$heap}_{funcstart\_719,1}.\text{p2}$

$\rightarrow$ *[negate goal and search for contradiction]*

[1.10] !(-32768 $< -\text{\$heap}_{funcstart\_719,1}.\text{p2}$)

$\rightarrow$ *[simplify]*

[1.13] 32767 $< \text{\$heap}_{funcstart\_719,1}.\text{p2}$

[Assume known post-assertion, class invariant or type constraint for term 1.13]

[12.0] $\text{\$heap}_{funcstart\_719,1}.\text{p2} \leq$ **maxof(short int**)

$\rightarrow$ *[simplify]*

[12.9] -32768 $< -\text{\$heap}_{funcstart\_719,1}.\text{p2}$

$\rightarrow$ *[from term 1.13, literala $< -\text{\$heap}_{funcstart\_719,1}.\text{p2}$ is false whenever -2 <
(32767 + literala)]*

Proof of rule precondition:

[12.9.0] -2 < (-32768 + 32767)

$\rightarrow$ *[simplify]*

[12.9.2] **true**

[12.10] **false**

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 (42,31)

Condition defined at:

To prove: $\mathbf{minof(int)} \leq \$\mathrm{heap}_{funcstart\_719,1}.\mathrm{a}2$

Given:

$\$\mathrm{heap}_{init}.\mathrm{LIMIT} == (\mathbf{int})80$

$\$\mathrm{heap}_{init}.\mathrm{M1} == \mathbf{asType{<}short\ int{>}}((\mathbf{int})30269)$

$\$\mathrm{heap}_{init}.\mathrm{r1} == \mathbf{asType{<}short\ int{>}}((\mathbf{int})171)$

$\$\mathrm{heap}_{init}.\mathrm{a1} == \mathbf{asType{<}short\ int{>}}((\mathbf{int})177)$

$\$\mathrm{heap}_{init}.\mathrm{b1} == \mathbf{asType{<}short\ int{>}}((\mathbf{int})2)$

$\$\mathrm{heap}_{init}.\mathrm{M2} == \mathbf{asType{<}short\ int{>}}((\mathbf{int})30307)$

$\$\mathrm{heap}_{init}.\mathrm{r2} == \mathbf{asType{<}short\ int{>}}((\mathbf{int})172)$

$\$\mathrm{heap}_{init}.\mathrm{a2} == \mathbf{asType{<}short\ int{>}}((\mathbf{int})176)$

$\$\mathrm{heap}_{init}.\mathrm{b2} == \mathbf{asType{<}short\ int{>}}((\mathbf{int})35)$

$\$\mathrm{heap}_{init}.\mathrm{M3} == \mathbf{asType{<}short\ int{>}}((\mathbf{int})30323)$

$\$\mathrm{heap}_{init}.\mathrm{r3} == \mathbf{asType{<}short\ int{>}}((\mathbf{int})170)$

$\$\mathrm{heap}_{init}.\mathrm{a3} == \mathbf{asType{<}short\ int{>}}((\mathbf{int})178)$

$\$\mathrm{heap}_{init}.\mathrm{b3} == \mathbf{asType{<}short\ int{>}}((\mathbf{int})63)$

$\$\mathrm{heap}_{init}.\mathrm{p1} == \mathbf{asType{<}short\ int{>}}((\mathbf{int})1)$

$\$\mathrm{heap}_{init}.\mathrm{p2} == \mathbf{asType{<}short\ int{>}}((\mathbf{int})2)$

$\$\mathrm{heap}_{init}.\mathrm{p3} == \mathbf{asType{<}short\ int{>}}((\mathbf{int})3)$

$\mathrm{div1} == \mathrm{div}(\mathbf{heapIs}\ \$\mathrm{heap}_{funcstart\_719,1},$
$\mathbf{asType{<}int{>}}(\$\mathrm{heap}_{funcstart\_719,1}.\mathrm{p1}),$
$\mathbf{asType{<}int{>}}(\$\mathrm{heap}_{funcstart\_719,1}.\mathrm{a1}))$

$(\mathbf{asType{<}integer{>}}(\mathbf{asType{<}int{>}}(\$\mathrm{heap}_{funcstart\_719,1}.\mathrm{p1}))\ /$
$\mathbf{asType{<}integer{>}}(\mathbf{asType{<}int{>}}(\$\mathrm{heap}_{funcstart\_719,1}.\mathrm{a1}))) ==$
$\mathbf{asType{<}integer{>}}(\mathrm{div1.quot})$

$(\mathbf{asType{<}integer{>}}(\mathbf{asType{<}int{>}}(\$\mathrm{heap}_{funcstart\_719,1}.\mathrm{p1}))\ \%$
$\mathbf{asType{<}integer{>}}(\mathbf{asType{<}int{>}}(\$\mathrm{heap}_{funcstart\_719,1}.\mathrm{a1}))) ==$
$\mathbf{asType{<}integer{>}}(\mathrm{div1.rem})$

Proof:

[Take goal term]

[1.0] $\mathbf{minof(int)} \leq \$\mathrm{heap}_{funcstart\_719,1}.\mathrm{a}2$

$\rightarrow$ *[simplify]*

[1.1] $-32768 \leq \$\mathrm{heap}_{funcstart\_719,1}.\mathrm{a}2$

$\rightarrow$ *[const static or extern object]*

[1.2] $-32768 \leq \$\mathrm{heap}_{init}.\mathrm{a}2$

$\rightarrow$ *[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 (42,31)

Condition defined at:

To prove: $\$\text{heap}_{funcstart\_719,1}$.a2 $\leq$ **maxof(int)**

Given:

$\$\text{heap}_{init}$.LIMIT == (**int**)80

$\$\text{heap}_{init}$.M1 == **asType\<short int\>**((**int**)30269)

$\$\text{heap}_{init}$.r1 == **asType\<short int\>**((**int**)171)

$\$\text{heap}_{init}$.a1 == **asType\<short int\>**((**int**)177)

$\$\text{heap}_{init}$.b1 == **asType\<short int\>**((**int**)2)

$\$\text{heap}_{init}$.M2 == **asType\<short int\>**((**int**)30307)

$\$\text{heap}_{init}$.r2 == **asType\<short int\>**((**int**)172)

$\$\text{heap}_{init}$.a2 == **asType\<short int\>**((**int**)176)

$\$\text{heap}_{init}$.b2 == **asType\<short int\>**((**int**)35)

$\$\text{heap}_{init}$.M3 == **asType\<short int\>**((**int**)30323)

$\$\text{heap}_{init}$.r3 == **asType\<short int\>**((**int**)170)

$\$\text{heap}_{init}$.a3 == **asType\<short int\>**((**int**)178)

$\$\text{heap}_{init}$.b3 == **asType\<short int\>**((**int**)63)

$\$\text{heap}_{init}$.p1 == **asType\<short int\>**((**int**)1)

$\$\text{heap}_{init}$.p2 == **asType\<short int\>**((**int**)2)

$\$\text{heap}_{init}$.p3 == **asType\<short int\>**((**int**)3)

div1 == div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$,
asType\<int\>($\$\text{heap}_{funcstart\_719,1}$.p1),
asType\<int\>($\$\text{heap}_{funcstart\_719,1}$.a1))

(**asType\<integer\>**(**asType\<int\>**($\$\text{heap}_{funcstart\_719,1}$.p1)) /
asType\<integer\>(**asType\<int\>**($\$\text{heap}_{funcstart\_719,1}$.a1))) ==
asType\<integer\>(div1.quot)

(**asType\<integer\>**(**asType\<int\>**($\$\text{heap}_{funcstart\_719,1}$.p1)) %

asType\<integer\>(asType\<int\>($heap$_{funcstart_719,1}$.a1))) ==
asType\<integer\>(div1.rem)

Proof:

[Take goal term]

[1.0] $heap$_{funcstart_719,1}$.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) $\leq$ maxof(int)**

$\rightarrow$ *[simplify]*

[1.6] **true**

Proof of verification condition: Precondition of 'div' satisfied

Condition generated at: C:\Escher\Customers\prang\prang.c (42,18)

Condition defined at: C:\Escher\ecv\standard\stdlib.h (94,10)

To prove: $0 <$ **asType\<integer\>(asType\<int\>($heap$_{funcstart_719,1}$.a2))**

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)**

$heap$_{init}$.M2 == **asType\<short int\>((int)30307)**

$heap$_{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)**

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

$heap$_{init}$.a3 == **asType\<short int\>((int)178)**

$heap$_{init}$.b3 == **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)**

div1 == div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$,
asType<int>($\$\text{heap}_{funcstart\_719,1}$.p1),
asType<int>($\$\text{heap}_{funcstart\_719,1}$.a1))

(**asType<integer>**(**asType<int>**($\$\text{heap}_{funcstart\_719,1}$.p1)) /
asType<integer>(**asType<int>**($\$\text{heap}_{funcstart\_719,1}$.a1))) ==
asType<integer>(div1.quot)

(**asType<integer>**(**asType<int>**($\$\text{heap}_{funcstart\_719,1}$.p1)) %
asType<integer>(**asType<int>**($\$\text{heap}_{funcstart\_719,1}$.a1))) ==
asType<integer>(div1.rem)

Proof:

[Take goal term]

[1.0] $0 <$ **asType<integer>**(**asType<int>**($\$\text{heap}_{funcstart\_719,1}$.a2))

$\rightarrow$ *[const static or extern object]*

[1.1] $0 <$ **asType<integer>**(**asType<int>**($\$\text{heap}_{init}$.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 (43,22)

Condition defined at:

To prove: minof(int) $\leq \$\text{heap}_{funcstart\_719,1}$.p3

Given:

$\$\text{heap}_{init}$.LIMIT == (**int**)80

$\$\text{heap}_{init}$.M1 == **asType<short int>**((**int**)30269)

$\$\text{heap}_{init}$.r1 == **asType<short int>**((**int**)171)

$\$\text{heap}_{init}$.a1 == **asType<short int>**((**int**)177)

$\$\text{heap}_{init}$.b1 == **asType<short int>**((**int**)2)

$\$\text{heap}_{init}$.M2 == **asType<short int>**((**int**)30307)

$\$\text{heap}_{init}$.r2 == **asType<short int>**((**int**)172)

$\$\text{heap}_{init}$.a2 == **asType<short int>**((**int**)176)

$\$\text{heap}_{init}$.b2 == **asType<short int>**((**int**)35)

$\$\text{heap}_{init}.\text{M3} == \textbf{asType}{<}\textbf{short int}{>}((\textbf{int})30323)$

$\$\text{heap}_{init}.\text{r3} == \textbf{asType}{<}\textbf{short int}{>}((\textbf{int})170)$

$\$\text{heap}_{init}.\text{a3} == \textbf{asType}{<}\textbf{short int}{>}((\textbf{int})178)$

$\$\text{heap}_{init}.\text{b3} == \textbf{asType}{<}\textbf{short int}{>}((\textbf{int})63)$

$\$\text{heap}_{init}.\text{p1} == \textbf{asType}{<}\textbf{short int}{>}((\textbf{int})1)$

$\$\text{heap}_{init}.\text{p2} == \textbf{asType}{<}\textbf{short int}{>}((\textbf{int})2)$

$\$\text{heap}_{init}.\text{p3} == \textbf{asType}{<}\textbf{short int}{>}((\textbf{int})3)$

div1 == div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$,
asType<**int**>($\$\text{heap}_{funcstart\_719,1}.\text{p1}$),
asType<**int**>($\$\text{heap}_{funcstart\_719,1}.\text{a1}$))

(**asType**<**integer**>(**asType**<**int**>($\$\text{heap}_{funcstart\_719,1}.\text{p1}$)) /
asType<**integer**>(**asType**<**int**>($\$\text{heap}_{funcstart\_719,1}.\text{a1}$))) ==
asType<**integer**>(div1.quot)

(**asType**<**integer**>(**asType**<**int**>($\$\text{heap}_{funcstart\_719,1}.\text{p1}$)) %
asType<**integer**>(**asType**<**int**>($\$\text{heap}_{funcstart\_719,1}.\text{a1}$))) ==
asType<**integer**>(div1.rem)

div2 == div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$,
asType<**int**>($\$\text{heap}_{funcstart\_719,1}.\text{p2}$),
asType<**int**>($\$\text{heap}_{funcstart\_719,1}.\text{a2}$))

(**asType**<**integer**>(**asType**<**int**>($\$\text{heap}_{funcstart\_719,1}.\text{p2}$)) /
asType<**integer**>(**asType**<**int**>($\$\text{heap}_{funcstart\_719,1}.\text{a2}$))) ==
asType<**integer**>(div2.quot)

(**asType**<**integer**>(**asType**<**int**>($\$\text{heap}_{funcstart\_719,1}.\text{p2}$)) %
asType<**integer**>(**asType**<**int**>($\$\text{heap}_{funcstart\_719,1}.\text{a2}$))) ==
asType<**integer**>(div2.rem)

Proof:

[Take goal term]

[1.0] **minof**(**int**) $\leq$ $\$\text{heap}_{funcstart\_719,1}.\text{p3}$

$\rightarrow$ *[simplify]*

[1.3] -32769 < $\$\text{heap}_{funcstart\_719,1}.\text{p3}$

$\rightarrow$ *[negate goal and search for contradiction]*

[1.4] !(-32769 < $\$\text{heap}_{funcstart\_719,1}.\text{p3}$)

$\rightarrow$ *[simplify]*

[1.6] 32768 < $-\$\text{heap}_{funcstart\_719,1}.\text{p3}$

[Assume known post-assertion, class invariant or type constraint for term 1.6]

[19.0] **minof**(**short int**) $\leq$ $\$\text{heap}_{funcstart\_719,1}.\text{p3}$

$\rightarrow$ *[simplify]*

[19.3] -32769 < $heap_{funcstart\_719,1}$.p3

$\rightarrow$ *[from term 1.6, literala < $heap_{funcstart\_719,1}$.p3 is false whenever -2 < (32768 + literala)]*

Proof of rule precondition:

[19.3.0] -2 < (-32769 + 32768)

$\rightarrow$ *[simplify]*

[19.3.2] **true**

[19.4] **false**

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

Condition generated at: C:\Escher\Customers\prang\prang.c (43,22)

Condition defined at:

To prove: $heap_{funcstart\_719,1}$.p3 $\leq$ **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)

$heap_{init}$.b1 == **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)

$heap_{init}$.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)

$heap_{init}$.b3 == **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)

div1 == div(**heapIs** $heap_{funcstart\_719,1}$,

asType<int>($heap$_{funcstart_719,1}$.p1),
asType<int>($heap$_{funcstart_719,1}$.a1))

(**asType<integer>**(**asType<int>**($heap$_{funcstart_719,1}$.p1)) /
asType<integer>(**asType<int>**($heap$_{funcstart_719,1}$.a1))) ==
asType<integer>(div1.quot)

(**asType<integer>**(**asType<int>**($heap$_{funcstart_719,1}$.p1)) %
asType<integer>(**asType<int>**($heap$_{funcstart_719,1}$.a1))) ==
asType<integer>(div1.rem)

div2 == div(**heapIs** $heap$_{funcstart_719,1}$,
asType<int>($heap$_{funcstart_719,1}$.p2),
asType<int>($heap$_{funcstart_719,1}$.a2))

(**asType<integer>**(**asType<int>**($heap$_{funcstart_719,1}$.p2)) /
asType<integer>(**asType<int>**($heap$_{funcstart_719,1}$.a2))) ==
asType<integer>(div2.quot)

(**asType<integer>**(**asType<int>**($heap$_{funcstart_719,1}$.p2)) %
asType<integer>(**asType<int>**($heap$_{funcstart_719,1}$.a2))) ==
asType<integer>(div2.rem)

Proof:

[Take goal term]

[1.0] $heap$_{funcstart_719,1}$.p3 $\leq$ **maxof(int)**

$\rightarrow$ *[simplify]*

[1.9] -32768 $< -$$heap$_{funcstart\_719,1}$.p3

$\rightarrow$ *[negate goal and search for contradiction]*

[1.10] !(-32768 $< -$$heap$_{funcstart\_719,1}$.p3)

$\rightarrow$ *[simplify]*

[1.13] 32767 $<$ $heap$_{funcstart_719,1}$.p3

[Assume known post-assertion, class invariant or type constraint for term 1.13]

[19.0] $heap$_{funcstart_719,1}$.p3 $\leq$ **maxof(short int)**

$\rightarrow$ *[simplify]*

[19.9] -32768 $< -$$heap$_{funcstart\_719,1}$.p3

$\rightarrow$ *[from term 1.13, literala $< -$$heap$_{funcstart\_719,1}$.p3 is false whenever -2 $<$
(32767 + literala)]*

Proof of rule precondition:

[19.9.0] -2 $<$ (-32768 + 32767)

$\rightarrow$ *[simplify]*

[19.9.2] **true**

[19.10] **false**

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 (43,31)

Condition defined at:

To prove: minof(int) $\leq$ \$heap$_{funcstart\_719,1}$.a3

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)

\$heap$_{init}$.M2 == **asType**<**short int**>((**int**)30307)

\$heap$_{init}$.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)

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

\$heap$_{init}$.a3 == **asType**<**short int**>((**int**)178)

\$heap$_{init}$.b3 == **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)

div1 == div(**heapIs** \$heap$_{funcstart\_719,1}$,
asType<**int**>(\$heap$_{funcstart\_719,1}$.p1),
asType<**int**>(\$heap$_{funcstart\_719,1}$.a1))

(**asType**<**integer**>(**asType**<**int**>(\$heap$_{funcstart\_719,1}$.p1)) /
asType<**integer**>(**asType**<**int**>(\$heap$_{funcstart\_719,1}$.a1))) ==
asType<**integer**>(div1.quot)

(**asType**<**integer**>(**asType**<**int**>(\$heap$_{funcstart\_719,1}$.p1)) %
asType<**integer**>(**asType**<**int**>(\$heap$_{funcstart\_719,1}$.a1))) ==
asType<**integer**>(div1.rem)

div2 == div(**heapIs** \$heap$_{funcstart\_719,1}$,
asType<**int**>(\$heap$_{funcstart\_719,1}$.p2),

asType\<int\>($heap_{funcstart\_719,1}$.a2))

(**asType\<integer\>**(**asType\<int\>**($heap_{funcstart\_719,1}$.p2)) /
asType\<integer\>(**asType\<int\>**($heap_{funcstart\_719,1}$.a2))) ==
asType\<integer\>(div2.quot)

(**asType\<integer\>**(**asType\<int\>**($heap_{funcstart\_719,1}$.p2)) %
asType\<integer\>(**asType\<int\>**($heap_{funcstart\_719,1}$.a2))) ==
asType\<integer\>(div2.rem)

Proof:

[Take goal term]

[1.0] **minof**(**int**) $\leq$ $heap_{funcstart\_719,1}$.a3

$\rightarrow$ *[simplify]*

[1.1] -32768 $\leq$ $heap_{funcstart\_719,1}$.a3

$\rightarrow$ *[const static or extern object]*

[1.2] -32768 $\leq$ $heap_{init}$.a3

$\rightarrow$ *[expand definition of constant 'a3' at prang.c (26,20)]*

[1.3] -32768 $\leq$ **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 (43,31)

Condition defined at:

To prove: $heap_{funcstart\_719,1}$.a3 $\leq$ **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)

$heap_{init}$.b1 == **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)

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

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$\$\text{heap}_{init}.\text{M3} == \textbf{asType}\textbf{<short int>}((\textbf{int})30323)$

$\$\text{heap}_{init}.\text{r3} == \textbf{asType}\textbf{<short int>}((\textbf{int})170)$

$\$\text{heap}_{init}.\text{a3} == \textbf{asType}\textbf{<short int>}((\textbf{int})178)$

$\$\text{heap}_{init}.\text{b3} == \textbf{asType}\textbf{<short int>}((\textbf{int})63)$

$\$\text{heap}_{init}.\text{p1} == \textbf{asType}\textbf{<short int>}((\textbf{int})1)$

$\$\text{heap}_{init}.\text{p2} == \textbf{asType}\textbf{<short int>}((\textbf{int})2)$

$\$\text{heap}_{init}.\text{p3} == \textbf{asType}\textbf{<short int>}((\textbf{int})3)$

div1 == div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$,
asType<**int**>($\$\text{heap}_{funcstart\_719,1}$.p1),
asType<**int**>($\$\text{heap}_{funcstart\_719,1}$.a1))

(**asType**<**integer**>(**asType**<**int**>($\$\text{heap}_{funcstart\_719,1}$.p1)) /
asType<**integer**>(**asType**<**int**>($\$\text{heap}_{funcstart\_719,1}$.a1))) ==
asType<**integer**>(div1.quot)

(**asType**<**integer**>(**asType**<**int**>($\$\text{heap}_{funcstart\_719,1}$.p1)) %
asType<**integer**>(**asType**<**int**>($\$\text{heap}_{funcstart\_719,1}$.a1))) ==
asType<**integer**>(div1.rem)

div2 == div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$,
asType<**int**>($\$\text{heap}_{funcstart\_719,1}$.p2),
asType<**int**>($\$\text{heap}_{funcstart\_719,1}$.a2))

(**asType**<**integer**>(**asType**<**int**>($\$\text{heap}_{funcstart\_719,1}$.p2)) /
asType<**integer**>(**asType**<**int**>($\$\text{heap}_{funcstart\_719,1}$.a2))) ==
asType<**integer**>(div2.quot)

(**asType**<**integer**>(**asType**<**int**>($\$\text{heap}_{funcstart\_719,1}$.p2)) %
asType<**integer**>(**asType**<**int**>($\$\text{heap}_{funcstart\_719,1}$.a2))) ==
asType<**integer**>(div2.rem)

Proof:

[Take goal term]

[1.0] $\$\text{heap}_{funcstart\_719,1}.\text{a3} \leq$ **maxof**(**int**)

$\rightarrow$ *[const static or extern object]*

[1.1] $\$\text{heap}_{init}.\text{a3} \leq$ **maxof**(**int**)

$\rightarrow$ *[expand definition of constant 'a3' at prang.c (26,20)]*

[1.2] **asType**<**short int**>((**int**)178) $\leq$ **maxof**(**int**)

$\rightarrow$ *[simplify]*

[1.6] **true**

Proof of verification condition: Precondition of 'div' satisfied

Condition generated at: C:\Escher\Customers\prang\prang.c (43,18)

Condition defined at: C:\Escher\ecv\standard\stdlib.h (94,10)

To prove: $0 < $ **asType\<integer\>(asType\<int\>**($\text{\$heap}_{funcstart\_719,1}.\text{a3}$))

Given:

$\text{\$heap}_{init}.\text{LIMIT} == (\textbf{int})80$

$\text{\$heap}_{init}.\text{M1} == \textbf{asType<short int>}((\textbf{int})30269)$

$\text{\$heap}_{init}.\text{r1} == \textbf{asType<short int>}((\textbf{int})171)$

$\text{\$heap}_{init}.\text{a1} == \textbf{asType<short int>}((\textbf{int})177)$

$\text{\$heap}_{init}.\text{b1} == \textbf{asType<short int>}((\textbf{int})2)$

$\text{\$heap}_{init}.\text{M2} == \textbf{asType<short int>}((\textbf{int})30307)$

$\text{\$heap}_{init}.\text{r2} == \textbf{asType<short int>}((\textbf{int})172)$

$\text{\$heap}_{init}.\text{a2} == \textbf{asType<short int>}((\textbf{int})176)$

$\text{\$heap}_{init}.\text{b2} == \textbf{asType<short int>}((\textbf{int})35)$

$\text{\$heap}_{init}.\text{M3} == \textbf{asType<short int>}((\textbf{int})30323)$

$\text{\$heap}_{init}.\text{r3} == \textbf{asType<short int>}((\textbf{int})170)$

$\text{\$heap}_{init}.\text{a3} == \textbf{asType<short int>}((\textbf{int})178)$

$\text{\$heap}_{init}.\text{b3} == \textbf{asType<short int>}((\textbf{int})63)$

$\text{\$heap}_{init}.\text{p1} == \textbf{asType<short int>}((\textbf{int})1)$

$\text{\$heap}_{init}.\text{p2} == \textbf{asType<short int>}((\textbf{int})2)$

$\text{\$heap}_{init}.\text{p3} == \textbf{asType<short int>}((\textbf{int})3)$

div1 == div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$,
asType\<int\>($\text{\$heap}_{funcstart\_719,1}.\text{p1}$),
asType\<int\>($\text{\$heap}_{funcstart\_719,1}.\text{a1}$))

(**asType\<integer\>**(**asType\<int\>**($\text{\$heap}_{funcstart\_719,1}.\text{p1}$)) /
asType\<integer\>(**asType\<int\>**($\text{\$heap}_{funcstart\_719,1}.\text{a1}$))) ==
asType\<integer\>(div1.quot)

(**asType\<integer\>**(**asType\<int\>**($\text{\$heap}_{funcstart\_719,1}.\text{p1}$)) %
asType\<integer\>(**asType\<int\>**($\text{\$heap}_{funcstart\_719,1}.\text{a1}$))) ==
asType\<integer\>(div1.rem)

div2 == div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$,
asType\<int\>($\text{\$heap}_{funcstart\_719,1}.\text{p2}$),
asType\<int\>($\text{\$heap}_{funcstart\_719,1}.\text{a2}$))

(**asType\<integer\>**(**asType\<int\>**($\text{\$heap}_{funcstart\_719,1}.\text{p2}$)) /
asType\<integer\>(**asType\<int\>**($\text{\$heap}_{funcstart\_719,1}.\text{a2}$))) ==
asType\<integer\>(div2.quot)

(**asType\<integer\>**(**asType\<int\>**($\text{heap}_{funcstart\_719,1}$.p2)) %
asType\<integer\>(**asType\<int\>**($\text{heap}_{funcstart\_719,1}$.a2))) ==
asType\<integer\>(div2.rem)

Proof:

[Take goal term]

[1.0] $0 <$ **asType\<integer\>**(**asType\<int\>**($\text{heap}_{funcstart\_719,1}$.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 (47,15)

Condition defined at:

To prove: minof(short int) $\leq$ div1.rem

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)

heap_{init}.M2 == **asType\<short int\>**((**int**)30307)

heap_{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)

heap_{init}.r3 == **asType\<short int\>**((**int**)170)

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

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

heap_{init}.p1 == **asType\<short int\>**((**int**)1)

$\text{\$heap}_{init}.\text{p2} == \textbf{asType}\textbf{<short int>}((\textbf{int})2)$

$\text{\$heap}_{init}.\text{p3} == \textbf{asType}\textbf{<short int>}((\textbf{int})3)$

$\text{div1} == \text{div}(\textbf{heapIs } \text{\$heap}_{funcstart\_719,1},$
$\textbf{asType}\textbf{<int>}(\text{\$heap}_{funcstart\_719,1}.\text{p1}),$
$\textbf{asType}\textbf{<int>}(\text{\$heap}_{funcstart\_719,1}.\text{a1}))$

$(\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<int>}(\text{\$heap}_{funcstart\_719,1}.\text{p1}))$ /
$\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<int>}(\text{\$heap}_{funcstart\_719,1}.\text{a1}))) ==$
$\textbf{asType}\textbf{<integer>}(\text{div1.quot})$

$(\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<int>}(\text{\$heap}_{funcstart\_719,1}.\text{p1}))$ %
$\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<int>}(\text{\$heap}_{funcstart\_719,1}.\text{a1}))) ==$
$\textbf{asType}\textbf{<integer>}(\text{div1.rem})$

$\text{div2} == \text{div}(\textbf{heapIs } \text{\$heap}_{funcstart\_719,1},$
$\textbf{asType}\textbf{<int>}(\text{\$heap}_{funcstart\_719,1}.\text{p2}),$
$\textbf{asType}\textbf{<int>}(\text{\$heap}_{funcstart\_719,1}.\text{a2}))$

$(\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<int>}(\text{\$heap}_{funcstart\_719,1}.\text{p2}))$ /
$\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<int>}(\text{\$heap}_{funcstart\_719,1}.\text{a2}))) ==$
$\textbf{asType}\textbf{<integer>}(\text{div2.quot})$

$(\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<int>}(\text{\$heap}_{funcstart\_719,1}.\text{p2}))$ %
$\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<int>}(\text{\$heap}_{funcstart\_719,1}.\text{a2}))) ==$
$\textbf{asType}\textbf{<integer>}(\text{div2.rem})$

$\text{div3} == \text{div}(\textbf{heapIs } \text{\$heap}_{funcstart\_719,1},$
$\textbf{asType}\textbf{<int>}(\text{\$heap}_{funcstart\_719,1}.\text{p3}),$
$\textbf{asType}\textbf{<int>}(\text{\$heap}_{funcstart\_719,1}.\text{a3}))$

$(\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<int>}(\text{\$heap}_{funcstart\_719,1}.\text{p3}))$ /
$\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<int>}(\text{\$heap}_{funcstart\_719,1}.\text{a3}))) ==$
$\textbf{asType}\textbf{<integer>}(\text{div3.quot})$

$(\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<int>}(\text{\$heap}_{funcstart\_719,1}.\text{p3}))$ %
$\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<int>}(\text{\$heap}_{funcstart\_719,1}.\text{a3}))) ==$
$\textbf{asType}\textbf{<integer>}(\text{div3.rem})$

Proof:

[Take given term]

[5.0] $\text{div1} == \text{div}(\textbf{heapIs } \text{\$heap}_{funcstart\_719,1},$
$\textbf{asType}\textbf{<int>}(\text{\$heap}_{funcstart\_719,1}.\text{p1}),$
$\textbf{asType}\textbf{<int>}(\text{\$heap}_{funcstart\_719,1}.\text{a1}))$

$\rightarrow$ *[simplify]*

[5.1] $\text{div1} == \text{div}(\textbf{heapIs } \text{\$heap}_{funcstart\_719,1}, \text{\$heap}_{funcstart\_719,1}.\text{p1},$
$\textbf{asType}\textbf{<int>}(\text{\$heap}_{funcstart\_719,1}.\text{a1}))$

$\rightarrow$ *[const static or extern object]*

[5.2] div1 == div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1,
asType<**int**>($\$heap_{init}$.a1))

$\rightarrow$ *[expand definition of constant 'a1' at prang.c (16,20)]*

[5.3] div1 == div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1,
asType<**int**>(**asType**<**short int**>((**int**)177)))

$\rightarrow$ *[simplify]*

[5.6] div1 == div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177)

[Take goal term]

[1.0] **minof**(**short int**) $\leq$ div1.rem

$\rightarrow$ *[simplify]*

[1.1] -32768 $\leq$ div1.rem

$\rightarrow$ *[from term 5.6, div1 is equal to div(**heapIs** $\$heap_{funcstart\_719,1}$,
$\$heap_{funcstart\_719,1}$.p1, 177)]*

[1.2] -32768 $\leq$ div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1,
177).rem

$\rightarrow$ *[simplify]*

[1.4] -32769 $<$ div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1,
177).rem

$\rightarrow$ *[negate goal and search for contradiction]*

[1.5] !(-32769 $<$ div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1,
177).rem)

$\rightarrow$ *[simplify]*

[1.7] 32768 $<$ $-$div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1,
177).rem

[Assume known post-assertion, class invariant or type constraint for term 1.7]

[26.0] **minof**(**int**) $\leq$ div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1,
177).rem

$\rightarrow$ *[simplify]*

[26.3] -32769 $<$ div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1,
177).rem

$\rightarrow$ *[from term 1.7, literala $<$ div(**heapIs** $\$heap_{funcstart\_719,1}$,
$\$heap_{funcstart\_719,1}$.p1, 177).rem is false whenever -2 $<$ (32768 + literala)]*

Proof of rule precondition:

[26.3.0] -2 $<$ (-32769 + 32768)

$\rightarrow$ *[simplify]*

[26.3.2] **true**

[26.4] **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 (47,15)

Condition defined at:

To prove: $\text{div1.rem} \leq \textbf{maxof}(\textbf{short int})$

Given:

$\$\text{heap}_{init}.\text{LIMIT} == (\textbf{int})80$

$\$\text{heap}_{init}.\text{M1} == \textbf{asType}<\textbf{short int}>((\textbf{int})30269)$

$\$\text{heap}_{init}.\text{r1} == \textbf{asType}<\textbf{short int}>((\textbf{int})171)$

$\$\text{heap}_{init}.\text{a1} == \textbf{asType}<\textbf{short int}>((\textbf{int})177)$

$\$\text{heap}_{init}.\text{b1} == \textbf{asType}<\textbf{short int}>((\textbf{int})2)$

$\$\text{heap}_{init}.\text{M2} == \textbf{asType}<\textbf{short int}>((\textbf{int})30307)$

$\$\text{heap}_{init}.\text{r2} == \textbf{asType}<\textbf{short int}>((\textbf{int})172)$

$\$\text{heap}_{init}.\text{a2} == \textbf{asType}<\textbf{short int}>((\textbf{int})176)$

$\$\text{heap}_{init}.\text{b2} == \textbf{asType}<\textbf{short int}>((\textbf{int})35)$

$\$\text{heap}_{init}.\text{M3} == \textbf{asType}<\textbf{short int}>((\textbf{int})30323)$

$\$\text{heap}_{init}.\text{r3} == \textbf{asType}<\textbf{short int}>((\textbf{int})170)$

$\$\text{heap}_{init}.\text{a3} == \textbf{asType}<\textbf{short int}>((\textbf{int})178)$

$\$\text{heap}_{init}.\text{b3} == \textbf{asType}<\textbf{short int}>((\textbf{int})63)$

$\$\text{heap}_{init}.\text{p1} == \textbf{asType}<\textbf{short int}>((\textbf{int})1)$

$\$\text{heap}_{init}.\text{p2} == \textbf{asType}<\textbf{short int}>((\textbf{int})2)$

$\$\text{heap}_{init}.\text{p3} == \textbf{asType}<\textbf{short int}>((\textbf{int})3)$

$\text{div1} == \text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_719,1},$
$\textbf{asType}<\textbf{int}>(\$\text{heap}_{funcstart\_719,1}.\text{p1}),$
$\textbf{asType}<\textbf{int}>(\$\text{heap}_{funcstart\_719,1}.\text{a1}))$

$(\textbf{asType}<\textbf{integer}>(\textbf{asType}<\textbf{int}>(\$\text{heap}_{funcstart\_719,1}.\text{p1})) /$
$\textbf{asType}<\textbf{integer}>(\textbf{asType}<\textbf{int}>(\$\text{heap}_{funcstart\_719,1}.\text{a1}))) ==$
$\textbf{asType}<\textbf{integer}>(\text{div1.quot})$

$(\textbf{asType}<\textbf{integer}>(\textbf{asType}<\textbf{int}>(\$\text{heap}_{funcstart\_719,1}.\text{p1})) \%$
$\textbf{asType}<\textbf{integer}>(\textbf{asType}<\textbf{int}>(\$\text{heap}_{funcstart\_719,1}.\text{a1}))) ==$
$\textbf{asType}<\textbf{integer}>(\text{div1.rem})$

$\text{div2} == \text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_719,1},$

asType<int>($heap$_{funcstart_719,1}$.p2),
asType<int>($heap$_{funcstart_719,1}$.a2))

(**asType<integer>**(**asType<int>**($heap$_{funcstart_719,1}$.p2)) /
asType<integer>(**asType<int>**($heap$_{funcstart_719,1}$.a2))) ==
asType<integer>(div2.quot)

(**asType<integer>**(**asType<int>**($heap$_{funcstart_719,1}$.p2)) %
asType<integer>(**asType<int>**($heap$_{funcstart_719,1}$.a2))) ==
asType<integer>(div2.rem)

div3 == div(**heapIs** $heap$_{funcstart_719,1}$,
asType<int>($heap$_{funcstart_719,1}$.p3),
asType<int>($heap$_{funcstart_719,1}$.a3))

(**asType<integer>**(**asType<int>**($heap$_{funcstart_719,1}$.p3)) /
asType<integer>(**asType<int>**($heap$_{funcstart_719,1}$.a3))) ==
asType<integer>(div3.quot)

(**asType<integer>**(**asType<int>**($heap$_{funcstart_719,1}$.p3)) %
asType<integer>(**asType<int>**($heap$_{funcstart_719,1}$.a3))) ==
asType<integer>(div3.rem)

Proof:

[Take given term]

[5.0] div1 == div(**heapIs** $heap$_{funcstart_719,1}$,
asType<int>($heap$_{funcstart_719,1}$.p1),
asType<int>($heap$_{funcstart_719,1}$.a1))

$\rightarrow$ *[simplify]*

[5.1] div1 == div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1,
asType<int>($heap$_{funcstart_719,1}$.a1))

$\rightarrow$ *[const static or extern object]*

[5.2] div1 == div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1,
asType<int>($heap$_{init}$.a1))

$\rightarrow$ *[expand definition of constant 'a1' at prang.c (16,20)]*

[5.3] div1 == div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1,
asType<int>(**asType<short int>**((**int**)177)))

$\rightarrow$ *[simplify]*

[5.6] div1 == div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1, 177)

[Take goal term]

[1.0] div1.rem $\leq$ **maxof**(**short int**)

$\rightarrow$ *[from term 5.6, div1 is equal to div(**heapIs** $heap$_{funcstart_719,1}$,
$heap$_{funcstart_719,1}$.p1, 177)]*

[1.1] div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).rem $\leq$ **maxof(short int)**

$\rightarrow$ *[simplify]*

[1.10] -32768 $< -$div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).rem

$\rightarrow$ *[negate goal and search for contradiction]*

[1.11] !(-32768 $< -$div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).rem)

$\rightarrow$ *[simplify]*

[1.14] 32767 $<$ div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).rem

[Assume known post-assertion, class invariant or type constraint for term 1.14]

[26.0] div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).rem $\leq$ **maxof(int)**

$\rightarrow$ *[simplify]*

[26.9] -32768 $< -$div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).rem

$\rightarrow$ *[from term 1.14, literala $< -$div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).rem is false whenever -2 $<$ (32767 + literala)]*

> **Proof of rule precondition:**
>
> *[26.9.0]* -2 $<$ (-32768 + 32767)
>
> $\rightarrow$ *[simplify]*
>
> *[26.9.2]* **true**

[26.10] **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 (47,15)

Condition defined at:

To prove: minof(int) $\leq$ **asType<short int>**(div1.rem)

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)

$\text{heap}_{init}.\text{b1} == \textbf{asType}\textbf{<short int>}((\textbf{int})2)$

$\text{heap}_{init}.\text{M2} == \textbf{asType}\textbf{<short int>}((\textbf{int})30307)$

$\text{heap}_{init}.\text{r2} == \textbf{asType}\textbf{<short int>}((\textbf{int})172)$

$\text{heap}_{init}.\text{a2} == \textbf{asType}\textbf{<short int>}((\textbf{int})176)$

$\text{heap}_{init}.\text{b2} == \textbf{asType}\textbf{<short int>}((\textbf{int})35)$

$\text{heap}_{init}.\text{M3} == \textbf{asType}\textbf{<short int>}((\textbf{int})30323)$

$\text{heap}_{init}.\text{r3} == \textbf{asType}\textbf{<short int>}((\textbf{int})170)$

$\text{heap}_{init}.\text{a3} == \textbf{asType}\textbf{<short int>}((\textbf{int})178)$

$\text{heap}_{init}.\text{b3} == \textbf{asType}\textbf{<short int>}((\textbf{int})63)$

$\text{heap}_{init}.\text{p1} == \textbf{asType}\textbf{<short int>}((\textbf{int})1)$

$\text{heap}_{init}.\text{p2} == \textbf{asType}\textbf{<short int>}((\textbf{int})2)$

$\text{heap}_{init}.\text{p3} == \textbf{asType}\textbf{<short int>}((\textbf{int})3)$

div1 == div(**heapIs** $\text{heap}_{funcstart\_719,1}$,
asType<int>($\text{heap}_{funcstart\_719,1}.\text{p1}$),
asType<int>($\text{heap}_{funcstart\_719,1}.\text{a1}$))

(**asType<integer>**(**asType<int>**($\text{heap}_{funcstart\_719,1}.\text{p1}$)) /
asType<integer>(**asType<int>**($\text{heap}_{funcstart\_719,1}.\text{a1}$))) ==
asType<integer>(div1.quot)

(**asType<integer>**(**asType<int>**($\text{heap}_{funcstart\_719,1}.\text{p1}$)) %
asType<integer>(**asType<int>**($\text{heap}_{funcstart\_719,1}.\text{a1}$))) ==
asType<integer>(div1.rem)

div2 == div(**heapIs** $\text{heap}_{funcstart\_719,1}$,
asType<int>($\text{heap}_{funcstart\_719,1}.\text{p2}$),
asType<int>($\text{heap}_{funcstart\_719,1}.\text{a2}$))

(**asType<integer>**(**asType<int>**($\text{heap}_{funcstart\_719,1}.\text{p2}$)) /
asType<integer>(**asType<int>**($\text{heap}_{funcstart\_719,1}.\text{a2}$))) ==
asType<integer>(div2.quot)

(**asType<integer>**(**asType<int>**($\text{heap}_{funcstart\_719,1}.\text{p2}$)) %
asType<integer>(**asType<int>**($\text{heap}_{funcstart\_719,1}.\text{a2}$))) ==
asType<integer>(div2.rem)

div3 == div(**heapIs** $\text{heap}_{funcstart\_719,1}$,
asType<int>($\text{heap}_{funcstart\_719,1}.\text{p3}$),
asType<int>($\text{heap}_{funcstart\_719,1}.\text{a3}$))

(**asType<integer>**(**asType<int>**($\text{heap}_{funcstart\_719,1}.\text{p3}$)) /
asType<integer>(**asType<int>**($\text{heap}_{funcstart\_719,1}.\text{a3}$))) ==
asType<integer>(div3.quot)

(**asType<integer>**(**asType<int>**($\text{heap}_{funcstart\_719,1}.\text{p3}$)) %

asType\<integer\>(asType\<int\>($heap$_{funcstart_719,1}$.a3))) == asType\<integer\>(div3.rem)

Proof:

[Take given term]

[5.0] div1 == div(**heapIs** $heap$_{funcstart_719,1}$,
asType\<int\>($heap$_{funcstart_719,1}$.p1),
asType\<int\>($heap$_{funcstart_719,1}$.a1))

$\rightarrow$ *[simplify]*

[5.1] div1 == div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1,
asType\<int\>($heap$_{funcstart_719,1}$.a1))

$\rightarrow$ *[const static or extern object]*

[5.2] div1 == div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1,
asType\<int\>($heap$_{init}$.a1))

$\rightarrow$ *[expand definition of constant 'a1' at prang.c (16,20)]*

[5.3] div1 == div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1,
asType\<int\>(asType\<short int\>((int)177)))

$\rightarrow$ *[simplify]*

[5.6] div1 == div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1, 177)

[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 5.6, div1 is equal to div(**heapIs** $heap$_{funcstart_719,1}$,
$heap$_{funcstart_719,1}$.p1, 177)]*

[1.2] -32768 $\leq$ **asType\<short int\>**(div(**heapIs** $heap$_{funcstart_719,1}$,
$heap$_{funcstart_719,1}$.p1, 177).rem)

$\rightarrow$ *[simplify]*

[1.5] -32769 $<$ div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1,
177).rem

$\rightarrow$ *[negate goal and search for contradiction]*

[1.6] !(-32769 $<$ div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1,
177).rem)

$\rightarrow$ *[simplify]*

[1.8] 32768 $< -$div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1,
177).rem

[Assume known post-assertion, class invariant or type constraint for term 1.8]

[26.0] **minof(int)** $\leq$ div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p1, 177).rem

$\rightarrow$ *[simplify]*

[26.3] -32769 < div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p1, 177).rem

$\rightarrow$ *[from term 1.8, literala < div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p1, 177).rem is false whenever -2 < (32768 + literala)]*

Proof of rule precondition:

[26.3.0] -2 < (-32769 + 32768)

$\rightarrow$ *[simplify]*

[26.3.2] **true**

[26.4] **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 (47,15)

Condition defined at:

To prove: asType<short int>(div1.rem) $\leq$ maxof(int)

Given:

$\text{\$heap}_{init}$.LIMIT == (**int**)80

$\text{\$heap}_{init}$.M1 == **asType<short int>**((**int**)30269)

$\text{\$heap}_{init}$.r1 == **asType<short int>**((**int**)171)

$\text{\$heap}_{init}$.a1 == **asType<short int>**((**int**)177)

$\text{\$heap}_{init}$.b1 == **asType<short int>**((**int**)2)

$\text{\$heap}_{init}$.M2 == **asType<short int>**((**int**)30307)

$\text{\$heap}_{init}$.r2 == **asType<short int>**((**int**)172)

$\text{\$heap}_{init}$.a2 == **asType<short int>**((**int**)176)

$\text{\$heap}_{init}$.b2 == **asType<short int>**((**int**)35)

$\text{\$heap}_{init}$.M3 == **asType<short int>**((**int**)30323)

$\text{\$heap}_{init}$.r3 == **asType<short int>**((**int**)170)

$\text{\$heap}_{init}$.a3 == **asType<short int>**((**int**)178)

$\text{\$heap}_{init}$.b3 == **asType<short int>**((**int**)63)

$\text{\$heap}_{init}$.p1 == **asType<short int>**((**int**)1)

$\text{\$heap}_{init}$.p2 == **asType<short int>**((**int**)2)

$\text{\$heap}_{init}.\text{p3} == \textbf{asType}\textbf{<short int>}((\textbf{int})3)$

$\text{div1} == \text{div}(\textbf{heapIs } \text{\$heap}_{funcstart\_719,1},$
$\textbf{asType}\textbf{<int>}(\text{\$heap}_{funcstart\_719,1}.\text{p1}),$
$\textbf{asType}\textbf{<int>}(\text{\$heap}_{funcstart\_719,1}.\text{a1}))$

$(\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<int>}(\text{\$heap}_{funcstart_719,1}.\text{p1})) \, / $
$\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<int>}(\text{\$heap}_{funcstart_719,1}.\text{a1}))) == $
$\textbf{asType}\textbf{<integer>}(\text{div1.quot})$

$(\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<int>}(\text{\$heap}_{funcstart_719,1}.\text{p1})) \, \% $
$\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<int>}(\text{\$heap}_{funcstart_719,1}.\text{a1}))) == $
$\textbf{asType}\textbf{<integer>}(\text{div1.rem})$

$\text{div2} == \text{div}(\textbf{heapIs } \text{\$heap}_{funcstart\_719,1},$
$\textbf{asType}\textbf{<int>}(\text{\$heap}_{funcstart\_719,1}.\text{p2}),$
$\textbf{asType}\textbf{<int>}(\text{\$heap}_{funcstart\_719,1}.\text{a2}))$

$(\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<int>}(\text{\$heap}_{funcstart_719,1}.\text{p2})) \, / $
$\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<int>}(\text{\$heap}_{funcstart_719,1}.\text{a2}))) == $
$\textbf{asType}\textbf{<integer>}(\text{div2.quot})$

$(\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<int>}(\text{\$heap}_{funcstart_719,1}.\text{p2})) \, \% $
$\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<int>}(\text{\$heap}_{funcstart_719,1}.\text{a2}))) == $
$\textbf{asType}\textbf{<integer>}(\text{div2.rem})$

$\text{div3} == \text{div}(\textbf{heapIs } \text{\$heap}_{funcstart\_719,1},$
$\textbf{asType}\textbf{<int>}(\text{\$heap}_{funcstart\_719,1}.\text{p3}),$
$\textbf{asType}\textbf{<int>}(\text{\$heap}_{funcstart\_719,1}.\text{a3}))$

$(\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<int>}(\text{\$heap}_{funcstart_719,1}.\text{p3})) \, / $
$\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<int>}(\text{\$heap}_{funcstart_719,1}.\text{a3}))) == $
$\textbf{asType}\textbf{<integer>}(\text{div3.quot})$

$(\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<int>}(\text{\$heap}_{funcstart_719,1}.\text{p3})) \, \% $
$\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<int>}(\text{\$heap}_{funcstart_719,1}.\text{a3}))) == $
$\textbf{asType}\textbf{<integer>}(\text{div3.rem})$

Proof:

[Take given term]

[5.0] $\text{div1} == \text{div}(\textbf{heapIs } \text{\$heap}_{funcstart\_719,1},$
$\textbf{asType}\textbf{<int>}(\text{\$heap}_{funcstart\_719,1}.\text{p1}),$
$\textbf{asType}\textbf{<int>}(\text{\$heap}_{funcstart\_719,1}.\text{a1}))$

$\rightarrow$ *[simplify]*

[5.1] $\text{div1} == \text{div}(\textbf{heapIs } \text{\$heap}_{funcstart\_719,1}, \text{\$heap}_{funcstart\_719,1}.\text{p1},$
$\textbf{asType}\textbf{<int>}(\text{\$heap}_{funcstart\_719,1}.\text{a1}))$

$\rightarrow$ *[const static or extern object]*

[5.2] $\text{div1} == \text{div}(\textbf{heapIs } \text{\$heap}_{funcstart\_719,1}, \text{\$heap}_{funcstart\_719,1}.\text{p1},$
$\textbf{asType}\textbf{<int>}(\text{\$heap}_{init}.\text{a1}))$

$\rightarrow$ *[expand definition of constant 'a1' at prang.c (16,20)]*

[5.3] div1 == div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, **asType**<**int**>(**asType**<**short int**>((**int**)177)))

$\rightarrow$ *[simplify]*

[5.6] div1 == div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177)

[Take goal term]

[1.0] **asType**<**short int**>(div1.rem) $\leq$ **maxof**(**int**)

$\rightarrow$ *[from term 5.6, div1 is equal to div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177)]*

[1.1] **asType**<**short int**>(div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).rem) $\leq$ **maxof**(**int**)

$\rightarrow$ *[simplify]*

[1.11] -32768 $<$ $-$div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).rem

$\rightarrow$ *[negate goal and search for contradiction]*

[1.12] !(-32768 $<$ $-$div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).rem)

$\rightarrow$ *[simplify]*

[1.15] 32767 $<$ div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).rem

[Assume known post-assertion, class invariant or type constraint for term 1.15]

[26.0] div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).rem $\leq$ **maxof**(**int**)

$\rightarrow$ *[simplify]*

[26.9] -32768 $<$ $-$div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).rem

$\rightarrow$ *[from term 1.15, literala $<$ $-$div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).rem is false whenever -2 $<$ (32767 + literala)]*

    Proof of rule precondition:

    [26.9.0] -2 $<$ (-32768 + 32767)

    $\rightarrow$ *[simplify]*

    [26.9.2] **true**

[26.10] **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 (47,10)

Condition defined at:

To prove: minof(int) $\leq$ $\text{\$heap}_{funcstart\_719,1}.\text{r1}$

Given:

$\text{\$heap}_{init}.\text{LIMIT} == (\textbf{int})80$

$\text{\$heap}_{init}.\text{M1} == \textbf{asType}<\textbf{short int}>((\textbf{int})30269)$

$\text{\$heap}_{init}.\text{r1} == \textbf{asType}<\textbf{short int}>((\textbf{int})171)$

$\text{\$heap}_{init}.\text{a1} == \textbf{asType}<\textbf{short int}>((\textbf{int})177)$

$\text{\$heap}_{init}.\text{b1} == \textbf{asType}<\textbf{short int}>((\textbf{int})2)$

$\text{\$heap}_{init}.\text{M2} == \textbf{asType}<\textbf{short int}>((\textbf{int})30307)$

$\text{\$heap}_{init}.\text{r2} == \textbf{asType}<\textbf{short int}>((\textbf{int})172)$

$\text{\$heap}_{init}.\text{a2} == \textbf{asType}<\textbf{short int}>((\textbf{int})176)$

$\text{\$heap}_{init}.\text{b2} == \textbf{asType}<\textbf{short int}>((\textbf{int})35)$

$\text{\$heap}_{init}.\text{M3} == \textbf{asType}<\textbf{short int}>((\textbf{int})30323)$

$\text{\$heap}_{init}.\text{r3} == \textbf{asType}<\textbf{short int}>((\textbf{int})170)$

$\text{\$heap}_{init}.\text{a3} == \textbf{asType}<\textbf{short int}>((\textbf{int})178)$

$\text{\$heap}_{init}.\text{b3} == \textbf{asType}<\textbf{short int}>((\textbf{int})63)$

$\text{\$heap}_{init}.\text{p1} == \textbf{asType}<\textbf{short int}>((\textbf{int})1)$

$\text{\$heap}_{init}.\text{p2} == \textbf{asType}<\textbf{short int}>((\textbf{int})2)$

$\text{\$heap}_{init}.\text{p3} == \textbf{asType}<\textbf{short int}>((\textbf{int})3)$

div1 == div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$,
asType$<$**int**$>$($\text{\$heap}_{funcstart\_719,1}.\text{p1}$),
asType$<$**int**$>$($\text{\$heap}_{funcstart\_719,1}.\text{a1}$))

(**asType**$<$**integer**$>$(**asType**$<$**int**$>$($\text{\$heap}_{funcstart\_719,1}.\text{p1}$)) /
asType$<$**integer**$>$(**asType**$<$**int**$>$($\text{\$heap}_{funcstart\_719,1}.\text{a1}$))) ==
asType$<$**integer**$>$(div1.quot)

(**asType**$<$**integer**$>$(**asType**$<$**int**$>$($\text{\$heap}_{funcstart\_719,1}.\text{p1}$)) %
asType$<$**integer**$>$(**asType**$<$**int**$>$($\text{\$heap}_{funcstart\_719,1}.\text{a1}$))) ==
asType$<$**integer**$>$(div1.rem)

div2 == div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$,
asType$<$**int**$>$($\text{\$heap}_{funcstart\_719,1}.\text{p2}$),
asType$<$**int**$>$($\text{\$heap}_{funcstart\_719,1}.\text{a2}$))

(**asType**$<$**integer**$>$(**asType**$<$**int**$>$($\text{\$heap}_{funcstart\_719,1}.\text{p2}$)) /
asType$<$**integer**$>$(**asType**$<$**int**$>$($\text{\$heap}_{funcstart\_719,1}.\text{a2}$))) ==
asType$<$**integer**$>$(div2.quot)

(**asType**<**integer**>(**asType**<**int**>($heap$_{funcstart_719,1}$.p2)) %
asType<**integer**>(**asType**<**int**>($heap$_{funcstart_719,1}$.a2))) ==
asType<**integer**>(div2.rem)

div3 == div(**heapIs** $heap$_{funcstart_719,1}$,
asType<**int**>($heap$_{funcstart_719,1}$.p3),
asType<**int**>($heap$_{funcstart_719,1}$.a3))

(**asType**<**integer**>(**asType**<**int**>($heap$_{funcstart_719,1}$.p3)) /
asType<**integer**>(**asType**<**int**>($heap$_{funcstart_719,1}$.a3))) ==
asType<**integer**>(div3.quot)

(**asType**<**integer**>(**asType**<**int**>($heap$_{funcstart_719,1}$.p3)) %
asType<**integer**>(**asType**<**int**>($heap$_{funcstart_719,1}$.a3))) ==
asType<**integer**>(div3.rem)

Proof:

[Take goal term]

[1.0] **minof**(**int**) $\leq$ $heap$_{funcstart_719,1}$.r1

$\rightarrow$ *[simplify]*

[1.1] -32768 $\leq$ $heap$_{funcstart_719,1}$.r1

$\rightarrow$ *[const static or extern object]*

[1.2] -32768 $\leq$ $heap$_{init}$.r1

$\rightarrow$ *[expand definition of constant 'r1' at prang.c (15,20)]*

[1.3] -32768 $\leq$ **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 (47,10)

Condition defined at:

To prove: $heap$_{funcstart_719,1}$.r1 $\leq$ **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)

$heap$_{init}$.b1 == **asType**<**short int**>((**int**)2)

$\$\text{heap}_{init}.\text{M2} == \textbf{asType}\!<\!\textbf{short int}\!>\!((\textbf{int})30307)$

$\$\text{heap}_{init}.\text{r2} == \textbf{asType}\!<\!\textbf{short int}\!>\!((\textbf{int})172)$

$\$\text{heap}_{init}.\text{a2} == \textbf{asType}\!<\!\textbf{short int}\!>\!((\textbf{int})176)$

$\$\text{heap}_{init}.\text{b2} == \textbf{asType}\!<\!\textbf{short int}\!>\!((\textbf{int})35)$

$\$\text{heap}_{init}.\text{M3} == \textbf{asType}\!<\!\textbf{short int}\!>\!((\textbf{int})30323)$

$\$\text{heap}_{init}.\text{r3} == \textbf{asType}\!<\!\textbf{short int}\!>\!((\textbf{int})170)$

$\$\text{heap}_{init}.\text{a3} == \textbf{asType}\!<\!\textbf{short int}\!>\!((\textbf{int})178)$

$\$\text{heap}_{init}.\text{b3} == \textbf{asType}\!<\!\textbf{short int}\!>\!((\textbf{int})63)$

$\$\text{heap}_{init}.\text{p1} == \textbf{asType}\!<\!\textbf{short int}\!>\!((\textbf{int})1)$

$\$\text{heap}_{init}.\text{p2} == \textbf{asType}\!<\!\textbf{short int}\!>\!((\textbf{int})2)$

$\$\text{heap}_{init}.\text{p3} == \textbf{asType}\!<\!\textbf{short int}\!>\!((\textbf{int})3)$

$\text{div1} == \text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_719,1},$
$\textbf{asType}\!<\!\textbf{int}\!>\!(\$\text{heap}_{funcstart\_719,1}.\text{p1}),$
$\textbf{asType}\!<\!\textbf{int}\!>\!(\$\text{heap}_{funcstart\_719,1}.\text{a1}))$

$(\textbf{asType}\!<\!\textbf{integer}\!>\!(\textbf{asType}\!<\!\textbf{int}\!>\!(\$\text{heap}_{funcstart\_719,1}.\text{p1}))\ /$
$\textbf{asType}\!<\!\textbf{integer}\!>\!(\textbf{asType}\!<\!\textbf{int}\!>\!(\$\text{heap}_{funcstart\_719,1}.\text{a1}))) ==$
$\textbf{asType}\!<\!\textbf{integer}\!>\!(\text{div1.quot})$

$(\textbf{asType}\!<\!\textbf{integer}\!>\!(\textbf{asType}\!<\!\textbf{int}\!>\!(\$\text{heap}_{funcstart\_719,1}.\text{p1}))\ \%$
$\textbf{asType}\!<\!\textbf{integer}\!>\!(\textbf{asType}\!<\!\textbf{int}\!>\!(\$\text{heap}_{funcstart\_719,1}.\text{a1}))) ==$
$\textbf{asType}\!<\!\textbf{integer}\!>\!(\text{div1.rem})$

$\text{div2} == \text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_719,1},$
$\textbf{asType}\!<\!\textbf{int}\!>\!(\$\text{heap}_{funcstart\_719,1}.\text{p2}),$
$\textbf{asType}\!<\!\textbf{int}\!>\!(\$\text{heap}_{funcstart\_719,1}.\text{a2}))$

$(\textbf{asType}\!<\!\textbf{integer}\!>\!(\textbf{asType}\!<\!\textbf{int}\!>\!(\$\text{heap}_{funcstart\_719,1}.\text{p2}))\ /$
$\textbf{asType}\!<\!\textbf{integer}\!>\!(\textbf{asType}\!<\!\textbf{int}\!>\!(\$\text{heap}_{funcstart\_719,1}.\text{a2}))) ==$
$\textbf{asType}\!<\!\textbf{integer}\!>\!(\text{div2.quot})$

$(\textbf{asType}\!<\!\textbf{integer}\!>\!(\textbf{asType}\!<\!\textbf{int}\!>\!(\$\text{heap}_{funcstart\_719,1}.\text{p2}))\ \%$
$\textbf{asType}\!<\!\textbf{integer}\!>\!(\textbf{asType}\!<\!\textbf{int}\!>\!(\$\text{heap}_{funcstart\_719,1}.\text{a2}))) ==$
$\textbf{asType}\!<\!\textbf{integer}\!>\!(\text{div2.rem})$

$\text{div3} == \text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_719,1},$
$\textbf{asType}\!<\!\textbf{int}\!>\!(\$\text{heap}_{funcstart\_719,1}.\text{p3}),$
$\textbf{asType}\!<\!\textbf{int}\!>\!(\$\text{heap}_{funcstart\_719,1}.\text{a3}))$

$(\textbf{asType}\!<\!\textbf{integer}\!>\!(\textbf{asType}\!<\!\textbf{int}\!>\!(\$\text{heap}_{funcstart\_719,1}.\text{p3}))\ /$
$\textbf{asType}\!<\!\textbf{integer}\!>\!(\textbf{asType}\!<\!\textbf{int}\!>\!(\$\text{heap}_{funcstart\_719,1}.\text{a3}))) ==$
$\textbf{asType}\!<\!\textbf{integer}\!>\!(\text{div3.quot})$

$(\textbf{asType}\!<\!\textbf{integer}\!>\!(\textbf{asType}\!<\!\textbf{int}\!>\!(\$\text{heap}_{funcstart\_719,1}.\text{p3}))\ \%$
$\textbf{asType}\!<\!\textbf{integer}\!>\!(\textbf{asType}\!<\!\textbf{int}\!>\!(\$\text{heap}_{funcstart\_719,1}.\text{a3}))) ==$
$\textbf{asType}\!<\!\textbf{integer}\!>\!(\text{div3.rem})$

Proof:

[Take goal term]

[1.0] $\$heap_{funcstart\_719,1}.r1 \leq$ **maxof(int)**

$\rightarrow$ *[const static or extern object]*

[1.1] $\$heap_{init}.r1 \leq$ **maxof(int)**

$\rightarrow$ *[expand definition of constant 'r1' at prang.c (15,20)]*

[1.2] **asType<short int>((int)171)** $\leq$ **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 (47,13)

Condition defined at:

To prove: minof(int) $\leq$ **(asType<int>(asType<short int>(div1.rem)) * asType<int>($\$heap_{funcstart\_719,1}.r1$))**

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)**

$\$heap_{init}.M2 ==$ **asType<short int>((int)30307)**

$\$heap_{init}.r2 ==$ **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)**

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

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

$\$heap_{init}.b3 ==$ **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)**

div1 == div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$,
asType\<int\>($\$\text{heap}_{funcstart\_719,1}$.p1),
asType\<int\>($\$\text{heap}_{funcstart\_719,1}$.a1))

(**asType\<integer\>**(**asType\<int\>**($\$\text{heap}_{funcstart\_719,1}$.p1)) /
asType\<integer\>(**asType\<int\>**($\$\text{heap}_{funcstart\_719,1}$.a1))) ==
asType\<integer\>(div1.quot)

(**asType\<integer\>**(**asType\<int\>**($\$\text{heap}_{funcstart\_719,1}$.p1)) %
asType\<integer\>(**asType\<int\>**($\$\text{heap}_{funcstart\_719,1}$.a1))) ==
asType\<integer\>(div1.rem)

div2 == div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$,
asType\<int\>($\$\text{heap}_{funcstart\_719,1}$.p2),
asType\<int\>($\$\text{heap}_{funcstart\_719,1}$.a2))

(**asType\<integer\>**(**asType\<int\>**($\$\text{heap}_{funcstart\_719,1}$.p2)) /
asType\<integer\>(**asType\<int\>**($\$\text{heap}_{funcstart\_719,1}$.a2))) ==
asType\<integer\>(div2.quot)

(**asType\<integer\>**(**asType\<int\>**($\$\text{heap}_{funcstart\_719,1}$.p2)) %
asType\<integer\>(**asType\<int\>**($\$\text{heap}_{funcstart\_719,1}$.a2))) ==
asType\<integer\>(div2.rem)

div3 == div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$,
asType\<int\>($\$\text{heap}_{funcstart\_719,1}$.p3),
asType\<int\>($\$\text{heap}_{funcstart\_719,1}$.a3))

(**asType\<integer\>**(**asType\<int\>**($\$\text{heap}_{funcstart\_719,1}$.p3)) /
asType\<integer\>(**asType\<int\>**($\$\text{heap}_{funcstart\_719,1}$.a3))) ==
asType\<integer\>(div3.quot)

(**asType\<integer\>**(**asType\<int\>**($\$\text{heap}_{funcstart\_719,1}$.p3)) %
asType\<integer\>(**asType\<int\>**($\$\text{heap}_{funcstart\_719,1}$.a3))) ==
asType\<integer\>(div3.rem)

Proof:

[Take given term]

[5.0] div1 == div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$,
asType\<int\>($\$\text{heap}_{funcstart\_719,1}$.p1),
asType\<int\>($\$\text{heap}_{funcstart\_719,1}$.a1))

$\rightarrow$ *[simplify]*

[5.1] div1 == div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}$.p1,
asType\<int\>($\$\text{heap}_{funcstart\_719,1}$.a1))

$\rightarrow$ *[const static or extern object]*

[5.2] div1 == div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}$.p1,
asType\<int\>($\$\text{heap}_{init}$.a1))

$\rightarrow$ *[expand definition of constant 'a1' at prang.c (16,20)]*

[5.3] div1 == div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p1,
asType\<int\>(asType\<short int\>((int)177)))

$\rightarrow$ *[simplify]*

[5.6] div1 == div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p1, 177)

[Take goal term]

[1.0] **minof(int)** $\leq$ (**asType\<int\>(asType\<short int\>**(div1.rem)) *
asType\<int\>($\text{\$heap}_{funcstart\_719,1}$.r1))

$\rightarrow$ *[simplify]*

[1.1] -32768 $\leq$ (**asType\<int\>(asType\<short int\>**(div1.rem)) *
asType\<int\>($\text{\$heap}_{funcstart\_719,1}$.r1))

$\rightarrow$ *[from term 5.6, div1 is equal to div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$,
$\text{\$heap}_{funcstart\_719,1}$.p1, 177)]*

[1.2] -32768 $\leq$ (**asType\<int\>(asType\<short int\>**(div(**heapIs**
$\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p1, 177).rem)) *
asType\<int\>($\text{\$heap}_{funcstart\_719,1}$.r1))

$\rightarrow$ *[simplify]*

[1.4] -32768 $\leq$ (div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p1,
177).rem * **asType\<int\>**($\text{\$heap}_{funcstart\_719,1}$.r1))

$\rightarrow$ *[const static or extern object]*

[1.5] -32768 $\leq$ (div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p1,
177).rem * **asType\<int\>**($\text{\$heap}_{init}$.r1))

$\rightarrow$ *[expand definition of constant 'r1' at prang.c (15,20)]*

[1.6] -32768 $\leq$ (div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p1,
177).rem * **asType\<int\>(asType\<short int\>((int)171)))**

$\rightarrow$ *[simplify]*

[1.11] -32769 < (171 * div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p1,
177).rem)

$\rightarrow$ *[literal comparison of product]*

[1.12] ([171 < 0]: (-32769 / -171) < $-$div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$,
$\text{\$heap}_{funcstart\_719,1}$.p1, 177).rem, [0 < 171]: (-32769 / 171) < div(**heapIs**
$\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p1, 177).rem, [0 == 171]: -32769 < 0)

$\rightarrow$ *[explicitly assert falsehood of skipped guards in subsequent guards]*

[1.13] ([171 < 0]: (-32769 / -171) < $-$div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$,
$\text{\$heap}_{funcstart\_719,1}$.p1, 177).rem, [(0 < 171) $\wedge$!(171 < 0)]: (-32769 / 171) <
div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p1, 177).rem, [(0 == 171)
$\wedge$!(0 < 171) $\wedge$!(171 < 0)]: -32769 < 0)

$\rightarrow$ *[simplify]*

[1.21] -192 < div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p1, 177).rem

$\rightarrow$ *[negate goal and search for contradiction]*

[1.22] !(-192 < div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p1, 177).rem)

$\rightarrow$ *[simplify]*

[1.24] 191 < $-$div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p1, 177).rem

[Assume known post-assertion, class invariant or type constraint for term 5.6]

[11.0] (**asType**<**integer**>($\text{\$heap}_{funcstart\_719,1}$.p1) % **asType**<**integer**>(177)) == **asType**<**integer**>(div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p1, 177).rem)

$\rightarrow$ *[simplify]*

[11.2] ($\text{\$heap}_{funcstart\_719,1}$.p1 % 177) == **asType**<**integer**>(div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p1, 177).rem)

$\rightarrow$ *[expand definition of operator '.%' in class 'int' at built in declaration]*

[11.3] ([**asType**<**integer**>($\text{\$heap}_{funcstart\_719,1}$.p1) < 0]: $-(-$**asType**<**integer**>($\text{\$heap}_{funcstart\_719,1}$.p1) % 177), []: **asType**<**integer**>($\text{\$heap}_{funcstart\_719,1}$.p1) % 177) == **asType**<**integer**>(div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p1, 177).rem)

$\rightarrow$ *[explicitly assert falsehood of skipped guards in subsequent guards]*

[11.4] ([**asType**<**integer**>($\text{\$heap}_{funcstart\_719,1}$.p1) < 0]: $-(-$**asType**<**integer**>($\text{\$heap}_{funcstart\_719,1}$.p1) % 177), [!(**asType**<**integer**>($\text{\$heap}_{funcstart\_719,1}$.p1) < 0)]: **asType**<**integer**>($\text{\$heap}_{funcstart\_719,1}$.p1) % 177) == **asType**<**integer**>(div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p1, 177).rem)

$\rightarrow$ *[simplify]*

[11.14] ([0 < $-\text{\$heap}_{funcstart\_719,1}$.p1]: $-(-\text{\$heap}_{funcstart\_719,1}$.p1 % 177), [-1 < $\text{\$heap}_{funcstart\_719,1}$.p1]: **asType**<**integer**>($\text{\$heap}_{funcstart\_719,1}$.p1) % 177) == **asType**<**integer**>(div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p1, 177).rem)

$\rightarrow$ *[remainder of negation]*

[11.15] ([0 < $-\text{\$heap}_{funcstart\_719,1}$.p1]: $-([0 == (\text{\$heap}_{funcstart\_719,1}$.p1 % 177)]: 0, []: 177 + $-(\text{\$heap}_{funcstart\_719,1}$.p1 % 177)), [-1 < $\text{\$heap}_{funcstart\_719,1}$.p1]: **asType**<**integer**>($\text{\$heap}_{funcstart\_719,1}$.p1) % 177) == **asType**<**integer**>(div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p1, 177).rem)

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

[11.16] ([0 < −$heap_{funcstart\_719,1}$.p1]: −([0 == ($heap_{funcstart\_719,1}$.p1 % 177)]: 0, [!(0 == ($heap_{funcstart\_719,1}$.p1 % 177))]: 177 + −($heap_{funcstart\_719,1}$.p1 % 177)), [-1 < $heap_{funcstart\_719,1}$.p1]: **asType**<**integer**>($heap_{funcstart\_719,1}$.p1) % 177) == **asType**<**integer**>(div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p1, 177).rem)

→ *[move guard outside expression]*

[11.17] ([0 < −$heap_{funcstart\_719,1}$.p1]: ([0 == ($heap_{funcstart\_719,1}$.p1 % 177)]: −0, [!(0 == ($heap_{funcstart\_719,1}$.p1 % 177))]: −(177 + −($heap_{funcstart\_719,1}$.p1 % 177))), [-1 < $heap_{funcstart\_719,1}$.p1]: **asType**<**integer**>($heap_{funcstart\_719,1}$.p1) % 177) == **asType**<**integer**>(div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p1, 177).rem)

→ *[simplify]*

[11.24] 0 == (−([0 < −$heap_{funcstart\_719,1}$.p1]: ([0 == ($heap_{funcstart\_719,1}$.p1 % 177)]: 0, [!(0 == ($heap_{funcstart\_719,1}$.p1 % 177))]: -177 + ($heap_{funcstart\_719,1}$.p1 % 177)), [-1 < $heap_{funcstart\_719,1}$.p1]: $heap_{funcstart\_719,1}$.p1 % 177) + div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p1, 177).rem)

→ *[move guard outside expression]*

[11.26] 0 == (((0 < −$heap_{funcstart\_719,1}$.p1]: ([0 == ($heap_{funcstart\_719,1}$.p1 % 177)]: −0, [!(0 == ($heap_{funcstart\_719,1}$.p1 % 177))]: −(-177 + ($heap_{funcstart\_719,1}$.p1 % 177))), [-1 < $heap_{funcstart\_719,1}$.p1]: −($heap_{funcstart\_719,1}$.p1 % 177)) + div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p1, 177).rem)

→ *[simplify]*

[11.29] 0 == (((0 < −$heap_{funcstart\_719,1}$.p1]: ([0 == ($heap_{funcstart\_719,1}$.p1 % 177)]: 0, [!(0 == ($heap_{funcstart\_719,1}$.p1 % 177))]: 177 + −($heap_{funcstart\_719,1}$.p1 % 177)), [-1 < $heap_{funcstart\_719,1}$.p1]: −($heap_{funcstart\_719,1}$.p1 % 177)) + div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p1, 177).rem)

→ *[move guard outside expression]*

[11.31] 0 == ([0 < −$heap_{funcstart\_719,1}$.p1]: ([0 == ($heap_{funcstart\_719,1}$.p1 % 177)]: 0 + div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p1, 177).rem, [!(0 == ($heap_{funcstart\_719,1}$.p1 % 177))]: (177 + −($heap_{funcstart\_719,1}$.p1 % 177)) + div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p1, 177).rem), [-1 < $heap_{funcstart\_719,1}$.p1]: −($heap_{funcstart\_719,1}$.p1 % 177) + div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p1, 177).rem)

→ *[simplify]*

[11.33] 0 == ([0 < −$heap$_{funcstart_719,1}$.p1]: ([0 == ($heap$_{funcstart\_719,1}$.p1 % 177)]: div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1, 177).rem, [!(0 == ($heap$_{funcstart\_719,1}$.p1 % 177))]: 177 + −($heap$_{funcstart_719,1}$.p1 % 177) + div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1, 177).rem), [-1 < $heap$_{funcstart_719,1}$.p1]: −($heap$_{funcstart\_719,1}$.p1 % 177) + div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1, 177).rem)

→ *[move guard outside expression]*

[11.35] ([0 < −$heap$_{funcstart_719,1}$.p1]: ([0 == ($heap$_{funcstart\_719,1}$.p1 % 177)]: 0 == div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1, 177).rem, [!(0 == ($heap$_{funcstart\_719,1}$.p1 % 177))]: 0 == (177 + −($heap$_{funcstart_719,1}$.p1 % 177) + div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1, 177).rem)), [-1 < $heap$_{funcstart_719,1}$.p1]: 0 == (−($heap$_{funcstart\_719,1}$.p1 % 177) + div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1, 177).rem))

→ *[simplify]*

[11.40] ([0 < −$heap$_{funcstart_719,1}$.p1]: ([0 == ($heap$_{funcstart\_719,1}$.p1 % 177)]: 0 == div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1, 177).rem, [!(0 == ($heap$_{funcstart\_719,1}$.p1 % 177))]: 177 == (($heap$_{funcstart_719,1}$.p1 % 177) + −div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1, 177).rem)), [-1 < $heap$_{funcstart_719,1}$.p1]: 0 == (−($heap$_{funcstart\_719,1}$.p1 % 177) + div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1, 177).rem))

→ *[from term 1.24, div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1, 177).rem == literala is false whenever -1 < (191 + literala)]*

Proof of rule precondition:

[11.40.0] -1 < (0 + 191)

→ *[simplify]*

[11.40.2] **true**

[11.41] ([0 < −$heap$_{funcstart_719,1}$.p1]: ([0 == ($heap$_{funcstart\_719,1}$.p1 % 177)]: **false**, [!(0 == ($heap$_{funcstart_719,1}$.p1 % 177))]: 177 == (−div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1, 177).rem + ($heap$_{funcstart\_719,1}$.p1 % 177))), [-1 < $heap$_{funcstart_719,1}$.p1]: 0 == (−($heap$_{funcstart\_719,1}$.p1 % 177) + div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1, 177).rem))

→ *[simplify]*

[11.43] ([0 < −$heap$_{funcstart_719,1}$.p1]: (177 == (−div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1, 177).rem + ($heap$_{funcstart\_719,1}$.p1 % 177))) ∧ !(0 == ($heap$_{funcstart_719,1}$.p1 % 177)), [-1 < $heap$_{funcstart_719,1}$.p1]: 0 == (−($heap$_{funcstart\_719,1}$.p1 % 177) + div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1, 177).rem))

[Branch on disjunction or conditional in term 11.43]

[27.0] ((177 == (−div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1,

177).rem + ($heap$_{funcstart_719,1}$.p1 % 177))) ∧ !(0 == ($heap$_{funcstart\_719,1}$.p1 % 177))) ∨ (0 == (−($heap$_{funcstart_719,1}$.p1 % 177) + div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1, 177).rem)) ∨ (-1 < $heap$_{funcstart_719,1}$.p1)

→ *[separate conjunction and work on first sub-term]*

[27.1] (177 == (−div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1, 177).rem + ($heap$_{funcstart\_719,1}$.p1 % 177))) ∨ ...

[Create new term from terms 27.1, 1.24 using rule: transitivity 15r]

[47.0] ((-177 + 191) < −($heap$_{funcstart_719,1}$.p1 % 177)) ∨ (0 == (−($heap$_{funcstart\_719,1}$.p1 % 177) + div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1, 177).rem)) ∨ (-1 < $heap$_{funcstart_719,1}$.p1)

→ *[simplify]*

[47.2] **false** ∨ ...

[Remove 'false' term 47.2 and fetch new term from containing clause]

[48.0] 0 == (−($heap$_{funcstart_719,1}$.p1 % 177) + div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1, 177).rem)

[Create new term from terms 1.24, 48.0 using rule: transitivity 16]

[52.0] (0 + 191) < −($heap$_{funcstart_719,1}$.p1 % 177)

→ *[simplify]*

[52.2] **false**

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

Condition generated at: C:\Escher\Customers\prang\prang.c (47,13)

Condition defined at:

To prove: (**asType**<**int**>(**asType**<**short int**>(div1.rem)) * **asType**<**int**>($heap$_{funcstart_719,1}$.r1)) ≤ **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)

$heap$_{init}$.b1 == **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$>$**$((\textbf{int})176)$

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

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

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

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

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

$\$heap_{init}.p1 == $ **asType$<$short int$>$**$((\textbf{int})1)$

$\$heap_{init}.p2 == $ **asType$<$short int$>$**$((\textbf{int})2)$

$\$heap_{init}.p3 == $ **asType$<$short int$>$**$((\textbf{int})3)$

div1 == div(**heapIs** $\$heap_{funcstart\_719,1}$,
asType$<$int$>$ $(\$heap_{funcstart\_719,1}.p1)$,
asType$<$int$>$ $(\$heap_{funcstart\_719,1}.a1))$

(**asType$<$integer$>$**(**asType$<$int$>$**$(\$heap_{funcstart\_719,1}.p1)$) /
asType$<$integer$>$(**asType$<$int$>$**$(\$heap_{funcstart\_719,1}.a1)$)) ==
asType$<$integer$>$(div1.quot)

(**asType$<$integer$>$**(**asType$<$int$>$**$(\$heap_{funcstart\_719,1}.p1)$) %
asType$<$integer$>$(**asType$<$int$>$**$(\$heap_{funcstart\_719,1}.a1)$)) ==
asType$<$integer$>$(div1.rem)

div2 == div(**heapIs** $\$heap_{funcstart\_719,1}$,
asType$<$int$>$ $(\$heap_{funcstart\_719,1}.p2)$,
asType$<$int$>$ $(\$heap_{funcstart\_719,1}.a2))$

(**asType$<$integer$>$**(**asType$<$int$>$**$(\$heap_{funcstart\_719,1}.p2)$) /
asType$<$integer$>$(**asType$<$int$>$**$(\$heap_{funcstart\_719,1}.a2)$)) ==
asType$<$integer$>$(div2.quot)

(**asType$<$integer$>$**(**asType$<$int$>$**$(\$heap_{funcstart\_719,1}.p2)$) %
asType$<$integer$>$(**asType$<$int$>$**$(\$heap_{funcstart\_719,1}.a2)$)) ==
asType$<$integer$>$(div2.rem)

div3 == div(**heapIs** $\$heap_{funcstart\_719,1}$,
asType$<$int$>$ $(\$heap_{funcstart\_719,1}.p3)$,
asType$<$int$>$ $(\$heap_{funcstart\_719,1}.a3))$

(**asType$<$integer$>$**(**asType$<$int$>$**$(\$heap_{funcstart\_719,1}.p3)$) /
asType$<$integer$>$(**asType$<$int$>$**$(\$heap_{funcstart\_719,1}.a3)$)) ==
asType$<$integer$>$(div3.quot)

(**asType$<$integer$>$**(**asType$<$int$>$**$(\$heap_{funcstart\_719,1}.p3)$) %
asType$<$integer$>$(**asType$<$int$>$**$(\$heap_{funcstart\_719,1}.a3)$)) ==
asType$<$integer$>$(div3.rem)

Proof:

[Take given term]

[5.0] div1 == div(**heapIs** $\$heap_{funcstart\_719,1}$,
asType\<int\>($\$heap_{funcstart\_719,1}$.p1),
asType\<int\>($\$heap_{funcstart\_719,1}$.a1))

$\rightarrow$ *[simplify]*

[5.1] div1 == div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1,
asType\<int\>($\$heap_{funcstart\_719,1}$.a1))

$\rightarrow$ *[const static or extern object]*

[5.2] div1 == div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1,
asType\<int\>($\$heap_{init}$.a1))

$\rightarrow$ *[expand definition of constant 'a1' at prang.c (16,20)]*

[5.3] div1 == div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1,
asType\<int\>(**asType\<short int\>**((**int**)177)))

$\rightarrow$ *[simplify]*

[5.6] div1 == div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177)

[Take goal term]

[1.0] (**asType\<int\>**(**asType\<short int\>**(div1.rem)) *
asType\<int\>($\$heap_{funcstart\_719,1}$.r1)) $\leq$ **maxof**(**int**)

$\rightarrow$ *[from term 5.6, div1 is equal to div(**heapIs** $\$heap_{funcstart\_719,1}$,
$\$heap_{funcstart\_719,1}$.p1, 177)]*

[1.1] (**asType\<int\>**(**asType\<short int\>**(div(**heapIs** $\$heap_{funcstart\_719,1}$,
$\$heap_{funcstart\_719,1}$.p1, 177).rem)) * **asType\<int\>**($\$heap_{funcstart\_719,1}$.r1)) $\leq$
maxof(**int**)

$\rightarrow$ *[simplify]*

[1.3] (div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).rem *
asType\<int\>($\$heap_{funcstart\_719,1}$.r1)) $\leq$ **maxof**(**int**)

$\rightarrow$ *[const static or extern object]*

[1.4] (div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).rem *
asType\<int\>($\$heap_{init}$.r1)) $\leq$ **maxof**(**int**)

$\rightarrow$ *[expand definition of constant 'r1' at prang.c (15,20)]*

[1.5] (div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).rem *
asType\<int\>(**asType\<short int\>**((**int**)171))) $\leq$ **maxof**(**int**)

$\rightarrow$ *[simplify]*

[1.18] -32768 < (-171 * div(**heapIs** $\$heap_{funcstart\_719,1}$,
$\$heap_{funcstart\_719,1}$.p1, 177).rem)

$\rightarrow$ *[literal comparison of product]*

[1.19] ([-171 < 0]: (-32768 / 171) < $-$div(**heapIs** $\$heap_{funcstart\_719,1}$,

$\text{heap}_{funcstart\_719,1}.\text{p1}, 177).\text{rem}, [0 < -171]: (-32768 \, / \, -171) < \text{div}(\textbf{heapIs}$
$\text{heap}_{funcstart\_719,1}, \text{heap}_{funcstart\_719,1}.\text{p1}, 177).\text{rem}, [-171 == 0]: -32768 <$
0)

$\rightarrow$ *[explicitly assert falsehood of skipped guards in subsequent guards]*

[1.20] ([-171 < 0]: (-32768 / 171) < $-$div(**heapIs** $\text{heap}_{funcstart\_719,1}$,
$\text{heap}_{funcstart\_719,1}.\text{p1}, 177).\text{rem}$, [(0 < -171) $\wedge$!(-171 < 0)]: (-32768 / -171) <
div(**heapIs** $\text{heap}_{funcstart\_719,1}$, $\text{heap}_{funcstart\_719,1}.\text{p1}, 177).\text{rem}$, [(-171 ==
0) $\wedge$!(-171 < 0) $\wedge$!(0 < -171)]: -32768 < 0)

$\rightarrow$ *[simplify]*

[1.24] -192 < $-$div(**heapIs** $\text{heap}_{funcstart\_719,1}$, $\text{heap}_{funcstart\_719,1}.\text{p1}$,
177).rem

$\rightarrow$ *[negate goal and search for contradiction]*

[1.25] !(-192 < $-$div(**heapIs** $\text{heap}_{funcstart\_719,1}$, $\text{heap}_{funcstart\_719,1}.\text{p1}$,
177).rem)

$\rightarrow$ *[simplify]*

[1.28] 191 < div(**heapIs** $\text{heap}_{funcstart\_719,1}$, $\text{heap}_{funcstart\_719,1}.\text{p1}, 177).\text{rem}$

[Assume known post-assertion, class invariant or type constraint for term 5.6]

[11.0] (**asType\<integer\>**($\text{heap}_{funcstart\_719,1}.\text{p1}$) %
asType\<integer\>(177)) == **asType\<integer\>**(div(**heapIs**
$\text{heap}_{funcstart\_719,1}$, $\text{heap}_{funcstart\_719,1}.\text{p1}, 177).\text{rem}$)

$\rightarrow$ *[simplify]*

[11.2] ($\text{heap}_{funcstart\_719,1}.\text{p1}$ % 177) == **asType\<integer\>**(div(**heapIs**
$\text{heap}_{funcstart\_719,1}$, $\text{heap}_{funcstart\_719,1}.\text{p1}, 177).\text{rem}$)

$\rightarrow$ *[expand definition of operator '.%' in class 'int' at built in declaration]*

[11.3] ([**asType\<integer\>**($\text{heap}_{funcstart\_719,1}.\text{p1}$) < 0]:
$-(-$**asType\<integer\>**($\text{heap}_{funcstart\_719,1}.\text{p1}$) % 177), []:
asType\<integer\>($\text{heap}_{funcstart\_719,1}.\text{p1}$) % 177) ==
asType\<integer\>(div(**heapIs** $\text{heap}_{funcstart\_719,1}$, $\text{heap}_{funcstart\_719,1}.\text{p1}$,
177).rem)

$\rightarrow$ *[explicitly assert falsehood of skipped guards in subsequent guards]*

[11.4] ([**asType\<integer\>**($\text{heap}_{funcstart\_719,1}.\text{p1}$) < 0]:
$-(-$**asType\<integer\>**($\text{heap}_{funcstart\_719,1}.\text{p1}$) % 177),
[!(**asType\<integer\>**($\text{heap}_{funcstart\_719,1}.\text{p1}$) < 0)]:
asType\<integer\>($\text{heap}_{funcstart\_719,1}.\text{p1}$) % 177) ==
asType\<integer\>(div(**heapIs** $\text{heap}_{funcstart\_719,1}$, $\text{heap}_{funcstart\_719,1}.\text{p1}$,
177).rem)

$\rightarrow$ *[simplify]*

[11.14] ([0 < $-\text{heap}_{funcstart\_719,1}.\text{p1}$]: $-(-\text{heap}_{funcstart\_719,1}.\text{p1}$ % 177), [-1

$< \$\text{heap}_{funcstart\_719,1}.\text{p1}$]: **asType**$<$**integer**$>$($\$\text{heap}_{funcstart\_719,1}.\text{p1}$) % 177)
== **asType**$<$**integer**$>$(div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$,
$\$\text{heap}_{funcstart\_719,1}.\text{p1}$, 177).rem)

$\rightarrow$ *[remainder of negation]*

[11.15] ([0 $< -\$\text{heap}_{funcstart\_719,1}.\text{p1}$]: $-$([0 == ($\$\text{heap}_{funcstart\_719,1}.\text{p1}$ %
177)]: 0, []: 177 + $-$($\$\text{heap}_{funcstart\_719,1}.\text{p1}$ % 177)), [-1 $<$
$\$\text{heap}_{funcstart\_719,1}.\text{p1}$]: **asType**$<$**integer**$>$($\$\text{heap}_{funcstart\_719,1}.\text{p1}$) % 177)
== **asType**$<$**integer**$>$(div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$,
$\$\text{heap}_{funcstart\_719,1}.\text{p1}$, 177).rem)

$\rightarrow$ *[explicitly assert falsehood of skipped guards in subsequent guards]*

[11.16] ([0 $< -\$\text{heap}_{funcstart\_719,1}.\text{p1}$]: $-$([0 == ($\$\text{heap}_{funcstart\_719,1}.\text{p1}$ %
177)]: 0, [!(0 == ($\$\text{heap}_{funcstart\_719,1}.\text{p1}$ % 177))]: 177 +
$-$($\$\text{heap}_{funcstart\_719,1}.\text{p1}$ % 177)), [-1 $<$ $\$\text{heap}_{funcstart\_719,1}.\text{p1}$]:
asType$<$**integer**$>$($\$\text{heap}_{funcstart\_719,1}.\text{p1}$) % 177) ==
asType$<$**integer**$>$(div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}.\text{p1}$,
177).rem)

$\rightarrow$ *[move guard outside expression]*

[11.17] ([0 $< -\$\text{heap}_{funcstart\_719,1}.\text{p1}$]: ([0 == ($\$\text{heap}_{funcstart\_719,1}.\text{p1}$ %
177)]: -0, [!(0 == ($\$\text{heap}_{funcstart\_719,1}.\text{p1}$ % 177))]: $-$(177 +
$-$($\$\text{heap}_{funcstart\_719,1}.\text{p1}$ % 177))), [-1 $<$ $\$\text{heap}_{funcstart\_719,1}.\text{p1}$]:
asType$<$**integer**$>$($\$\text{heap}_{funcstart\_719,1}.\text{p1}$) % 177) ==
asType$<$**integer**$>$(div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}.\text{p1}$,
177).rem)

$\rightarrow$ *[simplify]*

[11.24] 0 == ($-$([0 $< -\$\text{heap}_{funcstart\_719,1}.\text{p1}$]: ([0 ==
($\$\text{heap}_{funcstart\_719,1}.\text{p1}$ % 177)]: 0, [!(0 == ($\$\text{heap}_{funcstart\_719,1}.\text{p1}$ % 177))]:
-177 + ($\$\text{heap}_{funcstart\_719,1}.\text{p1}$ % 177)), [-1 $<$ $\$\text{heap}_{funcstart\_719,1}.\text{p1}$]:
$\$\text{heap}_{funcstart\_719,1}.\text{p1}$ % 177) + div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$,
$\$\text{heap}_{funcstart\_719,1}.\text{p1}$, 177).rem)

$\rightarrow$ *[move guard outside expression]*

[11.26] 0 == ((([0 $< -\$\text{heap}_{funcstart\_719,1}.\text{p1}$]: ([0 == ($\$\text{heap}_{funcstart\_719,1}.\text{p1}$
% 177)]: -0, [!(0 == ($\$\text{heap}_{funcstart\_719,1}.\text{p1}$ % 177))]: $-$(-177 +
($\$\text{heap}_{funcstart\_719,1}.\text{p1}$ % 177))), [-1 $<$ $\$\text{heap}_{funcstart\_719,1}.\text{p1}$]:
$-$($\$\text{heap}_{funcstart\_719,1}.\text{p1}$ % 177)) + div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$,
$\$\text{heap}_{funcstart\_719,1}.\text{p1}$, 177).rem)

$\rightarrow$ *[simplify]*

[11.29] 0 == (([0 $< -\$\text{heap}_{funcstart\_719,1}.\text{p1}$]: ([0 == ($\$\text{heap}_{funcstart\_719,1}.\text{p1}$
% 177)]: 0, [!(0 == ($\$\text{heap}_{funcstart\_719,1}.\text{p1}$ % 177))]: 177 +
$-$($\$\text{heap}_{funcstart\_719,1}.\text{p1}$ % 177)), [-1 $<$ $\$\text{heap}_{funcstart\_719,1}.\text{p1}$]:
$-$($\$\text{heap}_{funcstart\_719,1}.\text{p1}$ % 177)) + div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$,
$\$\text{heap}_{funcstart\_719,1}.\text{p1}$, 177).rem)

$\rightarrow$ *[move guard outside expression]*

[11.31] $0 == ([0 < -\$heap_{funcstart\_719,1}.p1]$: $([0 == (\$heap_{funcstart\_719,1}.p1 \%$ $177)]$: $0 + \text{div}(\textbf{heapIs } \$heap_{funcstart\_719,1}, \$heap_{funcstart\_719,1}.p1, 177).\text{rem},$ $[!(0 == (\$heap_{funcstart\_719,1}.p1 \% 177))]$: $(177 + -(\$heap_{funcstart\_719,1}.p1 \%$ $177)) + \text{div}(\textbf{heapIs } \$heap_{funcstart\_719,1}, \$heap_{funcstart\_719,1}.p1, 177).\text{rem}), [-1$ $< \$heap_{funcstart\_719,1}.p1]$: $-(\$heap_{funcstart\_719,1}.p1 \% 177) + \text{div}(\textbf{heapIs}$ $\$heap_{funcstart\_719,1}, \$heap_{funcstart\_719,1}.p1, 177).\text{rem})$

$\rightarrow$ *[simplify]*

[11.33] $0 == ([0 < -\$heap_{funcstart\_719,1}.p1]$: $([0 == (\$heap_{funcstart\_719,1}.p1$ $\% 177)]$: $\text{div}(\textbf{heapIs } \$heap_{funcstart\_719,1}, \$heap_{funcstart\_719,1}.p1, 177).\text{rem},$ $[!(0 == (\$heap_{funcstart\_719,1}.p1 \% 177))]$: $177 + -(\$heap_{funcstart\_719,1}.p1 \%$ $177) + \text{div}(\textbf{heapIs } \$heap_{funcstart\_719,1}, \$heap_{funcstart\_719,1}.p1, 177).\text{rem}), [-1$ $< \$heap_{funcstart\_719,1}.p1]$: $-(\$heap_{funcstart\_719,1}.p1 \% 177) + \text{div}(\textbf{heapIs}$ $\$heap_{funcstart\_719,1}, \$heap_{funcstart\_719,1}.p1, 177).\text{rem})$

$\rightarrow$ *[move guard outside expression]*

[11.35] $([0 < -\$heap_{funcstart\_719,1}.p1]$: $([0 == (\$heap_{funcstart\_719,1}.p1 \% 177)]$: $0 == \text{div}(\textbf{heapIs } \$heap_{funcstart\_719,1}, \$heap_{funcstart\_719,1}.p1, 177).\text{rem}, [!(0$ $== (\$heap_{funcstart\_719,1}.p1 \% 177))]$: $0 == (177 + -(\$heap_{funcstart\_719,1}.p1$ $\% 177) + \text{div}(\textbf{heapIs } \$heap_{funcstart\_719,1}, \$heap_{funcstart\_719,1}.p1, 177).\text{rem})),$ $[-1 < \$heap_{funcstart\_719,1}.p1]$: $0 == (-(\$heap_{funcstart\_719,1}.p1 \% 177) +$ $\text{div}(\textbf{heapIs } \$heap_{funcstart\_719,1}, \$heap_{funcstart\_719,1}.p1, 177).\text{rem}))$

$\rightarrow$ *[simplify]*

[11.40] $([0 < -\$heap_{funcstart\_719,1}.p1]$: $([0 == (\$heap_{funcstart\_719,1}.p1 \%$ $177)]$: $0 == \text{div}(\textbf{heapIs } \$heap_{funcstart\_719,1}, \$heap_{funcstart\_719,1}.p1, 177).\text{rem},$ $[!(0 == (\$heap_{funcstart\_719,1}.p1 \% 177))]$: $177 == ((\$heap_{funcstart\_719,1}.p1 \%$ $177) + -\text{div}(\textbf{heapIs } \$heap_{funcstart\_719,1}, \$heap_{funcstart\_719,1}.p1, 177).\text{rem})),$ $[-1 < \$heap_{funcstart\_719,1}.p1]$: $0 == (-(\$heap_{funcstart\_719,1}.p1 \% 177) +$ $\text{div}(\textbf{heapIs } \$heap_{funcstart\_719,1}, \$heap_{funcstart\_719,1}.p1, 177).\text{rem}))$

$\rightarrow$ *[from term 1.28, div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}.p1$,* *177).rem == literala is false whenever (-1 + literala) < 191]*

Proof of rule precondition:

[11.40.0] $(-1 + 0) < 191$

$\rightarrow$ *[simplify]*

[11.40.2] **true**

[11.41] $([0 < -\$heap_{funcstart\_719,1}.p1]$: $([0 == (\$heap_{funcstart\_719,1}.p1 \%$ $177)]$: **false**, $[!(0 == (\$heap_{funcstart\_719,1}.p1 \% 177))]$: $177 == (-\text{div}(\textbf{heapIs}$ $\$heap_{funcstart\_719,1}, \$heap_{funcstart\_719,1}.p1, 177).\text{rem} +$ $(\$heap_{funcstart\_719,1}.p1 \% 177))), [-1 < \$heap_{funcstart\_719,1}.p1]$: $0 ==$ $(-(\$heap_{funcstart\_719,1}.p1 \% 177) + \text{div}(\textbf{heapIs } \$heap_{funcstart\_719,1},$ $\$heap_{funcstart\_719,1}.p1, 177).\text{rem}))$

$\rightarrow$ *[remainder is less than divisor]*

Proof of rule precondition:

[11.41.0] $(177 + -\mathrm{div}(\textbf{heapIs}\ \$heap_{funcstart\_719,1}, \$heap_{funcstart\_719,1}.\mathrm{p1}, 177).\mathrm{rem}) \leq 177$

$\rightarrow$ *[simplify]*

[11.41.11] $-1 < \mathrm{div}(\textbf{heapIs}\ \$heap_{funcstart\_719,1}, \$heap_{funcstart\_719,1}.\mathrm{p1}, 177).\mathrm{rem}$

$\rightarrow$ *[from term 1.28, literala < div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p1, 177).rem is true whenever (-1 + literala) < 191]*

Proof of rule precondition:

[11.41.11.0] $(-1 + -1) < 191$

$\rightarrow$ *[simplify]*

[11.41.11.2] **true**

[11.41.12] **true**

[11.42] $([0 < -\$heap_{funcstart\_719,1}.\mathrm{p1}]:\ ([0 == (\$heap_{funcstart\_719,1}.\mathrm{p1}\ \%\ 177)]:\ \textbf{false},\ [!(0 == (\$heap_{funcstart\_719,1}.\mathrm{p1}\ \%\ 177))]:\ \textbf{false}),\ [-1 < \$heap_{funcstart\_719,1}.\mathrm{p1}]:\ 0 == (-(\$heap_{funcstart\_719,1}.\mathrm{p1}\ \%\ 177) + \mathrm{div}(\textbf{heapIs}\ \$heap_{funcstart\_719,1}, \$heap_{funcstart\_719,1}.\mathrm{p1}, 177).\mathrm{rem}))$

$\rightarrow$ *[all guards have equal guarded terms]*

[11.43] $([0 < -\$heap_{funcstart\_719,1}.\mathrm{p1}]:\ \textbf{false},\ [-1 < \$heap_{funcstart\_719,1}.\mathrm{p1}]:\ 0 == (-(\$heap_{funcstart\_719,1}.\mathrm{p1}\ \%\ 177) + \mathrm{div}(\textbf{heapIs}\ \$heap_{funcstart\_719,1}, \$heap_{funcstart\_719,1}.\mathrm{p1}, 177).\mathrm{rem}))$

$\rightarrow$ *[remainder is less than divisor]*

Proof of rule precondition:

[11.43.0] $(0 + 177) \leq \mathrm{div}(\textbf{heapIs}\ \$heap_{funcstart\_719,1}, \$heap_{funcstart\_719,1}.\mathrm{p1}, 177).\mathrm{rem}$

$\rightarrow$ *[simplify]*

[11.43.3] $176 < \mathrm{div}(\textbf{heapIs}\ \$heap_{funcstart\_719,1}, \$heap_{funcstart\_719,1}.\mathrm{p1}, 177).\mathrm{rem}$

$\rightarrow$ *[from term 1.28, literala < div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p1, 177).rem is true whenever (-1 + literala) < 191]*

Proof of rule precondition:

[11.43.3.0] $(-1 + 176) < 191$

$\rightarrow$ *[simplify]*

[11.43.3.2] **true**

[11.43.4] **true**

[11.44] ($[0 < -\$\text{heap}_{funcstart\_719,1}.\text{p1}]$: **false**, $[-1 < \$\text{heap}_{funcstart\_719,1}.\text{p1}]$: **false**)

$\rightarrow$ *[all guards have equal guarded terms]*

[11.45] **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 (47,40)

Condition defined at:

To prove: minof(short int) $\leq$ div1.quot

Given:

$\$\text{heap}_{init}.\text{LIMIT} == (\textbf{int})80$

$\$\text{heap}_{init}.\text{M1} == \textbf{asType}\langle\textbf{short int}\rangle((\textbf{int})30269)$

$\$\text{heap}_{init}.\text{r1} == \textbf{asType}\langle\textbf{short int}\rangle((\textbf{int})171)$

$\$\text{heap}_{init}.\text{a1} == \textbf{asType}\langle\textbf{short int}\rangle((\textbf{int})177)$

$\$\text{heap}_{init}.\text{b1} == \textbf{asType}\langle\textbf{short int}\rangle((\textbf{int})2)$

$\$\text{heap}_{init}.\text{M2} == \textbf{asType}\langle\textbf{short int}\rangle((\textbf{int})30307)$

$\$\text{heap}_{init}.\text{r2} == \textbf{asType}\langle\textbf{short int}\rangle((\textbf{int})172)$

$\$\text{heap}_{init}.\text{a2} == \textbf{asType}\langle\textbf{short int}\rangle((\textbf{int})176)$

$\$\text{heap}_{init}.\text{b2} == \textbf{asType}\langle\textbf{short int}\rangle((\textbf{int})35)$

$\$\text{heap}_{init}.\text{M3} == \textbf{asType}\langle\textbf{short int}\rangle((\textbf{int})30323)$

$\$\text{heap}_{init}.\text{r3} == \textbf{asType}\langle\textbf{short int}\rangle((\textbf{int})170)$

$\$\text{heap}_{init}.\text{a3} == \textbf{asType}\langle\textbf{short int}\rangle((\textbf{int})178)$

$\$\text{heap}_{init}.\text{b3} == \textbf{asType}\langle\textbf{short int}\rangle((\textbf{int})63)$

$\$\text{heap}_{init}.\text{p1} == \textbf{asType}\langle\textbf{short int}\rangle((\textbf{int})1)$

$\$\text{heap}_{init}.\text{p2} == \textbf{asType}\langle\textbf{short int}\rangle((\textbf{int})2)$

$\$\text{heap}_{init}.\text{p3} == \textbf{asType}\langle\textbf{short int}\rangle((\textbf{int})3)$

div1 == div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$,
asType$\langle\textbf{int}\rangle(\$\text{heap}_{funcstart\_719,1}.\text{p1})$,
asType$\langle\textbf{int}\rangle(\$\text{heap}_{funcstart\_719,1}.\text{a1}))$

(**asType**$\langle\textbf{integer}\rangle(\textbf{asType}\langle\textbf{int}\rangle(\$\text{heap}_{funcstart\_719,1}.\text{p1}))$ /
asType$\langle\textbf{integer}\rangle(\textbf{asType}\langle\textbf{int}\rangle(\$\text{heap}_{funcstart\_719,1}.\text{a1}))) ==$
asType$\langle\textbf{integer}\rangle(\text{div1.quot})$

(**asType**$\langle\textbf{integer}\rangle(\textbf{asType}\langle\textbf{int}\rangle(\$\text{heap}_{funcstart\_719,1}.\text{p1}))$ %
asType$\langle\textbf{integer}\rangle(\textbf{asType}\langle\textbf{int}\rangle(\$\text{heap}_{funcstart\_719,1}.\text{a1}))) ==$

asType\<integer\>(div1.rem)

div2 == div(**heapIs** $\$\mathrm{heap}_{funcstart\_719,1}$,
asType\<int\>($\$\mathrm{heap}_{funcstart\_719,1}$.p2),
asType\<int\>($\$\mathrm{heap}_{funcstart\_719,1}$.a2))

(**asType\<integer\>**(**asType\<int\>**($\$\mathrm{heap}_{funcstart\_719,1}$.p2)) /
asType\<integer\>(**asType\<int\>**($\$\mathrm{heap}_{funcstart\_719,1}$.a2))) ==
asType\<integer\>(div2.quot)

(**asType\<integer\>**(**asType\<int\>**($\$\mathrm{heap}_{funcstart\_719,1}$.p2)) %
asType\<integer\>(**asType\<int\>**($\$\mathrm{heap}_{funcstart\_719,1}$.a2))) ==
asType\<integer\>(div2.rem)

div3 == div(**heapIs** $\$\mathrm{heap}_{funcstart\_719,1}$,
asType\<int\>($\$\mathrm{heap}_{funcstart\_719,1}$.p3),
asType\<int\>($\$\mathrm{heap}_{funcstart\_719,1}$.a3))

(**asType\<integer\>**(**asType\<int\>**($\$\mathrm{heap}_{funcstart\_719,1}$.p3)) /
asType\<integer\>(**asType\<int\>**($\$\mathrm{heap}_{funcstart\_719,1}$.a3))) ==
asType\<integer\>(div3.quot)

(**asType\<integer\>**(**asType\<int\>**($\$\mathrm{heap}_{funcstart\_719,1}$.p3)) %
asType\<integer\>(**asType\<int\>**($\$\mathrm{heap}_{funcstart\_719,1}$.a3))) ==
asType\<integer\>(div3.rem)

Proof:

[Take given term]

[5.0] div1 == div(**heapIs** $\$\mathrm{heap}_{funcstart\_719,1}$,
asType\<int\>($\$\mathrm{heap}_{funcstart\_719,1}$.p1),
asType\<int\>($\$\mathrm{heap}_{funcstart\_719,1}$.a1))

$\rightarrow$ *[simplify]*

[5.1] div1 == div(**heapIs** $\$\mathrm{heap}_{funcstart\_719,1}$, $\$\mathrm{heap}_{funcstart\_719,1}$.p1,
asType\<int\>($\$\mathrm{heap}_{funcstart\_719,1}$.a1))

$\rightarrow$ *[const static or extern object]*

[5.2] div1 == div(**heapIs** $\$\mathrm{heap}_{funcstart\_719,1}$, $\$\mathrm{heap}_{funcstart\_719,1}$.p1,
asType\<int\>($\$\mathrm{heap}_{init}$.a1))

$\rightarrow$ *[expand definition of constant 'a1' at prang.c (16,20)]*

[5.3] div1 == div(**heapIs** $\$\mathrm{heap}_{funcstart\_719,1}$, $\$\mathrm{heap}_{funcstart\_719,1}$.p1,
asType\<int\>(**asType\<short int\>**((**int**)177)))

$\rightarrow$ *[simplify]*

[5.6] div1 == div(**heapIs** $\$\mathrm{heap}_{funcstart\_719,1}$, $\$\mathrm{heap}_{funcstart\_719,1}$.p1, 177)

[Take goal term]

[1.0] **minof**(**short int**) $\leq$ div1.quot

$\rightarrow$ *[simplify]*

[1.1] -32768 $\leq$ div1.quot

$\rightarrow$ *[from term 5.6, div1 is equal to div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p1, 177)]*

[1.2] -32768 $\leq$ div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p1, 177).quot

$\rightarrow$ *[simplify]*

[1.4] -32769 < div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p1, 177).quot

$\rightarrow$ *[negate goal and search for contradiction]*

[1.5] !(-32769 < div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p1, 177).quot)

$\rightarrow$ *[simplify]*

[1.7] 32768 < $-$div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p1, 177).quot

[Assume known post-assertion, class invariant or type constraint for term 1.7]

[26.0] **minof(int)** $\leq$ div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p1, 177).quot

$\rightarrow$ *[simplify]*

[26.3] -32769 < div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p1, 177).quot

$\rightarrow$ *[from term 1.7, literala < div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p1, 177).quot is false whenever -2 < (32768 + literala)]*

Proof of rule precondition:

[26.3.0] -2 < (-32769 + 32768)

$\rightarrow$ *[simplify]*

[26.3.2] **true**

[26.4] **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 (47,40)

Condition defined at:

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

Given:

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

$\$heap_{init}.\text{M1} == \textbf{asType}\textbf{<short int>}((\textbf{int})30269)$

$\$heap_{init}.\text{r1} == \textbf{asType}\textbf{<short int>}((\textbf{int})171)$

$\$heap_{init}.\text{a1} == \textbf{asType}\textbf{<short int>}((\textbf{int})177)$

$\$heap_{init}.\text{b1} == \textbf{asType}\textbf{<short int>}((\textbf{int})2)$

$\$heap_{init}.\text{M2} == \textbf{asType}\textbf{<short int>}((\textbf{int})30307)$

$\$heap_{init}.\text{r2} == \textbf{asType}\textbf{<short int>}((\textbf{int})172)$

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

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

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

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

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

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

$\$heap_{init}.\text{p1} == \textbf{asType}\textbf{<short int>}((\textbf{int})1)$

$\$heap_{init}.\text{p2} == \textbf{asType}\textbf{<short int>}((\textbf{int})2)$

$\$heap_{init}.\text{p3} == \textbf{asType}\textbf{<short int>}((\textbf{int})3)$

div1 == div(**heapIs** $\$heap_{funcstart\_719,1}$,
asType<int>$(\$heap_{funcstart\_719,1}.\text{p1})$,
asType<int>$(\$heap_{funcstart\_719,1}.\text{a1}))$

$(\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<int>}(\$heap_{funcstart\_719,1}.\text{p1}))$ /
$\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<int>}(\$heap_{funcstart\_719,1}.\text{a1}))) ==$
$\textbf{asType}\textbf{<integer>}(\text{div1.quot})$

$(\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<int>}(\$heap_{funcstart\_719,1}.\text{p1}))$ %
$\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<int>}(\$heap_{funcstart\_719,1}.\text{a1}))) ==$
$\textbf{asType}\textbf{<integer>}(\text{div1.rem})$

div2 == div(**heapIs** $\$heap_{funcstart\_719,1}$,
asType<int>$(\$heap_{funcstart\_719,1}.\text{p2})$,
asType<int>$(\$heap_{funcstart\_719,1}.\text{a2}))$

$(\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<int>}(\$heap_{funcstart\_719,1}.\text{p2}))$ /
$\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<int>}(\$heap_{funcstart\_719,1}.\text{a2}))) ==$
$\textbf{asType}\textbf{<integer>}(\text{div2.quot})$

$(\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<int>}(\$heap_{funcstart\_719,1}.\text{p2}))$ %
$\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<int>}(\$heap_{funcstart\_719,1}.\text{a2}))) ==$
$\textbf{asType}\textbf{<integer>}(\text{div2.rem})$

div3 == div(**heapIs** $\$heap_{funcstart\_719,1}$,
asType<int>$(\$heap_{funcstart\_719,1}.\text{p3})$,

asType\<int\>($\text{heap}_{funcstart\_719,1}$.a3))

(**asType\<integer\>**(**asType\<int\>**($\text{heap}_{funcstart\_719,1}$.p3)) /
asType\<integer\>(**asType\<int\>**($\text{heap}_{funcstart\_719,1}$.a3))) ==
asType\<integer\>(div3.quot)

(**asType\<integer\>**(**asType\<int\>**($\text{heap}_{funcstart\_719,1}$.p3)) %
asType\<integer\>(**asType\<int\>**($\text{heap}_{funcstart\_719,1}$.a3))) ==
asType\<integer\>(div3.rem)

Proof:

[Take given term]

[5.0] div1 == div(**heapIs** $\text{heap}_{funcstart\_719,1}$,
asType\<int\>($\text{heap}_{funcstart\_719,1}$.p1),
asType\<int\>($\text{heap}_{funcstart\_719,1}$.a1))

$\rightarrow$ *[simplify]*

[5.1] div1 == div(**heapIs** $\text{heap}_{funcstart\_719,1}$, $\text{heap}_{funcstart\_719,1}$.p1,
asType\<int\>($\text{heap}_{funcstart\_719,1}$.a1))

$\rightarrow$ *[const static or extern object]*

[5.2] div1 == div(**heapIs** $\text{heap}_{funcstart\_719,1}$, $\text{heap}_{funcstart\_719,1}$.p1,
asType\<int\>(heap_{init}.a1))

$\rightarrow$ *[expand definition of constant 'a1' at prang.c (16,20)]*

[5.3] div1 == div(**heapIs** $\text{heap}_{funcstart\_719,1}$, $\text{heap}_{funcstart\_719,1}$.p1,
asType\<int\>(**asType\<short int\>**((**int**)177)))

$\rightarrow$ *[simplify]*

[5.6] div1 == div(**heapIs** $\text{heap}_{funcstart\_719,1}$, $\text{heap}_{funcstart\_719,1}$.p1, 177)

[Take goal term]

[1.0] div1.quot $\leq$ **maxof**(**short int**)

$\rightarrow$ *[from term 5.6, div1 is equal to div(**heapIs** $\text{heap}_{funcstart\_719,1}$,*
$\text{heap}_{funcstart\_719,1}$.p1, 177)]

[1.1] div(**heapIs** $\text{heap}_{funcstart\_719,1}$, $\text{heap}_{funcstart\_719,1}$.p1, 177).quot $\leq$
maxof(**short int**)

$\rightarrow$ *[simplify]*

[1.10] -32768 $< -$div(**heapIs** $\text{heap}_{funcstart\_719,1}$, $\text{heap}_{funcstart\_719,1}$.p1,
177).quot

$\rightarrow$ *[negate goal and search for contradiction]*

[1.11] !(-32768 $< -$div(**heapIs** $\text{heap}_{funcstart\_719,1}$, $\text{heap}_{funcstart\_719,1}$.p1,
177).quot)

$\rightarrow$ *[simplify]*

[1.14] $32767 <$ div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot

[Assume known post-assertion, class invariant or type constraint for term 1.14]

[26.0] div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot $\leq$ **maxof(int)**

$\rightarrow$ *[simplify]*

[26.9] $-32768 < -$div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot

$\rightarrow$ *[from term 1.14, literala $< -$div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot is false whenever -2 < (32767 + literala)]*

    Proof of rule precondition:

    [26.9.0] $-2 < (-32768 + 32767)$

    $\rightarrow$ *[simplify]*

    [26.9.2] **true**

[26.10] **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 (47,40)

Condition defined at:

To prove: minof(int) $\leq$ asType\<short int\>(div1.quot)

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)

$\$heap_{init}$.M2 $==$ **asType\<short int\>**((**int**)30307)

$\$heap_{init}$.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)

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

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

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

$\$heap_{init}.p1 == \textbf{asType}\textbf{<short int>}((\textbf{int})1)$

$\$heap_{init}.p2 == \textbf{asType}\textbf{<short int>}((\textbf{int})2)$

$\$heap_{init}.p3 == \textbf{asType}\textbf{<short int>}((\textbf{int})3)$

div1 == div(**heapIs** $\$heap_{funcstart\_719,1}$,
asType<int>($\$heap_{funcstart\_719,1}$.p1),
asType<int>($\$heap_{funcstart\_719,1}$.a1))

(**asType<integer>**(**asType<int>**($\$heap_{funcstart\_719,1}$.p1)) /
asType<integer>(**asType<int>**($\$heap_{funcstart\_719,1}$.a1))) ==
asType<integer>(div1.quot)

(**asType<integer>**(**asType<int>**($\$heap_{funcstart\_719,1}$.p1)) %
asType<integer>(**asType<int>**($\$heap_{funcstart\_719,1}$.a1))) ==
asType<integer>(div1.rem)

div2 == div(**heapIs** $\$heap_{funcstart\_719,1}$,
asType<int>($\$heap_{funcstart\_719,1}$.p2),
asType<int>($\$heap_{funcstart\_719,1}$.a2))

(**asType<integer>**(**asType<int>**($\$heap_{funcstart\_719,1}$.p2)) /
asType<integer>(**asType<int>**($\$heap_{funcstart\_719,1}$.a2))) ==
asType<integer>(div2.quot)

(**asType<integer>**(**asType<int>**($\$heap_{funcstart\_719,1}$.p2)) %
asType<integer>(**asType<int>**($\$heap_{funcstart\_719,1}$.a2))) ==
asType<integer>(div2.rem)

div3 == div(**heapIs** $\$heap_{funcstart\_719,1}$,
asType<int>($\$heap_{funcstart\_719,1}$.p3),
asType<int>($\$heap_{funcstart\_719,1}$.a3))

(**asType<integer>**(**asType<int>**($\$heap_{funcstart\_719,1}$.p3)) /
asType<integer>(**asType<int>**($\$heap_{funcstart\_719,1}$.a3))) ==
asType<integer>(div3.quot)

(**asType<integer>**(**asType<int>**($\$heap_{funcstart\_719,1}$.p3)) %
asType<integer>(**asType<int>**($\$heap_{funcstart\_719,1}$.a3))) ==
asType<integer>(div3.rem)

Proof:

[Take given term]

[5.0] div1 == div(**heapIs** $\$heap_{funcstart\_719,1}$,
asType<int>($\$heap_{funcstart\_719,1}$.p1),
asType<int>($\$heap_{funcstart\_719,1}$.a1))

$\rightarrow$ *[simplify]*

[5.1] div1 == div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1,

asType<int>($heap$_{funcstart_719,1}$.a1))

→ *[const static or extern object]*

[5.2] div1 == div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1,
asType<int>($heap$_{init}$.a1))

→ *[expand definition of constant 'a1' at prang.c (16,20)]*

[5.3] div1 == div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1,
asType<int>(**asType<short int>**((**int**)177)))

→ *[simplify]*

[5.6] div1 == div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1, 177)

[Take goal term]

[1.0] **minof(int)** ≤ **asType<short int>**(div1.quot)

→ *[simplify]*

[1.1] -32768 ≤ **asType<short int>**(div1.quot)

→ *[from term 5.6, div1 is equal to div(**heapIs** $heap$_{funcstart_719,1}$,
$heap$_{funcstart_719,1}$.p1, 177)]*

[1.2] -32768 ≤ **asType<short int>**(div(**heapIs** $heap$_{funcstart_719,1}$,
$heap$_{funcstart_719,1}$.p1, 177).quot)

→ *[simplify]*

[1.5] -32769 < div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1,
177).quot

→ *[negate goal and search for contradiction]*

[1.6] !(-32769 < div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1,
177).quot)

→ *[simplify]*

[1.8] 32768 < −div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1,
177).quot

[Assume known post-assertion, class invariant or type constraint for term 1.8]

[26.0] **minof(int)** ≤ div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1,
177).quot

→ *[simplify]*

[26.3] -32769 < div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1,
177).quot

→ *[from term 1.8, literala < div(**heapIs** $heap$_{funcstart_719,1}$,
$heap$_{funcstart_719,1}$.p1, 177).quot is false whenever -2 < (32768 + literala)]*

Proof of rule precondition:

[26.3.0] -2 < (-32769 + 32768)

→ *[simplify]*

[26.3.2] **true**

[26.4] **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 (47,40)

Condition defined at:

To prove: asType<short int>(div1.quot) ≤ **maxof(int)**

Given:

$\text{\$heap}_{init}$.LIMIT == (**int**)80

$\text{\$heap}_{init}$.M1 == **asType<short int>**((**int**)30269)

$\text{\$heap}_{init}$.r1 == **asType<short int>**((**int**)171)

$\text{\$heap}_{init}$.a1 == **asType<short int>**((**int**)177)

$\text{\$heap}_{init}$.b1 == **asType<short int>**((**int**)2)

$\text{\$heap}_{init}$.M2 == **asType<short int>**((**int**)30307)

$\text{\$heap}_{init}$.r2 == **asType<short int>**((**int**)172)

$\text{\$heap}_{init}$.a2 == **asType<short int>**((**int**)176)

$\text{\$heap}_{init}$.b2 == **asType<short int>**((**int**)35)

$\text{\$heap}_{init}$.M3 == **asType<short int>**((**int**)30323)

$\text{\$heap}_{init}$.r3 == **asType<short int>**((**int**)170)

$\text{\$heap}_{init}$.a3 == **asType<short int>**((**int**)178)

$\text{\$heap}_{init}$.b3 == **asType<short int>**((**int**)63)

$\text{\$heap}_{init}$.p1 == **asType<short int>**((**int**)1)

$\text{\$heap}_{init}$.p2 == **asType<short int>**((**int**)2)

$\text{\$heap}_{init}$.p3 == **asType<short int>**((**int**)3)

div1 == div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$,
asType<int>($\text{\$heap}_{funcstart\_719,1}$.p1),
asType<int>($\text{\$heap}_{funcstart\_719,1}$.a1))

(**asType<integer>**(**asType<int>**($\text{\$heap}_{funcstart\_719,1}$.p1)) /
asType<integer>(**asType<int>**($\text{\$heap}_{funcstart\_719,1}$.a1))) ==
asType<integer>(div1.quot)

(**asType<integer>**(**asType<int>**($\text{\$heap}_{funcstart\_719,1}$.p1)) %

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asType<**integer**>(**asType**<**int**>($heap$_{funcstart_719,1}$.a1))) ==
asType<**integer**>(div1.rem)

div2 == div(**heapIs** $heap$_{funcstart_719,1}$,
asType<**int**>($heap$_{funcstart_719,1}$.p2),
asType<**int**>($heap$_{funcstart_719,1}$.a2))

(**asType**<**integer**>(**asType**<**int**>($heap$_{funcstart_719,1}$.p2)) /
asType<**integer**>(**asType**<**int**>($heap$_{funcstart_719,1}$.a2))) ==
asType<**integer**>(div2.quot)

(**asType**<**integer**>(**asType**<**int**>($heap$_{funcstart_719,1}$.p2)) %
asType<**integer**>(**asType**<**int**>($heap$_{funcstart_719,1}$.a2))) ==
asType<**integer**>(div2.rem)

div3 == div(**heapIs** $heap$_{funcstart_719,1}$,
asType<**int**>($heap$_{funcstart_719,1}$.p3),
asType<**int**>($heap$_{funcstart_719,1}$.a3))

(**asType**<**integer**>(**asType**<**int**>($heap$_{funcstart_719,1}$.p3)) /
asType<**integer**>(**asType**<**int**>($heap$_{funcstart_719,1}$.a3))) ==
asType<**integer**>(div3.quot)

(**asType**<**integer**>(**asType**<**int**>($heap$_{funcstart_719,1}$.p3)) %
asType<**integer**>(**asType**<**int**>($heap$_{funcstart_719,1}$.a3))) ==
asType<**integer**>(div3.rem)

Proof:

[Take given term]

[5.0] div1 == div(**heapIs** $heap$_{funcstart_719,1}$,
asType<**int**>($heap$_{funcstart_719,1}$.p1),
asType<**int**>($heap$_{funcstart_719,1}$.a1))

→ *[simplify]*

[5.1] div1 == div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1,
asType<**int**>($heap$_{funcstart_719,1}$.a1))

→ *[const static or extern object]*

[5.2] div1 == div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1,
asType<**int**>($heap$_{init}$.a1))

→ *[expand definition of constant 'a1' at prang.c (16,20)]*

[5.3] div1 == div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1,
asType<**int**>(**asType**<**short int**>((**int**)177)))

→ *[simplify]*

[5.6] div1 == div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1, 177)

[Take goal term]

[1.0] **asType**<**short int**>(div1.quot) ≤ **maxof**(**int**)

$\rightarrow$ *[from term 5.6, div1 is equal to div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177)]*

[1.1] **asType**<**short int**>(div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot) $\leq$ **maxof**(**int**)

$\rightarrow$ *[simplify]*

[1.11] -32768 $< -$div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot

$\rightarrow$ *[negate goal and search for contradiction]*

[1.12] !(-32768 $< -$div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot)

$\rightarrow$ *[simplify]*

[1.15] 32767 $<$ div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot

[Assume known post-assertion, class invariant or type constraint for term 1.15]

[26.0] div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot $\leq$ **maxof**(**int**)

$\rightarrow$ *[simplify]*

[26.9] -32768 $< -$div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot

$\rightarrow$ *[from term 1.15, literala $< -$div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot is false whenever -2 $<$ (32767 + literala)]*

Proof of rule precondition:

[26.9.0] -2 $<$ (-32768 + 32767)

$\rightarrow$ *[simplify]*

[26.9.2] **true**

[26.10] **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 (47,35)

Condition defined at:

To prove: minof(**int**) $\leq \$heap_{funcstart\_719,1}$.b1

Given:

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

$\$heap_{init}$.M1 == **asType**<**short int**>((**int**)30269)

$\$heap_{init}.r1 == \textbf{asType}<\textbf{short int}>((\textbf{int})171)$

$\$heap_{init}.a1 == \textbf{asType}<\textbf{short int}>((\textbf{int})177)$

$\$heap_{init}.b1 == \textbf{asType}<\textbf{short int}>((\textbf{int})2)$

$\$heap_{init}.M2 == \textbf{asType}<\textbf{short int}>((\textbf{int})30307)$

$\$heap_{init}.r2 == \textbf{asType}<\textbf{short int}>((\textbf{int})172)$

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

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

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

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

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

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

$\$heap_{init}.p1 == \textbf{asType}<\textbf{short int}>((\textbf{int})1)$

$\$heap_{init}.p2 == \textbf{asType}<\textbf{short int}>((\textbf{int})2)$

$\$heap_{init}.p3 == \textbf{asType}<\textbf{short int}>((\textbf{int})3)$

div1 == div(**heapIs** $\$heap_{funcstart\_719,1}$,
asType<**int**>($\$heap_{funcstart\_719,1}.p1$),
asType<**int**>($\$heap_{funcstart\_719,1}.a1$))

(**asType**<**integer**>(**asType**<**int**>($\$heap_{funcstart\_719,1}.p1$)) /
asType<**integer**>(**asType**<**int**>($\$heap_{funcstart\_719,1}.a1$))) ==
asType<**integer**>(div1.quot)

(**asType**<**integer**>(**asType**<**int**>($\$heap_{funcstart\_719,1}.p1$)) %
asType<**integer**>(**asType**<**int**>($\$heap_{funcstart\_719,1}.a1$))) ==
asType<**integer**>(div1.rem)

div2 == div(**heapIs** $\$heap_{funcstart\_719,1}$,
asType<**int**>($\$heap_{funcstart\_719,1}.p2$),
asType<**int**>($\$heap_{funcstart\_719,1}.a2$))

(**asType**<**integer**>(**asType**<**int**>($\$heap_{funcstart\_719,1}.p2$)) /
asType<**integer**>(**asType**<**int**>($\$heap_{funcstart\_719,1}.a2$))) ==
asType<**integer**>(div2.quot)

(**asType**<**integer**>(**asType**<**int**>($\$heap_{funcstart\_719,1}.p2$)) %
asType<**integer**>(**asType**<**int**>($\$heap_{funcstart\_719,1}.a2$))) ==
asType<**integer**>(div2.rem)

div3 == div(**heapIs** $\$heap_{funcstart\_719,1}$,
asType<**int**>($\$heap_{funcstart\_719,1}.p3$),
asType<**int**>($\$heap_{funcstart\_719,1}.a3$))

(**asType**<**integer**>(**asType**<**int**>($\$heap_{funcstart\_719,1}.p3$)) /
asType<**integer**>(**asType**<**int**>($\$heap_{funcstart\_719,1}.a3$))) ==

asType<integer>(div3.quot)

(asType<integer>(**asType<int>**($heap$_{funcstart_719,1}$.p3)) %
asType<integer>(**asType<int>**($heap$_{funcstart_719,1}$.a3))) ==
asType<integer>(div3.rem)

Proof:

[Take goal term]

[1.0] **minof(int)** $\leq$ $heap$_{funcstart_719,1}$.b1

$\rightarrow$ *[simplify]*

[1.1] -32768 $\leq$ $heap$_{funcstart_719,1}$.b1

$\rightarrow$ *[const static or extern object]*

[1.2] -32768 $\leq$ $heap$_{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 (47,35)

Condition defined at:

To prove: $heap$_{funcstart_719,1}$.b1 $\leq$ **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)

$heap$_{init}$.b1 == **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)

$heap$_{init}$.b2 == **asType<short int>**((**int**)35)

$heap$_{init}$.M3 == **asType<short int>**((**int**)30323)

$heap$_{init}$.r3 == **asType<short int>**((**int**)170)

$\text{\$heap}_{init}.a3 == \textbf{asType}\langle\textbf{short int}\rangle((\textbf{int})178)$

$\text{\$heap}_{init}.b3 == \textbf{asType}\langle\textbf{short int}\rangle((\textbf{int})63)$

$\text{\$heap}_{init}.p1 == \textbf{asType}\langle\textbf{short int}\rangle((\textbf{int})1)$

$\text{\$heap}_{init}.p2 == \textbf{asType}\langle\textbf{short int}\rangle((\textbf{int})2)$

$\text{\$heap}_{init}.p3 == \textbf{asType}\langle\textbf{short int}\rangle((\textbf{int})3)$

$\text{div1} == \text{div}(\textbf{heapIs } \text{\$heap}_{funcstart\_719,1},$
$\textbf{asType}\langle\textbf{int}\rangle(\text{\$heap}_{funcstart\_719,1}.p1),$
$\textbf{asType}\langle\textbf{int}\rangle(\text{\$heap}_{funcstart\_719,1}.a1))$

$(\textbf{asType}\langle\textbf{integer}\rangle(\textbf{asType}\langle\textbf{int}\rangle(\text{\$heap}_{funcstart\_719,1}.p1))$ /
$\textbf{asType}\langle\textbf{integer}\rangle(\textbf{asType}\langle\textbf{int}\rangle(\text{\$heap}_{funcstart\_719,1}.a1))) ==$
$\textbf{asType}\langle\textbf{integer}\rangle(\text{div1.quot})$

$(\textbf{asType}\langle\textbf{integer}\rangle(\textbf{asType}\langle\textbf{int}\rangle(\text{\$heap}_{funcstart\_719,1}.p1))$ %
$\textbf{asType}\langle\textbf{integer}\rangle(\textbf{asType}\langle\textbf{int}\rangle(\text{\$heap}_{funcstart\_719,1}.a1))) ==$
$\textbf{asType}\langle\textbf{integer}\rangle(\text{div1.rem})$

$\text{div2} == \text{div}(\textbf{heapIs } \text{\$heap}_{funcstart\_719,1},$
$\textbf{asType}\langle\textbf{int}\rangle(\text{\$heap}_{funcstart\_719,1}.p2),$
$\textbf{asType}\langle\textbf{int}\rangle(\text{\$heap}_{funcstart\_719,1}.a2))$

$(\textbf{asType}\langle\textbf{integer}\rangle(\textbf{asType}\langle\textbf{int}\rangle(\text{\$heap}_{funcstart\_719,1}.p2))$ /
$\textbf{asType}\langle\textbf{integer}\rangle(\textbf{asType}\langle\textbf{int}\rangle(\text{\$heap}_{funcstart\_719,1}.a2))) ==$
$\textbf{asType}\langle\textbf{integer}\rangle(\text{div2.quot})$

$(\textbf{asType}\langle\textbf{integer}\rangle(\textbf{asType}\langle\textbf{int}\rangle(\text{\$heap}_{funcstart\_719,1}.p2))$ %
$\textbf{asType}\langle\textbf{integer}\rangle(\textbf{asType}\langle\textbf{int}\rangle(\text{\$heap}_{funcstart\_719,1}.a2))) ==$
$\textbf{asType}\langle\textbf{integer}\rangle(\text{div2.rem})$

$\text{div3} == \text{div}(\textbf{heapIs } \text{\$heap}_{funcstart\_719,1},$
$\textbf{asType}\langle\textbf{int}\rangle(\text{\$heap}_{funcstart\_719,1}.p3),$
$\textbf{asType}\langle\textbf{int}\rangle(\text{\$heap}_{funcstart\_719,1}.a3))$

$(\textbf{asType}\langle\textbf{integer}\rangle(\textbf{asType}\langle\textbf{int}\rangle(\text{\$heap}_{funcstart\_719,1}.p3))$ /
$\textbf{asType}\langle\textbf{integer}\rangle(\textbf{asType}\langle\textbf{int}\rangle(\text{\$heap}_{funcstart\_719,1}.a3))) ==$
$\textbf{asType}\langle\textbf{integer}\rangle(\text{div3.quot})$

$(\textbf{asType}\langle\textbf{integer}\rangle(\textbf{asType}\langle\textbf{int}\rangle(\text{\$heap}_{funcstart\_719,1}.p3))$ %
$\textbf{asType}\langle\textbf{integer}\rangle(\textbf{asType}\langle\textbf{int}\rangle(\text{\$heap}_{funcstart\_719,1}.a3))) ==$
$\textbf{asType}\langle\textbf{integer}\rangle(\text{div3.rem})$

Proof:

[Take goal term]

[1.0] $\text{\$heap}_{funcstart\_719,1}.b1 \leq \textbf{maxof}(\textbf{int})$

$\rightarrow$ *[const static or extern object]*

[1.1] $\text{\$heap}_{init}.b1 \leq \textbf{maxof}(\textbf{int})$

$\rightarrow$ *[expand definition of constant 'b1' at prang.c (17,20)]*

[1.2] **asType<short int>((int)2) ≤ maxof(int)**

→ *[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 (47,38)

Condition defined at:

To prove: minof(int) ≤ (asType<int>(asType<short int>(div1.quot)) * asType<int>($heap$_{funcstart_719,1}$.b1))

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)**

$heap$_{init}$.M2 == **asType<short int>((int)30307)**

$heap$_{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)**

$heap$_{init}$.r3 == **asType<short int>((int)170)**

$heap$_{init}$.a3 == **asType<short int>((int)178)**

$heap$_{init}$.b3 == **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)**

div1 == div(**heapIs** $heap$_{funcstart_719,1}$,
asType<int>($heap$_{funcstart_719,1}$.p1),
asType<int>($heap$_{funcstart_719,1}$.a1))

(**asType<integer>(asType<int>**($heap$_{funcstart_719,1}$.p1)) /
asType<integer>(asType<int>($heap$_{funcstart_719,1}$.a1))) ==
asType<integer>(div1.quot)

(**asType<integer>(asType<int>**($heap$_{funcstart_719,1}$.p1)) %
asType<integer>(asType<int>($heap$_{funcstart_719,1}$.a1))) ==

asType<integer>(div1.rem)

div2 == div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$,
asType<int>($\$\text{heap}_{funcstart\_719,1}$.p2),
asType<int>($\$\text{heap}_{funcstart\_719,1}$.a2))

(**asType<integer>**(**asType<int>**($\$\text{heap}_{funcstart\_719,1}$.p2)) /
asType<integer>(**asType<int>**($\$\text{heap}_{funcstart\_719,1}$.a2))) ==
asType<integer>(div2.quot)

(**asType<integer>**(**asType<int>**($\$\text{heap}_{funcstart\_719,1}$.p2)) %
asType<integer>(**asType<int>**($\$\text{heap}_{funcstart\_719,1}$.a2))) ==
asType<integer>(div2.rem)

div3 == div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$,
asType<int>($\$\text{heap}_{funcstart\_719,1}$.p3),
asType<int>($\$\text{heap}_{funcstart\_719,1}$.a3))

(**asType<integer>**(**asType<int>**($\$\text{heap}_{funcstart\_719,1}$.p3)) /
asType<integer>(**asType<int>**($\$\text{heap}_{funcstart\_719,1}$.a3))) ==
asType<integer>(div3.quot)

(**asType<integer>**(**asType<int>**($\$\text{heap}_{funcstart\_719,1}$.p3)) %
asType<integer>(**asType<int>**($\$\text{heap}_{funcstart\_719,1}$.a3))) ==
asType<integer>(div3.rem)

Proof:

[Take given term]

[5.0] div1 == div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$,
asType<int>($\$\text{heap}_{funcstart\_719,1}$.p1),
asType<int>($\$\text{heap}_{funcstart\_719,1}$.a1))

$\rightarrow$ *[simplify]*

[5.1] div1 == div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}$.p1,
asType<int>($\$\text{heap}_{funcstart\_719,1}$.a1))

$\rightarrow$ *[const static or extern object]*

[5.2] div1 == div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}$.p1,
asType<int>($\$\text{heap}_{init}$.a1))

$\rightarrow$ *[expand definition of constant 'a1' at prang.c (16,20)]*

[5.3] div1 == div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}$.p1,
asType<int>(**asType<short int>**((**int**)177)))

$\rightarrow$ *[simplify]*

[5.6] div1 == div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}$.p1, 177)

[Take goal term]

[1.0] **minof(int)** $\leq$ (**asType<int>**(**asType<short int>**(div1.quot)) *
asType<int>($\$\text{heap}_{funcstart\_719,1}$.b1))

$\rightarrow$ *[simplify]*

[1.1] -32768 $\leq$ (**asType\<int\>**(**asType\<short int\>**(div1.quot)) * **asType\<int\>**($\text{\$heap}_{funcstart\_719,1}$.b1))

$\rightarrow$ *[from term 5.6, div1 is equal to div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p1, 177)]*

[1.2] -32768 $\leq$ (**asType\<int\>**(**asType\<short int\>**(div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p1, 177).quot)) * **asType\<int\>**($\text{\$heap}_{funcstart\_719,1}$.b1))

$\rightarrow$ *[simplify]*

[1.4] -32768 $\leq$ (div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p1, 177).quot * **asType\<int\>**($\text{\$heap}_{funcstart\_719,1}$.b1))

$\rightarrow$ *[const static or extern object]*

[1.5] -32768 $\leq$ (div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p1, 177).quot * **asType\<int\>**($\text{\$heap}_{init}$.b1))

$\rightarrow$ *[expand definition of constant 'b1' at prang.c (17,20)]*

[1.6] -32768 $\leq$ (div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p1, 177).quot * **asType\<int\>**(**asType\<short int\>**((**int**)2)))

$\rightarrow$ *[simplify]*

[1.11] -32769 $<$ (2 * div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p1, 177).quot)

$\rightarrow$ *[literal comparison of product]*

[1.12] ([2 $<$ 0]: (-32769 / -2) $<$ $-$div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p1, 177).quot, [0 $<$ 2]: (-32769 / 2) $<$ div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p1, 177).quot, [0 == 2]: -32769 $<$ 0)

$\rightarrow$ *[explicitly assert falsehood of skipped guards in subsequent guards]*

[1.13] ([2 $<$ 0]: (-32769 / -2) $<$ $-$div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p1, 177).quot, [(0 $<$ 2) $\wedge$!(2 $<$ 0)]: (-32769 / 2) $<$ div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p1, 177).quot, [(0 == 2) $\wedge$!(0 $<$ 2) $\wedge$!(2 $<$ 0)]: -32769 $<$ 0)

$\rightarrow$ *[simplify]*

[1.21] -16385 $<$ div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p1, 177).quot

$\rightarrow$ *[negate goal and search for contradiction]*

[1.22] !(-16385 $<$ div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p1, 177).quot)

$\rightarrow$ *[simplify]*

[1.24] 16384 $<$ $-$div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p1,

177).quot

[Assume known post-assertion, class invariant or type constraint for term 5.6]

[8.0] **minof**(**short int**) $\leq$ \$heap$_{funcstart\_719,1}$.p1

$\rightarrow$ *[simplify]*

[8.3] -32769 $<$ \$heap$_{funcstart\_719,1}$.p1

[Assume known post-assertion, class invariant or type constraint for term 5.6]

[10.0] (**asType**$<$**integer**$>$(\$heap$_{funcstart\_719,1}$.p1) /
asType$<$**integer**$>$(177)) == **asType**$<$**integer**$>$(div(**heapIs**
\$heap$_{funcstart\_719,1}$, \$heap$_{funcstart\_719,1}$.p1, 177).quot)

$\rightarrow$ *[simplify]*

[10.2] (\$heap$_{funcstart\_719,1}$.p1 / 177) == **asType**$<$**integer**$>$(div(**heapIs**
\$heap$_{funcstart\_719,1}$, \$heap$_{funcstart\_719,1}$.p1, 177).quot)

$\rightarrow$ *[expand definition of operator './' in class 'int' at built in declaration]*

[10.3] ([**asType**$<$**integer**$>$(\$heap$_{funcstart\_719,1}$.p1) $<$ 0]:
$-(-$**asType**$<$**integer**$>$(\$heap$_{funcstart\_719,1}$.p1) / 177), []:
asType$<$**integer**$>$(\$heap$_{funcstart\_719,1}$.p1) / 177) ==
asType$<$**integer**$>$(div(**heapIs** \$heap$_{funcstart\_719,1}$, \$heap$_{funcstart\_719,1}$.p1,
177).quot)

$\rightarrow$ *[explicitly assert falsehood of skipped guards in subsequent guards]*

[10.4] ([**asType**$<$**integer**$>$(\$heap$_{funcstart\_719,1}$.p1) $<$ 0]:
$-(-$**asType**$<$**integer**$>$(\$heap$_{funcstart\_719,1}$.p1) / 177),
[!(**asType**$<$**integer**$>$(\$heap$_{funcstart\_719,1}$.p1) $<$ 0)]:
asType$<$**integer**$>$(\$heap$_{funcstart\_719,1}$.p1) / 177) ==
asType$<$**integer**$>$(div(**heapIs** \$heap$_{funcstart\_719,1}$, \$heap$_{funcstart\_719,1}$.p1,
177).quot)

$\rightarrow$ *[simplify]*

[10.17] 0 == ($-$([0 $<$ $-$\$heap$_{funcstart\_719,1}$.p1]: $-(-$\$heap$_{funcstart\_719,1}$.p1 /
177), [-1 $<$ \$heap$_{funcstart\_719,1}$.p1]: \$heap$_{funcstart\_719,1}$.p1 / 177) +
div(**heapIs** \$heap$_{funcstart\_719,1}$, \$heap$_{funcstart\_719,1}$.p1, 177).quot)

$\rightarrow$ *[move guard outside expression]*

[10.18] 0 == (([0 $<$ $-$\$heap$_{funcstart\_719,1}$.p1]: $-(-(-$\$heap$_{funcstart\_719,1}$.p1 /
177)), [-1 $<$ \$heap$_{funcstart\_719,1}$.p1]: $-($\$heap$_{funcstart\_719,1}$.p1 / 177)) +
div(**heapIs** \$heap$_{funcstart\_719,1}$, \$heap$_{funcstart\_719,1}$.p1, 177).quot)

$\rightarrow$ *[simplify]*

[10.19] 0 == (([0 $<$ $-$\$heap$_{funcstart\_719,1}$.p1]: $-$\$heap$_{funcstart\_719,1}$.p1 / 177,
[-1 $<$ \$heap$_{funcstart\_719,1}$.p1]: $-($\$heap$_{funcstart\_719,1}$.p1 / 177)) + div(**heapIs**
\$heap$_{funcstart\_719,1}$, \$heap$_{funcstart\_719,1}$.p1, 177).quot)

$\rightarrow$ *[move guard outside expression]*

[10.21] ([0 < −$\$\text{heap}_{funcstart\_719,1}$.p1]: 0 == ((−$\$\text{heap}_{funcstart\_719,1}$.p1 / 177) + div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}$.p1, 177).quot), [-1 < $\$\text{heap}_{funcstart\_719,1}$.p1]: 0 == (−($\$\text{heap}_{funcstart\_719,1}$.p1 / 177) + div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}$.p1, 177).quot))

[Branch on disjunction or conditional in term 10.21]

[27.0] (0 == ((−$\$\text{heap}_{funcstart\_719,1}$.p1 / 177) + div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}$.p1, 177).quot)) ∨ (0 == (−($\$\text{heap}_{funcstart\_719,1}$.p1 / 177) + div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}$.p1, 177).quot)) ∨ (-1 < $\$\text{heap}_{funcstart\_719,1}$.p1)

[Create new term from terms 1.24, 27.0 using rule: transitivity 16]

[46.0] ((0 + 16384) < (−$\$\text{heap}_{funcstart\_719,1}$.p1 / 177)) ∨ (0 == (−($\$\text{heap}_{funcstart\_719,1}$.p1 / 177) + div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}$.p1, 177).quot)) ∨ (-1 < $\$\text{heap}_{funcstart\_719,1}$.p1)

→ *[simplify]*

[46.8] (2900144 < −$\$\text{heap}_{funcstart\_719,1}$.p1) ∨ ...

→ *[from term 8.3, literala < −$\$\text{heap}_{funcstart\_719,1}$.p1 is false whenever -2 < (-32769 + literala)]*

Proof of rule precondition:

[46.8.0] -2 < (-32769 + 2900144)

→ *[simplify]*

[46.8.2] **true**

[46.9] **false** ∨ ...

[Remove 'false' term 46.9 and fetch new term from containing clause]

[47.0] 0 == (−($\$\text{heap}_{funcstart\_719,1}$.p1 / 177) + div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}$.p1, 177).quot)

[Remove 'false' term 46.9 and fetch new term from containing clause]

[48.0] -1 < $\$\text{heap}_{funcstart\_719,1}$.p1

[Copy term 1.24]

[51.0] 16384 < −div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}$.p1, 177).quot

→ *[from term 47.0, div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}$.p1, 177).quot is equal to $\$\text{heap}_{funcstart\_719,1}$.p1 / 177]*

[51.1] 16384 < −($\$\text{heap}_{funcstart\_719,1}$.p1 / 177)

→ *[simplify]*

[51.7] 2899968 < −$\$\text{heap}_{funcstart\_719,1}$.p1

→ *[from term 48.0, literala < −$\$\text{heap}_{funcstart\_719,1}$.p1 is false whenever -2 <*

(-1 + literala)]

Proof of rule precondition:

[51.7.0] -2 < (-1 + 2899968)

$\rightarrow$ *[simplify]*

[51.7.2] **true**

[51.8] **false**

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

Condition generated at: C:\Escher\Customers\prang\prang.c (47,38)

Condition defined at:

To prove: (asType\<int\>(asType\<short int\>(div1.quot)) * asType\<int\>(\$heap$_{funcstart\_719,1}$.b1)) $\leq$ 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)

$\$heap_{init}$.b1 == **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)

$\$heap_{init}$.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)

$\$heap_{init}$.b3 == **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)

div1 == div(**heapIs** \$heap$_{funcstart\_719,1}$,
asType\<int\>(\$heap$_{funcstart\_719,1}$.p1),
asType\<int\>(\$heap$_{funcstart\_719,1}$.a1))

(asType\<integer\>(asType\<int\>(\$heap$_{funcstart\_719,1}$.p1)) /

asType\<integer\>(**asType\<int\>**($heap$_{funcstart_719,1}$.a1))) == **asType\<integer\>**(div1.quot)

(**asType\<integer\>**(**asType\<int\>**($heap$_{funcstart_719,1}$.p1)) % **asType\<integer\>**(**asType\<int\>**($heap$_{funcstart\_719,1}$.a1))) == **asType\<integer\>**(div1.rem)

div2 == div(**heapIs** $heap$_{funcstart_719,1}$, **asType\<int\>**($heap$_{funcstart\_719,1}$.p2), **asType\<int\>**($heap$_{funcstart_719,1}$.a2))

(**asType\<integer\>**(**asType\<int\>**($heap$_{funcstart_719,1}$.p2)) / **asType\<integer\>**(**asType\<int\>**($heap$_{funcstart\_719,1}$.a2))) == **asType\<integer\>**(div2.quot)

(**asType\<integer\>**(**asType\<int\>**($heap$_{funcstart_719,1}$.p2)) % **asType\<integer\>**(**asType\<int\>**($heap$_{funcstart\_719,1}$.a2))) == **asType\<integer\>**(div2.rem)

div3 == div(**heapIs** $heap$_{funcstart_719,1}$, **asType\<int\>**($heap$_{funcstart\_719,1}$.p3), **asType\<int\>**($heap$_{funcstart_719,1}$.a3))

(**asType\<integer\>**(**asType\<int\>**($heap$_{funcstart_719,1}$.p3)) / **asType\<integer\>**(**asType\<int\>**($heap$_{funcstart\_719,1}$.a3))) == **asType\<integer\>**(div3.quot)

(**asType\<integer\>**(**asType\<int\>**($heap$_{funcstart_719,1}$.p3)) % **asType\<integer\>**(**asType\<int\>**($heap$_{funcstart\_719,1}$.a3))) == **asType\<integer\>**(div3.rem)

Proof:

[Take given term]

[5.0] div1 == div(**heapIs** $heap$_{funcstart_719,1}$, **asType\<int\>**($heap$_{funcstart\_719,1}$.p1), **asType\<int\>**($heap$_{funcstart_719,1}$.a1))

$\rightarrow$ *[simplify]*

[5.1] div1 == div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1, **asType\<int\>**($heap$_{funcstart\_719,1}$.a1))

$\rightarrow$ *[const static or extern object]*

[5.2] div1 == div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1, **asType\<int\>**($heap$_{init}$.a1))

$\rightarrow$ *[expand definition of constant 'a1' at prang.c (16,20)]*

[5.3] div1 == div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1, **asType\<int\>**(**asType\<short int\>**((**int**)177)))

$\rightarrow$ *[simplify]*

[5.6] div1 == div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177)

[Take goal term]

[1.0] (**asType<int>**(**asType<short int>**(div1.quot)) *
asType<int>($\$heap_{funcstart\_719,1}$.b1)) ≤ **maxof(int)**

→ *[from term 5.6, div1 is equal to div(**heapIs** $\$heap_{funcstart\_719,1}$,
$\$heap_{funcstart\_719,1}$.p1, 177)]*

[1.1] (**asType<int>**(**asType<short int>**(div(**heapIs** $\$heap_{funcstart\_719,1}$,
$\$heap_{funcstart\_719,1}$.p1, 177).quot)) * **asType<int>**($\$heap_{funcstart\_719,1}$.b1))
≤ **maxof(int)**

→ *[simplify]*

[1.3] (div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot *
asType<int>($\$heap_{funcstart\_719,1}$.b1)) ≤ **maxof(int)**

→ *[const static or extern object]*

[1.4] (div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot *
asType<int>($\$heap_{init}$.b1)) ≤ **maxof(int)**

→ *[expand definition of constant 'b1' at prang.c (17,20)]*

[1.5] (div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot *
asType<int>(**asType<short int>**((**int**)2))) ≤ **maxof(int)**

→ *[simplify]*

[1.18] -32768 < (-2 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1,
177).quot)

→ *[literal comparison of product]*

[1.19] ([-2 < 0]: (-32768 / 2) < −div(**heapIs** $\$heap_{funcstart\_719,1}$,
$\$heap_{funcstart\_719,1}$.p1, 177).quot, [0 < -2]: (-32768 / -2) < div(**heapIs**
$\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot, [-2 == 0]: -32768 < 0)

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

[1.20] ([-2 < 0]: (-32768 / 2) < −div(**heapIs** $\$heap_{funcstart\_719,1}$,
$\$heap_{funcstart\_719,1}$.p1, 177).quot, [(0 < -2) ∧ !(-2 < 0)]: (-32768 / -2) <
div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot, [(-2 == 0)
∧ !(-2 < 0) ∧ !(0 < -2)]: -32768 < 0)

→ *[simplify]*

[1.24] -16384 < −div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1,
177).quot

→ *[negate goal and search for contradiction]*

[1.25] !(-16384 < −div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1,
177).quot)

→ *[simplify]*

[1.28] $16383 <$ div(**heapIs** \$heap$_{funcstart\_719,1}$, \$heap$_{funcstart\_719,1}$.p1, 177).quot

[Assume known post-assertion, class invariant or type constraint for term 5.6]

[9.0] \$heap$_{funcstart\_719,1}$.p1 $\leq$ **maxof**(**short int**)

$\rightarrow$ *[simplify]*

[9.9] $-32768 < -$\$heap$_{funcstart\_719,1}$.p1

[Assume known post-assertion, class invariant or type constraint for term 5.6]

[10.0] (**asType**<**integer**>(\$heap$_{funcstart\_719,1}$.p1) / **asType**<**integer**>(177)) == **asType**<**integer**>(div(**heapIs** \$heap$_{funcstart\_719,1}$, \$heap$_{funcstart\_719,1}$.p1, 177).quot)

$\rightarrow$ *[simplify]*

[10.2] (\$heap$_{funcstart\_719,1}$.p1 / 177) == **asType**<**integer**>(div(**heapIs** \$heap$_{funcstart\_719,1}$, \$heap$_{funcstart\_719,1}$.p1, 177).quot)

$\rightarrow$ *[expand definition of operator './' in class 'int' at built in declaration]*

[10.3] ([**asType**<**integer**>(\$heap$_{funcstart\_719,1}$.p1) < 0]: $-(-$**asType**<**integer**>(\$heap$_{funcstart\_719,1}$.p1) / 177), []: **asType**<**integer**>(\$heap$_{funcstart\_719,1}$.p1) / 177) == **asType**<**integer**>(div(**heapIs** \$heap$_{funcstart\_719,1}$, \$heap$_{funcstart\_719,1}$.p1, 177).quot)

$\rightarrow$ *[explicitly assert falsehood of skipped guards in subsequent guards]*

[10.4] ([**asType**<**integer**>(\$heap$_{funcstart\_719,1}$.p1) < 0]: $-(-$**asType**<**integer**>(\$heap$_{funcstart\_719,1}$.p1) / 177), [!(**asType**<**integer**>(\$heap$_{funcstart\_719,1}$.p1) < 0)]: **asType**<**integer**>(\$heap$_{funcstart\_719,1}$.p1) / 177) == **asType**<**integer**>(div(**heapIs** \$heap$_{funcstart\_719,1}$, \$heap$_{funcstart\_719,1}$.p1, 177).quot)

$\rightarrow$ *[simplify]*

[10.17] $0 ==$ ($-$([$0 < -$\$heap$_{funcstart\_719,1}$.p1]: $-(-$\$heap$_{funcstart\_719,1}$.p1 / 177), [-1 $<$ \$heap$_{funcstart\_719,1}$.p1]: \$heap$_{funcstart\_719,1}$.p1 / 177) + div(**heapIs** \$heap$_{funcstart\_719,1}$, \$heap$_{funcstart\_719,1}$.p1, 177).quot)

$\rightarrow$ *[move guard outside expression]*

[10.18] $0 ==$ (([$0 < -$\$heap$_{funcstart\_719,1}$.p1]: $-(-(-$\$heap$_{funcstart\_719,1}$.p1 / 177)), [-1 $<$ \$heap$_{funcstart\_719,1}$.p1]: $-($\$heap$_{funcstart\_719,1}$.p1 / 177)) + div(**heapIs** \$heap$_{funcstart\_719,1}$, \$heap$_{funcstart\_719,1}$.p1, 177).quot)

$\rightarrow$ *[simplify]*

[10.19] $0 ==$ (([$0 < -$\$heap$_{funcstart\_719,1}$.p1]: $-$\$heap$_{funcstart\_719,1}$.p1 / 177, [-1 $<$ \$heap$_{funcstart\_719,1}$.p1]: $-($\$heap$_{funcstart\_719,1}$.p1 / 177)) + div(**heapIs** \$heap$_{funcstart\_719,1}$, \$heap$_{funcstart\_719,1}$.p1, 177).quot)

→ *[move guard outside expression]*

[10.21] ([$0 < -\$\text{heap}_{funcstart\_719,1}.\text{p1}$]: $0 == ((-\$\text{heap}_{funcstart\_719,1}.\text{p1} \; / \; 177)$ + div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}.\text{p1}$, 177).quot), [$-1 < \$\text{heap}_{funcstart\_719,1}.\text{p1}$]: $0 == (-(\$\text{heap}_{funcstart_719,1}.\text{p1} \; / \; 177) + $ div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}.\text{p1}$, 177).quot))

[Branch on disjunction or conditional in term 10.21]

[27.0] ($0 == ((-\$\text{heap}_{funcstart_719,1}.\text{p1} \; / \; 177) + $ div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}.\text{p1}$, 177).quot)) $\lor$ ($0 == (-(\$\text{heap}_{funcstart_719,1}.\text{p1} \; / \; 177) + $ div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}.\text{p1}$, 177).quot)) $\lor$ ($-1 < \$\text{heap}_{funcstart\_719,1}.\text{p1}$)

[Branch on disjunction or conditional in term 10.21]

[28.0] ($0 < -\$\text{heap}_{funcstart\_719,1}.\text{p1}$) $\lor$ ($0 == (-(\$\text{heap}_{funcstart_719,1}.\text{p1} \; / \; 177) + $ div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}.\text{p1}$, 177).quot)) $\lor$ ($-1 < \$\text{heap}_{funcstart\_719,1}.\text{p1}$)

[Create new term from terms 1.28, 27.0 using rule: transitivity 15]

[46.0] ((0 + 16383) $< -(-\$\text{heap}_{funcstart\_719,1}.\text{p1} \; / \; 177)$) $\lor$ ($0 == (-(\$\text{heap}_{funcstart_719,1}.\text{p1} \; / \; 177) + $ div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}.\text{p1}$, 177).quot)) $\lor$ ($-1 < \$\text{heap}_{funcstart\_719,1}.\text{p1}$)

→ *[simplify]*

[46.8] ($2899791 < \$\text{heap}_{funcstart\_719,1}.\text{p1}$) $\lor$ ...

→ *[from term 28.0, literala $< \$\text{heap}_{funcstart\_719,1}.\text{p1}$ is false whenever -2 < (0 + literala)]*

Proof of rule precondition:

[46.8.0] -2 < (0 + 2899791)

→ *[simplify]*

[46.8.2] **true**

[46.9] **false** $\lor$ ...

[Remove 'false' term 46.9 and fetch new term from containing clause]

[47.0] $0 == (-(\$\text{heap}_{funcstart_719,1}.\text{p1} \; / \; 177) + $ div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}.\text{p1}$, 177).quot)

[Copy term 1.28]

[51.0] $16383 < $ div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}.\text{p1}$, 177).quot

→ *[from term 47.0, div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}.\text{p1}$, 177).quot is equal to $\$\text{heap}_{funcstart\_719,1}.\text{p1} \; / \; 177$]*

[51.1] $16383 < (\$\text{heap}_{funcstart\_719,1}.\text{p1} \; / \; 177)$

$\rightarrow$ *[simplify]*

[51.8] $2899967 < \$heap_{funcstart\_719,1}.p1$

$\rightarrow$ *[from term 9.9, literala $< \$heap_{funcstart\_719,1}.p1$ is false whenever -2 $<$ (-32768 + literala)]*

Proof of rule precondition:

[51.8.0] -2 $<$ (-32768 + 2899967)

$\rightarrow$ *[simplify]*

[51.8.2] **true**

[51.9] **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 (47,33)

Condition defined at:

To prove: minof(short int) $\leq$ ((**asType**$<$**int**$>$(**asType**$<$**short int**$>$(div1.rem)) * **asType**$<$**int**$>$($\$heap_{funcstart\_719,1}.r1$)) $-$ (**asType**$<$**int**$>$(**asType**$<$**short int**$>$(div1.quot)) * **asType**$<$**int**$>$($\$heap_{funcstart\_719,1}.b1$)))

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)

$\$heap_{init}.M2 ==$ **asType**$<$**short int**$>$((**int**)30307)

$\$heap_{init}.r2 ==$ **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)

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

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

$\$heap_{init}.b3 ==$ **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)**

div1 $==$ div(**heapIs** $\$heap_{funcstart\_719,1}$,
asType$<$int$>$($\$heap_{funcstart\_719,1}$.p1),
asType$<$int$>$($\$heap_{funcstart\_719,1}$.a1))

(**asType$<$integer$>$**(**asType$<$int$>$**($\$heap_{funcstart\_719,1}$.p1)) /
asType$<$integer$>$(**asType$<$int$>$**($\$heap_{funcstart\_719,1}$.a1))) $==$
asType$<$integer$>$(div1.quot)

(**asType$<$integer$>$**(**asType$<$int$>$**($\$heap_{funcstart\_719,1}$.p1)) %
asType$<$integer$>$(**asType$<$int$>$**($\$heap_{funcstart\_719,1}$.a1))) $==$
asType$<$integer$>$(div1.rem)

div2 $==$ div(**heapIs** $\$heap_{funcstart\_719,1}$,
asType$<$int$>$($\$heap_{funcstart\_719,1}$.p2),
asType$<$int$>$($\$heap_{funcstart\_719,1}$.a2))

(**asType$<$integer$>$**(**asType$<$int$>$**($\$heap_{funcstart\_719,1}$.p2)) /
asType$<$integer$>$(**asType$<$int$>$**($\$heap_{funcstart\_719,1}$.a2))) $==$
asType$<$integer$>$(div2.quot)

(**asType$<$integer$>$**(**asType$<$int$>$**($\$heap_{funcstart\_719,1}$.p2)) %
asType$<$integer$>$(**asType$<$int$>$**($\$heap_{funcstart\_719,1}$.a2))) $==$
asType$<$integer$>$(div2.rem)

div3 $==$ div(**heapIs** $\$heap_{funcstart\_719,1}$,
asType$<$int$>$($\$heap_{funcstart\_719,1}$.p3),
asType$<$int$>$($\$heap_{funcstart\_719,1}$.a3))

(**asType$<$integer$>$**(**asType$<$int$>$**($\$heap_{funcstart\_719,1}$.p3)) /
asType$<$integer$>$(**asType$<$int$>$**($\$heap_{funcstart\_719,1}$.a3))) $==$
asType$<$integer$>$(div3.quot)

(**asType$<$integer$>$**(**asType$<$int$>$**($\$heap_{funcstart\_719,1}$.p3)) %
asType$<$integer$>$(**asType$<$int$>$**($\$heap_{funcstart\_719,1}$.a3))) $==$
asType$<$integer$>$(div3.rem)

Proof:

[Take given term]

[5.0] div1 $==$ div(**heapIs** $\$heap_{funcstart\_719,1}$,
asType$<$int$>$($\$heap_{funcstart\_719,1}$.p1),
asType$<$int$>$($\$heap_{funcstart\_719,1}$.a1))

$\rightarrow$ *[simplify]*

[5.1] div1 $==$ div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1,
asType$<$int$>$($\$heap_{funcstart\_719,1}$.a1))

$\rightarrow$ *[const static or extern object]*

[5.2] div1 $==$ div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1,
asType$<$int$>$($\$heap_{init}$.a1))

$\rightarrow$ *[expand definition of constant 'a1' at prang.c (16,20)]*

[5.3] div1 == div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}$.p1, **asType**<**int**>(**asType**<**short int**>((**int**)177)))

$\rightarrow$ *[simplify]*

[5.6] div1 == div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}$.p1, 177)

[Take goal term]

[1.0] **minof**(**short int**) $\leq$ ((**asType**<**int**>(**asType**<**short int**>(div1.rem)) * **asType**<**int**>($\$\text{heap}_{funcstart\_719,1}$.r1)) $-$ (**asType**<**int**>(**asType**<**short int**>(div1.quot)) * **asType**<**int**>($\$\text{heap}_{funcstart\_719,1}$.b1)))

$\rightarrow$ *[simplify]*

[1.1] -32768 $\leq$ ((**asType**<**int**>(**asType**<**short int**>(div1.rem)) * **asType**<**int**>($\$\text{heap}_{funcstart\_719,1}$.r1)) $-$ (**asType**<**int**>(**asType**<**short int**>(div1.quot)) * **asType**<**int**>($\$\text{heap}_{funcstart\_719,1}$.b1)))

$\rightarrow$ *[from term 5.6, div1 is equal to div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177)]*

[1.2] -32768 $\leq$ ((**asType**<**int**>(**asType**<**short int**>(div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}$.p1, 177).rem)) * **asType**<**int**>($\$\text{heap}_{funcstart\_719,1}$.r1)) $-$ (**asType**<**int**>(**asType**<**short int**>(div1.quot)) * **asType**<**int**>($\$\text{heap}_{funcstart\_719,1}$.b1)))

$\rightarrow$ *[simplify]*

[1.4] -32768 $\leq$ ((div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}$.p1, 177).rem * **asType**<**int**>($\$\text{heap}_{funcstart\_719,1}$.r1)) $-$ (**asType**<**int**>(**asType**<**short int**>(div1.quot)) * **asType**<**int**>($\$\text{heap}_{funcstart\_719,1}$.b1)))

$\rightarrow$ *[const static or extern object]*

[1.5] -32768 $\leq$ ((div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}$.p1, 177).rem * **asType**<**int**>($\$\text{heap}_{init}$.r1)) $-$ (**asType**<**int**>(**asType**<**short int**>(div1.quot)) * **asType**<**int**>($\$\text{heap}_{funcstart\_719,1}$.b1)))

$\rightarrow$ *[expand definition of constant 'r1' at prang.c (15,20)]*

[1.6] -32768 $\leq$ ((div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}$.p1, 177).rem * **asType**<**int**>(**asType**<**short int**>((**int**)171))) $-$ (**asType**<**int**>(**asType**<**short int**>(div1.quot)) * **asType**<**int**>($\$\text{heap}_{funcstart\_719,1}$.b1)))

$\rightarrow$ *[simplify]*

[1.9] -32768 $\leq$ ((div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}$.p1, 177).rem * 171) $-$ (**asType**<**int**>(**asType**<**short int**>(div1.quot)) * **asType**<**int**>($\$\text{heap}_{funcstart\_719,1}$.b1)))

$\rightarrow$ *[from term 5.6, div1 is equal to div(**heapIs** $\$heap_{funcstart\_719,1}$,*

$heap_{funcstart\_719,1}.p1, 177)]$

[1.10] -32768 $\leq$ ((171 * div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}.p1, 177).rem) − (**asType$<$int$>$**(**asType$<$short int$>$**(div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}.p1, 177).quot)) * **asType$<$int$>$**($heap_{funcstart_719,1}.b1)))

$\rightarrow$ *[simplify]*

[1.12] -32768 $\leq$ ((171 * div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart_719,1}.p1, 177).rem) − (div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}.p1, 177).quot * **asType$<$int$>$**($heap_{funcstart_719,1}.b1)))

$\rightarrow$ *[const static or extern object]*

[1.13] -32768 $\leq$ ((171 * div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart_719,1}.p1, 177).rem) − (div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}.p1, 177).quot * **asType$<$int$>$**($heap_{init}.b1)))

$\rightarrow$ *[expand definition of constant 'b1' at prang.c (17,20)]*

[1.14] -32768 $\leq$ ((171 * div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart_719,1}.p1, 177).rem) − (div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}.p1, 177).quot * **asType$<$int$>$**(**asType$<$short int$>$**((**int**)2))))

$\rightarrow$ *[simplify]*

[1.21] -32769 $<$ ((-2 * div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart_719,1}.p1, 177).quot) + (171 * div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart_719,1}.p1, 177).rem))

$\rightarrow$ *[negate goal and search for contradiction]*

[1.22] !(-32769 $<$ ((-2 * div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart_719,1}.p1, 177).quot) + (171 * div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart_719,1}.p1, 177).rem)))

$\rightarrow$ *[simplify]*

[1.27] 32768 $<$ ((2 * div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart_719,1}.p1, 177).quot) + (-171 * div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart_719,1}.p1, 177).rem))

[Assume known post-assertion, class invariant or type constraint for term 5.6]

[9.0] $heap_{funcstart\_719,1}.p1 \leq$ **maxof(short int)**

$\rightarrow$ *[simplify]*

[9.9] -32768 $< -$heap$_{funcstart\_719,1}.p1$

[Assume known post-assertion, class invariant or type constraint for term 5.6]

[10.0] (**asType$<$integer$>$**($heap_{funcstart\_719,1}.p1) / **asType$<$integer$>$**(177)) == **asType$<$integer$>$**(div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart_719,1}.p1, 177).quot)

$\rightarrow$ *[simplify]*

[10.2] ($\$\text{heap}_{funcstart\_719,1}.\text{p1}$ / 177) == **asType**<**integer**>(div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}.\text{p1}$, 177).quot)

$\rightarrow$ *[expand definition of operator './' in class 'int' at built in declaration]*

[10.3] ([**asType**<**integer**>($\$\text{heap}_{funcstart\_719,1}.\text{p1}$) < 0]:
$-(-$**asType**<**integer**>($\$\text{heap}_{funcstart\_719,1}.\text{p1}$) / 177), []:
asType<**integer**>($\$\text{heap}_{funcstart\_719,1}.\text{p1}$) / 177) ==
asType<**integer**>(div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}.\text{p1}$,
177).quot)

$\rightarrow$ *[explicitly assert falsehood of skipped guards in subsequent guards]*

[10.4] ([**asType**<**integer**>($\$\text{heap}_{funcstart\_719,1}.\text{p1}$) < 0]:
$-(-$**asType**<**integer**>($\$\text{heap}_{funcstart\_719,1}.\text{p1}$) / 177),
[!(**asType**<**integer**>($\$\text{heap}_{funcstart\_719,1}.\text{p1}$) < 0)]:
asType<**integer**>($\$\text{heap}_{funcstart\_719,1}.\text{p1}$) / 177) ==
asType<**integer**>(div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}.\text{p1}$,
177).quot)

$\rightarrow$ *[simplify]*

[10.17] 0 == ($-$([0 < $-\$\text{heap}_{funcstart\_719,1}.\text{p1}$]: $-(-\$\text{heap}_{funcstart\_719,1}.\text{p1}$ /
177), [-1 < $\$\text{heap}_{funcstart\_719,1}.\text{p1}$]: $\$\text{heap}_{funcstart\_719,1}.\text{p1}$ / 177) +
div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}.\text{p1}$, 177).quot)

$\rightarrow$ *[move guard outside expression]*

[10.18] 0 == (([0 < $-\$\text{heap}_{funcstart\_719,1}.\text{p1}$]: $-(-(-\$\text{heap}_{funcstart\_719,1}.\text{p1}$ /
177)), [-1 < $\$\text{heap}_{funcstart\_719,1}.\text{p1}$]: $-(\$\text{heap}_{funcstart\_719,1}.\text{p1}$ / 177)) +
div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}.\text{p1}$, 177).quot)

$\rightarrow$ *[simplify]*

[10.19] 0 == (([0 < $-\$\text{heap}_{funcstart\_719,1}.\text{p1}$]: $-\$\text{heap}_{funcstart\_719,1}.\text{p1}$ / 177,
[-1 < $\$\text{heap}_{funcstart\_719,1}.\text{p1}$]: $-(\$\text{heap}_{funcstart\_719,1}.\text{p1}$ / 177)) + div(**heapIs**
$\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}.\text{p1}$, 177).quot)

$\rightarrow$ *[move guard outside expression]*

[10.21] ([0 < $-\$\text{heap}_{funcstart\_719,1}.\text{p1}$]: 0 == (($-\$\text{heap}_{funcstart\_719,1}.\text{p1}$ / 177)
+ div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}.\text{p1}$, 177).quot), [-1 <
$\$\text{heap}_{funcstart\_719,1}.\text{p1}$]: 0 == ($-(\$\text{heap}_{funcstart\_719,1}.\text{p1}$ / 177) + div(**heapIs**
$\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}.\text{p1}$, 177).quot))

[Assume known post-assertion, class invariant or type constraint for term 5.6]

[11.0] (**asType**<**integer**>($\$\text{heap}_{funcstart\_719,1}.\text{p1}$) %
asType<**integer**>(177)) == **asType**<**integer**>(div(**heapIs**
$\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}.\text{p1}$, 177).rem)

$\rightarrow$ *[simplify]*

[11.2] ($heap$_{funcstart_719,1}$.p1 % 177) == **asType**<**integer**>(div(**heapIs**
$heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1, 177).rem)

→ *[expand definition of operator '.%' in class 'int' at built in declaration]*

[11.3] ([**asType**<**integer**>($heap$_{funcstart_719,1}$.p1) < 0]:
−(−**asType**<**integer**>($heap$_{funcstart_719,1}$.p1) % 177), []:
asType<**integer**>($heap$_{funcstart_719,1}$.p1) % 177) ==
asType<**integer**>(div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1,
177).rem)

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

[11.4] ([**asType**<**integer**>($heap$_{funcstart_719,1}$.p1) < 0]:
−(−**asType**<**integer**>($heap$_{funcstart_719,1}$.p1) % 177),
[!(**asType**<**integer**>($heap$_{funcstart_719,1}$.p1) < 0)]:
asType<**integer**>($heap$_{funcstart_719,1}$.p1) % 177) ==
asType<**integer**>(div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1,
177).rem)

→ *[simplify]*

[11.14] ([0 < −$heap$_{funcstart_719,1}$.p1]: −(−$heap$_{funcstart\_719,1}$.p1 % 177), [-1
< $heap$_{funcstart_719,1}$.p1]: **asType**<**integer**>($heap$_{funcstart\_719,1}$.p1) % 177)
== **asType**<**integer**>(div(**heapIs** $heap$_{funcstart_719,1}$,
$heap$_{funcstart_719,1}$.p1, 177).rem)

→ *[remainder of negation]*

[11.15] ([0 < −$heap$_{funcstart_719,1}$.p1]: −([0 == ($heap$_{funcstart\_719,1}$.p1 %
177)]: 0, []: 177 + −($heap$_{funcstart_719,1}$.p1 % 177)), [-1 <
$heap$_{funcstart_719,1}$.p1]: **asType**<**integer**>($heap$_{funcstart\_719,1}$.p1) % 177)
== **asType**<**integer**>(div(**heapIs** $heap$_{funcstart_719,1}$,
$heap$_{funcstart_719,1}$.p1, 177).rem)

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

[11.16] ([0 < −$heap$_{funcstart_719,1}$.p1]: −([0 == ($heap$_{funcstart\_719,1}$.p1 %
177)]: 0, [!(0 == ($heap$_{funcstart_719,1}$.p1 % 177))]: 177 +
−($heap$_{funcstart_719,1}$.p1 % 177)), [-1 < $heap$_{funcstart_719,1}$.p1]:
asType<**integer**>($heap$_{funcstart_719,1}$.p1) % 177) ==
asType<**integer**>(div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1,
177).rem)

→ *[move guard outside expression]*

[11.17] ([0 < −$heap$_{funcstart_719,1}$.p1]: ([0 == ($heap$_{funcstart\_719,1}$.p1 %
177)]: −0, [!(0 == ($heap$_{funcstart_719,1}$.p1 % 177))]: −(177 +
−($heap$_{funcstart_719,1}$.p1 % 177))), [-1 < $heap$_{funcstart_719,1}$.p1]:
asType<**integer**>($heap$_{funcstart_719,1}$.p1) % 177) ==
asType<**integer**>(div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1,
177).rem)

→ *[simplify]*

[11.24] $0 == (-([0 < -\$heap_{funcstart\_719,1}.p1]: ([0 == (\$heap_{funcstart\_719,1}.p1 \% 177)]: 0, [!(0 == (\$heap_{funcstart\_719,1}.p1 \% 177))]: -177 + (\$heap_{funcstart\_719,1}.p1 \% 177)), [-1 < \$heap_{funcstart\_719,1}.p1]: \$heap_{funcstart\_719,1}.p1 \% 177) + \text{div}(\textbf{heapIs } \$heap_{funcstart\_719,1}, \$heap_{funcstart\_719,1}.p1, 177).\text{rem})$

→ *[move guard outside expression]*

[11.26] $0 == (((0 < -\$heap_{funcstart\_719,1}.p1]: ([0 == (\$heap_{funcstart\_719,1}.p1 \% 177)]: -0, [!(0 == (\$heap_{funcstart\_719,1}.p1 \% 177))]: -(-177 + (\$heap_{funcstart\_719,1}.p1 \% 177))), [-1 < \$heap_{funcstart\_719,1}.p1]: -(\$heap_{funcstart\_719,1}.p1 \% 177)) + \text{div}(\textbf{heapIs } \$heap_{funcstart\_719,1}, \$heap_{funcstart\_719,1}.p1, 177).\text{rem})$

→ *[simplify]*

[11.29] $0 == (((0 < -\$heap_{funcstart\_719,1}.p1]: ([0 == (\$heap_{funcstart\_719,1}.p1 \% 177)]: 0, [!(0 == (\$heap_{funcstart\_719,1}.p1 \% 177))]: 177 + -(\$heap_{funcstart\_719,1}.p1 \% 177)), [-1 < \$heap_{funcstart\_719,1}.p1]: -(\$heap_{funcstart\_719,1}.p1 \% 177)) + \text{div}(\textbf{heapIs } \$heap_{funcstart\_719,1}, \$heap_{funcstart\_719,1}.p1, 177).\text{rem})$

→ *[move guard outside expression]*

[11.31] $0 == ([0 < -\$heap_{funcstart\_719,1}.p1]: ([0 == (\$heap_{funcstart\_719,1}.p1 \% 177)]: 0 + \text{div}(\textbf{heapIs } \$heap_{funcstart\_719,1}, \$heap_{funcstart\_719,1}.p1, 177).\text{rem}, [!(0 == (\$heap_{funcstart\_719,1}.p1 \% 177))]: (177 + -(\$heap_{funcstart\_719,1}.p1 \% 177)) + \text{div}(\textbf{heapIs } \$heap_{funcstart\_719,1}, \$heap_{funcstart\_719,1}.p1, 177).\text{rem}), [-1 < \$heap_{funcstart\_719,1}.p1]: -(\$heap_{funcstart\_719,1}.p1 \% 177) + \text{div}(\textbf{heapIs } \$heap_{funcstart\_719,1}, \$heap_{funcstart\_719,1}.p1, 177).\text{rem})$

→ *[simplify]*

[11.33] $0 == ([0 < -\$heap_{funcstart\_719,1}.p1]: ([0 == (\$heap_{funcstart\_719,1}.p1 \% 177)]: \text{div}(\textbf{heapIs } \$heap_{funcstart\_719,1}, \$heap_{funcstart\_719,1}.p1, 177).\text{rem}, [!(0 == (\$heap_{funcstart\_719,1}.p1 \% 177))]: 177 + -(\$heap_{funcstart\_719,1}.p1 \% 177) + \text{div}(\textbf{heapIs } \$heap_{funcstart\_719,1}, \$heap_{funcstart\_719,1}.p1, 177).\text{rem}), [-1 < \$heap_{funcstart\_719,1}.p1]: -(\$heap_{funcstart\_719,1}.p1 \% 177) + \text{div}(\textbf{heapIs } \$heap_{funcstart\_719,1}, \$heap_{funcstart\_719,1}.p1, 177).\text{rem})$

→ *[move guard outside expression]*

[11.35] $([0 < -\$heap_{funcstart\_719,1}.p1]: ([0 == (\$heap_{funcstart\_719,1}.p1 \% 177)]: 0 == \text{div}(\textbf{heapIs } \$heap_{funcstart\_719,1}, \$heap_{funcstart\_719,1}.p1, 177).\text{rem}, [!(0 == (\$heap_{funcstart\_719,1}.p1 \% 177))]: 0 == (177 + -(\$heap_{funcstart\_719,1}.p1 \% 177) + \text{div}(\textbf{heapIs } \$heap_{funcstart\_719,1}, \$heap_{funcstart\_719,1}.p1, 177).\text{rem})), [-1 < \$heap_{funcstart\_719,1}.p1]: 0 == (-(\$heap_{funcstart\_719,1}.p1 \% 177) + \text{div}(\textbf{heapIs } \$heap_{funcstart\_719,1}, \$heap_{funcstart\_719,1}.p1, 177).\text{rem}))$

→ *[simplify]*

[11.40] ([0 < −$heap$_{funcstart_719,1}$.p1]: ([0 == ($heap$_{funcstart\_719,1}$.p1 % 177)]: 0 == div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1, 177).rem, [!(0 == ($heap$_{funcstart\_719,1}$.p1 % 177))]: 177 == (($heap$_{funcstart_719,1}$.p1 % 177) + −div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1, 177).rem)), [-1 < $heap$_{funcstart_719,1}$.p1]: 0 == (−($heap$_{funcstart\_719,1}$.p1 % 177) + div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1, 177).rem))

[Branch on disjunction or conditional in term 10.21]

[30.0] (0 == ((−$heap$_{funcstart_719,1}$.p1 / 177) + div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1, 177).quot)) ∨ (0 == (−($heap$_{funcstart\_719,1}$.p1 / 177) + div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1, 177).quot)) ∨ (-1 < $heap$_{funcstart_719,1}$.p1)

[Branch on disjunction or conditional in term 10.21]

[31.0] (0 < −$heap$_{funcstart_719,1}$.p1) ∨ (0 == (−($heap$_{funcstart\_719,1}$.p1 / 177) + div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1, 177).quot)) ∨ (-1 < $heap$_{funcstart_719,1}$.p1)

[Copy term 11.40]

[32.0] ([0 < −$heap$_{funcstart_719,1}$.p1]: ([0 == ($heap$_{funcstart\_719,1}$.p1 % 177)]: 0 == div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1, 177).rem, [!(0 == ($heap$_{funcstart\_719,1}$.p1 % 177))]: 177 == (−div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1, 177).rem + ($heap$_{funcstart\_719,1}$.p1 % 177))), [-1 < $heap$_{funcstart_719,1}$.p1]: 0 == (−($heap$_{funcstart\_719,1}$.p1 % 177) + div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1, 177).rem)) ∨ (0 == (−($heap$_{funcstart\_719,1}$.p1 / 177) + div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1, 177).quot)) ∨ (-1 < $heap$_{funcstart_719,1}$.p1)

→ *[from term 31.0, literala < −$heap$_{funcstart_719,1}$.p1 is true whenever (-1 + literala) < 0]*

Proof of rule precondition:

[32.0.0] (-1 + 0) < 0

→ *[simplify]*

[32.0.2] **true**

[32.1] ([**true**]: ([0 == ($heap$_{funcstart_719,1}$.p1 % 177)]: 0 == div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1, 177).rem, [!(0 == ($heap$_{funcstart\_719,1}$.p1 % 177))]: 177 == (−div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1, 177).rem + ($heap$_{funcstart\_719,1}$.p1 % 177))), [-1 < $heap$_{funcstart_719,1}$.p1]: 0 == (−($heap$_{funcstart\_719,1}$.p1 % 177) + div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1, 177).rem)) ∨ ...

→ *[simplify]*

[32.3] ([0 == ($heap$_{funcstart_719,1}$.p1 % 177)]: 0 == div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1, 177).rem, [!(0 ==

($heap$_{funcstart_719,1}$.p1 % 177))]: 177 == (−div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1, 177).rem + ($heap$_{funcstart\_719,1}$.p1 % 177))) ∨ ...

[Branch on disjunction or conditional in term 32.3]

[33.0] (0 == div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1, 177).rem) ∨ (0 == (−($heap$_{funcstart\_719,1}$.p1 / 177) + div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1, 177).quot)) ∨ (-1 < $heap$_{funcstart_719,1}$.p1) ∨ (177 == (−div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1, 177).rem + ($heap$_{funcstart\_719,1}$.p1 % 177))) ∨ !(0 == ($heap$_{funcstart_719,1}$.p1 % 177))

[Copy term 1.27]

[35.0] (32768 < ((-171 * div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1, 177).rem) + (2 * div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1, 177).quot))) ∨ (0 == (−($heap$_{funcstart\_719,1}$.p1 / 177) + div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1, 177).quot)) ∨ (-1 < $heap$_{funcstart_719,1}$.p1) ∨ (177 == (−div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1, 177).rem + ($heap$_{funcstart\_719,1}$.p1 % 177))) ∨ !(0 == ($heap$_{funcstart_719,1}$.p1 % 177))

→ *[from term 33.0, div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p1, 177).rem is equal to 0]*

[35.1] (32768 < ((-171 * 0) + (2 * div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1, 177).quot))) ∨ ...

→ *[simplify]*

[35.3] (32768 < (2 * div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1, 177).quot)) ∨ ...

→ *[literal comparison of product]*

[35.4] ([2 < 0]: (32768 / -2) < −div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1, 177).quot, [0 < 2]: (32768 / 2) < div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1, 177).quot, [0 == 2]: 32768 < 0) ∨ ...

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

[35.5] ([2 < 0]: (32768 / -2) < −div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1, 177).quot, [(0 < 2) ∧ !(2 < 0)]: (32768 / 2) < div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1, 177).quot, [(0 == 2) ∧ !(0 < 2) ∧ !(2 < 0)]: 32768 < 0) ∨ ...

→ *[simplify]*

[35.13] (16384 < div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1, 177).quot) ∨ ...

[Create new term from terms 35.13, 30.0 using rule: transitivity 15]

[51.0] ((0 + 16384) < −(−$heap$_{funcstart_719,1}$.p1 / 177)) ∨ (0 == (−($heap$_{funcstart\_719,1}$.p1 / 177) + div(**heapIs** $heap$_{funcstart_719,1}$,

$\$\text{heap}_{funcstart\_719,1}$.p1, 177).quot)) $\lor$ (-1 < $\$\text{heap}_{funcstart\_719,1}$.p1) $\lor$ (177 == ($-$div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}$.p1, 177).rem + ($\$\text{heap}_{funcstart\_719,1}$.p1 % 177))) $\lor$!(0 == ($\$\text{heap}_{funcstart\_719,1}$.p1 % 177))

$\to$ *[simplify]*

[51.8] (2899968 < $\$\text{heap}_{funcstart\_719,1}$.p1) $\lor$ ...

$\to$ *[from term 31.0, literala < $\$\text{heap}_{funcstart\_719,1}$.p1 is false whenever -2 < (0 + literala)]*

Proof of rule precondition:

[51.8.0] -2 < (0 + 2899968)

$\to$ *[simplify]*

[51.8.2] **true**

[51.9] **false** $\lor$ ...

[Remove 'false' term 51.9 and fetch new term from containing clause]

[52.0] (177 == ($-$div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}$.p1, 177).rem + ($\$\text{heap}_{funcstart\_719,1}$.p1 % 177))) $\lor$ (0 == ($-$($\$\text{heap}_{funcstart\_719,1}$.p1 / 177) + div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}$.p1, 177).quot)) $\lor$ (-1 < $\$\text{heap}_{funcstart\_719,1}$.p1)

[Copy term 1.27]

[54.0] (32768 < ((-171 * div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}$.p1, 177).rem) + (2 * div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}$.p1, 177).quot))) $\lor$ (0 == ($-$($\$\text{heap}_{funcstart\_719,1}$.p1 / 177) + div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}$.p1, 177).quot)) $\lor$ (-1 < $\$\text{heap}_{funcstart\_719,1}$.p1)

$\to$ *[from term 52.0, div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).rem is equal to -177 + ($\$heap_{funcstart\_719,1}$.p1 % 177)]*

[54.1] (32768 < ((-171 * (-177 + ($\$\text{heap}_{funcstart\_719,1}$.p1 % 177))) + (2 * div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}$.p1, 177).quot))) $\lor$ ...

$\to$ *[simplify]*

[54.6] (2501 < ((-171 * ($\$\text{heap}_{funcstart\_719,1}$.p1 % 177)) + (2 * div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}$.p1, 177).quot))) $\lor$ ...

[Create new term from term 30.0 using rule: condition for equality of division]

[60.0] (($-\$\text{heap}_{funcstart\_719,1}$.p1 < (177 * (0 + 1 + $-$div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}$.p1, 177).quot))) $\land$ ((177 * (0 + $-$div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}$.p1, 177).quot)) < (1 + $-\$\text{heap}_{funcstart\_719,1}$.p1))) $\lor$ (0 == ($-$($\$\text{heap}_{funcstart\_719,1}$.p1 / 177) + div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}$.p1, 177).quot)) $\lor$ (-1 < $\$\text{heap}_{funcstart\_719,1}$.p1)

$\to$ *[simplify]*

[60.18] ((-177 < ((-177 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot) + $\$heap_{funcstart\_719,1}$.p1)) ∧ (-1 < (−$\$heap_{funcstart\_719,1}$.p1 + (177 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot)))) ∨ ...

→ *[separate conjunction and work on first sub-term]*

[60.19] (-177 < ((-177 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot) + $\$heap_{funcstart\_719,1}$.p1)) ∨ ...

[Create new term from terms 60.19, 31.0 using rule: transitivity 2]

[64.0] ((-177 + 0 + 1) < (-177 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot)) ∨ (0 == (−($\$heap_{funcstart\_719,1}$.p1 / 177) + div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot)) ∨ (-1 < $\$heap_{funcstart\_719,1}$.p1)

→ *[simplify]*

[64.1] (-176 < (-177 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot)) ∨ ...

→ *[literal comparison of product]*

[64.2] ([-177 < 0]: (-176 / 177) < −div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot, [0 < -177]: (-176 / -177) < div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot, [-177 == 0]: -176 < 0) ∨ ...

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

[64.3] ([-177 < 0]: (-176 / 177) < −div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot, [(0 < -177) ∧ !(-177 < 0)]: (-176 / -177) < div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot, [(-177 == 0) ∧ !(-177 < 0) ∧ !(0 < -177)]: -176 < 0) ∨ ...

→ *[simplify]*

[64.7] (-1 < −div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot) ∨ ...

[Create new term from terms 64.7, 54.6 using rule: transitivity 5]

[70.0] (2501 < ((-171 * ($\$heap_{funcstart\_719,1}$.p1 % 177)) + (2 * −(-1 + 1)))) ∨ (0 == (−($\$heap_{funcstart\_719,1}$.p1 / 177) + div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot)) ∨ (-1 < $\$heap_{funcstart\_719,1}$.p1)

→ *[simplify]*

[70.4] (2501 < (-171 * ($\$heap_{funcstart\_719,1}$.p1 % 177))) ∨ ...

→ *[literal comparison of product]*

[70.5] ([-171 < 0]: (2501 / 171) < −($\$heap_{funcstart\_719,1}$.p1 % 177), [0 < -171]: (2501 / -171) < ($\$heap_{funcstart\_719,1}$.p1 % 177), [-171 == 0]: 2501 < 0) ∨ ...

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

[70.6] ([-171 < 0]: (2501 / 171) < −($heap$_{funcstart_719,1}$.p1 % 177), [(0 < -171) ∧ !(-171 < 0)]: (2501 / -171) < ($heap$_{funcstart\_719,1}$.p1 % 177), [(-171 == 0) ∧ !(-171 < 0) ∧ !(0 < -171)]: 2501 < 0) ∨ ...

→ *[simplify]*

[70.11] **false** ∨ ...

[Remove 'false' term 70.11 and fetch new term from containing clause]

[72.0] 0 == (−($heap$_{funcstart_719,1}$.p1 / 177) + div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1, 177).quot)

[Remove 'false' term 70.11 and fetch new term from containing clause]

[73.0] -1 < $heap$_{funcstart_719,1}$.p1

[Assume known post-assertion, class invariant or type constraint for term 5.6]

[11.40] ([0 < −$heap$_{funcstart_719,1}$.p1]: ([0 == ($heap$_{funcstart\_719,1}$.p1 % 177)]: 0 == div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1, 177).rem, [!(0 == ($heap$_{funcstart\_719,1}$.p1 % 177))]: 177 == (($heap$_{funcstart_719,1}$.p1 % 177) + −div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1, 177).rem)), [-1 < $heap$_{funcstart_719,1}$.p1]: 0 == (−($heap$_{funcstart\_719,1}$.p1 % 177) + div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1, 177).rem))

→ *[from term 73.0, literala < −$heap$_{funcstart_719,1}$.p1 is false whenever -2 < (-1 + literala)]*

Proof of rule precondition:

[11.40.0] -2 < (-1 + 0)

→ *[simplify]*

[11.40.2] **true**

[11.41] ([**false**]: ([0 == ($heap$_{funcstart_719,1}$.p1 % 177)]: 0 == div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1, 177).rem, [!(0 == ($heap$_{funcstart\_719,1}$.p1 % 177))]: 177 == (−div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1, 177).rem + ($heap$_{funcstart\_719,1}$.p1 % 177))), [-1 < $heap$_{funcstart_719,1}$.p1]: 0 == (−($heap$_{funcstart\_719,1}$.p1 % 177) + div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1, 177).rem))

→ *[from term 73.0, literala < $heap$_{funcstart_719,1}$.p1 is true whenever (-1 + literala) < -1]*

Proof of rule precondition:

[11.41.0] (-1 + -1) < -1

→ *[simplify]*

[11.41.2] **true**

[11.42] ([**false**]: ([0 == ($heap$_{funcstart_719,1}$.p1 % 177)]: 0 == div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1, 177).rem, [!(0 ==

($heap$_{funcstart_719,1}$.p1 % 177))]: 177 == ($-$div(**heapIs** $heap$_{funcstart_719,1}$,
$heap$_{funcstart_719,1}$.p1, 177).rem + ($heap$_{funcstart\_719,1}$.p1 % 177))), [**true**]: 0
== ($-$($heap$_{funcstart_719,1}$.p1 % 177) + div(**heapIs** $heap$_{funcstart_719,1}$,
$heap$_{funcstart_719,1}$.p1, 177).rem))

$\rightarrow$ *[simplify]*

[11.44] 0 == ($-$($heap$_{funcstart_719,1}$.p1 % 177) + div(**heapIs**
$heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1, 177).rem)

[Copy term 1.27]

[75.0] 32768 < ((-171 * div(**heapIs** $heap$_{funcstart_719,1}$,
$heap$_{funcstart_719,1}$.p1, 177).rem) + (2 * div(**heapIs** $heap$_{funcstart_719,1}$,
$heap$_{funcstart_719,1}$.p1, 177).quot))

$\rightarrow$ *[from term 11.44, div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1,
177).rem is equal to $heap$_{funcstart_719,1}$.p1 % 177]*

[75.1] 32768 < ((-171 * ($heap$_{funcstart_719,1}$.p1 % 177)) + (2 * div(**heapIs**
$heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1, 177).quot))

[Create new term from term 72.0 using rule: condition for equality of division]

[84.0] (0 < (1 + (177 * (0 + $-$div(**heapIs** $heap$_{funcstart_719,1}$,
$heap$_{funcstart_719,1}$.p1, 177).quot)) + $heap$_{funcstart_719,1}$.p1)) $\wedge$
($heap$_{funcstart_719,1}$.p1 < (177 * (0 + 1 + div(**heapIs** $heap$_{funcstart_719,1}$,
$heap$_{funcstart_719,1}$.p1, 177).quot)))

$\rightarrow$ *[simplify]*

[84.12] (-1 < ((-177 * div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1,
177).quot) + $heap$_{funcstart_719,1}$.p1)) $\wedge$ (-177 < ($-$$heap$_{funcstart\_719,1}$.p1 +
(177 * div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1, 177).quot)))

[Work on sub-term 2 of conjunction in term 84.12]

[85.0] -1 < ((-177 * div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1,
177).quot) + $heap$_{funcstart_719,1}$.p1)

[Create new term from terms 85.0, 9.9 using rule: transitivity 2]

[88.0] (-32768 + -1 + 1) < (-177 * div(**heapIs** $heap$_{funcstart_719,1}$,
$heap$_{funcstart_719,1}$.p1, 177).quot)

$\rightarrow$ *[simplify]*

[88.1] -32768 < (-177 * div(**heapIs** $heap$_{funcstart_719,1}$,
$heap$_{funcstart_719,1}$.p1, 177).quot)

$\rightarrow$ *[literal comparison of product]*

[88.2] ([-177 < 0]: (-32768 / 177) < $-$div(**heapIs** $heap$_{funcstart_719,1}$,
$heap$_{funcstart_719,1}$.p1, 177).quot, [0 < -177]: (-32768 / -177) < div(**heapIs**
$heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1, 177).quot, [-177 == 0]: -32768 <
0)

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

[88.3] ([-177 < 0]: (-32768 / 177) < −div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot, [(0 < -177) ∧ !(-177 < 0)]: (-32768 / -177) < div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot, [(-177 == 0) ∧ !(-177 < 0) ∧ !(0 < -177)]: -32768 < 0)

→ *[simplify]*

[88.7] -186 < −div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot

[Create new term from terms 88.7, 75.1 using rule: transitivity 5]

[90.0] 32768 < ((-171 * ($\$heap_{funcstart\_719,1}$.p1 % 177)) + (2 * −(-186 + 1)))

→ *[simplify]*

[90.5] 32398 < (-171 * ($\$heap_{funcstart\_719,1}$.p1 % 177))

→ *[literal comparison of product]*

[90.6] ([-171 < 0]: (32398 / 171) < −($\$heap_{funcstart\_719,1}$.p1 % 177), [0 < -171]: (32398 / -171) < ($\$heap_{funcstart\_719,1}$.p1 % 177), [-171 == 0]: 32398 < 0)

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

[90.7] ([-171 < 0]: (32398 / 171) < −($\$heap_{funcstart\_719,1}$.p1 % 177), [(0 < -171) ∧ !(-171 < 0)]: (32398 / -171) < ($\$heap_{funcstart\_719,1}$.p1 % 177), [(-171 == 0) ∧ !(-171 < 0) ∧ !(0 < -171)]: 32398 < 0)

→ *[simplify]*

[90.12] **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 (47,33)

Condition defined at:

To prove: ((**asType**<**int**>(**asType**<**short int**>(div1.rem)) * **asType**<**int**>($\$heap_{funcstart\_719,1}$.r1)) − (**asType**<**int**>(**asType**<**short int**>(div1.quot)) * **asType**<**int**>($\$heap_{funcstart\_719,1}$.b1))) ≤ **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)

$\text{\$heap}_{init}.\text{b1} == \textbf{asType}\textbf{<short int>}((\textbf{int})2)$

$\text{\$heap}_{init}.\text{M2} == \textbf{asType}\textbf{<short int>}((\textbf{int})30307)$

$\text{\$heap}_{init}.\text{r2} == \textbf{asType}\textbf{<short int>}((\textbf{int})172)$

$\text{\$heap}_{init}.\text{a2} == \textbf{asType}\textbf{<short int>}((\textbf{int})176)$

$\text{\$heap}_{init}.\text{b2} == \textbf{asType}\textbf{<short int>}((\textbf{int})35)$

$\text{\$heap}_{init}.\text{M3} == \textbf{asType}\textbf{<short int>}((\textbf{int})30323)$

$\text{\$heap}_{init}.\text{r3} == \textbf{asType}\textbf{<short int>}((\textbf{int})170)$

$\text{\$heap}_{init}.\text{a3} == \textbf{asType}\textbf{<short int>}((\textbf{int})178)$

$\text{\$heap}_{init}.\text{b3} == \textbf{asType}\textbf{<short int>}((\textbf{int})63)$

$\text{\$heap}_{init}.\text{p1} == \textbf{asType}\textbf{<short int>}((\textbf{int})1)$

$\text{\$heap}_{init}.\text{p2} == \textbf{asType}\textbf{<short int>}((\textbf{int})2)$

$\text{\$heap}_{init}.\text{p3} == \textbf{asType}\textbf{<short int>}((\textbf{int})3)$

div1 == div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$,
asType<**int**>($\text{\$heap}_{funcstart\_719,1}.\text{p1}$),
asType<**int**>($\text{\$heap}_{funcstart\_719,1}.\text{a1}$))

(**asType**<**integer**>(**asType**<**int**>($\text{\$heap}_{funcstart\_719,1}.\text{p1}$)) /
asType<**integer**>(**asType**<**int**>($\text{\$heap}_{funcstart\_719,1}.\text{a1}$))) ==
asType<**integer**>(div1.quot)

(**asType**<**integer**>(**asType**<**int**>($\text{\$heap}_{funcstart\_719,1}.\text{p1}$)) %
asType<**integer**>(**asType**<**int**>($\text{\$heap}_{funcstart\_719,1}.\text{a1}$))) ==
asType<**integer**>(div1.rem)

div2 == div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$,
asType<**int**>($\text{\$heap}_{funcstart\_719,1}.\text{p2}$),
asType<**int**>($\text{\$heap}_{funcstart\_719,1}.\text{a2}$))

(**asType**<**integer**>(**asType**<**int**>($\text{\$heap}_{funcstart\_719,1}.\text{p2}$)) /
asType<**integer**>(**asType**<**int**>($\text{\$heap}_{funcstart\_719,1}.\text{a2}$))) ==
asType<**integer**>(div2.quot)

(**asType**<**integer**>(**asType**<**int**>($\text{\$heap}_{funcstart\_719,1}.\text{p2}$)) %
asType<**integer**>(**asType**<**int**>($\text{\$heap}_{funcstart\_719,1}.\text{a2}$))) ==
asType<**integer**>(div2.rem)

div3 == div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$,
asType<**int**>($\text{\$heap}_{funcstart\_719,1}.\text{p3}$),
asType<**int**>($\text{\$heap}_{funcstart\_719,1}.\text{a3}$))

(**asType**<**integer**>(**asType**<**int**>($\text{\$heap}_{funcstart\_719,1}.\text{p3}$)) /
asType<**integer**>(**asType**<**int**>($\text{\$heap}_{funcstart\_719,1}.\text{a3}$))) ==
asType<**integer**>(div3.quot)

(**asType**<**integer**>(**asType**<**int**>($\text{\$heap}_{funcstart\_719,1}.\text{p3}$)) %

**asType<integer>(asType<int>($heap$_{funcstart_719,1}$.a3))) ==
asType<integer>(div3.rem)**

Proof:

[Take given term]

[5.0] div1 == div(**heapIs** $heap$_{funcstart_719,1}$,
asType<int>($heap$_{funcstart_719,1}$.p1),
asType<int>($heap$_{funcstart_719,1}$.a1))

→ *[simplify]*

[5.1] div1 == div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1,
asType<int>($heap$_{funcstart_719,1}$.a1))

→ *[const static or extern object]*

[5.2] div1 == div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1,
asType<int>($heap$_{init}$.a1))

→ *[expand definition of constant 'a1' at prang.c (16,20)]*

[5.3] div1 == div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1,
asType<int>(**asType<short int>**((**int**)177)))

→ *[simplify]*

[5.6] div1 == div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1, 177)

[Take goal term]

[1.0] ((**asType<int>**(**asType<short int>**(div1.rem)) *
asType<int>($heap$_{funcstart_719,1}$.r1)) − (**asType<int>**(**asType<short
int>**(div1.quot)) * **asType<int>**($heap$_{funcstart_719,1}$.b1))) ≤ **maxof(short
int**)

→ *[from term 5.6, div1 is equal to div(**heapIs** $heap$_{funcstart_719,1}$,
$heap$_{funcstart_719,1}$.p1, 177)]*

[1.1] ((**asType<int>**(**asType<short int>**(div(**heapIs** $heap$_{funcstart_719,1}$,
$heap$_{funcstart_719,1}$.p1, 177).rem)) * **asType<int>**($heap$_{funcstart\_719,1}$.r1)) −
(**asType<int>**(**asType<short int>**(div1.quot)) *
asType<int>($heap$_{funcstart_719,1}$.b1))) ≤ **maxof(short int**)

→ *[simplify]*

[1.3] ((div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1, 177).rem *
asType<int>($heap$_{funcstart_719,1}$.r1)) − (**asType<int>**(**asType<short
int>**(div1.quot)) * **asType<int>**($heap$_{funcstart_719,1}$.b1))) ≤ **maxof(short
int**)

→ *[const static or extern object]*

[1.4] ((div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1, 177).rem *
asType<int>($heap$_{init}$.r1)) − (**asType<int>**(**asType<short
int>**(div1.quot)) * **asType<int>**($heap$_{funcstart_719,1}$.b1))) ≤ **maxof(short

int)

→ *[expand definition of constant 'r1' at prang.c (15,20)]*

[1.5] ((div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}$.p1, 177).rem *
asType<int>(asType<short int>((int)171))) −
(**asType<int>(asType<short int>**(div1.quot)) *
asType<int>($\$\text{heap}_{funcstart\_719,1}$.b1))) ≤ **maxof(short int)**

→ *[simplify]*

[1.8] ((div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}$.p1, 177).rem * 171)
− (**asType<int>(asType<short int>**(div1.quot)) *
asType<int>($\$\text{heap}_{funcstart\_719,1}$.b1))) ≤ **maxof(short int)**

→ *[from term 5.6, div1 is equal to div(**heapIs** $\$heap_{funcstart\_719,1}$,*
$\$heap_{funcstart\_719,1}$.p1, 177)]

[1.9] ((171 * div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}$.p1, 177).rem)
− (**asType<int>(asType<short int>**(div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$,
$\$\text{heap}_{funcstart\_719,1}$.p1, 177).quot)) * **asType<int>**($\$\text{heap}_{funcstart\_719,1}$.b1)))
≤ **maxof(short int)**

→ *[simplify]*

[1.11] ((171 * div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}$.p1,
177).rem) − (div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}$.p1,
177).quot * **asType<int>**($\$\text{heap}_{funcstart\_719,1}$.b1))) ≤ **maxof(short int)**

→ *[const static or extern object]*

[1.12] ((171 * div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}$.p1,
177).rem) − (div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}$.p1,
177).quot * **asType<int>**($\$\text{heap}_{init}$.b1))) ≤ **maxof(short int)**

→ *[expand definition of constant 'b1' at prang.c (17,20)]*

[1.13] ((171 * div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}$.p1,
177).rem) − (div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}$.p1,
177).quot * **asType<int>(asType<short int>((int)2))))** ≤ **maxof(short
int)**

→ *[simplify]*

[1.32] -32768 < ((-171 * div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$,
$\$\text{heap}_{funcstart\_719,1}$.p1, 177).rem) + (2 * div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$,
$\$\text{heap}_{funcstart\_719,1}$.p1, 177).quot))

→ *[negate goal and search for contradiction]*

[1.33] !(-32768 < ((-171 * div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$,
$\$\text{heap}_{funcstart\_719,1}$.p1, 177).rem) + (2 * div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$,
$\$\text{heap}_{funcstart\_719,1}$.p1, 177).quot)))

→ *[simplify]*

[1.38] 32767 < ((171 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).rem) + (-2 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot))

[Assume known post-assertion, class invariant or type constraint for term 5.6]

[8.0] **minof(short int**) $\leq$ $\$heap_{funcstart\_719,1}$.p1

$\rightarrow$ *[simplify]*

[8.3] -32769 < $\$heap_{funcstart\_719,1}$.p1

[Assume known post-assertion, class invariant or type constraint for term 5.6]

[10.0] (**asType<integer>**($\$heap_{funcstart\_719,1}$.p1) / **asType<integer>**(177)) == **asType<integer>**(div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot)

$\rightarrow$ *[simplify]*

[10.2] ($\$heap_{funcstart\_719,1}$.p1 / 177) == **asType<integer>**(div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot)

$\rightarrow$ *[expand definition of operator './' in class 'int' at built in declaration]*

[10.3] ([**asType<integer>**($\$heap_{funcstart\_719,1}$.p1) < 0]: $-(-$**asType<integer>**($\$heap_{funcstart\_719,1}$.p1) / 177), []: **asType<integer>**($\$heap_{funcstart\_719,1}$.p1) / 177) == **asType<integer>**(div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot)

$\rightarrow$ *[explicitly assert falsehood of skipped guards in subsequent guards]*

[10.4] ([**asType<integer>**($\$heap_{funcstart\_719,1}$.p1) < 0]: $-(-$**asType<integer>**($\$heap_{funcstart\_719,1}$.p1) / 177), [!(**asType<integer>**($\$heap_{funcstart\_719,1}$.p1) < 0)]: **asType<integer>**($\$heap_{funcstart\_719,1}$.p1) / 177) == **asType<integer>**(div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot)

$\rightarrow$ *[simplify]*

[10.17] 0 == ($-$([0 < $-\$heap_{funcstart\_719,1}$.p1]: $-(-\$heap_{funcstart\_719,1}$.p1 / 177), [-1 < $\$heap_{funcstart\_719,1}$.p1]: $\$heap_{funcstart\_719,1}$.p1 / 177) + div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot)

$\rightarrow$ *[move guard outside expression]*

[10.18] 0 == (([0 < $-\$heap_{funcstart\_719,1}$.p1]: $-(-(-\$heap_{funcstart\_719,1}$.p1 / 177)), [-1 < $\$heap_{funcstart\_719,1}$.p1]: $-(\$heap_{funcstart\_719,1}$.p1 / 177)) + div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot)

$\rightarrow$ *[simplify]*

[10.19] 0 == (([0 < $-\$heap_{funcstart\_719,1}$.p1]: $-\$heap_{funcstart\_719,1}$.p1 / 177, [-1 < $\$heap_{funcstart\_719,1}$.p1]: $-(\$heap_{funcstart\_719,1}$.p1 / 177)) + div(**heapIs**

$heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p1, 177).quot)

$\rightarrow$ *[move guard outside expression]*

[10.21] ([0 < $-heap_{funcstart\_719,1}$.p1]: 0 == (($-heap_{funcstart\_719,1}$.p1 / 177) + div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p1, 177).quot), [-1 < $heap_{funcstart\_719,1}$.p1]: 0 == ($-heap_{funcstart\_719,1}$.p1 / 177) + div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p1, 177).quot))

[Assume known post-assertion, class invariant or type constraint for term 5.6]

[11.0] (**asType**<**integer**>($heap_{funcstart\_719,1}$.p1) % **asType**<**integer**>(177)) == **asType**<**integer**>(div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p1, 177).rem)

$\rightarrow$ *[simplify]*

[11.2] ($heap_{funcstart\_719,1}$.p1 % 177) == **asType**<**integer**>(div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p1, 177).rem)

$\rightarrow$ *[expand definition of operator '.%' in class 'int' at built in declaration]*

[11.3] ([**asType**<**integer**>($heap_{funcstart\_719,1}$.p1) < 0]: $-(-$**asType**<**integer**>($heap_{funcstart\_719,1}$.p1) % 177), []: **asType**<**integer**>($heap_{funcstart\_719,1}$.p1) % 177) == **asType**<**integer**>(div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p1, 177).rem)

$\rightarrow$ *[explicitly assert falsehood of skipped guards in subsequent guards]*

[11.4] ([**asType**<**integer**>($heap_{funcstart\_719,1}$.p1) < 0]: $-(-$**asType**<**integer**>($heap_{funcstart\_719,1}$.p1) % 177), [!(**asType**<**integer**>($heap_{funcstart\_719,1}$.p1) < 0)]: **asType**<**integer**>($heap_{funcstart\_719,1}$.p1) % 177) == **asType**<**integer**>(div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p1, 177).rem)

$\rightarrow$ *[simplify]*

[11.14] ([0 < $-heap_{funcstart\_719,1}$.p1]: $-(-heap_{funcstart\_719,1}$.p1 % 177), [-1 < $heap_{funcstart\_719,1}$.p1]: **asType**<**integer**>($heap_{funcstart\_719,1}$.p1) % 177) == **asType**<**integer**>(div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p1, 177).rem)

$\rightarrow$ *[remainder of negation]*

[11.15] ([0 < $-heap_{funcstart\_719,1}$.p1]: $-$([0 == ($heap_{funcstart\_719,1}$.p1 % 177)]: 0, []: 177 + $-$($heap_{funcstart\_719,1}$.p1 % 177)), [-1 < $heap_{funcstart\_719,1}$.p1]: **asType**<**integer**>($heap_{funcstart\_719,1}$.p1) % 177) == **asType**<**integer**>(div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p1, 177).rem)

$\rightarrow$ *[explicitly assert falsehood of skipped guards in subsequent guards]*

[11.16] ([0 < $-heap_{funcstart\_719,1}$.p1]: $-$([0 == ($heap_{funcstart\_719,1}$.p1 %

177)]: 0, [!(0 == ($heap$_{funcstart_719,1}$.p1 % 177))]: 177 +
$-$($heap$_{funcstart_719,1}$.p1 % 177)), [-1 < $heap$_{funcstart_719,1}$.p1]:
asType<**integer**>($heap$_{funcstart_719,1}$.p1) % 177) ==
asType<**integer**>(div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1,
177).rem)

$\rightarrow$ *[move guard outside expression]*

[11.17] ([0 < $-$$heap$_{funcstart\_719,1}$.p1]: ([0 == ($heap$_{funcstart_719,1}$.p1 %
177)]: $-$0, [!(0 == ($heap$_{funcstart\_719,1}$.p1 % 177))]: $-$(177 +
$-$($heap$_{funcstart_719,1}$.p1 % 177))), [-1 < $heap$_{funcstart_719,1}$.p1]:
asType<**integer**>($heap$_{funcstart_719,1}$.p1) % 177) ==
asType<**integer**>(div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1,
177).rem)

$\rightarrow$ *[simplify]*

[11.24] 0 == ($-$([0 < $-$$heap$_{funcstart\_719,1}$.p1]: ([0 ==
($heap$_{funcstart_719,1}$.p1 % 177)]: 0, [!(0 == ($heap$_{funcstart\_719,1}$.p1 % 177))]:
-177 + ($heap$_{funcstart_719,1}$.p1 % 177)), [-1 < $heap$_{funcstart_719,1}$.p1]:
$heap$_{funcstart_719,1}$.p1 % 177) + div(**heapIs** $heap$_{funcstart_719,1}$,
$heap$_{funcstart_719,1}$.p1, 177).rem)

$\rightarrow$ *[move guard outside expression]*

[11.26] 0 == (([0 < $-$$heap$_{funcstart\_719,1}$.p1]: ([0 == ($heap$_{funcstart_719,1}$.p1
% 177)]: $-$0, [!(0 == ($heap$_{funcstart\_719,1}$.p1 % 177))]: $-$(-177 +
($heap$_{funcstart_719,1}$.p1 % 177))), [-1 < $heap$_{funcstart_719,1}$.p1]:
$-$($heap$_{funcstart_719,1}$.p1 % 177)) + div(**heapIs** $heap$_{funcstart_719,1}$,
$heap$_{funcstart_719,1}$.p1, 177).rem)

$\rightarrow$ *[simplify]*

[11.29] 0 == (([0 < $-$$heap$_{funcstart\_719,1}$.p1]: ([0 == ($heap$_{funcstart_719,1}$.p1
% 177)]: 0, [!(0 == ($heap$_{funcstart_719,1}$.p1 % 177))]: 177 +
$-$($heap$_{funcstart_719,1}$.p1 % 177)), [-1 < $heap$_{funcstart_719,1}$.p1]:
$-$($heap$_{funcstart_719,1}$.p1 % 177)) + div(**heapIs** $heap$_{funcstart_719,1}$,
$heap$_{funcstart_719,1}$.p1, 177).rem)

$\rightarrow$ *[move guard outside expression]*

[11.31] 0 == ([0 < $-$$heap$_{funcstart\_719,1}$.p1]: ([0 == ($heap$_{funcstart_719,1}$.p1 %
177)]: 0 + div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1, 177).rem,
[!(0 == ($heap$_{funcstart_719,1}$.p1 % 177))]: (177 + $-$($heap$_{funcstart_719,1}$.p1 %
177)) + div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1, 177).rem), [-1
< $heap$_{funcstart_719,1}$.p1]: $-$($heap$_{funcstart_719,1}$.p1 % 177) + div(**heapIs**
$heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1, 177).rem)

$\rightarrow$ *[simplify]*

[11.33] 0 == ([0 < $-$$heap$_{funcstart\_719,1}$.p1]: ([0 == ($heap$_{funcstart_719,1}$.p1
% 177)]: div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1, 177).rem,
[!(0 == ($heap$_{funcstart_719,1}$.p1 % 177))]: 177 + $-$($heap$_{funcstart_719,1}$.p1 %

177) + div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).rem), [-1 < $\$heap_{funcstart\_719,1}$.p1]: $-(\$heap_{funcstart\_719,1}$.p1 % 177) + div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).rem)

→ *[move guard outside expression]*

[11.35] ([0 < $-\$heap_{funcstart\_719,1}$.p1]: ([0 == ($\$heap_{funcstart\_719,1}$.p1 % 177)]: 0 == div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).rem, [!(0 == ($\$heap_{funcstart\_719,1}$.p1 % 177))]: 0 == (177 + $-\$heap_{funcstart\_719,1}$.p1 % 177) + div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).rem)), [-1 < $\$heap_{funcstart\_719,1}$.p1]: 0 == ($-(\$heap_{funcstart\_719,1}$.p1 % 177) + div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).rem))

→ *[simplify]*

[11.40] ([0 < $-\$heap_{funcstart\_719,1}$.p1]: ([0 == ($\$heap_{funcstart\_719,1}$.p1 % 177)]: 0 == div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).rem, [!(0 == ($\$heap_{funcstart\_719,1}$.p1 % 177))]: 177 == (($\$heap_{funcstart\_719,1}$.p1 % 177) + $-$div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).rem)), [-1 < $\$heap_{funcstart\_719,1}$.p1]: 0 == ($-(\$heap_{funcstart\_719,1}$.p1 % 177) + div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).rem))

[Branch on disjunction or conditional in term 10.21]

[30.0] (0 == (($-\$heap_{funcstart\_719,1}$.p1 / 177) + div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot)) ∨ (0 == ($-(\$heap_{funcstart\_719,1}$.p1 / 177) + div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot)) ∨ (-1 < $\$heap_{funcstart\_719,1}$.p1)

[Branch on disjunction or conditional in term 10.21]

[31.0] (0 < $-\$heap_{funcstart\_719,1}$.p1) ∨ (0 == ($-(\$heap_{funcstart\_719,1}$.p1 / 177) + div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot)) ∨ (-1 < $\$heap_{funcstart\_719,1}$.p1)

[Copy term 11.40]

[32.0] ([0 < $-\$heap_{funcstart\_719,1}$.p1]: ([0 == ($\$heap_{funcstart\_719,1}$.p1 % 177)]: 0 == div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).rem, [!(0 == ($\$heap_{funcstart\_719,1}$.p1 % 177))]: 177 == ($-$div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).rem + ($\$heap_{funcstart\_719,1}$.p1 % 177))), [-1 < $\$heap_{funcstart\_719,1}$.p1]: 0 == ($-(\$heap_{funcstart\_719,1}$.p1 % 177) + div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).rem)) ∨ (0 == ($-(\$heap_{funcstart\_719,1}$.p1 / 177) + div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot)) ∨ (-1 < $\$heap_{funcstart\_719,1}$.p1)

→ *[from term 31.0, literala < $-\$heap_{funcstart\_719,1}$.p1 is true whenever (-1 + literala) < 0]*

Proof of rule precondition:

[32.0.0] (-1 + 0) < 0

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$\rightarrow$ *[simplify]*

[32.0.2] **true**

[32.1] ([**true**]: ([0 == ($heap$_{funcstart_719,1}$.p1 % 177)]: 0 == div(**heapIs**
$heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1, 177).rem, [!(0 ==
($heap$_{funcstart_719,1}$.p1 % 177))]: 177 == ($-$div(**heapIs** $heap$_{funcstart_719,1}$,
$heap$_{funcstart_719,1}$.p1, 177).rem + ($heap$_{funcstart\_719,1}$.p1 % 177))), [-1 <
$heap$_{funcstart_719,1}$.p1]: 0 == ($-$($heap$_{funcstart\_719,1}$.p1 % 177) + div(**heapIs**
$heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1, 177).rem)) $\lor$ ...

$\rightarrow$ *[simplify]*

[32.3] ([0 == ($heap$_{funcstart_719,1}$.p1 % 177)]: 0 == div(**heapIs**
$heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1, 177).rem, [!(0 ==
($heap$_{funcstart_719,1}$.p1 % 177))]: 177 == ($-$div(**heapIs** $heap$_{funcstart_719,1}$,
$heap$_{funcstart_719,1}$.p1, 177).rem + ($heap$_{funcstart\_719,1}$.p1 % 177))) $\lor$ ...

[Branch on disjunction or conditional in term 32.3]

[33.0] (0 == div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1, 177).rem)
$\lor$ (0 == ($-$($heap$_{funcstart_719,1}$.p1 / 177) + div(**heapIs** $heap$_{funcstart_719,1}$,
$heap$_{funcstart_719,1}$.p1, 177).quot)) $\lor$ (-1 < $heap$_{funcstart_719,1}$.p1) $\lor$ (177 ==
($-$div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1, 177).rem +
($heap$_{funcstart_719,1}$.p1 % 177))) $\lor$!(0 == ($heap$_{funcstart_719,1}$.p1 % 177))

[Copy term 1.38]

[35.0] (32767 < ((-2 * div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1,
177).quot) + (171 * div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1,
177).rem))) $\lor$ (0 == ($-$($heap$_{funcstart_719,1}$.p1 / 177) + div(**heapIs**
$heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1, 177).quot)) $\lor$ (-1 <
$heap$_{funcstart_719,1}$.p1) $\lor$ (177 == ($-$div(**heapIs** $heap$_{funcstart_719,1}$,
$heap$_{funcstart_719,1}$.p1, 177).rem + ($heap$_{funcstart\_719,1}$.p1 % 177))) $\lor$!(0 ==
($heap$_{funcstart_719,1}$.p1 % 177))

$\rightarrow$ *[from term 33.0, div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1} \cdot p1$,
177).rem is equal to 0]*

[35.1] (32767 < ((-2 * div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1,
177).quot) + (171 * 0))) $\lor$ ...

$\rightarrow$ *[simplify]*

[35.3] (32767 < (-2 * div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1,
177).quot)) $\lor$ ...

$\rightarrow$ *[literal comparison of product]*

[35.4] ([-2 < 0]: (32767 / 2) < $-$div(**heapIs** $heap$_{funcstart_719,1}$,
$heap$_{funcstart_719,1}$.p1, 177).quot, [0 < -2]: (32767 / -2) < div(**heapIs**
$heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1, 177).quot, [-2 == 0]: 32767 < 0)
$\lor$ ...

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

[35.5] ([-2 < 0]: (32767 / 2) < −div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot, [(0 < -2) ∧ !(-2 < 0)]: (32767 / -2) < div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot, [(-2 == 0) ∧ !(-2 < 0) ∧ !(0 < -2)]: 32767 < 0) ∨ ...

→ *[simplify]*

[35.9] (16383 < −div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot) ∨ ...

[Create new term from terms 35.9, 30.0 using rule: transitivity 16]

[50.0] ((0 + 16383) < (−$\$heap_{funcstart\_719,1}$.p1 / 177)) ∨ (0 == (−(−$\$heap_{funcstart\_719,1}$.p1 / 177) + div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot)) ∨ (-1 < $\$heap_{funcstart\_719,1}$.p1) ∨ (177 == (−div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).rem + ($\$heap_{funcstart\_719,1}$.p1 % 177))) ∨ !(0 == ($\$heap_{funcstart\_719,1}$.p1 % 177))

→ *[simplify]*

[50.8] (2899967 < −$\$heap_{funcstart\_719,1}$.p1) ∨ ...

→ *[from term 8.3, literala < −$\$heap_{funcstart\_719,1}$.p1 is false whenever -2 < (-32769 + literala)]*

Proof of rule precondition:

[50.8.0] -2 < (-32769 + 2899967)

→ *[simplify]*

[50.8.2] **true**

[50.9] **false** ∨ ...

[Remove 'false' term 50.9 and fetch new term from containing clause]

[51.0] (177 == (−div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).rem + ($\$heap_{funcstart\_719,1}$.p1 % 177))) ∨ (0 == (−($\$heap_{funcstart\_719,1}$.p1 / 177) + div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot)) ∨ (-1 < $\$heap_{funcstart\_719,1}$.p1)

[Remove 'false' term 50.9 and fetch new term from containing clause]

[52.0] !(0 == ($\$heap_{funcstart\_719,1}$.p1 % 177)) ∨ (0 == (−($\$heap_{funcstart\_719,1}$.p1 / 177) + div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot)) ∨ (-1 < $\$heap_{funcstart\_719,1}$.p1)

[Copy term 1.38]

[54.0] (32767 < ((-2 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).rem))) ∨ (0 == (−($\$heap_{funcstart\_719,1}$.p1 / 177) + div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot)) ∨ (-1 < $\$heap_{funcstart\_719,1}$.p1)

→ [from term 51.0, div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.*p1*, 177).rem is equal to -177 + ($\$heap_{funcstart\_719,1}$.*p1* % 177)]

[54.1] (32767 < ((-2 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot) + (171 * (-177 + ($\$heap_{funcstart\_719,1}$.p1 % 177))))) ∨ ...

→ [simplify]

[54.6] (63034 < ((-2 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot) + (171 * ($\$heap_{funcstart\_719,1}$.p1 % 177)))) ∨ ...

[Create new term from term 52.0 using rule: try to prove equality by contradiction]

[58.0] ((0 < ($\$heap_{funcstart\_719,1}$.p1 % 177)) ∨ (($\$heap_{funcstart\_719,1}$.p1 % 177) < 0)) ∨ (0 == (−($\$heap_{funcstart\_719,1}$.p1 / 177) + div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot)) ∨ (-1 < $\$heap_{funcstart\_719,1}$.p1)

→ [simplify]

[58.1] ((([-1 < 0]: ∃ **integer** n • (0 < ($\$heap_{funcstart\_719,1}$.p1 + (177 * n))) ∧ (($\$heap_{funcstart\_719,1}$.p1 + (177 * n)) < 177), []: **true**) ∨ (($\$heap_{funcstart\_719,1}$.p1 % 177) < 0)) ∨ ...

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

[58.2] ((([-1 < 0]: ∃ **integer** n • (0 < ($\$heap_{funcstart\_719,1}$.p1 + (177 * n))) ∧ (($\$heap_{funcstart\_719,1}$.p1 + (177 * n)) < 177), [!(-1 < 0)]: **true**) ∨ (($\$heap_{funcstart\_719,1}$.p1 % 177) < 0)) ∨ ...

→ [simplify]

[58.15] (∃ **integer** n • (-177 < (−$\$heap_{funcstart\_719,1}$.p1 + (-177 * n))) ∧ (0 < ((177 * n) + $\$heap_{funcstart\_719,1}$.p1))) ∨ ...

→ [introduce skolem term and eliminate 'exists']

[58.16] ((-177 < (−$\$heap_{funcstart\_719,1}$.p1 + (-177 * $\$a\_n$))) ∧ (0 < ((177 * $\$a\_n$) + $\$heap_{funcstart\_719,1}$.p1))) ∨ ...

→ [separate conjunction and work on first sub-term]

[58.17] (-177 < (−$\$heap_{funcstart\_719,1}$.p1 + (-177 * $\$a\_n$))) ∨ ...

[Work on sub-term 2 of conjunction in term 58.16]

[59.0] (0 < ((177 * $\$a\_n$) + $\$heap_{funcstart\_719,1}$.p1)) ∨ (0 == (−($\$heap_{funcstart\_719,1}$.p1 / 177) + div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot)) ∨ (-1 < $\$heap_{funcstart\_719,1}$.p1)

[Create new term from term 30.0 using rule: condition for equality of division]

[60.0] ((−$\$heap_{funcstart\_719,1}$.p1 < (177 * (0 + 1 + −div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot))) ∧ ((177 * (0 + −div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot)) < (1 + −$\$heap_{funcstart\_719,1}$.p1))) ∨ (0 == (−($\$heap_{funcstart\_719,1}$.p1 / 177) +

div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot)) $\vee$ (-1 < $\$heap_{funcstart\_719,1}$.p1)

$\rightarrow$ *[simplify]*

[60.18] ((-177 < ((-177 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot) + $\$heap_{funcstart\_719,1}$.p1)) $\wedge$ (-1 < ($-\$heap_{funcstart\_719,1}$.p1 + (177 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot)))) $\vee$ ...

$\rightarrow$ *[separate conjunction and work on first sub-term]*

[60.19] (-177 < ((-177 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot) + $\$heap_{funcstart\_719,1}$.p1)) $\vee$ ...

[Work on sub-term 2 of conjunction in term 60.18]

[61.0] (-1 < ($-\$heap_{funcstart\_719,1}$.p1 + (177 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot))) $\vee$ (0 == ($-(\$heap_{funcstart\_719,1}$.p1 / 177) + div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot)) $\vee$ (-1 < $\$heap_{funcstart\_719,1}$.p1)

[Create new term from terms 60.19, 58.17 using rule: transitivity 1]

[63.0] ((-177 + -177 + 1) < ((-177 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot) + (-177 * $\$a\_n$))) $\vee$ (0 == ($-(\$heap_{funcstart\_719,1}$.p1 / 177) + div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot)) $\vee$ (-1 < $\$heap_{funcstart\_719,1}$.p1)

$\rightarrow$ *[simplify]*

[63.1] (-353 < ((-177 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot) + (-177 * $\$a\_n$))) $\vee$ ...

$\rightarrow$ *[cancel common factor]*

> **Proof of rule precondition 1:**
>
> *[63.1.0.0]* !(-177 == 0)
>
> $\rightarrow$ *[simplify]*
>
> *[63.1.0.2]* **true**
>
> **Proof of rule precondition 2:**
>
> *[63.1.1.0]* 1 < $\$gcf$(-177, -177)
>
> $\rightarrow$ *[simplify]*
>
> *[63.1.1.2]* **true**

[63.2] ((-353 / $\$gcf$(-177, -177)) < (((-177 / $\$gcf$(-177, -177)) * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot) + ((-177 / $\$gcf$(-177, -177)) * $\$a\_n$))) $\vee$ ...

$\rightarrow$ *[simplify]*

[63.10] (-2 < (−div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot + −$\$a\_n$)) ∨ ...

[Create new term from terms 61.0, 59.0 using rule: transitivity 1]

[66.0] ((-1 + 0 + 1) < ((177 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot) + (177 * $\$a\_n$))) ∨ (0 == (−($\$heap_{funcstart\_719,1}$.p1 / 177) + div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot)) ∨ (-1 < $\$heap_{funcstart\_719,1}$.p1)

→ *[simplify]*

[66.1] (0 < ((177 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot) + (177 * $\$a\_n$))) ∨ ...

→ *[cancel common factor]*

Proof of rule precondition 1:

[66.1.0.0] !(0 == 177)

→ *[simplify]*

[66.1.0.2] **true**

Proof of rule precondition 2:

[66.1.1.0] 1 < $\$gcf(177, 177)$

→ *[simplify]*

[66.1.1.2] **true**

[66.2] ((0 / $\$gcf(177, 177)$) < (((177 / $\$gcf(177, 177)$) * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot) + ((177 / $\$gcf(177, 177)$) * $\$a\_n$))) ∨ ...

→ *[simplify]*

[66.10] (0 < (div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot + $\$a\_n$)) ∨ ...

→ *[from term 63.10, 0 < (div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot + $\$a\_n$) is true if and only if -1 == (−div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot + −$\$a\_n$)]*

[66.11] (-1 == (−div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot + −$\$a\_n$)) ∨ ...

→ *[simplify]*

[66.15] (1 == (div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot + $\$a\_n$)) ∨ ...

[Create new term from terms 58.17, 8.3 using rule: transitivity 2]

[62.0] ((-32769 + -177 + 1) < (-177 * $\$a\_n$)) ∨ (0 ==

$(-(\$heap_{funcstart\_719,1}.p1 \ / \ 177) + \text{div}(\textbf{heapIs} \ \$heap_{funcstart\_719,1},$
$\$heap_{funcstart\_719,1}.p1, \ 177).\text{quot})) \lor (-1 < \$heap_{funcstart\_719,1}.p1)$

$\rightarrow$ *[simplify]*

[62.1] $(-32945 < (-177 * \$a\_n)) \lor ...$

$\rightarrow$ *[literal comparison of product]*

[62.2] $([-177 < 0]: (-32945 \ / \ 177) < -\$a\_n, [0 < -177]: (-32945 \ / \ -177) < \$a\_n,$
$[-177 == 0]: -32945 < 0) \lor ...$

$\rightarrow$ *[explicitly assert falsehood of skipped guards in subsequent guards]*

[62.3] $([-177 < 0]: (-32945 \ / \ 177) < -\$a\_n, [(0 < -177) \land !(-177 < 0)]: (-32945$
$/ \ -177) < \$a\_n, [(-177 == 0) \land !(-177 < 0) \land !(0 < -177)]: -32945 < 0) \lor ...$

$\rightarrow$ *[simplify]*

[62.7] $(-187 < -\$a\_n) \lor ...$

$\rightarrow$ *[from term 66.15, \$a_n is equal to $1 + -\text{div}(\textbf{heapIs} \ \$heap_{funcstart\_719,1},$*
$\$heap_{funcstart\_719,1}.p1, \ 177).\text{quot}]$

[62.8] $(-187 < -(1 + -\text{div}(\textbf{heapIs} \ \$heap_{funcstart\_719,1}, \ \$heap_{funcstart\_719,1}.p1,$
$177).\text{quot})) \lor ...$

$\rightarrow$ *[simplify]*

[62.13] $(-186 < \text{div}(\textbf{heapIs} \ \$heap_{funcstart\_719,1}, \ \$heap_{funcstart\_719,1}.p1,$
$177).\text{quot}) \lor ...$

[Create new term from terms 62.13, 54.6 using rule: transitivity 11]

[70.0] $((1 + 63034 + (-186 * 2)) < (171 * (\$heap_{funcstart\_719,1}.p1 \ \% \ 177))) \lor$
$(0 == (-(\$heap_{funcstart\_719,1}.p1 \ / \ 177) + \text{div}(\textbf{heapIs} \ \$heap_{funcstart\_719,1},$
$\$heap_{funcstart\_719,1}.p1, \ 177).\text{quot})) \lor (-1 < \$heap_{funcstart\_719,1}.p1)$

$\rightarrow$ *[simplify]*

[70.2] $(62663 < (171 * (\$heap_{funcstart\_719,1}.p1 \ \% \ 177))) \lor ...$

$\rightarrow$ *[literal comparison of product]*

[70.3] $([171 < 0]: (62663 \ / \ -171) < -(\$heap_{funcstart\_719,1}.p1 \ \% \ 177), [0 < 171]:$
$(62663 \ / \ 171) < (\$heap_{funcstart\_719,1}.p1 \ \% \ 177), [0 == 171]: 62663 < 0) \lor ...$

$\rightarrow$ *[explicitly assert falsehood of skipped guards in subsequent guards]*

[70.4] $([171 < 0]: (62663 \ / \ -171) < -(\$heap_{funcstart\_719,1}.p1 \ \% \ 177), [(0 <$
$171) \land !(171 < 0)]: (62663 \ / \ 171) < (\$heap_{funcstart\_719,1}.p1 \ \% \ 177), [(0 ==$
$171) \land !(0 < 171) \land !(171 < 0)]: 62663 < 0) \lor ...$

$\rightarrow$ *[simplify]*

[70.13] **false** $\lor ...$

[Remove 'false' term 70.13 and fetch new term from containing clause]

[71.0] $0 == (-(\$heap_{funcstart\_719,1}.p1 \ / \ 177) + \text{div}(\textbf{heapIs}$

$\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p1, 177).quot)

[Remove 'false' term 70.13 and fetch new term from containing clause]

[72.0] -1 < $\text{\$heap}_{funcstart\_719,1}$.p1

[Assume known post-assertion, class invariant or type constraint for term 5.6]

[11.40] ([0 < $-\text{\$heap}_{funcstart\_719,1}$.p1]: ([0 == ($\text{\$heap}_{funcstart\_719,1}$.p1 % 177)]: 0 == div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p1, 177).rem, [!(0 == ($\text{\$heap}_{funcstart\_719,1}$.p1 % 177))]: 177 == (($\text{\$heap}_{funcstart\_719,1}$.p1 % 177) + $-$div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p1, 177).rem)), [-1 < $\text{\$heap}_{funcstart\_719,1}$.p1]: 0 == ($-$($\text{\$heap}_{funcstart\_719,1}$.p1 % 177) + div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p1, 177).rem))

$\rightarrow$ *[from term 72.0, literala < $-\text{\$heap}_{funcstart\_719,1}$.p1 is false whenever -2 < (-1 + literala)]*

Proof of rule precondition:

[11.40.0] -2 < (-1 + 0)

$\rightarrow$ *[simplify]*

[11.40.2] **true**

[11.41] ([**false**]: ([0 == ($\text{\$heap}_{funcstart\_719,1}$.p1 % 177)]: 0 == div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p1, 177).rem, [!(0 == ($\text{\$heap}_{funcstart\_719,1}$.p1 % 177))]: 177 == ($-$div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p1, 177).rem + ($\text{\$heap}_{funcstart\_719,1}$.p1 % 177))), [-1 < $\text{\$heap}_{funcstart\_719,1}$.p1]: 0 == ($-$($\text{\$heap}_{funcstart\_719,1}$.p1 % 177) + div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p1, 177).rem))

$\rightarrow$ *[from term 72.0, literala < $\text{\$heap}_{funcstart\_719,1}$.p1 is true whenever (-1 + literala) < -1]*

Proof of rule precondition:

[11.41.0] (-1 + -1) < -1

$\rightarrow$ *[simplify]*

[11.41.2] **true**

[11.42] ([**false**]: ([0 == ($\text{\$heap}_{funcstart\_719,1}$.p1 % 177)]: 0 == div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p1, 177).rem, [!(0 == ($\text{\$heap}_{funcstart\_719,1}$.p1 % 177))]: 177 == ($-$div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p1, 177).rem + ($\text{\$heap}_{funcstart\_719,1}$.p1 % 177))), [**true**]: 0 == ($-$($\text{\$heap}_{funcstart\_719,1}$.p1 % 177) + div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p1, 177).rem))

$\rightarrow$ *[simplify]*

[11.44] 0 == ($-$($\text{\$heap}_{funcstart\_719,1}$.p1 % 177) + div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p1, 177).rem)

[Copy term 1.38]

[74.0] 32767 < ((-2 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).rem))

→ *[from term 11.44, div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).rem is equal to $\$heap_{funcstart\_719,1}$.p1 % 177]*

[74.1] 32767 < ((-2 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot) + (171 * ($\$heap_{funcstart\_719,1}$.p1 % 177)))

[Create new term from term 71.0 using rule: condition for equality of division]

[84.0] (0 < (1 + (177 * (0 + −div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot)) + $\$heap_{funcstart\_719,1}$.p1)) ∧ ($\$heap_{funcstart\_719,1}$.p1 < (177 * (0 + 1 + div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot)))

→ *[simplify]*

[84.12] (-1 < ((-177 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot) + $\$heap_{funcstart\_719,1}$.p1)) ∧ (-177 < (−$\$heap_{funcstart\_719,1}$.p1 + (177 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot)))

→ *[separate conjunction and work on first sub-term]*

[84.13] -177 < (−$\$heap_{funcstart\_719,1}$.p1 + (177 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot))

[Create new term from terms 84.13, 72.0 using rule: transitivity 2]

[86.0] (-177 + -1 + 1) < (177 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot)

→ *[simplify]*

[86.1] -177 < (177 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot)

→ *[literal comparison of product]*

[86.2] ([177 < 0]: (-177 / -177) < −div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot, [0 < 177]: (-177 / 177) < div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot, [0 == 177]: -177 < 0)

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

[86.3] ([177 < 0]: (-177 / -177) < −div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot, [(0 < 177) ∧ !(177 < 0)]: (-177 / 177) < div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot, [(0 == 177) ∧ !(0 < 177) ∧ !(177 < 0)]: -177 < 0)

→ *[simplify]*

[86.11] -1 < div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot

[Create new term from terms 86.11, 74.1 using rule: transitivity 11]

[88.0] $(1 + 32767 + (-1 * 2)) < (171 * (\$heap_{funcstart\_719,1}.p1 \% 177))$

$\rightarrow$ *[simplify]*

[88.2] $32766 < (171 * (\$heap_{funcstart\_719,1}.p1 \% 177))$

$\rightarrow$ *[literal comparison of product]*

[88.3] $([171 < 0]: (32766 / -171) < -(\$heap_{funcstart\_719,1}.p1 \% 177), [0 < 171]:$ $(32766 / 171) < (\$heap_{funcstart\_719,1}.p1 \% 177), [0 == 171]: 32766 < 0)$

$\rightarrow$ *[explicitly assert falsehood of skipped guards in subsequent guards]*

[88.4] $([171 < 0]: (32766 / -171) < -(\$heap_{funcstart\_719,1}.p1 \% 177), [(0 < 171) \wedge !(171 < 0)]: (32766 / 171) < (\$heap_{funcstart\_719,1}.p1 \% 177), [(0 == 171) \wedge !(0 < 171) \wedge !(171 < 0)]: 32766 < 0)$

$\rightarrow$ *[simplify]*

[88.13] **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 (48,15)

Condition defined at:

To prove: $\mathbf{minof(short\ int)} \leq$ div2.rem

Given:

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

$\$heap_{init}.M1 == \mathbf{asType}<\mathbf{short\ int}>((\mathbf{int})30269)$

$\$heap_{init}.r1 == \mathbf{asType}<\mathbf{short\ int}>((\mathbf{int})171)$

$\$heap_{init}.a1 == \mathbf{asType}<\mathbf{short\ int}>((\mathbf{int})177)$

$\$heap_{init}.b1 == \mathbf{asType}<\mathbf{short\ int}>((\mathbf{int})2)$

$\$heap_{init}.M2 == \mathbf{asType}<\mathbf{short\ int}>((\mathbf{int})30307)$

$\$heap_{init}.r2 == \mathbf{asType}<\mathbf{short\ int}>((\mathbf{int})172)$

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

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

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

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

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

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

$\$heap_{init}.p1 == \mathbf{asType}<\mathbf{short\ int}>((\mathbf{int})1)$

$\$heap_{init}.p2 == \mathbf{asType}<\mathbf{short\ int}>((\mathbf{int})2)$

$\text{\$heap}_{init}.\text{p3} == \textbf{asType}\textbf{<short int>}((\textbf{int})3)$

$\text{div1} == \text{div}(\textbf{heapIs } \text{\$heap}_{funcstart\_719,1},$
$\textbf{asType}\textbf{<int>}(\text{\$heap}_{funcstart\_719,1}.\text{p1}),$
$\textbf{asType}\textbf{<int>}(\text{\$heap}_{funcstart\_719,1}.\text{a1}))$

$(\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<int>}(\text{\$heap}_{funcstart\_719,1}.\text{p1})) \text{ / }$
$\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<int>}(\text{\$heap}_{funcstart\_719,1}.\text{a1}))) ==$
$\textbf{asType}\textbf{<integer>}(\text{div1.quot})$

$(\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<int>}(\text{\$heap}_{funcstart\_719,1}.\text{p1})) \text{ \% }$
$\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<int>}(\text{\$heap}_{funcstart\_719,1}.\text{a1}))) ==$
$\textbf{asType}\textbf{<integer>}(\text{div1.rem})$

$\text{div2} == \text{div}(\textbf{heapIs } \text{\$heap}_{funcstart\_719,1},$
$\textbf{asType}\textbf{<int>}(\text{\$heap}_{funcstart\_719,1}.\text{p2}),$
$\textbf{asType}\textbf{<int>}(\text{\$heap}_{funcstart\_719,1}.\text{a2}))$

$(\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<int>}(\text{\$heap}_{funcstart\_719,1}.\text{p2})) \text{ / }$
$\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<int>}(\text{\$heap}_{funcstart\_719,1}.\text{a2}))) ==$
$\textbf{asType}\textbf{<integer>}(\text{div2.quot})$

$(\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<int>}(\text{\$heap}_{funcstart\_719,1}.\text{p2})) \text{ \% }$
$\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<int>}(\text{\$heap}_{funcstart\_719,1}.\text{a2}))) ==$
$\textbf{asType}\textbf{<integer>}(\text{div2.rem})$

$\text{div3} == \text{div}(\textbf{heapIs } \text{\$heap}_{funcstart\_719,1},$
$\textbf{asType}\textbf{<int>}(\text{\$heap}_{funcstart\_719,1}.\text{p3}),$
$\textbf{asType}\textbf{<int>}(\text{\$heap}_{funcstart\_719,1}.\text{a3}))$

$(\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<int>}(\text{\$heap}_{funcstart\_719,1}.\text{p3})) \text{ / }$
$\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<int>}(\text{\$heap}_{funcstart\_719,1}.\text{a3}))) ==$
$\textbf{asType}\textbf{<integer>}(\text{div3.quot})$

$(\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<int>}(\text{\$heap}_{funcstart\_719,1}.\text{p3})) \text{ \% }$
$\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<int>}(\text{\$heap}_{funcstart\_719,1}.\text{a3}))) ==$
$\textbf{asType}\textbf{<integer>}(\text{div3.rem})$

$\text{\$heap}_{719,1;729,8} == \text{\$heap}_{funcstart\_719,1}.\_\textbf{replace}(\text{p1} \rightarrow \textbf{asType}\textbf{<short}$
$\textbf{int>}((\textbf{asType}\textbf{<int>}(\textbf{asType}\textbf{<short int>}(\text{div1.rem})) \text{ * }$
$\textbf{asType}\textbf{<int>}(\text{\$heap}_{funcstart\_719,1}.\text{r1})) - (\textbf{asType}\textbf{<int>}(\textbf{asType}\textbf{<short}$
$\textbf{int>}(\text{div1.quot})) \text{ * } \textbf{asType}\textbf{<int>}(\text{\$heap}_{funcstart\_719,1}.\text{b1}))))$

Proof:

[Take given term]

[12.0] $\text{div2} == \text{div}(\textbf{heapIs } \text{\$heap}_{funcstart\_719,1},$
$\textbf{asType}\textbf{<int>}(\text{\$heap}_{funcstart\_719,1}.\text{p2}),$
$\textbf{asType}\textbf{<int>}(\text{\$heap}_{funcstart\_719,1}.\text{a2}))$

$\rightarrow$ *[simplify]*

[12.1] $\text{div2} == \text{div}(\textbf{heapIs } \text{\$heap}_{funcstart\_719,1}, \text{\$heap}_{funcstart\_719,1}.\text{p2},$

asType<**int**>($\text{heap}_{funcstart\_719,1}$.a2))

→ *[const static or extern object]*

[12.2] div2 == div(**heapIs** $\text{heap}_{funcstart\_719,1}$, $\text{heap}_{funcstart\_719,1}$.p2, **asType**<**int**>(heap_{init}.a2))

→ *[expand definition of constant 'a2' at prang.c (21,20)]*

[12.3] div2 == div(**heapIs** $\text{heap}_{funcstart\_719,1}$, $\text{heap}_{funcstart\_719,1}$.p2, **asType**<**int**>(**asType**<**short int**>((**int**)176)))

→ *[simplify]*

[12.6] div2 == div(**heapIs** $\text{heap}_{funcstart\_719,1}$, $\text{heap}_{funcstart\_719,1}$.p2, 176)

[Take goal term]

[1.0] **minof**(**short int**) ≤ div2.rem

→ *[simplify]*

[1.1] -32768 ≤ div2.rem

→ *[from term 12.6, div2 is equal to div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p2, 176)]*

[1.2] -32768 ≤ div(**heapIs** $\text{heap}_{funcstart\_719,1}$, $\text{heap}_{funcstart\_719,1}$.p2, 176).rem

→ *[simplify]*

[1.4] -32769 < div(**heapIs** $\text{heap}_{funcstart\_719,1}$, $\text{heap}_{funcstart\_719,1}$.p2, 176).rem

→ *[negate goal and search for contradiction]*

[1.5] !(-32769 < div(**heapIs** $\text{heap}_{funcstart\_719,1}$, $\text{heap}_{funcstart\_719,1}$.p2, 176).rem)

→ *[simplify]*

[1.7] 32768 < −div(**heapIs** $\text{heap}_{funcstart\_719,1}$, $\text{heap}_{funcstart\_719,1}$.p2, 176).rem

[Assume known post-assertion, class invariant or type constraint for term 1.7]

[31.0] **minof**(**int**) ≤ div(**heapIs** $\text{heap}_{funcstart\_719,1}$, $\text{heap}_{funcstart\_719,1}$.p2, 176).rem

→ *[simplify]*

[31.3] -32769 < div(**heapIs** $\text{heap}_{funcstart\_719,1}$, $\text{heap}_{funcstart\_719,1}$.p2, 176).rem

→ *[from term 1.7, literala < div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p2, 176).rem is false whenever -2 < (32768 + literala)]*

Proof of rule precondition:

[31.3.0] -2 < (-32769 + 32768)

$\rightarrow$ *[simplify]*

[31.3.2] **true**

[31.4] **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 (48,15)

Condition defined at:

To prove: div2.rem $\leq$ **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)

$\$heap_{init}$.M2 == **asType\<short int\>**((**int**)30307)

$\$heap_{init}$.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)

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

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

$\$heap_{init}$.b3 == **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)

div1 == div(**heapIs** $\$heap_{funcstart\_719,1}$,
asType\<int\>($\$heap_{funcstart\_719,1}$.p1),
asType\<int\>($\$heap_{funcstart\_719,1}$.a1))

(**asType\<integer\>**(**asType\<int\>**($\$heap_{funcstart\_719,1}$.p1)) /
asType\<integer\>(**asType\<int\>**($\$heap_{funcstart\_719,1}$.a1))) ==
asType\<integer\>(div1.quot)

(**asType\<integer\>**(**asType\<int\>**($\$heap_{funcstart\_719,1}$.p1)) %

asType\<integer\>(**asType\<int\>**($\text{heap}_{funcstart\_719,1}$.a1))) ==
asType\<integer\>(div1.rem)

div2 == div(**heapIs** $\text{heap}_{funcstart\_719,1}$,
asType\<int\>($\text{heap}_{funcstart\_719,1}$.p2),
asType\<int\>($\text{heap}_{funcstart\_719,1}$.a2))

(**asType\<integer\>**(**asType\<int\>**($\text{heap}_{funcstart\_719,1}$.p2)) /
asType\<integer\>(**asType\<int\>**($\text{heap}_{funcstart\_719,1}$.a2))) ==
asType\<integer\>(div2.quot)

(**asType\<integer\>**(**asType\<int\>**($\text{heap}_{funcstart\_719,1}$.p2)) %
asType\<integer\>(**asType\<int\>**($\text{heap}_{funcstart\_719,1}$.a2))) ==
asType\<integer\>(div2.rem)

div3 == div(**heapIs** $\text{heap}_{funcstart\_719,1}$,
asType\<int\>($\text{heap}_{funcstart\_719,1}$.p3),
asType\<int\>($\text{heap}_{funcstart\_719,1}$.a3))

(**asType\<integer\>**(**asType\<int\>**($\text{heap}_{funcstart\_719,1}$.p3)) /
asType\<integer\>(**asType\<int\>**($\text{heap}_{funcstart\_719,1}$.a3))) ==
asType\<integer\>(div3.quot)

(**asType\<integer\>**(**asType\<int\>**($\text{heap}_{funcstart\_719,1}$.p3)) %
asType\<integer\>(**asType\<int\>**($\text{heap}_{funcstart\_719,1}$.a3))) ==
asType\<integer\>(div3.rem)

$\text{heap}_{719,1;729,8}$ == $\text{heap}_{funcstart\_719,1}$.**replace**(p1 → **asType\<short
int\>**((**asType\<int\>**(**asType\<short int\>**(div1.rem)) *
asType\<int\>($\text{heap}_{funcstart\_719,1}$.r1)) − (**asType\<int\>**(**asType\<short
int\>**(div1.quot)) * **asType\<int\>**($\text{heap}_{funcstart\_719,1}$.b1)))))

Proof:

[Take given term]

[12.0] div2 == div(**heapIs** $\text{heap}_{funcstart\_719,1}$,
asType\<int\>($\text{heap}_{funcstart\_719,1}$.p2),
asType\<int\>($\text{heap}_{funcstart\_719,1}$.a2))

→ *[simplify]*

[12.1] div2 == div(**heapIs** $\text{heap}_{funcstart\_719,1}$, $\text{heap}_{funcstart\_719,1}$.p2,
asType\<int\>($\text{heap}_{funcstart\_719,1}$.a2))

→ *[const static or extern object]*

[12.2] div2 == div(**heapIs** $\text{heap}_{funcstart\_719,1}$, $\text{heap}_{funcstart\_719,1}$.p2,
asType\<int\>(heap_{init}.a2))

→ *[expand definition of constant 'a2' at prang.c (21,20)]*

[12.3] div2 == div(**heapIs** $\text{heap}_{funcstart\_719,1}$, $\text{heap}_{funcstart\_719,1}$.p2,
asType\<int\>(**asType\<short int\>**((**int**)176)))

$\rightarrow$ *[simplify]*

[12.6] div2 == div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176)

[Take goal term]

[1.0] div2.rem $\leq$ **maxof**(**short int**)

$\rightarrow$ *[from term 12.6, div2 is equal to div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176)]*

[1.1] div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).rem $\leq$ **maxof**(**short int**)

$\rightarrow$ *[simplify]*

[1.10] -32768 < $-$div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).rem

$\rightarrow$ *[negate goal and search for contradiction]*

[1.11] !(-32768 < $-$div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).rem)

$\rightarrow$ *[simplify]*

[1.14] 32767 < div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).rem

[Assume known post-assertion, class invariant or type constraint for term 1.14]

[31.0] div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).rem $\leq$ **maxof**(**int**)

$\rightarrow$ *[simplify]*

[31.9] -32768 < $-$div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).rem

$\rightarrow$ *[from term 1.14, literala < $-$div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).rem is false whenever -2 < (32767 + literala)]*

> **Proof of rule precondition:**
>
> *[31.9.0]* -2 < (-32768 + 32767)
>
> $\rightarrow$ *[simplify]*
>
> *[31.9.2]* **true**

[31.10] **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 (48,15)

Condition defined at:

To prove: minof(int) $\leq$ asType<short int>(div2.rem)

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)

$\$heap_{init}$.M2 == **asType<short int>**((**int**)30307)

$\$heap_{init}$.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)

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

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

$\$heap_{init}$.b3 == **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)

div1 == div(**heapIs** $\$heap_{funcstart\_719,1}$,
asType<int>($\$heap_{funcstart\_719,1}$.p1),
asType<int>($\$heap_{funcstart\_719,1}$.a1))

(**asType<integer>**(**asType<int>**($\$heap_{funcstart\_719,1}$.p1)) /
asType<integer>(**asType<int>**($\$heap_{funcstart\_719,1}$.a1))) ==
asType<integer>(div1.quot)

(**asType<integer>**(**asType<int>**($\$heap_{funcstart\_719,1}$.p1)) %
asType<integer>(**asType<int>**($\$heap_{funcstart\_719,1}$.a1))) ==
asType<integer>(div1.rem)

div2 == div(**heapIs** $\$heap_{funcstart\_719,1}$,
asType<int>($\$heap_{funcstart\_719,1}$.p2),
asType<int>($\$heap_{funcstart\_719,1}$.a2))

(**asType<integer>**(**asType<int>**($\$heap_{funcstart\_719,1}$.p2)) /
asType<integer>(**asType<int>**($\$heap_{funcstart\_719,1}$.a2))) ==
asType<integer>(div2.quot)

(**asType<integer>**(**asType<int>**($\$heap_{funcstart\_719,1}$.p2)) %
asType<integer>(**asType<int>**($\$heap_{funcstart\_719,1}$.a2))) ==
asType<integer>(div2.rem)

div3 == div(**heapIs** $\$heap_{funcstart\_719,1}$,
asType\<int\>($\$heap_{funcstart\_719,1}$.p3),
asType\<int\>($\$heap_{funcstart\_719,1}$.a3))

(**asType\<integer\>**(**asType\<int\>**($\$heap_{funcstart\_719,1}$.p3)) /
asType\<integer\>(**asType\<int\>**($\$heap_{funcstart\_719,1}$.a3))) ==
asType\<integer\>(div3.quot)

(**asType\<integer\>**(**asType\<int\>**($\$heap_{funcstart\_719,1}$.p3)) %
asType\<integer\>(**asType\<int\>**($\$heap_{funcstart\_719,1}$.a3))) ==
asType\<integer\>(div3.rem)

$\$heap_{719,1;729,8}$ == $\$heap_{funcstart\_719,1}$.**replace**(p1 → **asType\<short
int\>**((**asType\<int\>**(**asType\<short int\>**(div1.rem)) *
asType\<int\>($\$heap_{funcstart\_719,1}$.r1)) − (**asType\<int\>**(**asType\<short
int\>**(div1.quot)) * **asType\<int\>**($\$heap_{funcstart\_719,1}$.b1))))

Proof:

[Take given term]

[12.0] div2 == div(**heapIs** $\$heap_{funcstart\_719,1}$,
asType\<int\>($\$heap_{funcstart\_719,1}$.p2),
asType\<int\>($\$heap_{funcstart\_719,1}$.a2))

→ *[simplify]*

[12.1] div2 == div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2,
asType\<int\>($\$heap_{funcstart\_719,1}$.a2))

→ *[const static or extern object]*

[12.2] div2 == div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2,
asType\<int\>($\$heap_{init}$.a2))

→ *[expand definition of constant 'a2' at prang.c (21,20)]*

[12.3] div2 == div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2,
asType\<int\>(**asType\<short int\>**((**int**)176)))

→ *[simplify]*

[12.6] div2 == div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176)

[Take goal term]

[1.0] **minof**(**int**) ≤ **asType\<short int\>**(div2.rem)

→ *[simplify]*

[1.1] -32768 ≤ **asType\<short int\>**(div2.rem)

→ *[from term 12.6, div2 is equal to div(**heapIs** $\$heap_{funcstart\_719,1}$,
$\$heap_{funcstart\_719,1}$.p2, 176)]*

[1.2] -32768 ≤ **asType\<short int\>**(div(**heapIs** $\$heap_{funcstart\_719,1}$,
$\$heap_{funcstart\_719,1}$.p2, 176).rem)

→ *[simplify]*

[1.5] -32769 < div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).rem

→ *[negate goal and search for contradiction]*

[1.6] !(-32769 < div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).rem)

→ *[simplify]*

[1.8] $32768 < -$div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).rem

[Assume known post-assertion, class invariant or type constraint for term 1.8]

[31.0] **minof**(**int**) $\leq$ div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).rem

→ *[simplify]*

[31.3] -32769 < div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).rem

→ *[from term 1.8, literala < div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).rem is false whenever -2 < (32768 + literala)]*

Proof of rule precondition:

[31.3.0] -2 < (-32769 + 32768)

→ *[simplify]*

[31.3.2] **true**

[31.4] **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 (48,15)

Condition defined at:

To prove: asType<**short int**>(div2.rem) $\leq$ **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)

$\$heap_{init}$.b1 == **asType**<**short int**>((**int**)2)

$\$heap_{init}$.M2 == **asType**<**short int**>((**int**)30307)

$\text{\$heap}_{init}.\text{r2} == \textbf{asType}<\textbf{short int}>((\textbf{int})172)$

$\text{\$heap}_{init}.\text{a2} == \textbf{asType}<\textbf{short int}>((\textbf{int})176)$

$\text{\$heap}_{init}.\text{b2} == \textbf{asType}<\textbf{short int}>((\textbf{int})35)$

$\text{\$heap}_{init}.\text{M3} == \textbf{asType}<\textbf{short int}>((\textbf{int})30323)$

$\text{\$heap}_{init}.\text{r3} == \textbf{asType}<\textbf{short int}>((\textbf{int})170)$

$\text{\$heap}_{init}.\text{a3} == \textbf{asType}<\textbf{short int}>((\textbf{int})178)$

$\text{\$heap}_{init}.\text{b3} == \textbf{asType}<\textbf{short int}>((\textbf{int})63)$

$\text{\$heap}_{init}.\text{p1} == \textbf{asType}<\textbf{short int}>((\textbf{int})1)$

$\text{\$heap}_{init}.\text{p2} == \textbf{asType}<\textbf{short int}>((\textbf{int})2)$

$\text{\$heap}_{init}.\text{p3} == \textbf{asType}<\textbf{short int}>((\textbf{int})3)$

$\text{div1} == \text{div}(\textbf{heapIs } \text{\$heap}_{funcstart\_719,1},$
$\textbf{asType}<\textbf{int}>(\text{\$heap}_{funcstart\_719,1}.\text{p1}),$
$\textbf{asType}<\textbf{int}>(\text{\$heap}_{funcstart\_719,1}.\text{a1}))$

$(\textbf{asType}<\textbf{integer}>(\textbf{asType}<\textbf{int}>(\text{\$heap}_{funcstart_719,1}.\text{p1})) \; / $
$\textbf{asType}<\textbf{integer}>(\textbf{asType}<\textbf{int}>(\text{\$heap}_{funcstart\_719,1}.\text{a1}))) ==$
$\textbf{asType}<\textbf{integer}>(\text{div1.quot})$

$(\textbf{asType}<\textbf{integer}>(\textbf{asType}<\textbf{int}>(\text{\$heap}_{funcstart_719,1}.\text{p1})) \; \% $
$\textbf{asType}<\textbf{integer}>(\textbf{asType}<\textbf{int}>(\text{\$heap}_{funcstart\_719,1}.\text{a1}))) ==$
$\textbf{asType}<\textbf{integer}>(\text{div1.rem})$

$\text{div2} == \text{div}(\textbf{heapIs } \text{\$heap}_{funcstart\_719,1},$
$\textbf{asType}<\textbf{int}>(\text{\$heap}_{funcstart\_719,1}.\text{p2}),$
$\textbf{asType}<\textbf{int}>(\text{\$heap}_{funcstart\_719,1}.\text{a2}))$

$(\textbf{asType}<\textbf{integer}>(\textbf{asType}<\textbf{int}>(\text{\$heap}_{funcstart_719,1}.\text{p2})) \; / $
$\textbf{asType}<\textbf{integer}>(\textbf{asType}<\textbf{int}>(\text{\$heap}_{funcstart\_719,1}.\text{a2}))) ==$
$\textbf{asType}<\textbf{integer}>(\text{div2.quot})$

$(\textbf{asType}<\textbf{integer}>(\textbf{asType}<\textbf{int}>(\text{\$heap}_{funcstart_719,1}.\text{p2})) \; \% $
$\textbf{asType}<\textbf{integer}>(\textbf{asType}<\textbf{int}>(\text{\$heap}_{funcstart\_719,1}.\text{a2}))) ==$
$\textbf{asType}<\textbf{integer}>(\text{div2.rem})$

$\text{div3} == \text{div}(\textbf{heapIs } \text{\$heap}_{funcstart\_719,1},$
$\textbf{asType}<\textbf{int}>(\text{\$heap}_{funcstart\_719,1}.\text{p3}),$
$\textbf{asType}<\textbf{int}>(\text{\$heap}_{funcstart\_719,1}.\text{a3}))$

$(\textbf{asType}<\textbf{integer}>(\textbf{asType}<\textbf{int}>(\text{\$heap}_{funcstart_719,1}.\text{p3})) \; / $
$\textbf{asType}<\textbf{integer}>(\textbf{asType}<\textbf{int}>(\text{\$heap}_{funcstart\_719,1}.\text{a3}))) ==$
$\textbf{asType}<\textbf{integer}>(\text{div3.quot})$

$(\textbf{asType}<\textbf{integer}>(\textbf{asType}<\textbf{int}>(\text{\$heap}_{funcstart_719,1}.\text{p3})) \; \% $
$\textbf{asType}<\textbf{integer}>(\textbf{asType}<\textbf{int}>(\text{\$heap}_{funcstart\_719,1}.\text{a3}))) ==$
$\textbf{asType}<\textbf{integer}>(\text{div3.rem})$

$\text{\$heap}_{719,1;729,8} == \text{\$heap}_{funcstart\_719,1}.\_\textbf{replace}(\text{p1} \rightarrow \textbf{asType}<\textbf{short}$

int>((**asType**<**int**>(**asType**<**short int**>(div1.rem)) * **asType**<**int**>($heap$_{funcstart_719,1}$.r1)) − (**asType**<**int**>(**asType**<**short int**>(div1.quot)) * **asType**<**int**>($heap$_{funcstart\_719,1}$.b1))))

Proof:

[Take given term]

[12.0] div2 == div(**heapIs** $heap$_{funcstart_719,1}$, **asType**<**int**>($heap$_{funcstart\_719,1}$.p2), **asType**<**int**>($heap$_{funcstart_719,1}$.a2))

→ *[simplify]*

[12.1] div2 == div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p2, **asType**<**int**>($heap$_{funcstart\_719,1}$.a2))

→ *[const static or extern object]*

[12.2] div2 == div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p2, **asType**<**int**>($heap$_{init}$.a2))

→ *[expand definition of constant 'a2' at prang.c (21,20)]*

[12.3] div2 == div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p2, **asType**<**int**>(**asType**<**short int**>((**int**)176)))

→ *[simplify]*

[12.6] div2 == div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p2, 176)

[Take goal term]

[1.0] **asType**<**short int**>(div2.rem) ≤ **maxof**(**int**)

→ *[from term 12.6, div2 is equal to div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p2, 176)]*

[1.1] **asType**<**short int**>(div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p2, 176).rem) ≤ **maxof**(**int**)

→ *[simplify]*

[1.11] -32768 < −div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p2, 176).rem

→ *[negate goal and search for contradiction]*

[1.12] !(-32768 < −div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p2, 176).rem)

→ *[simplify]*

[1.15] 32767 < div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p2, 176).rem

[Assume known post-assertion, class invariant or type constraint for term 1.15]

[31.0] div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p2, 176).rem ≤

maxof(int)

$\rightarrow$ *[simplify]*

[31.9] -32768 < $-$div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).rem

$\rightarrow$ *[from term 1.15, literala < $-$div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).rem is false whenever -2 < (32767 + literala)]*

    Proof of rule precondition:

    [31.9.0] -2 < (-32768 + 32767)

    $\rightarrow$ *[simplify]*

    [31.9.2] **true**

[31.10] **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 (48,10)

Condition defined at:

To prove: minof(int) $\leq$ $\$heap_{719,1;729,8}$.r2

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)

$\$heap_{init}$.M2 == **asType**<**short int**>((**int**)30307)

$\$heap_{init}$.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)

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

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

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

$\$heap_{init}$.p1 == **asType**<**short int**>((**int**)1)

$\$heap_{init}$.p2 == **asType**<**short int**>((**int**)2)

$\$\text{heap}_{init}.\text{p3} == \textbf{asType}\textbf{<short int>}((\textbf{int})3)$

$\text{div1} == \text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_719,1},$
$\textbf{asType}\textbf{<int>}(\$\text{heap}_{funcstart\_719,1}.\text{p1}),$
$\textbf{asType}\textbf{<int>}(\$\text{heap}_{funcstart\_719,1}.\text{a1}))$

$(\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<int>}(\$\text{heap}_{funcstart\_719,1}.\text{p1})) \,/$
$\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<int>}(\$\text{heap}_{funcstart\_719,1}.\text{a1}))) ==$
$\textbf{asType}\textbf{<integer>}(\text{div1.quot})$

$(\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<int>}(\$\text{heap}_{funcstart\_719,1}.\text{p1})) \,\%$
$\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<int>}(\$\text{heap}_{funcstart\_719,1}.\text{a1}))) ==$
$\textbf{asType}\textbf{<integer>}(\text{div1.rem})$

$\text{div2} == \text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_719,1},$
$\textbf{asType}\textbf{<int>}(\$\text{heap}_{funcstart\_719,1}.\text{p2}),$
$\textbf{asType}\textbf{<int>}(\$\text{heap}_{funcstart\_719,1}.\text{a2}))$

$(\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<int>}(\$\text{heap}_{funcstart\_719,1}.\text{p2})) \,/$
$\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<int>}(\$\text{heap}_{funcstart\_719,1}.\text{a2}))) ==$
$\textbf{asType}\textbf{<integer>}(\text{div2.quot})$

$(\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<int>}(\$\text{heap}_{funcstart\_719,1}.\text{p2})) \,\%$
$\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<int>}(\$\text{heap}_{funcstart\_719,1}.\text{a2}))) ==$
$\textbf{asType}\textbf{<integer>}(\text{div2.rem})$

$\text{div3} == \text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_719,1},$
$\textbf{asType}\textbf{<int>}(\$\text{heap}_{funcstart\_719,1}.\text{p3}),$
$\textbf{asType}\textbf{<int>}(\$\text{heap}_{funcstart\_719,1}.\text{a3}))$

$(\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<int>}(\$\text{heap}_{funcstart\_719,1}.\text{p3})) \,/$
$\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<int>}(\$\text{heap}_{funcstart\_719,1}.\text{a3}))) ==$
$\textbf{asType}\textbf{<integer>}(\text{div3.quot})$

$(\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<int>}(\$\text{heap}_{funcstart\_719,1}.\text{p3})) \,\%$
$\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<int>}(\$\text{heap}_{funcstart\_719,1}.\text{a3}))) ==$
$\textbf{asType}\textbf{<integer>}(\text{div3.rem})$

$\$\text{heap}_{719,1;729,8} == \$\text{heap}_{funcstart\_719,1}.\_\textbf{replace}(\text{p1} \rightarrow \textbf{asType}\textbf{<short}$
$\textbf{int>}((\textbf{asType}\textbf{<int>}(\textbf{asType}\textbf{<short int>}(\text{div1.rem})) \,*$
$\textbf{asType}\textbf{<int>}(\$\text{heap}_{funcstart\_719,1}.\text{r1})) - (\textbf{asType}\textbf{<int>}(\textbf{asType}\textbf{<short}$
$\textbf{int>}(\text{div1.quot})) \,* \textbf{asType}\textbf{<int>}(\$\text{heap}_{funcstart\_719,1}.\text{b1}))))$

Proof:

[Take given term]

[5.0] $\text{div1} == \text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_719,1},$
$\textbf{asType}\textbf{<int>}(\$\text{heap}_{funcstart\_719,1}.\text{p1}),$
$\textbf{asType}\textbf{<int>}(\$\text{heap}_{funcstart\_719,1}.\text{a1}))$

$\rightarrow$ *[simplify]*

[5.1] $\text{div1} == \text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_719,1}, \$\text{heap}_{funcstart\_719,1}.\text{p1},$

asType<int>($heap$_{funcstart_719,1}$.a1))

$\rightarrow$ *[const static or extern object]*

[5.2] div1 == div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1,
asType<int>($heap$_{init}$.a1))

$\rightarrow$ *[expand definition of constant 'a1' at prang.c (16,20)]*

[5.3] div1 == div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1,
asType<int>(**asType<short int>**((**int**)177)))

$\rightarrow$ *[simplify]*

[5.6] div1 == div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1, 177)

[Take given term]

[26.0] $heap$_{719,1;729,8}$ == $heap$_{funcstart_719,1}$._**replace**(p1 $\rightarrow$ **asType<short int>**((**asType<int>**(**asType<short int>**(div1.rem)) *
asType<int>($heap$_{funcstart_719,1}$.r1)) $-$ (**asType<int>**(**asType<short int>**(div1.quot)) * **asType<int>**($heap$_{funcstart_719,1}$.b1))))

$\rightarrow$ *[from term 5.6, div1 is equal to div(**heapIs** $heap$_{funcstart,719,1}$,
$heap$_{funcstart_719,1}$.p1, 177)]*

[26.1] $heap$_{719,1;729,8}$ == $heap$_{funcstart_719,1}$._**replace**(p1 $\rightarrow$ **asType<short int>**((**asType<int>**(**asType<short int>**(div(**heapIs** $heap$_{funcstart_719,1}$,
$heap$_{funcstart_719,1}$.p1, 177).rem)) * **asType<int>**($heap$_{funcstart\_719,1}$.r1)) $-$
(**asType<int>**(**asType<short int>**(div1.quot)) *
asType<int>($heap$_{funcstart_719,1}$.b1))))

$\rightarrow$ *[simplify]*

[26.3] $heap$_{719,1;729,8}$ == $heap$_{funcstart_719,1}$._**replace**(p1 $\rightarrow$ **asType<short int>**((div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1, 177).rem *
asType<int>($heap$_{funcstart_719,1}$.r1)) $-$ (**asType<int>**(**asType<short int>**(div1.quot)) * **asType<int>**($heap$_{funcstart_719,1}$.b1))))

$\rightarrow$ *[const static or extern object]*

[26.4] $heap$_{719,1;729,8}$ == $heap$_{funcstart_719,1}$._**replace**(p1 $\rightarrow$ **asType<short int>**((div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1, 177).rem *
asType<int>($heap$_{init}$.r1)) $-$ (**asType<int>**(**asType<short int>**(div1.quot)) * **asType<int>**($heap$_{funcstart_719,1}$.b1))))

$\rightarrow$ *[expand definition of constant 'r1' at prang.c (15,20)]*

[26.5] $heap$_{719,1;729,8}$ == $heap$_{funcstart_719,1}$._**replace**(p1 $\rightarrow$ **asType<short int>**((div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1, 177).rem *
asType<int>(**asType<short int>**((**int**)171))) $-$
(**asType<int>**(**asType<short int>**(div1.quot)) *
asType<int>($heap$_{funcstart_719,1}$.b1))))

$\rightarrow$ *[simplify]*

[26.8] $\$heap_{719,1;729,8}$ == $\$heap_{funcstart\_719,1}$.**replace**(p1 → **asType<short int>**((div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).rem * 171) − (**asType<int>**(**asType<short int>**(div1.quot)) * **asType<int>**($\$heap_{funcstart\_719,1}$.b1))))

→ *[from term 5.6, div1 is equal to div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177)]*

[26.9] $\$heap_{719,1;729,8}$ == $\$heap_{funcstart\_719,1}$.**replace**(p1 → **asType<short int>**((171 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).rem) − (**asType<int>**(**asType<short int>**(div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot)) * **asType<int>**($\$heap_{funcstart\_719,1}$.b1))))

→ *[simplify]*

[26.11] $\$heap_{719,1;729,8}$ == $\$heap_{funcstart\_719,1}$.**replace**(p1 → **asType<short int>**((171 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).rem) − (div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot * **asType<int>**($\$heap_{funcstart\_719,1}$.b1))))

→ *[const static or extern object]*

[26.12] $\$heap_{719,1;729,8}$ == $\$heap_{funcstart\_719,1}$.**replace**(p1 → **asType<short int>**((171 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).rem) − (div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot * **asType<int>**($\$heap_{init}$.b1))))

→ *[expand definition of constant 'b1' at prang.c (17,20)]*

[26.13] $\$heap_{719,1;729,8}$ == $\$heap_{funcstart\_719,1}$.**replace**(p1 → **asType<short int>**((171 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).rem) − (div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot * **asType<int>**(**asType<short int>**((**int**)2)))))

→ *[simplify]*

[26.19] $\$heap_{719,1;729,8}$ == $\$heap_{funcstart\_719,1}$.**replace**(p1 → ((-2 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).rem)))

[Take goal term]

[1.0] **minof(int)** ≤ $\$heap_{719,1;729,8}$.r2

→ *[simplify]*

[1.1] -32768 ≤ $\$heap_{719,1;729,8}$.r2

→ *[from term 26.19, $\$heap_{719,1;729,8}$ is equal to $\$heap_{funcstart\_719,1}$.**replace**(p1 → (-2 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).rem))]*

[1.2] -32768 ≤ $\$heap_{funcstart\_719,1}$.**replace**(p1 → ((-2 * div(**heapIs**

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$\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}$.p1, 177).rem))).r2

$\rightarrow$ *[const member of object with modified fields]*

[1.3] -32768 $\leq \$\text{heap}_{funcstart\_719,1}$.r2

$\rightarrow$ *[const static or extern object]*

[1.4] -32768 $\leq \$\text{heap}_{init}$.r2

$\rightarrow$ *[expand definition of constant 'r2' at prang.c (20,20)]*

[1.5] -32768 $\leq$ **asType<short int>**(**(int)**172)

$\rightarrow$ *[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 (48,10)

Condition defined at:

To prove: $\$\text{heap}_{719,1;729,8}$.r2 $\leq$ **maxof(int)**

Given:

$\$\text{heap}_{init}$.LIMIT == **(int)**80

$\$\text{heap}_{init}$.M1 == **asType<short int>**(**(int)**30269)

$\$\text{heap}_{init}$.r1 == **asType<short int>**(**(int)**171)

$\$\text{heap}_{init}$.a1 == **asType<short int>**(**(int)**177)

$\$\text{heap}_{init}$.b1 == **asType<short int>**(**(int)**2)

$\$\text{heap}_{init}$.M2 == **asType<short int>**(**(int)**30307)

$\$\text{heap}_{init}$.r2 == **asType<short int>**(**(int)**172)

$\$\text{heap}_{init}$.a2 == **asType<short int>**(**(int)**176)

$\$\text{heap}_{init}$.b2 == **asType<short int>**(**(int)**35)

$\$\text{heap}_{init}$.M3 == **asType<short int>**(**(int)**30323)

$\$\text{heap}_{init}$.r3 == **asType<short int>**(**(int)**170)

$\$\text{heap}_{init}$.a3 == **asType<short int>**(**(int)**178)

$\$\text{heap}_{init}$.b3 == **asType<short int>**(**(int)**63)

$\$\text{heap}_{init}$.p1 == **asType<short int>**(**(int)**1)

$\$\text{heap}_{init}$.p2 == **asType<short int>**(**(int)**2)

$\$\text{heap}_{init}$.p3 == **asType<short int>**(**(int)**3)

div1 == div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$,
asType\<int\>($\$\text{heap}_{funcstart\_719,1}$.p1),
asType\<int\>($\$\text{heap}_{funcstart\_719,1}$.a1))

(**asType\<integer\>**(**asType\<int\>**($\$\text{heap}_{funcstart\_719,1}$.p1)) /
asType\<integer\>(**asType\<int\>**($\$\text{heap}_{funcstart\_719,1}$.a1))) ==
asType\<integer\>(div1.quot)

(**asType\<integer\>**(**asType\<int\>**($\$\text{heap}_{funcstart\_719,1}$.p1)) %
asType\<integer\>(**asType\<int\>**($\$\text{heap}_{funcstart\_719,1}$.a1))) ==
asType\<integer\>(div1.rem)

div2 == div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$,
asType\<int\>($\$\text{heap}_{funcstart\_719,1}$.p2),
asType\<int\>($\$\text{heap}_{funcstart\_719,1}$.a2))

(**asType\<integer\>**(**asType\<int\>**($\$\text{heap}_{funcstart\_719,1}$.p2)) /
asType\<integer\>(**asType\<int\>**($\$\text{heap}_{funcstart\_719,1}$.a2))) ==
asType\<integer\>(div2.quot)

(**asType\<integer\>**(**asType\<int\>**($\$\text{heap}_{funcstart\_719,1}$.p2)) %
asType\<integer\>(**asType\<int\>**($\$\text{heap}_{funcstart\_719,1}$.a2))) ==
asType\<integer\>(div2.rem)

div3 == div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$,
asType\<int\>($\$\text{heap}_{funcstart\_719,1}$.p3),
asType\<int\>($\$\text{heap}_{funcstart\_719,1}$.a3))

(**asType\<integer\>**(**asType\<int\>**($\$\text{heap}_{funcstart\_719,1}$.p3)) /
asType\<integer\>(**asType\<int\>**($\$\text{heap}_{funcstart\_719,1}$.a3))) ==
asType\<integer\>(div3.quot)

(**asType\<integer\>**(**asType\<int\>**($\$\text{heap}_{funcstart\_719,1}$.p3)) %
asType\<integer\>(**asType\<int\>**($\$\text{heap}_{funcstart\_719,1}$.a3))) ==
asType\<integer\>(div3.rem)

$\$\text{heap}_{719,1;729,8}$ == $\$\text{heap}_{funcstart\_719,1}$.**replace**(p1 → **asType\<short
int\>**((**asType\<int\>**(**asType\<short int\>**(div1.rem)) *
asType\<int\>($\$\text{heap}_{funcstart\_719,1}$.r1)) − (**asType\<int\>**(**asType\<short
int\>**(div1.quot)) * **asType\<int\>**($\$\text{heap}_{funcstart\_719,1}$.b1)))))

Proof:

[Take given term]

[5.0] div1 == div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$,
asType\<int\>($\$\text{heap}_{funcstart\_719,1}$.p1),
asType\<int\>($\$\text{heap}_{funcstart\_719,1}$.a1))

→ *[simplify]*

[5.1] div1 == div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}$.p1,
asType\<int\>($\$\text{heap}_{funcstart\_719,1}$.a1))

$\rightarrow$ *[const static or extern object]*

[5.2] div1 == div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, **asType\<int\>**($\$heap_{init}$.a1))

$\rightarrow$ *[expand definition of constant 'a1' at prang.c (16,20)]*

[5.3] div1 == div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, **asType\<int\>**(**asType\<short int\>**((**int**)177)))

$\rightarrow$ *[simplify]*

[5.6] div1 == div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177)

[Take given term]

[26.0] $\$heap_{719,1;729,8}$ == $\$heap_{funcstart\_719,1}$.**replace**(p1 $\rightarrow$ **asType\<short int\>**((**asType\<int\>**(**asType\<short int\>**(div1.rem)) * **asType\<int\>**($\$heap_{funcstart\_719,1}$.r1)) $-$ (**asType\<int\>**(**asType\<short int\>**(div1.quot)) * **asType\<int\>**($\$heap_{funcstart\_719,1}$.b1)))))

$\rightarrow$ *[from term 5.6, div1 is equal to div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177)]*

[26.1] $\$heap_{719,1;729,8}$ == $\$heap_{funcstart\_719,1}$.**replace**(p1 $\rightarrow$ **asType\<short int\>**((**asType\<int\>**(**asType\<short int\>**(div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).rem)) * **asType\<int\>**($\$heap_{funcstart\_719,1}$.r1)) $-$ (**asType\<int\>**(**asType\<short int\>**(div1.quot)) * **asType\<int\>**($\$heap_{funcstart\_719,1}$.b1)))))

$\rightarrow$ *[simplify]*

[26.3] $\$heap_{719,1;729,8}$ == $\$heap_{funcstart\_719,1}$.**replace**(p1 $\rightarrow$ **asType\<short int\>**((div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).rem * **asType\<int\>**($\$heap_{funcstart\_719,1}$.r1)) $-$ (**asType\<int\>**(**asType\<short int\>**(div1.quot)) * **asType\<int\>**($\$heap_{funcstart\_719,1}$.b1)))))

$\rightarrow$ *[const static or extern object]*

[26.4] $\$heap_{719,1;729,8}$ == $\$heap_{funcstart\_719,1}$.**replace**(p1 $\rightarrow$ **asType\<short int\>**((div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).rem * **asType\<int\>**($\$heap_{init}$.r1)) $-$ (**asType\<int\>**(**asType\<short int\>**(div1.quot)) * **asType\<int\>**($\$heap_{funcstart\_719,1}$.b1)))))

$\rightarrow$ *[expand definition of constant 'r1' at prang.c (15,20)]*

[26.5] $\$heap_{719,1;729,8}$ == $\$heap_{funcstart\_719,1}$.**replace**(p1 $\rightarrow$ **asType\<short int\>**((div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).rem * **asType\<int\>**(**asType\<short int\>**((**int**)171))) $-$ (**asType\<int\>**(**asType\<short int\>**(div1.quot)) * **asType\<int\>**($\$heap_{funcstart\_719,1}$.b1)))))

$\rightarrow$ *[simplify]*

[26.8] $\$heap_{719,1;729,8}$ == $\$heap_{funcstart\_719,1}$.**replace**(p1 $\rightarrow$ **asType\<short**

int>((div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}$.p1, 177).rem * 171)
− (**asType**<**int**>(**asType**<**short int**>(div1.quot)) *
asType<**int**>($\$\text{heap}_{funcstart\_719,1}$.b1))))

→ *[from term 5.6, div1 is equal to div(**heapIs** $heap_{funcstart\_719,1}$,*
$heap_{funcstart\_719,1}$.p1, 177)]

[26.9] $\$\text{heap}_{719,1;729,8}$ == $\$\text{heap}_{funcstart\_719,1}$.**replace**(p1 → **asType**<**short
int**>((171 * div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}$.p1, 177).rem)
− (**asType**<**int**>(**asType**<**short int**>(div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$,
$\$\text{heap}_{funcstart\_719,1}$.p1, 177).quot)) *
asType<**int**>($\$\text{heap}_{funcstart\_719,1}$.b1))))

→ *[simplify]*

[26.11] $\$\text{heap}_{719,1;729,8}$ == $\$\text{heap}_{funcstart\_719,1}$.**replace**(p1 → **asType**<**short
int**>((171 * div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}$.p1, 177).rem)
− (div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}$.p1, 177).quot *
asType<**int**>($\$\text{heap}_{funcstart\_719,1}$.b1))))

→ *[const static or extern object]*

[26.12] $\$\text{heap}_{719,1;729,8}$ == $\$\text{heap}_{funcstart\_719,1}$.**replace**(p1 → **asType**<**short
int**>((171 * div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}$.p1, 177).rem)
− (div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}$.p1, 177).quot *
asType<**int**>($\$\text{heap}_{init}$.b1))))

→ *[expand definition of constant 'b1' at prang.c (17,20)]*

[26.13] $\$\text{heap}_{719,1;729,8}$ == $\$\text{heap}_{funcstart\_719,1}$.**replace**(p1 → **asType**<**short
int**>((171 * div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}$.p1, 177).rem)
− (div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}$.p1, 177).quot *
asType<**int**>(**asType**<**short int**>((**int**)2)))))

→ *[simplify]*

[26.19] $\$\text{heap}_{719,1;729,8}$ == $\$\text{heap}_{funcstart\_719,1}$.**replace**(p1 → ((-2 *
div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}$.p1, 177).rem)))

[Take goal term]

[1.0] $\$\text{heap}_{719,1;729,8}$.r2 ≤ **maxof**(**int**)

→ *[from term 26.19, $heap_{719,1;729,8}$ is equal to*
*$heap_{funcstart\_719,1}$.**replace**(p1 → (-2 * div(**heapIs** $heap_{funcstart\_719,1}$,*
*$heap_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs** $heap_{funcstart\_719,1}$,*
$heap_{funcstart\_719,1}$.p1, 177).rem))]

[1.1] $\$\text{heap}_{funcstart\_719,1}$.**replace**(p1 → ((-2 * div(**heapIs**
$\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs**
$\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}$.p1, 177).rem))).r2 ≤ **maxof**(**int**)

→ *[const member of object with modified fields]*

[1.2] $heap_{funcstart\_719,1}.r2 \leq$ **maxof(int)**

$\rightarrow$ *[const static or extern object]*

[1.3] $heap_{init}.r2 \leq$ **maxof(int)**

$\rightarrow$ *[expand definition of constant 'r2' at prang.c (20,20)]*

[1.4] **asType<short int>((int)172)** $\leq$ **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 (48,13)

Condition defined at:

To prove: minof(int) $\leq$ **(asType<int>(asType<short int>(div2.rem)) * asType<int>($heap$_{719,1;729,8}$.r2))**

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)

$heap_{init}$.M2 == **asType<short int>((int)**30307)

$heap_{init}$.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)

$heap_{init}$.r3 == **asType<short int>((int)**170)

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

$heap_{init}$.b3 == **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)

div1 == div(**heapIs** $heap_{funcstart\_719,1}$, **asType<int>**($heap_{funcstart\_719,1}$.p1), **asType<int>**($heap_{funcstart\_719,1}$.a1))

(**asType\<integer\>**(**asType\<int\>**($\text{heap}_{funcstart\_719,1}$.p1)) /
asType\<integer\>(**asType\<int\>**($\text{heap}_{funcstart\_719,1}$.a1))) ==
asType\<integer\>(div1.quot)

(**asType\<integer\>**(**asType\<int\>**($\text{heap}_{funcstart\_719,1}$.p1)) %
asType\<integer\>(**asType\<int\>**($\text{heap}_{funcstart\_719,1}$.a1))) ==
asType\<integer\>(div1.rem)

div2 == div(**heapIs** $\text{heap}_{funcstart\_719,1}$,
asType\<int\>($\text{heap}_{funcstart\_719,1}$.p2),
asType\<int\>($\text{heap}_{funcstart\_719,1}$.a2))

(**asType\<integer\>**(**asType\<int\>**($\text{heap}_{funcstart\_719,1}$.p2)) /
asType\<integer\>(**asType\<int\>**($\text{heap}_{funcstart\_719,1}$.a2))) ==
asType\<integer\>(div2.quot)

(**asType\<integer\>**(**asType\<int\>**($\text{heap}_{funcstart\_719,1}$.p2)) %
asType\<integer\>(**asType\<int\>**($\text{heap}_{funcstart\_719,1}$.a2))) ==
asType\<integer\>(div2.rem)

div3 == div(**heapIs** $\text{heap}_{funcstart\_719,1}$,
asType\<int\>($\text{heap}_{funcstart\_719,1}$.p3),
asType\<int\>($\text{heap}_{funcstart\_719,1}$.a3))

(**asType\<integer\>**(**asType\<int\>**($\text{heap}_{funcstart\_719,1}$.p3)) /
asType\<integer\>(**asType\<int\>**($\text{heap}_{funcstart\_719,1}$.a3))) ==
asType\<integer\>(div3.quot)

(**asType\<integer\>**(**asType\<int\>**($\text{heap}_{funcstart\_719,1}$.p3)) %
asType\<integer\>(**asType\<int\>**($\text{heap}_{funcstart\_719,1}$.a3))) ==
asType\<integer\>(div3.rem)

$\text{heap}_{719,1;729,8}$ == $\text{heap}_{funcstart\_719,1}$._**replace**(p1 → **asType\<short
int\>**((**asType\<int\>**(**asType\<short int\>**(div1.rem)) *
asType\<int\>($\text{heap}_{funcstart\_719,1}$.r1)) − (**asType\<int\>**(**asType\<short
int\>**(div1.quot)) * **asType\<int\>**($\text{heap}_{funcstart\_719,1}$.b1))))

Proof:

[Take given term]

[5.0] div1 == div(**heapIs** $\text{heap}_{funcstart\_719,1}$,
asType\<int\>($\text{heap}_{funcstart\_719,1}$.p1),
asType\<int\>($\text{heap}_{funcstart\_719,1}$.a1))

→ *[simplify]*

[5.1] div1 == div(**heapIs** $\text{heap}_{funcstart\_719,1}$, $\text{heap}_{funcstart\_719,1}$.p1,
asType\<int\>($\text{heap}_{funcstart\_719,1}$.a1))

→ *[const static or extern object]*

[5.2] div1 == div(**heapIs** $\text{heap}_{funcstart\_719,1}$, $\text{heap}_{funcstart\_719,1}$.p1,
asType\<int\>(heap_{init}.a1))

$\rightarrow$ *[expand definition of constant 'a1' at prang.c (16,20)]*

[5.3] div1 == div(**heapIs** \$heap$_{funcstart\_719,1}$, \$heap$_{funcstart\_719,1}$.p1,
asType<**int**>(**asType**<**short int**>((**int**)177)))

$\rightarrow$ *[simplify]*

[5.6] div1 == div(**heapIs** \$heap$_{funcstart\_719,1}$, \$heap$_{funcstart\_719,1}$.p1, 177)

[Take given term]

[12.0] div2 == div(**heapIs** \$heap$_{funcstart\_719,1}$,
asType<**int**>(\$heap$_{funcstart\_719,1}$.p2),
asType<**int**>(\$heap$_{funcstart\_719,1}$.a2))

$\rightarrow$ *[simplify]*

[12.1] div2 == div(**heapIs** \$heap$_{funcstart\_719,1}$, \$heap$_{funcstart\_719,1}$.p2,
asType<**int**>(\$heap$_{funcstart\_719,1}$.a2))

$\rightarrow$ *[const static or extern object]*

[12.2] div2 == div(**heapIs** \$heap$_{funcstart\_719,1}$, \$heap$_{funcstart\_719,1}$.p2,
asType<**int**>(\$heap$_{init}$.a2))

$\rightarrow$ *[expand definition of constant 'a2' at prang.c (21,20)]*

[12.3] div2 == div(**heapIs** \$heap$_{funcstart\_719,1}$, \$heap$_{funcstart\_719,1}$.p2,
asType<**int**>(**asType**<**short int**>((**int**)176)))

$\rightarrow$ *[simplify]*

[12.6] div2 == div(**heapIs** \$heap$_{funcstart\_719,1}$, \$heap$_{funcstart\_719,1}$.p2, 176)

[Take given term]

[26.0] \$heap$_{719,1;729,8}$ == \$heap$_{funcstart\_719,1}$.**replace**(p1 $\rightarrow$ **asType**<**short
int**>((**asType**<**int**>(**asType**<**short int**>(div1.rem)) *
asType<**int**>(\$heap$_{funcstart\_719,1}$.r1)) $-$ (**asType**<**int**>(**asType**<**short
int**>(div1.quot)) * **asType**<**int**>(\$heap$_{funcstart\_719,1}$.b1)))))

$\rightarrow$ *[from term 5.6, div1 is equal to div(**heapIs** \$heap$_{funcstart\_719,1}$,
\$heap$_{funcstart\_719,1}$.p1, 177)]*

[26.1] \$heap$_{719,1;729,8}$ == \$heap$_{funcstart\_719,1}$.**replace**(p1 $\rightarrow$ **asType**<**short
int**>((**asType**<**int**>(**asType**<**short int**>(div(**heapIs** \$heap$_{funcstart\_719,1}$,
\$heap$_{funcstart\_719,1}$.p1, 177).rem)) * **asType**<**int**>(\$heap$_{funcstart\_719,1}$.r1)) $-$
(**asType**<**int**>(**asType**<**short int**>(div1.quot)) *
asType<**int**>(\$heap$_{funcstart\_719,1}$.b1)))))

$\rightarrow$ *[simplify]*

[26.3] \$heap$_{719,1;729,8}$ == \$heap$_{funcstart\_719,1}$.**replace**(p1 $\rightarrow$ **asType**<**short
int**>((div(**heapIs** \$heap$_{funcstart\_719,1}$, \$heap$_{funcstart\_719,1}$.p1, 177).rem *
asType<**int**>(\$heap$_{funcstart\_719,1}$.r1)) $-$ (**asType**<**int**>(**asType**<**short
int**>(div1.quot)) * **asType**<**int**>(\$heap$_{funcstart\_719,1}$.b1)))))

$\rightarrow$ *[const static or extern object]*

[26.4] $\$heap_{719,1;729,8} ==$ $\$heap_{funcstart\_719,1}.\_$**replace**(p1 $\rightarrow$ **asType**<**short int**>((div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).rem * **asType**<**int**>($\$heap_{init}$.r1)) $-$ (**asType**<**int**>(**asType**<**short int**>(div1.quot)) * **asType**<**int**>($\$heap_{funcstart\_719,1}$.b1)))))

$\rightarrow$ *[expand definition of constant 'r1' at prang.c (15,20)]*

[26.5] $\$heap_{719,1;729,8} ==$ $\$heap_{funcstart\_719,1}.\_$**replace**(p1 $\rightarrow$ **asType**<**short int**>((div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).rem * **asType**<**int**>(**asType**<**short int**>((**int**)171))) $-$ (**asType**<**int**>(**asType**<**short int**>(div1.quot)) * **asType**<**int**>($\$heap_{funcstart\_719,1}$.b1)))))

$\rightarrow$ *[simplify]*

[26.8] $\$heap_{719,1;729,8} ==$ $\$heap_{funcstart\_719,1}.\_$**replace**(p1 $\rightarrow$ **asType**<**short int**>((div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).rem * 171) $-$ (**asType**<**int**>(**asType**<**short int**>(div1.quot)) * **asType**<**int**>($\$heap_{funcstart\_719,1}$.b1)))))

$\rightarrow$ *[from term 5.6, div1 is equal to div(heapIs $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177)]*

[26.9] $\$heap_{719,1;729,8} ==$ $\$heap_{funcstart\_719,1}.\_$**replace**(p1 $\rightarrow$ **asType**<**short int**>((171 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).rem) $-$ (**asType**<**int**>(**asType**<**short int**>(div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot)) * **asType**<**int**>($\$heap_{funcstart\_719,1}$.b1)))))

$\rightarrow$ *[simplify]*

[26.11] $\$heap_{719,1;729,8} ==$ $\$heap_{funcstart\_719,1}.\_$**replace**(p1 $\rightarrow$ **asType**<**short int**>((171 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).rem) $-$ (div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot * **asType**<**int**>($\$heap_{funcstart\_719,1}$.b1)))))

$\rightarrow$ *[const static or extern object]*

[26.12] $\$heap_{719,1;729,8} ==$ $\$heap_{funcstart\_719,1}.\_$**replace**(p1 $\rightarrow$ **asType**<**short int**>((171 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).rem) $-$ (div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot * **asType**<**int**>($\$heap_{init}$.b1)))))

$\rightarrow$ *[expand definition of constant 'b1' at prang.c (17,20)]*

[26.13] $\$heap_{719,1;729,8} ==$ $\$heap_{funcstart\_719,1}.\_$**replace**(p1 $\rightarrow$ **asType**<**short int**>((171 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).rem) $-$ (div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot * **asType**<**int**>(**asType**<**short int**>((**int**)2))))))

$\rightarrow$ *[simplify]*

[26.19] $\text{\$heap}_{719,1;729,8}$ == $\text{\$heap}_{funcstart\_719,1}.$**replace**(p1 → ((-2 *
div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}.$p1, 177).quot) + (171 *
div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}.$p1, 177).rem)))

[Take goal term]

[1.0] **minof(int)** ≤ (**asType<int>**(**asType<short int>**(div2.rem)) *
asType<int>($\text{\$heap}_{719,1;729,8}.$r2))

→ *[simplify]*

[1.1] -32768 ≤ (**asType<int>**(**asType<short int>**(div2.rem)) *
asType<int>($\text{\$heap}_{719,1;729,8}.$r2))

→ *[from term 12.6, div2 is equal to div(**heapIs** $heap_{funcstart\_719,1}$,
$heap_{funcstart_719,1}.p2, 176)]*

[1.2] -32768 ≤ (**asType<int>**(**asType<short int>**(div(**heapIs**
$\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}.$p2, 176).rem)) *
asType<int>($\text{\$heap}_{719,1;729,8}.$r2))

→ *[simplify]*

[1.4] -32768 ≤ (div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}.$p2,
176).rem * **asType<int>**($\text{\$heap}_{719,1;729,8}.$r2))

→ *[from term 26.19, $heap_{719,1;729,8}$ is equal to
$heap_{funcstart\_719,1}.$**replace**(p1 → (-2 * div(**heapIs** $heap_{funcstart\_719,1}$,
$heap_{funcstart_719,1}.p1, 177).quot) + (171 * div(**heapIs** $heap_{funcstart\_719,1}$,
$heap_{funcstart_719,1}.p1, 177).rem))]*

[1.5] -32768 ≤ (div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}.$p2,
176).rem * **asType<int>**($\text{\$heap}_{funcstart\_719,1}.$**replace**(p1 → ((-2 *
div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}.$p1, 177).quot) + (171 *
div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}.$p1, 177).rem))).r2))

→ *[const member of object with modified fields]*

[1.6] -32768 ≤ (div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}.$p2,
176).rem * **asType<int>**($\text{\$heap}_{funcstart\_719,1}.$r2))

→ *[const static or extern object]*

[1.7] -32768 ≤ (div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}.$p2,
176).rem * **asType<int>**($\text{\$heap}_{init}.$r2))

→ *[expand definition of constant 'r2' at prang.c (20,20)]*

[1.8] -32768 ≤ (div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}.$p2,
176).rem * **asType<int>**(**asType<short int>**((**int**)172)))

→ *[simplify]*

[1.13] -32769 < (172 * div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}.$p2,
176).rem)

→ *[literal comparison of product]*

[1.14] ([172 < 0]: (-32769 / -172) < −div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p2, 176).rem, [0 < 172]: (-32769 / 172) < div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p2, 176).rem, [0 == 172]: -32769 < 0)

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

[1.15] ([172 < 0]: (-32769 / -172) < −div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p2, 176).rem, [(0 < 172) ∧ !(172 < 0)]: (-32769 / 172) < div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p2, 176).rem, [(0 == 172) ∧ !(0 < 172) ∧ !(172 < 0)]: -32769 < 0)

→ *[simplify]*

[1.23] -191 < div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p2, 176).rem

→ *[negate goal and search for contradiction]*

[1.24] !(-191 < div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p2, 176).rem)

→ *[simplify]*

[1.26] 190 < −div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p2, 176).rem

[Assume known post-assertion, class invariant or type constraint for term 12.6]

[18.0] (**asType**<**integer**>($heap_{funcstart\_719,1}$.p2) % **asType**<**integer**>(176)) == **asType**<**integer**>(div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p2, 176).rem)

→ *[simplify]*

[18.2] ($heap_{funcstart\_719,1}$.p2 % 176) == **asType**<**integer**>(div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p2, 176).rem)

→ *[expand definition of operator '.%' in class 'int' at built in declaration]*

[18.3] ([**asType**<**integer**>($heap_{funcstart\_719,1}$.p2) < 0]: −(−**asType**<**integer**>($heap_{funcstart\_719,1}$.p2) % 176), []: **asType**<**integer**>($heap_{funcstart\_719,1}$.p2) % 176) == **asType**<**integer**>(div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p2, 176).rem)

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

[18.4] ([**asType**<**integer**>($heap_{funcstart\_719,1}$.p2) < 0]: −(−**asType**<**integer**>($heap_{funcstart\_719,1}$.p2) % 176), [!(**asType**<**integer**>($heap_{funcstart\_719,1}$.p2) < 0)]: **asType**<**integer**>($heap_{funcstart\_719,1}$.p2) % 176) == **asType**<**integer**>(div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p2, 176).rem)

→ *[simplify]*

[18.14] ([0 < −$heap_{funcstart\_719,1}$.p2]: −(−$heap_{funcstart\_719,1}$.p2 % 176), [-1

$<$ \$heap$_{funcstart\_719,1}$.p2]: **asType**$<$**integer**$>$(\$heap$_{funcstart\_719,1}$.p2) % 176)
== **asType**$<$**integer**$>$(div(**heapIs** \$heap$_{funcstart\_719,1}$,
\$heap$_{funcstart\_719,1}$.p2, 176).rem)

$\rightarrow$ *[remainder of negation]*

[18.15] ([0 $<$ $-$\$heap$_{funcstart\_719,1}$.p2]: $-$([0 == (\$heap$_{funcstart\_719,1}$.p2 %
176)]: 0, []: 176 + $-$(\$heap$_{funcstart\_719,1}$.p2 % 176)), [-1 $<$
\$heap$_{funcstart\_719,1}$.p2]: **asType**$<$**integer**$>$(\$heap$_{funcstart\_719,1}$.p2) % 176)
== **asType**$<$**integer**$>$(div(**heapIs** \$heap$_{funcstart\_719,1}$,
\$heap$_{funcstart\_719,1}$.p2, 176).rem)

$\rightarrow$ *[explicitly assert falsehood of skipped guards in subsequent guards]*

[18.16] ([0 $<$ $-$\$heap$_{funcstart\_719,1}$.p2]: $-$([0 == (\$heap$_{funcstart\_719,1}$.p2 %
176)]: 0, [!(0 == (\$heap$_{funcstart\_719,1}$.p2 % 176))]: 176 +
$-$(\$heap$_{funcstart\_719,1}$.p2 % 176)), [-1 $<$ \$heap$_{funcstart\_719,1}$.p2]:
asType$<$**integer**$>$(\$heap$_{funcstart\_719,1}$.p2) % 176) ==
asType$<$**integer**$>$(div(**heapIs** \$heap$_{funcstart\_719,1}$, \$heap$_{funcstart\_719,1}$.p2,
176).rem)

$\rightarrow$ *[move guard outside expression]*

[18.17] ([0 $<$ $-$\$heap$_{funcstart\_719,1}$.p2]: ([0 == (\$heap$_{funcstart\_719,1}$.p2 %
176)]: $-$0, [!(0 == (\$heap$_{funcstart_719,1}$.p2 % 176))]: $-$(176 +
$-$(\$heap$_{funcstart\_719,1}$.p2 % 176))), [-1 $<$ \$heap$_{funcstart\_719,1}$.p2]:
asType$<$**integer**$>$(\$heap$_{funcstart\_719,1}$.p2) % 176) ==
asType$<$**integer**$>$(div(**heapIs** \$heap$_{funcstart\_719,1}$, \$heap$_{funcstart\_719,1}$.p2,
176).rem)

$\rightarrow$ *[simplify]*

[18.24] 0 == ($-$([0 $<$ $-$\$heap$_{funcstart\_719,1}$.p2]: ([0 ==
(\$heap$_{funcstart\_719,1}$.p2 % 176)]: 0, [!(0 == (\$heap$_{funcstart\_719,1}$.p2 % 176))]:
-176 + (\$heap$_{funcstart\_719,1}$.p2 % 176)), [-1 $<$ \$heap$_{funcstart\_719,1}$.p2]:
\$heap$_{funcstart\_719,1}$.p2 % 176) + div(**heapIs** \$heap$_{funcstart\_719,1}$,
\$heap$_{funcstart\_719,1}$.p2, 176).rem)

$\rightarrow$ *[move guard outside expression]*

[18.26] 0 == (([0 $<$ $-$\$heap$_{funcstart\_719,1}$.p2]: ([0 == (\$heap$_{funcstart\_719,1}$.p2
% 176)]: $-$0, [!(0 == (\$heap$_{funcstart_719,1}$.p2 % 176))]: $-$(-176 +
(\$heap$_{funcstart\_719,1}$.p2 % 176))), [-1 $<$ \$heap$_{funcstart\_719,1}$.p2]:
$-$(\$heap$_{funcstart\_719,1}$.p2 % 176)) + div(**heapIs** \$heap$_{funcstart\_719,1}$,
\$heap$_{funcstart\_719,1}$.p2, 176).rem)

$\rightarrow$ *[simplify]*

[18.29] 0 == (([0 $<$ $-$\$heap$_{funcstart\_719,1}$.p2]: ([0 == (\$heap$_{funcstart\_719,1}$.p2
% 176)]: 0, [!(0 == (\$heap$_{funcstart\_719,1}$.p2 % 176))]: 176 +
$-$(\$heap$_{funcstart\_719,1}$.p2 % 176)), [-1 $<$ \$heap$_{funcstart\_719,1}$.p2]:
$-$(\$heap$_{funcstart\_719,1}$.p2 % 176)) + div(**heapIs** \$heap$_{funcstart\_719,1}$,
\$heap$_{funcstart\_719,1}$.p2, 176).rem)

$\rightarrow$ *[move guard outside expression]*

[18.31] $0 == ([0 < -\$heap_{funcstart\_719,1}.p2]: ([0 == (\$heap_{funcstart\_719,1}.p2$ % $176)]: 0 + \text{div}(\textbf{heapIs } \$heap_{funcstart\_719,1}, \$heap_{funcstart\_719,1}.p2, 176).\text{rem},$ $[!(0 == (\$heap_{funcstart\_719,1}.p2$ % $176))]: (176 + -(\$heap_{funcstart\_719,1}.p2$ % $176)) + \text{div}(\textbf{heapIs } \$heap_{funcstart\_719,1}, \$heap_{funcstart\_719,1}.p2, 176).\text{rem}), [-1 < \$heap_{funcstart\_719,1}.p2]: -(\$heap_{funcstart\_719,1}.p2$ % $176) + \text{div}(\textbf{heapIs } \$heap_{funcstart\_719,1}, \$heap_{funcstart\_719,1}.p2, 176).\text{rem})$

$\rightarrow$ *[simplify]*

[18.33] $0 == ([0 < -\$heap_{funcstart\_719,1}.p2]: ([0 == (\$heap_{funcstart\_719,1}.p2$ % $176)]: \text{div}(\textbf{heapIs } \$heap_{funcstart\_719,1}, \$heap_{funcstart\_719,1}.p2, 176).\text{rem},$ $[!(0 == (\$heap_{funcstart\_719,1}.p2$ % $176))]: 176 + -(\$heap_{funcstart\_719,1}.p2$ % $176) + \text{div}(\textbf{heapIs } \$heap_{funcstart\_719,1}, \$heap_{funcstart\_719,1}.p2, 176).\text{rem}), [-1 < \$heap_{funcstart\_719,1}.p2]: -(\$heap_{funcstart\_719,1}.p2$ % $176) + \text{div}(\textbf{heapIs } \$heap_{funcstart\_719,1}, \$heap_{funcstart\_719,1}.p2, 176).\text{rem})$

$\rightarrow$ *[move guard outside expression]*

[18.35] $([0 < -\$heap_{funcstart\_719,1}.p2]: ([0 == (\$heap_{funcstart\_719,1}.p2$ % $176)]:$ $0 == \text{div}(\textbf{heapIs } \$heap_{funcstart\_719,1}, \$heap_{funcstart\_719,1}.p2, 176).\text{rem}, [!(0 == (\$heap_{funcstart\_719,1}.p2$ % $176))]: 0 == (176 + -(\$heap_{funcstart\_719,1}.p2$ % $176) + \text{div}(\textbf{heapIs } \$heap_{funcstart\_719,1}, \$heap_{funcstart\_719,1}.p2, 176).\text{rem})),$ $[-1 < \$heap_{funcstart\_719,1}.p2]: 0 == (-(\$heap_{funcstart\_719,1}.p2$ % $176) +$ $\text{div}(\textbf{heapIs } \$heap_{funcstart\_719,1}, \$heap_{funcstart\_719,1}.p2, 176).\text{rem}))$

$\rightarrow$ *[simplify]*

[18.40] $([0 < -\$heap_{funcstart\_719,1}.p2]: ([0 == (\$heap_{funcstart\_719,1}.p2$ % $176)]: 0 == \text{div}(\textbf{heapIs } \$heap_{funcstart\_719,1}, \$heap_{funcstart\_719,1}.p2, 176).\text{rem},$ $[!(0 == (\$heap_{funcstart\_719,1}.p2$ % $176))]: 176 == ((\$heap_{funcstart\_719,1}.p2$ % $176) + -\text{div}(\textbf{heapIs } \$heap_{funcstart\_719,1}, \$heap_{funcstart\_719,1}.p2, 176).\text{rem})),$ $[-1 < \$heap_{funcstart\_719,1}.p2]: 0 == (-(\$heap_{funcstart\_719,1}.p2$ % $176) +$ $\text{div}(\textbf{heapIs } \$heap_{funcstart\_719,1}, \$heap_{funcstart\_719,1}.p2, 176).\text{rem}))$

$\rightarrow$ *[from term 1.26, div(\textbf{heapIs} $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}.p2$, 176).rem == literala is false whenever -1 < (190 + literala)]*

Proof of rule precondition:

[18.40.0] $-1 < (0 + 190)$

$\rightarrow$ *[simplify]*

[18.40.2] **true**

[18.41] $([0 < -\$heap_{funcstart\_719,1}.p2]: ([0 == (\$heap_{funcstart\_719,1}.p2$ % $176)]: \textbf{false}, [!(0 == (\$heap_{funcstart\_719,1}.p2$ % $176))]: 176 == (-\text{div}(\textbf{heapIs } \$heap_{funcstart\_719,1}, \$heap_{funcstart\_719,1}.p2, 176).\text{rem} +$ $(\$heap_{funcstart\_719,1}.p2$ % $176))), [-1 < \$heap_{funcstart\_719,1}.p2]: 0 ==$ $(-(\$heap_{funcstart\_719,1}.p2$ % $176) + \text{div}(\textbf{heapIs } \$heap_{funcstart\_719,1},$ $\$heap_{funcstart\_719,1}.p2, 176).\text{rem}))$

→ *[simplify]*

[18.43] ([0 < −\$heap$_{funcstart\_719,1}$.p2]: (176 == (−div(**heapIs**
\$heap$_{funcstart\_719,1}$, \$heap$_{funcstart\_719,1}$.p2, 176).rem +
(\$heap$_{funcstart\_719,1}$.p2 % 176))) ∧ !(0 == (\$heap$_{funcstart\_719,1}$.p2 % 176)), [-1
< \$heap$_{funcstart\_719,1}$.p2]: 0 == (−(\$heap$_{funcstart\_719,1}$.p2 % 176) +
div(**heapIs** \$heap$_{funcstart\_719,1}$, \$heap$_{funcstart\_719,1}$.p2, 176).rem))

[Branch on disjunction or conditional in term 18.43]

[32.0] ((176 == (−div(**heapIs** \$heap$_{funcstart\_719,1}$, \$heap$_{funcstart\_719,1}$.p2,
176).rem + (\$heap$_{funcstart\_719,1}$.p2 % 176))) ∧ !(0 == (\$heap$_{funcstart\_719,1}$.p2
% 176))) ∨ (0 == (−(\$heap$_{funcstart\_719,1}$.p2 % 176) + div(**heapIs**
\$heap$_{funcstart\_719,1}$, \$heap$_{funcstart\_719,1}$.p2, 176).rem)) ∨ (-1 <
\$heap$_{funcstart\_719,1}$.p2)

→ *[separate conjunction and work on first sub-term]*

[32.1] (176 == (−div(**heapIs** \$heap$_{funcstart\_719,1}$, \$heap$_{funcstart\_719,1}$.p2,
176).rem + (\$heap$_{funcstart\_719,1}$.p2 % 176))) ∨ ...

[Create new term from terms 32.1, 1.26 using rule: transitivity 15r]

[51.0] ((-176 + 190) < −(\$heap$_{funcstart\_719,1}$.p2 % 176)) ∨ (0 ==
(−(\$heap$_{funcstart\_719,1}$.p2 % 176) + div(**heapIs** \$heap$_{funcstart\_719,1}$,
\$heap$_{funcstart\_719,1}$.p2, 176).rem)) ∨ (-1 < \$heap$_{funcstart\_719,1}$.p2)

→ *[simplify]*

[51.2] **false** ∨ ...

[Remove 'false' term 51.2 and fetch new term from containing clause]

[52.0] 0 == (−(\$heap$_{funcstart\_719,1}$.p2 % 176) + div(**heapIs**
\$heap$_{funcstart\_719,1}$, \$heap$_{funcstart\_719,1}$.p2, 176).rem)

[Create new term from terms 1.26, 52.0 using rule: transitivity 16]

[56.0] (0 + 190) < −(\$heap$_{funcstart\_719,1}$.p2 % 176)

→ *[simplify]*

[56.2] **false**

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

Condition generated at: C:\Escher\Customers\prang\prang.c (48,13)

Condition defined at:

To prove: (**asType**<**int**>(**asType**<**short int**>(div2.rem)) *
asType<**int**>(\$heap$_{719,1;729,8}$.r2)) ≤ **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)

$\$heap_{init}$.b1 == **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)

$\$heap_{init}$.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)

$\$heap_{init}$.b3 == **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)

div1 == div(**heapIs** $\$heap_{funcstart\_719,1}$,
asType\<int\>($\$heap_{funcstart\_719,1}$.p1),
asType\<int\>($\$heap_{funcstart\_719,1}$.a1))

(**asType\<integer\>**(**asType\<int\>**($\$heap_{funcstart\_719,1}$.p1)) /
asType\<integer\>(**asType\<int\>**($\$heap_{funcstart\_719,1}$.a1))) ==
asType\<integer\>(div1.quot)

(**asType\<integer\>**(**asType\<int\>**($\$heap_{funcstart\_719,1}$.p1)) %
asType\<integer\>(**asType\<int\>**($\$heap_{funcstart\_719,1}$.a1))) ==
asType\<integer\>(div1.rem)

div2 == div(**heapIs** $\$heap_{funcstart\_719,1}$,
asType\<int\>($\$heap_{funcstart\_719,1}$.p2),
asType\<int\>($\$heap_{funcstart\_719,1}$.a2))

(**asType\<integer\>**(**asType\<int\>**($\$heap_{funcstart\_719,1}$.p2)) /
asType\<integer\>(**asType\<int\>**($\$heap_{funcstart\_719,1}$.a2))) ==
asType\<integer\>(div2.quot)

(**asType\<integer\>**(**asType\<int\>**($\$heap_{funcstart\_719,1}$.p2)) %
asType\<integer\>(**asType\<int\>**($\$heap_{funcstart\_719,1}$.a2))) ==
asType\<integer\>(div2.rem)

div3 == div(**heapIs** $\$heap_{funcstart\_719,1}$,
asType\<int\>($\$heap_{funcstart\_719,1}$.p3),
asType\<int\>($\$heap_{funcstart\_719,1}$.a3))

(**asType**<**integer**>(**asType**<**int**>($\text{heap}_{funcstart\_719,1}$.p3)) /
asType<**integer**>(**asType**<**int**>($\text{heap}_{funcstart\_719,1}$.a3))) ==
asType<**integer**>(div3.quot)

(**asType**<**integer**>(**asType**<**int**>($\text{heap}_{funcstart\_719,1}$.p3)) %
asType<**integer**>(**asType**<**int**>($\text{heap}_{funcstart\_719,1}$.a3))) ==
asType<**integer**>(div3.rem)

$\text{heap}_{719,1;729,8}$ == $\text{heap}_{funcstart\_719,1}$.**replace**(p1 → **asType**<**short
int**>((**asType**<**int**>(**asType**<**short int**>(div1.rem)) *
asType<**int**>($\text{heap}_{funcstart\_719,1}$.r1)) − (**asType**<**int**>(**asType**<**short
int**>(div1.quot)) * **asType**<**int**>($\text{heap}_{funcstart\_719,1}$.b1))))

Proof:

[Take given term]

[5.0] div1 == div(**heapIs** $\text{heap}_{funcstart\_719,1}$,
asType<**int**>($\text{heap}_{funcstart\_719,1}$.p1),
asType<**int**>($\text{heap}_{funcstart\_719,1}$.a1))

→ *[simplify]*

[5.1] div1 == div(**heapIs** $\text{heap}_{funcstart\_719,1}$, $\text{heap}_{funcstart\_719,1}$.p1,
asType<**int**>($\text{heap}_{funcstart\_719,1}$.a1))

→ *[const static or extern object]*

[5.2] div1 == div(**heapIs** $\text{heap}_{funcstart\_719,1}$, $\text{heap}_{funcstart\_719,1}$.p1,
asType<**int**>(heap_{init}.a1))

→ *[expand definition of constant 'a1' at prang.c (16,20)]*

[5.3] div1 == div(**heapIs** $\text{heap}_{funcstart\_719,1}$, $\text{heap}_{funcstart\_719,1}$.p1,
asType<**int**>(**asType**<**short int**>((**int**)177)))

→ *[simplify]*

[5.6] div1 == div(**heapIs** $\text{heap}_{funcstart\_719,1}$, $\text{heap}_{funcstart\_719,1}$.p1, 177)

[Take given term]

[12.0] div2 == div(**heapIs** $\text{heap}_{funcstart\_719,1}$,
asType<**int**>($\text{heap}_{funcstart\_719,1}$.p2),
asType<**int**>($\text{heap}_{funcstart\_719,1}$.a2))

→ *[simplify]*

[12.1] div2 == div(**heapIs** $\text{heap}_{funcstart\_719,1}$, $\text{heap}_{funcstart\_719,1}$.p2,
asType<**int**>($\text{heap}_{funcstart\_719,1}$.a2))

→ *[const static or extern object]*

[12.2] div2 == div(**heapIs** $\text{heap}_{funcstart\_719,1}$, $\text{heap}_{funcstart\_719,1}$.p2,
asType<**int**>(heap_{init}.a2))

→ *[expand definition of constant 'a2' at prang.c (21,20)]*

[12.3] div2 == div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}$.p2, **asType**<**int**>(**asType**<**short int**>((**int**)176)))

→ *[simplify]*

[12.6] div2 == div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}$.p2, 176)

[Take given term]

[26.0] $\$\text{heap}_{719,1;729,8}$ == $\$\text{heap}_{funcstart\_719,1}$.**replace**(p1 → **asType**<**short int**>((**asType**<**int**>(**asType**<**short int**>(div1.rem)) * **asType**<**int**>($\$\text{heap}_{funcstart\_719,1}$.r1)) − (**asType**<**int**>(**asType**<**short int**>(div1.quot)) * **asType**<**int**>($\$\text{heap}_{funcstart\_719,1}$.b1))))

→ *[from term 5.6, div1 is equal to div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}$.p1, 177)]*

[26.1] $\$\text{heap}_{719,1;729,8}$ == $\$\text{heap}_{funcstart\_719,1}$.**replace**(p1 → **asType**<**short int**>((**asType**<**int**>(**asType**<**short int**>(div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}$.p1, 177).rem)) * **asType**<**int**>($\$\text{heap}_{funcstart\_719,1}$.r1)) − (**asType**<**int**>(**asType**<**short int**>(div1.quot)) * **asType**<**int**>($\$\text{heap}_{funcstart\_719,1}$.b1))))

→ *[simplify]*

[26.3] $\$\text{heap}_{719,1;729,8}$ == $\$\text{heap}_{funcstart\_719,1}$.**replace**(p1 → **asType**<**short int**>((div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}$.p1, 177).rem * **asType**<**int**>($\$\text{heap}_{funcstart\_719,1}$.r1)) − (**asType**<**int**>(**asType**<**short int**>(div1.quot)) * **asType**<**int**>($\$\text{heap}_{funcstart\_719,1}$.b1))))

→ *[const static or extern object]*

[26.4] $\$\text{heap}_{719,1;729,8}$ == $\$\text{heap}_{funcstart\_719,1}$.**replace**(p1 → **asType**<**short int**>((div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}$.p1, 177).rem * **asType**<**int**>($\$\text{heap}_{init}$.r1)) − (**asType**<**int**>(**asType**<**short int**>(div1.quot)) * **asType**<**int**>($\$\text{heap}_{funcstart\_719,1}$.b1))))

→ *[expand definition of constant 'r1' at prang.c (15,20)]*

[26.5] $\$\text{heap}_{719,1;729,8}$ == $\$\text{heap}_{funcstart\_719,1}$.**replace**(p1 → **asType**<**short int**>((div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}$.p1, 177).rem * **asType**<**int**>(**asType**<**short int**>((**int**)171))) − (**asType**<**int**>(**asType**<**short int**>(div1.quot)) * **asType**<**int**>($\$\text{heap}_{funcstart\_719,1}$.b1))))

→ *[simplify]*

[26.8] $\$\text{heap}_{719,1;729,8}$ == $\$\text{heap}_{funcstart\_719,1}$.**replace**(p1 → **asType**<**short int**>((div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}$.p1, 177).rem * 171) − (**asType**<**int**>(**asType**<**short int**>(div1.quot)) * **asType**<**int**>($\$\text{heap}_{funcstart\_719,1}$.b1))))

→ *[from term 5.6, div1 is equal to div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}$.p1, 177)]*

[26.9] $\$heap_{719,1;729,8} ==\$heap_{funcstart\_719,1}.\_$**replace**$(p1 \rightarrow$ **asType**$<$**short int**$>((171 *$ div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}.p1, 177).rem)$ $-$ (**asType**$<$**int**$>($**asType**$<$**short int**$>($div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}.p1, 177).$quot$)) *$ **asType**$<$**int**$>(\$heap_{funcstart\_719,1}.b1))))$

$\rightarrow$ *[simplify]*

[26.11] $\$heap_{719,1;729,8} ==\$heap_{funcstart\_719,1}.\_$**replace**$(p1 \rightarrow$ **asType**$<$**short int**$>((171 *$ div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}.p1, 177).rem)$ $-$ (div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}.p1, 177).$quot $*$ **asType**$<$**int**$>(\$heap_{funcstart\_719,1}.b1))))$

$\rightarrow$ *[const static or extern object]*

[26.12] $\$heap_{719,1;729,8} ==\$heap_{funcstart\_719,1}.\_$**replace**$(p1 \rightarrow$ **asType**$<$**short int**$>((171 *$ div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}.p1, 177).rem)$ $-$ (div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}.p1, 177).$quot $*$ **asType**$<$**int**$>(\$heap_{init}.b1))))$

$\rightarrow$ *[expand definition of constant 'b1' at prang.c (17,20)]*

[26.13] $\$heap_{719,1;729,8} ==\$heap_{funcstart\_719,1}.\_$**replace**$(p1 \rightarrow$ **asType**$<$**short int**$>((171 *$ div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}.p1, 177).rem)$ $-$ (div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}.p1, 177).$quot $*$ **asType**$<$**int**$>($**asType**$<$**short int**$>(($**int**$)2)))))$

$\rightarrow$ *[simplify]*

[26.19] $\$heap_{719,1;729,8} ==\$heap_{funcstart\_719,1}.\_$**replace**$(p1 \rightarrow ((-2 *$ div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}.p1, 177).$quot$) + (171 *$ div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}.p1, 177).rem)))$

[Take goal term]

[1.0] (**asType**$<$**int**$>($**asType**$<$**short int**$>($div2.rem$)) *$ **asType**$<$**int**$>(\$heap_{719,1;729,8}.r2)) \leq$ **maxof**(**int**)

$\rightarrow$ *[from term 12.6, div2 is equal to div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}.p2, 176)]$*

[1.1] (**asType**$<$**int**$>($**asType**$<$**short int**$>($div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}.p2, 176).rem)) *$ **asType**$<$**int**$>(\$heap_{719,1;729,8}.r2)) \leq$ **maxof**(**int**)

$\rightarrow$ *[simplify]*

[1.3] (div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}.p2, 176).$rem $*$ **asType**$<$**int**$>(\$heap_{719,1;729,8}.r2)) \leq$ **maxof**(**int**)

$\rightarrow$ *[from term 26.19, $\$heap_{719,1;729,8}$ is equal to $\$heap_{funcstart\_719,1}.\_$**replace**$(p1 \rightarrow (-2 *$ div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}.p1, 177).$quot$) + (171 *$ div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}.p1, 177).rem))]$*

[1.4] $(\text{div}(\textbf{heapIs}\ \$\text{heap}_{funcstart\_719,1}, \$\text{heap}_{funcstart\_719,1}.\text{p2}, 176).\text{rem} *$
$\textbf{asType}\textless\textbf{int}\textgreater(\$\text{heap}_{funcstart\_719,1}.\_\textbf{replace}(\text{p1} \rightarrow ((-2 * \text{div}(\textbf{heapIs}$
$\$\text{heap}_{funcstart\_719,1}, \$\text{heap}_{funcstart\_719,1}.\text{p1}, 177).\text{quot}) + (171 * \text{div}(\textbf{heapIs}$
$\$\text{heap}_{funcstart\_719,1}, \$\text{heap}_{funcstart\_719,1}.\text{p1}, 177).\text{rem}))).\text{r2})) \leq \textbf{maxof}(\textbf{int})$

$\rightarrow$ *[const member of object with modified fields]*

[1.5] $(\text{div}(\textbf{heapIs}\ \$\text{heap}_{funcstart\_719,1}, \$\text{heap}_{funcstart\_719,1}.\text{p2}, 176).\text{rem} *$
$\textbf{asType}\textless\textbf{int}\textgreater(\$\text{heap}_{funcstart\_719,1}.\text{r2})) \leq \textbf{maxof}(\textbf{int})$

$\rightarrow$ *[const static or extern object]*

[1.6] $(\text{div}(\textbf{heapIs}\ \$\text{heap}_{funcstart\_719,1}, \$\text{heap}_{funcstart\_719,1}.\text{p2}, 176).\text{rem} *$
$\textbf{asType}\textless\textbf{int}\textgreater(\$\text{heap}_{init}.\text{r2})) \leq \textbf{maxof}(\textbf{int})$

$\rightarrow$ *[expand definition of constant 'r2' at prang.c (20,20)]*

[1.7] $(\text{div}(\textbf{heapIs}\ \$\text{heap}_{funcstart\_719,1}, \$\text{heap}_{funcstart\_719,1}.\text{p2}, 176).\text{rem} *$
$\textbf{asType}\textless\textbf{int}\textgreater(\textbf{asType}\textless\textbf{short int}\textgreater((\textbf{int})172))) \leq \textbf{maxof}(\textbf{int})$

$\rightarrow$ *[simplify]*

[1.20] $-32768 < (-172 * \text{div}(\textbf{heapIs}\ \$\text{heap}_{funcstart\_719,1},$
$\$\text{heap}_{funcstart\_719,1}.\text{p2}, 176).\text{rem})$

$\rightarrow$ *[literal comparison of product]*

[1.21] $([-172 < 0]: (-32768 / 172) < -\text{div}(\textbf{heapIs}\ \$\text{heap}_{funcstart\_719,1},$
$\$\text{heap}_{funcstart\_719,1}.\text{p2}, 176).\text{rem}, [0 < -172]: (-32768 / -172) < \text{div}(\textbf{heapIs}$
$\$\text{heap}_{funcstart\_719,1}, \$\text{heap}_{funcstart\_719,1}.\text{p2}, 176).\text{rem}, [-172 == 0]: -32768 <$
$0)$

$\rightarrow$ *[explicitly assert falsehood of skipped guards in subsequent guards]*

[1.22] $([-172 < 0]: (-32768 / 172) < -\text{div}(\textbf{heapIs}\ \$\text{heap}_{funcstart\_719,1},$
$\$\text{heap}_{funcstart\_719,1}.\text{p2}, 176).\text{rem}, [(0 < -172) \wedge !(-172 < 0)]: (-32768 / -172) <$
$\text{div}(\textbf{heapIs}\ \$\text{heap}_{funcstart\_719,1}, \$\text{heap}_{funcstart\_719,1}.\text{p2}, 176).\text{rem}, [(-172 ==$
$0) \wedge !(-172 < 0) \wedge !(0 < -172)]: -32768 < 0)$

$\rightarrow$ *[simplify]*

[1.26] $-191 < -\text{div}(\textbf{heapIs}\ \$\text{heap}_{funcstart\_719,1}, \$\text{heap}_{funcstart\_719,1}.\text{p2},$
$176).\text{rem}$

$\rightarrow$ *[negate goal and search for contradiction]*

[1.27] $!(-191 < -\text{div}(\textbf{heapIs}\ \$\text{heap}_{funcstart\_719,1}, \$\text{heap}_{funcstart\_719,1}.\text{p2},$
$176).\text{rem})$

$\rightarrow$ *[simplify]*

[1.30] $190 < \text{div}(\textbf{heapIs}\ \$\text{heap}_{funcstart\_719,1}, \$\text{heap}_{funcstart\_719,1}.\text{p2}, 176).\text{rem}$

[Assume known post-assertion, class invariant or type constraint for term 12.6]

[18.0] $(\textbf{asType}\textless\textbf{integer}\textgreater(\$\text{heap}_{funcstart\_719,1}.\text{p2}) \%$
$\textbf{asType}\textless\textbf{integer}\textgreater(176)) == \textbf{asType}\textless\textbf{integer}\textgreater(\text{div}(\textbf{heapIs}$

$\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}.\text{p2}$, 176).rem)

$\rightarrow$ *[simplify]*

[18.2] ($\$\text{heap}_{funcstart\_719,1}.\text{p2}$ % 176) == **asType**<**integer**>(div(**heapIs**
$\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}.\text{p2}$, 176).rem)

$\rightarrow$ *[expand definition of operator '.%' in class 'int' at built in declaration]*

[18.3] ([**asType**<**integer**>($\$\text{heap}_{funcstart\_719,1}.\text{p2}$) < 0]:
$-(-$**asType**<**integer**>($\$\text{heap}_{funcstart\_719,1}.\text{p2}$) % 176), []:
asType<**integer**>($\$\text{heap}_{funcstart\_719,1}.\text{p2}$) % 176) ==
asType<**integer**>(div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}.\text{p2}$,
176).rem)

$\rightarrow$ *[explicitly assert falsehood of skipped guards in subsequent guards]*

[18.4] ([**asType**<**integer**>($\$\text{heap}_{funcstart\_719,1}.\text{p2}$) < 0]:
$-(-$**asType**<**integer**>($\$\text{heap}_{funcstart\_719,1}.\text{p2}$) % 176),
[!(**asType**<**integer**>($\$\text{heap}_{funcstart\_719,1}.\text{p2}$) < 0)]:
asType<**integer**>($\$\text{heap}_{funcstart\_719,1}.\text{p2}$) % 176) ==
asType<**integer**>(div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}.\text{p2}$,
176).rem)

$\rightarrow$ *[simplify]*

[18.14] ([0 < $-\$\text{heap}_{funcstart\_719,1}.\text{p2}$]: $-(-\$\text{heap}_{funcstart\_719,1}.\text{p2}$ % 176), [-1
< $\$\text{heap}_{funcstart\_719,1}.\text{p2}$]: **asType**<**integer**>($\$\text{heap}_{funcstart\_719,1}.\text{p2}$) % 176)
== **asType**<**integer**>(div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$,
$\$\text{heap}_{funcstart\_719,1}.\text{p2}$, 176).rem)

$\rightarrow$ *[remainder of negation]*

[18.15] ([0 < $-\$\text{heap}_{funcstart\_719,1}.\text{p2}$]: $-([0$ == ($\$\text{heap}_{funcstart\_719,1}.\text{p2}$ %
176)]: 0, []: 176 + $-(\$\text{heap}_{funcstart\_719,1}.\text{p2}$ % 176)), [-1 <
$\$\text{heap}_{funcstart\_719,1}.\text{p2}$]: **asType**<**integer**>($\$\text{heap}_{funcstart\_719,1}.\text{p2}$) % 176)
== **asType**<**integer**>(div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$,
$\$\text{heap}_{funcstart\_719,1}.\text{p2}$, 176).rem)

$\rightarrow$ *[explicitly assert falsehood of skipped guards in subsequent guards]*

[18.16] ([0 < $-\$\text{heap}_{funcstart\_719,1}.\text{p2}$]: $-([0$ == ($\$\text{heap}_{funcstart\_719,1}.\text{p2}$ %
176)]: 0, [!(0 == ($\$\text{heap}_{funcstart\_719,1}.\text{p2}$ % 176))]: 176 +
$-(\$\text{heap}_{funcstart\_719,1}.\text{p2}$ % 176)), [-1 < $\$\text{heap}_{funcstart\_719,1}.\text{p2}$]:
asType<**integer**>($\$\text{heap}_{funcstart\_719,1}.\text{p2}$) % 176) ==
asType<**integer**>(div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}.\text{p2}$,
176).rem)

$\rightarrow$ *[move guard outside expression]*

[18.17] ([0 < $-\$\text{heap}_{funcstart\_719,1}.\text{p2}$]: ([0 == ($\$\text{heap}_{funcstart\_719,1}.\text{p2}$ %
176)]: -0, [!(0 == ($\$\text{heap}_{funcstart\_719,1}.\text{p2}$ % 176))]: $-(176 +$
$-(\$\text{heap}_{funcstart\_719,1}.\text{p2}$ % 176))), [-1 < $\$\text{heap}_{funcstart\_719,1}.\text{p2}$]:
asType<**integer**>($\$\text{heap}_{funcstart\_719,1}.\text{p2}$) % 176) ==

asType<**integer**>(div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).rem)

$\rightarrow$ *[simplify]*

[18.24] $0 == (-([0 < -\$heap_{funcstart\_719,1}.p2]: ([0 == (\$heap_{funcstart\_719,1}.p2 \% 176)]: 0, [!(0 == (\$heap_{funcstart\_719,1}.p2 \% 176))]:$ -176 + $(\$heap_{funcstart\_719,1}.p2 \% 176)), [-1 < \$heap_{funcstart\_719,1}.p2]:$ $\$heap_{funcstart\_719,1}.p2 \% 176) + div(\mathbf{heapIs}\ \$heap_{funcstart\_719,1},$ $\$heap_{funcstart\_719,1}.p2, 176).rem)$

$\rightarrow$ *[move guard outside expression]*

[18.26] $0 == (([0 < -\$heap_{funcstart\_719,1}.p2]: ([0 == (\$heap_{funcstart\_719,1}.p2 \% 176)]: -0, [!(0 == (\$heap_{funcstart\_719,1}.p2 \% 176))]: -(-176 + (\$heap_{funcstart\_719,1}.p2 \% 176))), [-1 < \$heap_{funcstart\_719,1}.p2]: -(\$heap_{funcstart\_719,1}.p2 \% 176)) + div(\mathbf{heapIs}\ \$heap_{funcstart\_719,1}, \$heap_{funcstart\_719,1}.p2, 176).rem)$

$\rightarrow$ *[simplify]*

[18.29] $0 == (([0 < -\$heap_{funcstart\_719,1}.p2]: ([0 == (\$heap_{funcstart\_719,1}.p2 \% 176)]: 0, [!(0 == (\$heap_{funcstart\_719,1}.p2 \% 176))]: 176 + -(\$heap_{funcstart\_719,1}.p2 \% 176)), [-1 < \$heap_{funcstart\_719,1}.p2]: -(\$heap_{funcstart\_719,1}.p2 \% 176)) + div(\mathbf{heapIs}\ \$heap_{funcstart\_719,1}, \$heap_{funcstart\_719,1}.p2, 176).rem)$

$\rightarrow$ *[move guard outside expression]*

[18.31] $0 == ([0 < -\$heap_{funcstart\_719,1}.p2]: ([0 == (\$heap_{funcstart\_719,1}.p2 \% 176)]: 0 + div(\mathbf{heapIs}\ \$heap_{funcstart\_719,1}, \$heap_{funcstart\_719,1}.p2, 176).rem, [!(0 == (\$heap_{funcstart\_719,1}.p2 \% 176))]: (176 + -(\$heap_{funcstart\_719,1}.p2 \% 176)) + div(\mathbf{heapIs}\ \$heap_{funcstart\_719,1}, \$heap_{funcstart\_719,1}.p2, 176).rem), [-1 < \$heap_{funcstart\_719,1}.p2]: -(\$heap_{funcstart\_719,1}.p2 \% 176) + div(\mathbf{heapIs}\ \$heap_{funcstart\_719,1}, \$heap_{funcstart\_719,1}.p2, 176).rem)$

$\rightarrow$ *[simplify]*

[18.33] $0 == ([0 < -\$heap_{funcstart\_719,1}.p2]: ([0 == (\$heap_{funcstart\_719,1}.p2 \% 176)]: div(\mathbf{heapIs}\ \$heap_{funcstart\_719,1}, \$heap_{funcstart\_719,1}.p2, 176).rem, [!(0 == (\$heap_{funcstart\_719,1}.p2 \% 176))]: 176 + -(\$heap_{funcstart\_719,1}.p2 \% 176) + div(\mathbf{heapIs}\ \$heap_{funcstart\_719,1}, \$heap_{funcstart\_719,1}.p2, 176).rem), [-1 < \$heap_{funcstart\_719,1}.p2]: -(\$heap_{funcstart\_719,1}.p2 \% 176) + div(\mathbf{heapIs}\ \$heap_{funcstart\_719,1}, \$heap_{funcstart\_719,1}.p2, 176).rem)$

$\rightarrow$ *[move guard outside expression]*

[18.35] $([0 < -\$heap_{funcstart\_719,1}.p2]: ([0 == (\$heap_{funcstart\_719,1}.p2 \% 176)]: 0 == div(\mathbf{heapIs}\ \$heap_{funcstart\_719,1}, \$heap_{funcstart\_719,1}.p2, 176).rem, [!(0 == (\$heap_{funcstart\_719,1}.p2 \% 176))]: 0 == (176 + -(\$heap_{funcstart\_719,1}.p2 \% 176) + div(\mathbf{heapIs}\ \$heap_{funcstart\_719,1}, \$heap_{funcstart\_719,1}.p2, 176).rem)), [-1 < \$heap_{funcstart\_719,1}.p2]: 0 == (-(\$heap_{funcstart\_719,1}.p2 \% 176) + div(\mathbf{heapIs}\ \$heap_{funcstart\_719,1}, \$heap_{funcstart\_719,1}.p2, 176).rem))$

$\rightarrow$ *[simplify]*

[18.40] ([0 < $-\$\text{heap}_{funcstart\_719,1}$.p2]: ([0 == ($\$\text{heap}_{funcstart\_719,1}$.p2 %
176)]: 0 == div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}$.p2, 176).rem,
[!(0 == ($\$\text{heap}_{funcstart\_719,1}$.p2 % 176))]: 176 == (($\$\text{heap}_{funcstart\_719,1}$.p2 %
176) + $-$div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}$.p2, 176).rem)),
[-1 < $\$\text{heap}_{funcstart\_719,1}$.p2]: 0 == ($-$($\$\text{heap}_{funcstart\_719,1}$.p2 % 176) +
div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}$.p2, 176).rem))

$\rightarrow$ *[from term 1.30, div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2,
176).rem == literala is false whenever (-1 + literala) < 190]*

Proof of rule precondition:

[18.40.0] (-1 + 0) < 190

$\rightarrow$ *[simplify]*

[18.40.2] **true**

[18.41] ([0 < $-\$\text{heap}_{funcstart\_719,1}$.p2]: ([0 == ($\$\text{heap}_{funcstart\_719,1}$.p2 %
176)]: **false**, [!(0 == ($\$\text{heap}_{funcstart\_719,1}$.p2 % 176))]: 176 == ($-$div(**heapIs**
$\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}$.p2, 176).rem +
($\$\text{heap}_{funcstart\_719,1}$.p2 % 176))), [-1 < $\$\text{heap}_{funcstart\_719,1}$.p2]: 0 ==
($-$($\$\text{heap}_{funcstart\_719,1}$.p2 % 176) + div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$,
$\$\text{heap}_{funcstart\_719,1}$.p2, 176).rem))

$\rightarrow$ *[remainder is less than divisor]*

Proof of rule precondition:

[18.41.0] (176 + $-$div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}$.p2,
176).rem) $\leq$ 176

$\rightarrow$ *[simplify]*

[18.41.11] -1 < div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}$.p2,
176).rem

$\rightarrow$ *[from term 1.30, literala < div(**heapIs** $\$heap_{funcstart\_719,1}$,
$\$heap_{funcstart\_719,1}$.p2, 176).rem is true whenever (-1 + literala) < 190]*

Proof of rule precondition:

[18.41.11.0] (-1 + -1) < 190

$\rightarrow$ *[simplify]*

[18.41.11.2] **true**

[18.41.12] **true**

[18.42] ([0 < $-\$\text{heap}_{funcstart\_719,1}$.p2]: ([0 == ($\$\text{heap}_{funcstart\_719,1}$.p2 %
176)]: **false**, [!(0 == ($\$\text{heap}_{funcstart\_719,1}$.p2 % 176))]: **false**), [-1 <
$\$\text{heap}_{funcstart\_719,1}$.p2]: 0 == ($-$($\$\text{heap}_{funcstart\_719,1}$.p2 % 176) + div(**heapIs**
$\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}$.p2, 176).rem))

$\rightarrow$ [all guards have equal guarded terms]

[18.43] ([0 < $-\$heap_{funcstart\_719,1}$.p2]: **false**, [-1 < $\$heap_{funcstart\_719,1}$.p2]: 0 == ($-(\$heap_{funcstart\_719,1}$.p2 % 176) + div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).rem))

$\rightarrow$ [remainder is less than divisor]

   Proof of rule precondition:

   [18.43.0] (0 + 176) $\leq$ div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).rem

   $\rightarrow$ [simplify]

   [18.43.3] 175 < div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).rem

   $\rightarrow$ [from term 1.30, literala < div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).rem is true whenever (-1 + literala) < 190]

      Proof of rule precondition:

      [18.43.3.0] (-1 + 175) < 190

      $\rightarrow$ [simplify]

      [18.43.3.2] **true**

   [18.43.4] **true**

[18.44] ([0 < $-\$heap_{funcstart\_719,1}$.p2]: **false**, [-1 < $\$heap_{funcstart\_719,1}$.p2]: **false**)

$\rightarrow$ [all guards have equal guarded terms]

[18.45] **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 (48,40)

Condition defined at:

To prove: minof(short int) $\leq$ div2.quot

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)

$\$heap_{init}$.M2 == **asType**<**short int**>((**int**)30307)

$\text{\$heap}_{init}.\text{r2} == \textbf{asType}\textbf{<short int>}((\textbf{int})172)$

$\text{\$heap}_{init}.\text{a2} == \textbf{asType}\textbf{<short int>}((\textbf{int})176)$

$\text{\$heap}_{init}.\text{b2} == \textbf{asType}\textbf{<short int>}((\textbf{int})35)$

$\text{\$heap}_{init}.\text{M3} == \textbf{asType}\textbf{<short int>}((\textbf{int})30323)$

$\text{\$heap}_{init}.\text{r3} == \textbf{asType}\textbf{<short int>}((\textbf{int})170)$

$\text{\$heap}_{init}.\text{a3} == \textbf{asType}\textbf{<short int>}((\textbf{int})178)$

$\text{\$heap}_{init}.\text{b3} == \textbf{asType}\textbf{<short int>}((\textbf{int})63)$

$\text{\$heap}_{init}.\text{p1} == \textbf{asType}\textbf{<short int>}((\textbf{int})1)$

$\text{\$heap}_{init}.\text{p2} == \textbf{asType}\textbf{<short int>}((\textbf{int})2)$

$\text{\$heap}_{init}.\text{p3} == \textbf{asType}\textbf{<short int>}((\textbf{int})3)$

div1 == div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$,
asType<int>$(\text{\$heap}_{funcstart\_719,1}.\text{p1})$,
asType<int>$(\text{\$heap}_{funcstart\_719,1}.\text{a1}))$

$(\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<int>}(\text{\$heap}_{funcstart\_719,1}.\text{p1}))$ /
$\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<int>}(\text{\$heap}_{funcstart\_719,1}.\text{a1}))) ==$
asType<integer>(div1.quot)

$(\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<int>}(\text{\$heap}_{funcstart\_719,1}.\text{p1}))$ %
$\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<int>}(\text{\$heap}_{funcstart\_719,1}.\text{a1}))) ==$
asType<integer>(div1.rem)

div2 == div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$,
asType<int>$(\text{\$heap}_{funcstart\_719,1}.\text{p2})$,
asType<int>$(\text{\$heap}_{funcstart\_719,1}.\text{a2}))$

$(\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<int>}(\text{\$heap}_{funcstart\_719,1}.\text{p2}))$ /
$\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<int>}(\text{\$heap}_{funcstart\_719,1}.\text{a2}))) ==$
asType<integer>(div2.quot)

$(\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<int>}(\text{\$heap}_{funcstart\_719,1}.\text{p2}))$ %
$\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<int>}(\text{\$heap}_{funcstart\_719,1}.\text{a2}))) ==$
asType<integer>(div2.rem)

div3 == div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$,
asType<int>$(\text{\$heap}_{funcstart\_719,1}.\text{p3})$,
asType<int>$(\text{\$heap}_{funcstart\_719,1}.\text{a3}))$

$(\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<int>}(\text{\$heap}_{funcstart\_719,1}.\text{p3}))$ /
$\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<int>}(\text{\$heap}_{funcstart\_719,1}.\text{a3}))) ==$
asType<integer>(div3.quot)

$(\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<int>}(\text{\$heap}_{funcstart\_719,1}.\text{p3}))$ %
$\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<int>}(\text{\$heap}_{funcstart\_719,1}.\text{a3}))) ==$
asType<integer>(div3.rem)

$\text{\$heap}_{719,1;729,8} == \text{\$heap}_{funcstart\_719,1}.\textbf{\_replace}(\text{p1} \rightarrow \textbf{asType<short}$

int>((asType<int>(asType<short int>(div1.rem)) * asType<int>($heap$_{funcstart_719,1}$.r1)) − (asType<int>(asType<short int>(div1.quot)) * asType<int>($heap$_{funcstart\_719,1}$.b1)))))

Proof:

[Take given term]

[12.0] div2 == div(**heapIs** $heap$_{funcstart_719,1}$, **asType<int>**($heap$_{funcstart\_719,1}$.p2), **asType<int>**($heap$_{funcstart_719,1}$.a2))

→ *[simplify]*

[12.1] div2 == div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p2, **asType<int>**($heap$_{funcstart\_719,1}$.a2))

→ *[const static or extern object]*

[12.2] div2 == div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p2, **asType<int>**($heap$_{init}$.a2))

→ *[expand definition of constant 'a2' at prang.c (21,20)]*

[12.3] div2 == div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p2, **asType<int>**(**asType<short int>**(**(int)**176)))

→ *[simplify]*

[12.6] div2 == div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p2, 176)

[Take goal term]

[1.0] **minof(short int)** ≤ div2.quot

→ *[simplify]*

[1.1] -32768 ≤ div2.quot

→ *[from term 12.6, div2 is equal to div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p2, 176)]*

[1.2] -32768 ≤ div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p2, 176).quot

→ *[simplify]*

[1.4] -32769 < div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p2, 176).quot

→ *[negate goal and search for contradiction]*

[1.5] !(-32769 < div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p2, 176).quot)

→ *[simplify]*

[1.7] 32768 < −div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p2, 176).quot

[Assume known post-assertion, class invariant or type constraint for term 1.7]

[31.0] **minof(int)** $\leq$ div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).quot

$\rightarrow$ *[simplify]*

[31.3] -32769 $<$ div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).quot

$\rightarrow$ *[from term 1.7, literala $<$ div(**heapIs** $\$heap_{funcstart\_719,1}$,*
$\$heap_{funcstart\_719,1}$.p2, 176).quot is false whenever -2 $<$ (32768 + literala)]

> **Proof of rule precondition:**
>
> *[31.3.0]* -2 $<$ (-32769 + 32768)
>
> $\rightarrow$ *[simplify]*
>
> *[31.3.2]* **true**

[31.4] **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 (48,40)

Condition defined at:

To prove: div2.quot $\leq$ **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)

$\$heap_{init}$.M2 == **asType<short int>**((**int**)30307)

$\$heap_{init}$.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)

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

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

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

$\$heap_{init}$.p1 == **asType<short int>**((**int**)1)

$\text{\$heap}_{init}.\text{p2} == \textbf{asType}\text{<}\textbf{short int}\text{>}((\textbf{int})2)$

$\text{\$heap}_{init}.\text{p3} == \textbf{asType}\text{<}\textbf{short int}\text{>}((\textbf{int})3)$

$\text{div1} == \text{div}(\textbf{heapIs }\text{\$heap}_{funcstart\_719,1},$
$\textbf{asType}\text{<}\textbf{int}\text{>}(\text{\$heap}_{funcstart\_719,1}.\text{p1}),$
$\textbf{asType}\text{<}\textbf{int}\text{>}(\text{\$heap}_{funcstart\_719,1}.\text{a1}))$

$(\textbf{asType}\text{<}\textbf{integer}\text{>}(\textbf{asType}\text{<}\textbf{int}\text{>}(\text{\$heap}_{funcstart\_719,1}.\text{p1}))\ /$
$\textbf{asType}\text{<}\textbf{integer}\text{>}(\textbf{asType}\text{<}\textbf{int}\text{>}(\text{\$heap}_{funcstart\_719,1}.\text{a1}))) ==$
$\textbf{asType}\text{<}\textbf{integer}\text{>}(\text{div1.quot})$

$(\textbf{asType}\text{<}\textbf{integer}\text{>}(\textbf{asType}\text{<}\textbf{int}\text{>}(\text{\$heap}_{funcstart\_719,1}.\text{p1}))\ \%$
$\textbf{asType}\text{<}\textbf{integer}\text{>}(\textbf{asType}\text{<}\textbf{int}\text{>}(\text{\$heap}_{funcstart\_719,1}.\text{a1}))) ==$
$\textbf{asType}\text{<}\textbf{integer}\text{>}(\text{div1.rem})$

$\text{div2} == \text{div}(\textbf{heapIs }\text{\$heap}_{funcstart\_719,1},$
$\textbf{asType}\text{<}\textbf{int}\text{>}(\text{\$heap}_{funcstart\_719,1}.\text{p2}),$
$\textbf{asType}\text{<}\textbf{int}\text{>}(\text{\$heap}_{funcstart\_719,1}.\text{a2}))$

$(\textbf{asType}\text{<}\textbf{integer}\text{>}(\textbf{asType}\text{<}\textbf{int}\text{>}(\text{\$heap}_{funcstart\_719,1}.\text{p2}))\ /$
$\textbf{asType}\text{<}\textbf{integer}\text{>}(\textbf{asType}\text{<}\textbf{int}\text{>}(\text{\$heap}_{funcstart\_719,1}.\text{a2}))) ==$
$\textbf{asType}\text{<}\textbf{integer}\text{>}(\text{div2.quot})$

$(\textbf{asType}\text{<}\textbf{integer}\text{>}(\textbf{asType}\text{<}\textbf{int}\text{>}(\text{\$heap}_{funcstart\_719,1}.\text{p2}))\ \%$
$\textbf{asType}\text{<}\textbf{integer}\text{>}(\textbf{asType}\text{<}\textbf{int}\text{>}(\text{\$heap}_{funcstart\_719,1}.\text{a2}))) ==$
$\textbf{asType}\text{<}\textbf{integer}\text{>}(\text{div2.rem})$

$\text{div3} == \text{div}(\textbf{heapIs }\text{\$heap}_{funcstart\_719,1},$
$\textbf{asType}\text{<}\textbf{int}\text{>}(\text{\$heap}_{funcstart\_719,1}.\text{p3}),$
$\textbf{asType}\text{<}\textbf{int}\text{>}(\text{\$heap}_{funcstart\_719,1}.\text{a3}))$

$(\textbf{asType}\text{<}\textbf{integer}\text{>}(\textbf{asType}\text{<}\textbf{int}\text{>}(\text{\$heap}_{funcstart\_719,1}.\text{p3}))\ /$
$\textbf{asType}\text{<}\textbf{integer}\text{>}(\textbf{asType}\text{<}\textbf{int}\text{>}(\text{\$heap}_{funcstart\_719,1}.\text{a3}))) ==$
$\textbf{asType}\text{<}\textbf{integer}\text{>}(\text{div3.quot})$

$(\textbf{asType}\text{<}\textbf{integer}\text{>}(\textbf{asType}\text{<}\textbf{int}\text{>}(\text{\$heap}_{funcstart\_719,1}.\text{p3}))\ \%$
$\textbf{asType}\text{<}\textbf{integer}\text{>}(\textbf{asType}\text{<}\textbf{int}\text{>}(\text{\$heap}_{funcstart\_719,1}.\text{a3}))) ==$
$\textbf{asType}\text{<}\textbf{integer}\text{>}(\text{div3.rem})$

$\text{\$heap}_{719,1;729,8} == \text{\$heap}_{funcstart\_719,1}.\_\textbf{replace}(\text{p1} \rightarrow \textbf{asType}\text{<}\textbf{short}$
$\textbf{int}\text{>}((\textbf{asType}\text{<}\textbf{int}\text{>}(\textbf{asType}\text{<}\textbf{short int}\text{>}(\text{div1.rem}))\ *$
$\textbf{asType}\text{<}\textbf{int}\text{>}(\text{\$heap}_{funcstart\_719,1}.\text{r1})) - (\textbf{asType}\text{<}\textbf{int}\text{>}(\textbf{asType}\text{<}\textbf{short}$
$\textbf{int}\text{>}(\text{div1.quot})\ *\ \textbf{asType}\text{<}\textbf{int}\text{>}(\text{\$heap}_{funcstart\_719,1}.\text{b1}))))$

Proof:

[Take given term]

$\text{[12.0] div2} == \text{div}(\textbf{heapIs }\text{\$heap}_{funcstart\_719,1},$
$\textbf{asType}\text{<}\textbf{int}\text{>}(\text{\$heap}_{funcstart\_719,1}.\text{p2}),$
$\textbf{asType}\text{<}\textbf{int}\text{>}(\text{\$heap}_{funcstart\_719,1}.\text{a2}))$

$\rightarrow$ *[simplify]*

[12.1] div2 == div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, **asType**<**int**>($\$heap_{funcstart\_719,1}$.a2))

$\rightarrow$ *[const static or extern object]*

[12.2] div2 == div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, **asType**<**int**>($\$heap_{init}$.a2))

$\rightarrow$ *[expand definition of constant 'a2' at prang.c (21,20)]*

[12.3] div2 == div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, **asType**<**int**>(**asType**<**short int**>((**int**)176)))

$\rightarrow$ *[simplify]*

[12.6] div2 == div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176)

[Take goal term]

[1.0] div2.quot $\leq$ **maxof**(**short int**)

$\rightarrow$ *[from term 12.6, div2 is equal to div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176)]*

[1.1] div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).quot $\leq$ **maxof**(**short int**)

$\rightarrow$ *[simplify]*

[1.10] -32768 < $-$div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).quot

$\rightarrow$ *[negate goal and search for contradiction]*

[1.11] !(-32768 < $-$div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).quot)

$\rightarrow$ *[simplify]*

[1.14] 32767 < div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).quot

[Assume known post-assertion, class invariant or type constraint for term 1.14]

[31.0] div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).quot $\leq$ **maxof**(**int**)

$\rightarrow$ *[simplify]*

[31.9] -32768 < $-$div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).quot

$\rightarrow$ *[from term 1.14, literala < $-$div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).quot is false whenever -2 < (32767 + literala)]*

Proof of rule precondition:

[31.9.0] -2 < (-32768 + 32767)

$\rightarrow$ *[simplify]*

[31.9.2] **true**

[31.10] **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 (48,40)

Condition defined at:

To prove: minof(int) $\leq$ asType$<$short int$>$(div2.quot)

Given:

$\$\text{heap}_{init}$.LIMIT == (**int**)80

$\$\text{heap}_{init}$.M1 == **asType$<$short int$>$**((**int**)30269)

$\$\text{heap}_{init}$.r1 == **asType$<$short int$>$**((**int**)171)

$\$\text{heap}_{init}$.a1 == **asType$<$short int$>$**((**int**)177)

$\$\text{heap}_{init}$.b1 == **asType$<$short int$>$**((**int**)2)

$\$\text{heap}_{init}$.M2 == **asType$<$short int$>$**((**int**)30307)

$\$\text{heap}_{init}$.r2 == **asType$<$short int$>$**((**int**)172)

$\$\text{heap}_{init}$.a2 == **asType$<$short int$>$**((**int**)176)

$\$\text{heap}_{init}$.b2 == **asType$<$short int$>$**((**int**)35)

$\$\text{heap}_{init}$.M3 == **asType$<$short int$>$**((**int**)30323)

$\$\text{heap}_{init}$.r3 == **asType$<$short int$>$**((**int**)170)

$\$\text{heap}_{init}$.a3 == **asType$<$short int$>$**((**int**)178)

$\$\text{heap}_{init}$.b3 == **asType$<$short int$>$**((**int**)63)

$\$\text{heap}_{init}$.p1 == **asType$<$short int$>$**((**int**)1)

$\$\text{heap}_{init}$.p2 == **asType$<$short int$>$**((**int**)2)

$\$\text{heap}_{init}$.p3 == **asType$<$short int$>$**((**int**)3)

div1 == div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$,
asType$<$int$>$($\$\text{heap}_{funcstart\_719,1}$.p1),
asType$<$int$>$($\$\text{heap}_{funcstart\_719,1}$.a1))

(**asType$<$integer$>$**(**asType$<$int$>$**($\$\text{heap}_{funcstart\_719,1}$.p1)) /
asType$<$integer$>$(**asType$<$int$>$**($\$\text{heap}_{funcstart\_719,1}$.a1))) ==
asType$<$integer$>$(div1.quot)

(**asType$<$integer$>$**(**asType$<$int$>$**($\$\text{heap}_{funcstart\_719,1}$.p1)) %
asType$<$integer$>$(**asType$<$int$>$**($\$\text{heap}_{funcstart\_719,1}$.a1))) ==
asType$<$integer$>$(div1.rem)

div2 == div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$,

asType<int>($heap$_{funcstart_719,1}$.p2),
asType<int>($heap$_{funcstart_719,1}$.a2))

(**asType<integer>**(**asType<int>**($heap$_{funcstart_719,1}$.p2)) /
asType<integer>(**asType<int>**($heap$_{funcstart_719,1}$.a2))) ==
asType<integer>(div2.quot)

(**asType<integer>**(**asType<int>**($heap$_{funcstart_719,1}$.p2)) %
asType<integer>(**asType<int>**($heap$_{funcstart_719,1}$.a2))) ==
asType<integer>(div2.rem)

div3 == div(**heapIs** $heap$_{funcstart_719,1}$,
asType<int>($heap$_{funcstart_719,1}$.p3),
asType<int>($heap$_{funcstart_719,1}$.a3))

(**asType<integer>**(**asType<int>**($heap$_{funcstart_719,1}$.p3)) /
asType<integer>(**asType<int>**($heap$_{funcstart_719,1}$.a3))) ==
asType<integer>(div3.quot)

(**asType<integer>**(**asType<int>**($heap$_{funcstart_719,1}$.p3)) %
asType<integer>(**asType<int>**($heap$_{funcstart_719,1}$.a3))) ==
asType<integer>(div3.rem)

$heap$_{719,1;729,8}$ == $heap$_{funcstart_719,1}$.**replace**(p1 $\rightarrow$ **asType<short
int>**((**asType<int>**(**asType<short int>**(div1.rem)) *
asType<int>($heap$_{funcstart_719,1}$.r1)) $-$ (**asType<int>**(**asType<short
int>**(div1.quot)) * **asType<int>**($heap$_{funcstart_719,1}$.b1))))

Proof:

[Take given term]

[12.0] div2 == div(**heapIs** $heap$_{funcstart_719,1}$,
asType<int>($heap$_{funcstart_719,1}$.p2),
asType<int>($heap$_{funcstart_719,1}$.a2))

$\rightarrow$ *[simplify]*

[12.1] div2 == div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p2,
asType<int>($heap$_{funcstart_719,1}$.a2))

$\rightarrow$ *[const static or extern object]*

[12.2] div2 == div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p2,
asType<int>($heap$_{init}$.a2))

$\rightarrow$ *[expand definition of constant 'a2' at prang.c (21,20)]*

[12.3] div2 == div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p2,
asType<int>(**asType<short int>**((**int**)176)))

$\rightarrow$ *[simplify]*

[12.6] div2 == div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p2, 176)

[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 12.6, div2 is equal to div(***heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176)]*

[1.2] -32768 $\leq$ **asType$<$short int$>$**(div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).quot)

$\rightarrow$ *[simplify]*

[1.5] -32769 $<$ div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).quot

$\rightarrow$ *[negate goal and search for contradiction]*

[1.6] !(-32769 $<$ div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).quot)

$\rightarrow$ *[simplify]*

[1.8] 32768 $< -$div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).quot

[Assume known post-assertion, class invariant or type constraint for term 1.8]

[31.0] **minof(int)** $\leq$ div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).quot

$\rightarrow$ *[simplify]*

[31.3] -32769 $<$ div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).quot

$\rightarrow$ *[from term 1.8, literala $<$ div(***heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).quot is false whenever -2 $<$ (32768 + literala)]*

> **Proof of rule precondition:**
>
> *[31.3.0]* -2 $<$ (-32769 + 32768)
>
> $\rightarrow$ *[simplify]*
>
> *[31.3.2]* **true**

[31.4] **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 (48,40)

Condition defined at:

To prove: asType$<$short int$>$(div2.quot) $\leq$ **maxof(int)**

Given:

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

$\$heap_{init}.M1 == \textbf{asType}\textbf{<short int>}((\textbf{int})30269)$

$\$heap_{init}.r1 == \textbf{asType}\textbf{<short int>}((\textbf{int})171)$

$\$heap_{init}.a1 == \textbf{asType}\textbf{<short int>}((\textbf{int})177)$

$\$heap_{init}.b1 == \textbf{asType}\textbf{<short int>}((\textbf{int})2)$

$\$heap_{init}.M2 == \textbf{asType}\textbf{<short int>}((\textbf{int})30307)$

$\$heap_{init}.r2 == \textbf{asType}\textbf{<short int>}((\textbf{int})172)$

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

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

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

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

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

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

$\$heap_{init}.p1 == \textbf{asType}\textbf{<short int>}((\textbf{int})1)$

$\$heap_{init}.p2 == \textbf{asType}\textbf{<short int>}((\textbf{int})2)$

$\$heap_{init}.p3 == \textbf{asType}\textbf{<short int>}((\textbf{int})3)$

div1 == div(**heapIs** $\$heap_{funcstart\_719,1}$,
asType<int>($\$heap_{funcstart\_719,1}.p1$),
asType<int>($\$heap_{funcstart\_719,1}.a1$))

(**asType<integer>**(**asType<int>**$\$heap_{funcstart\_719,1}.p1$)) /
asType<integer>(**asType<int>**($\$heap_{funcstart\_719,1}.a1$))) ==
asType<integer>(div1.quot)

(**asType<integer>**(**asType<int>**$\$heap_{funcstart\_719,1}.p1$)) %
asType<integer>(**asType<int>**($\$heap_{funcstart\_719,1}.a1$))) ==
asType<integer>(div1.rem)

div2 == div(**heapIs** $\$heap_{funcstart\_719,1}$,
asType<int>($\$heap_{funcstart\_719,1}.p2$),
asType<int>($\$heap_{funcstart\_719,1}.a2$))

(**asType<integer>**(**asType<int>**$\$heap_{funcstart\_719,1}.p2$)) /
asType<integer>(**asType<int>**($\$heap_{funcstart\_719,1}.a2$))) ==
asType<integer>(div2.quot)

(**asType<integer>**(**asType<int>**$\$heap_{funcstart\_719,1}.p2$)) %
asType<integer>(**asType<int>**($\$heap_{funcstart\_719,1}.a2$))) ==
asType<integer>(div2.rem)

div3 == div(**heapIs** $\$heap_{funcstart\_719,1}$,

asType<int>($heap$_{funcstart_719,1}$.p3),
asType<int>($heap$_{funcstart_719,1}$.a3))

(**asType<integer>**(**asType<int>**($heap$_{funcstart_719,1}$.p3)) /
asType<integer>(**asType<int>**($heap$_{funcstart_719,1}$.a3))) ==
asType<integer>(div3.quot)

(**asType<integer>**(**asType<int>**($heap$_{funcstart_719,1}$.p3)) %
asType<integer>(**asType<int>**($heap$_{funcstart_719,1}$.a3))) ==
asType<integer>(div3.rem)

$heap$_{719,1;729,8}$ == $heap$_{funcstart_719,1}$._**replace**(p1 → **asType<short int>**((**asType<int>**(**asType<short int>**(div1.rem)) *
asType<int>($heap$_{funcstart_719,1}$.r1)) − (**asType<int>**(**asType<short int>**(div1.quot)) * **asType<int>**($heap$_{funcstart\_719,1}$.b1))))

Proof:

[Take given term]

[12.0] div2 == div(**heapIs** $heap$_{funcstart_719,1}$,
asType<int>($heap$_{funcstart_719,1}$.p2),
asType<int>($heap$_{funcstart_719,1}$.a2))

→ *[simplify]*

[12.1] div2 == div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p2,
asType<int>($heap$_{funcstart_719,1}$.a2))

→ *[const static or extern object]*

[12.2] div2 == div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p2,
asType<int>($heap$_{init}$.a2))

→ *[expand definition of constant 'a2' at prang.c (21,20)]*

[12.3] div2 == div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p2,
asType<int>(**asType<short int>**((**int**)176)))

→ *[simplify]*

[12.6] div2 == div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p2, 176)

[Take goal term]

[1.0] **asType<short int>**(div2.quot) ≤ **maxof(int)**

→ *[from term 12.6, div2 is equal to div(**heapIs** $heap$_{funcstart_719,1}$,
$heap$_{funcstart_719,1}$.p2, 176)]*

[1.1] **asType<short int>**(div(**heapIs** $heap$_{funcstart_719,1}$,
$heap$_{funcstart_719,1}$.p2, 176).quot) ≤ **maxof(int)**

→ *[simplify]*

[1.11] -32768 < −div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p2,
176).quot

$\rightarrow$ *[negate goal and search for contradiction]*

[1.12] !(-32768 < −div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).quot)

$\rightarrow$ *[simplify]*

[1.15] 32767 < div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).quot

[Assume known post-assertion, class invariant or type constraint for term 1.15]

[31.0] div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).quot $\leq$ **maxof**(**int**)

$\rightarrow$ *[simplify]*

[31.9] -32768 < −div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).quot

$\rightarrow$ *[from term 1.15, literala < −div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).quot is false whenever -2 < (32767 + literala)]*

    Proof of rule precondition:

    [31.9.0] -2 < (-32768 + 32767)

    $\rightarrow$ *[simplify]*

    [31.9.2] **true**

[31.10] **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 (48,35)

Condition defined at:

To prove: minof(**int**) $\leq$ $\$heap_{719,1;729,8}$.b2

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)

$\$heap_{init}$.M2 == **asType**<**short int**>((**int**)30307)

$\$heap_{init}$.r2 == **asType**<**short int**>((**int**)172)

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

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

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

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

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

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

$\$heap_{init}.p1 == \textbf{asType}\textbf{<short int>}((\textbf{int})1)$

$\$heap_{init}.p2 == \textbf{asType}\textbf{<short int>}((\textbf{int})2)$

$\$heap_{init}.p3 == \textbf{asType}\textbf{<short int>}((\textbf{int})3)$

$\text{div1} == \text{div}(\textbf{heapIs } \$heap_{funcstart\_719,1},$
$\textbf{asType}\textbf{<int>}(\$heap_{funcstart\_719,1}.p1),$
$\textbf{asType}\textbf{<int>}(\$heap_{funcstart\_719,1}.a1))$

$(\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<int>}(\$heap_{funcstart\_719,1}.p1))\ /$
$\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<int>}(\$heap_{funcstart\_719,1}.a1))) ==$
$\textbf{asType}\textbf{<integer>}(\text{div1.quot})$

$(\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<int>}(\$heap_{funcstart\_719,1}.p1))\ \%$
$\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<int>}(\$heap_{funcstart\_719,1}.a1))) ==$
$\textbf{asType}\textbf{<integer>}(\text{div1.rem})$

$\text{div2} == \text{div}(\textbf{heapIs } \$heap_{funcstart\_719,1},$
$\textbf{asType}\textbf{<int>}(\$heap_{funcstart\_719,1}.p2),$
$\textbf{asType}\textbf{<int>}(\$heap_{funcstart\_719,1}.a2))$

$(\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<int>}(\$heap_{funcstart\_719,1}.p2))\ /$
$\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<int>}(\$heap_{funcstart\_719,1}.a2))) ==$
$\textbf{asType}\textbf{<integer>}(\text{div2.quot})$

$(\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<int>}(\$heap_{funcstart\_719,1}.p2))\ \%$
$\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<int>}(\$heap_{funcstart\_719,1}.a2))) ==$
$\textbf{asType}\textbf{<integer>}(\text{div2.rem})$

$\text{div3} == \text{div}(\textbf{heapIs } \$heap_{funcstart\_719,1},$
$\textbf{asType}\textbf{<int>}(\$heap_{funcstart\_719,1}.p3),$
$\textbf{asType}\textbf{<int>}(\$heap_{funcstart\_719,1}.a3))$

$(\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<int>}(\$heap_{funcstart\_719,1}.p3))\ /$
$\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<int>}(\$heap_{funcstart\_719,1}.a3))) ==$
$\textbf{asType}\textbf{<integer>}(\text{div3.quot})$

$(\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<int>}(\$heap_{funcstart\_719,1}.p3))\ \%$
$\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<int>}(\$heap_{funcstart\_719,1}.a3))) ==$
$\textbf{asType}\textbf{<integer>}(\text{div3.rem})$

$\$heap_{719,1;729,8} == \$heap_{funcstart\_719,1}.\textbf{replace}(p1 \rightarrow \textbf{asType}\textbf{<short}$
$\textbf{int>}((\textbf{asType}\textbf{<int>}(\textbf{asType}\textbf{<short int>}(\text{div1.rem}))\ *$
$\textbf{asType}\textbf{<int>}(\$heap_{funcstart\_719,1}.r1)) - (\textbf{asType}\textbf{<int>}(\textbf{asType}\textbf{<short}$

int>(div1.quot)) * **asType**<**int**>($\text{heap}_{funcstart\_719,1}$.b1))))

Proof:

[Take given term]

[5.0] div1 == div(**heapIs** $\text{heap}_{funcstart\_719,1}$,
asType<**int**>($\text{heap}_{funcstart\_719,1}$.p1),
asType<**int**>($\text{heap}_{funcstart\_719,1}$.a1))

$\rightarrow$ *[simplify]*

[5.1] div1 == div(**heapIs** $\text{heap}_{funcstart\_719,1}$, $\text{heap}_{funcstart\_719,1}$.p1,
asType<**int**>($\text{heap}_{funcstart\_719,1}$.a1))

$\rightarrow$ *[const static or extern object]*

[5.2] div1 == div(**heapIs** $\text{heap}_{funcstart\_719,1}$, $\text{heap}_{funcstart\_719,1}$.p1,
asType<**int**>(heap_{init}.a1))

$\rightarrow$ *[expand definition of constant 'a1' at prang.c (16,20)]*

[5.3] div1 == div(**heapIs** $\text{heap}_{funcstart\_719,1}$, $\text{heap}_{funcstart\_719,1}$.p1,
asType<**int**>(**asType**<**short int**>(((**int**)177)))

$\rightarrow$ *[simplify]*

[5.6] div1 == div(**heapIs** $\text{heap}_{funcstart\_719,1}$, $\text{heap}_{funcstart\_719,1}$.p1, 177)

[Take given term]

[26.0] $\text{heap}_{719,1;729,8}$ == $\text{heap}_{funcstart\_719,1}$.**replace**(p1 $\rightarrow$ **asType**<**short int**>((**asType**<**int**>(**asType**<**short int**>(div1.rem)) *
asType<**int**>($\text{heap}_{funcstart\_719,1}$.r1)) $-$ (**asType**<**int**>(**asType**<**short int**>(div1.quot)) * **asType**<**int**>($\text{heap}_{funcstart\_719,1}$.b1))))

$\rightarrow$ *[from term 5.6, div1 is equal to div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p1, 177)]*

[26.1] $\text{heap}_{719,1;729,8}$ == $\text{heap}_{funcstart\_719,1}$.**replace**(p1 $\rightarrow$ **asType**<**short int**>((**asType**<**int**>(**asType**<**short int**>(div(**heapIs** $\text{heap}_{funcstart\_719,1}$, $\text{heap}_{funcstart\_719,1}$.p1, 177).rem)) * **asType**<**int**>($\text{heap}_{funcstart\_719,1}$.r1)) $-$ (**asType**<**int**>(**asType**<**short int**>(div1.quot)) * **asType**<**int**>($\text{heap}_{funcstart\_719,1}$.b1))))

$\rightarrow$ *[simplify]*

[26.3] $\text{heap}_{719,1;729,8}$ == $\text{heap}_{funcstart\_719,1}$.**replace**(p1 $\rightarrow$ **asType**<**short int**>((div(**heapIs** $\text{heap}_{funcstart\_719,1}$, $\text{heap}_{funcstart\_719,1}$.p1, 177).rem * **asType**<**int**>($\text{heap}_{funcstart\_719,1}$.r1)) $-$ (**asType**<**int**>(**asType**<**short int**>(div1.quot)) * **asType**<**int**>($\text{heap}_{funcstart\_719,1}$.b1))))

$\rightarrow$ *[const static or extern object]*

[26.4] $\text{heap}_{719,1;729,8}$ == $\text{heap}_{funcstart\_719,1}$.**replace**(p1 $\rightarrow$ **asType**<**short int**>((div(**heapIs** $\text{heap}_{funcstart\_719,1}$, $\text{heap}_{funcstart\_719,1}$.p1, 177).rem * **asType**<**int**>(heap_{init}.r1)) $-$ (**asType**<**int**>(**asType**<**short**

int>(div1.quot)) * **asType**<**int**>($heap$_{funcstart_719,1}$.b1))))

→ *[expand definition of constant 'r1' at prang.c (15,20)]*

[26.5] $heap$_{719,1;729,8}$ == $heap$_{funcstart_719,1}$._**replace**(p1 → **asType**<**short int**>((div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1, 177).rem * **asType**<**int**>(**asType**<**short int**>((**int**)171))) − (**asType**<**int**>(**asType**<**short int**>(div1.quot)) * **asType**<**int**>($heap$_{funcstart\_719,1}$.b1))))

→ *[simplify]*

[26.8] $heap$_{719,1;729,8}$ == $heap$_{funcstart_719,1}$._**replace**(p1 → **asType**<**short int**>((div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1, 177).rem * 171) − (**asType**<**int**>(**asType**<**short int**>(div1.quot)) * **asType**<**int**>($heap$_{funcstart\_719,1}$.b1))))

→ *[from term 5.6, div1 is equal to div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1, 177)]*

[26.9] $heap$_{719,1;729,8}$ == $heap$_{funcstart_719,1}$._**replace**(p1 → **asType**<**short int**>((171 * div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1, 177).rem) − (**asType**<**int**>(**asType**<**short int**>(div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1, 177).quot)) * **asType**<**int**>($heap$_{funcstart\_719,1}$.b1))))

→ *[simplify]*

[26.11] $heap$_{719,1;729,8}$ == $heap$_{funcstart_719,1}$._**replace**(p1 → **asType**<**short int**>((171 * div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1, 177).rem) − (div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1, 177).quot * **asType**<**int**>($heap$_{funcstart\_719,1}$.b1))))

→ *[const static or extern object]*

[26.12] $heap$_{719,1;729,8}$ == $heap$_{funcstart_719,1}$._**replace**(p1 → **asType**<**short int**>((171 * div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1, 177).rem) − (div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1, 177).quot * **asType**<**int**>($heap$_{init}$.b1))))

→ *[expand definition of constant 'b1' at prang.c (17,20)]*

[26.13] $heap$_{719,1;729,8}$ == $heap$_{funcstart_719,1}$._**replace**(p1 → **asType**<**short int**>((171 * div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1, 177).rem) − (div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1, 177).quot * **asType**<**int**>(**asType**<**short int**>((**int**)2)))))

→ *[simplify]*

[26.19] $heap$_{719,1;729,8}$ == $heap$_{funcstart_719,1}$._**replace**(p1 → ((-2 * div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1, 177).quot) + (171 * div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1, 177).rem)))

[Take goal term]

[1.0] **minof(int)** $\leq$ $heap$_{719,1;729,8}$.b2

$\rightarrow$ *[simplify]*

[1.1] -32768 $\leq$ $heap$_{719,1;729,8}$.b2

$\rightarrow$ *[from term 26.19, $heap$_{719,1;729,8}$ is equal to $heap$_{funcstart_719,1}$.**replace**(p1 $\rightarrow$ (-2 * div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1, 177).quot) + (171 * div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1, 177).rem))]*

[1.2] -32768 $\leq$ $heap$_{funcstart_719,1}$.**replace**(p1 $\rightarrow$ ((-2 * div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1, 177).quot) + (171 * div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1, 177).rem))).b2

$\rightarrow$ *[const member of object with modified fields]*

[1.3] -32768 $\leq$ $heap$_{funcstart_719,1}$.b2

$\rightarrow$ *[const static or extern object]*

[1.4] -32768 $\leq$ $heap$_{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 (48,35)

Condition defined at:

To prove: $heap$_{719,1;729,8}$.b2 $\leq$ **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)

$heap$_{init}$.b1 == **asType$<$short int$>$**((**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)

$heap$_{init}$.b2 == **asType$<$short int$>$**((**int**)35)

$\$\text{heap}_{init}.\text{M3} == \textbf{asType}\textbf{<short int>}((\textbf{int})30323)$

$\$\text{heap}_{init}.\text{r3} == \textbf{asType}\textbf{<short int>}((\textbf{int})170)$

$\$\text{heap}_{init}.\text{a3} == \textbf{asType}\textbf{<short int>}((\textbf{int})178)$

$\$\text{heap}_{init}.\text{b3} == \textbf{asType}\textbf{<short int>}((\textbf{int})63)$

$\$\text{heap}_{init}.\text{p1} == \textbf{asType}\textbf{<short int>}((\textbf{int})1)$

$\$\text{heap}_{init}.\text{p2} == \textbf{asType}\textbf{<short int>}((\textbf{int})2)$

$\$\text{heap}_{init}.\text{p3} == \textbf{asType}\textbf{<short int>}((\textbf{int})3)$

div1 == div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$,
asType<int>($\$\text{heap}_{funcstart\_719,1}.\text{p1}$),
asType<int>($\$\text{heap}_{funcstart\_719,1}.\text{a1}$))

(**asType<integer>**(**asType<int>**($\$\text{heap}_{funcstart\_719,1}.\text{p1}$)) /
asType<integer>(**asType<int>**($\$\text{heap}_{funcstart\_719,1}.\text{a1}$))) ==
asType<integer>(div1.quot)

(**asType<integer>**(**asType<int>**($\$\text{heap}_{funcstart\_719,1}.\text{p1}$)) %
asType<integer>(**asType<int>**($\$\text{heap}_{funcstart\_719,1}.\text{a1}$))) ==
asType<integer>(div1.rem)

div2 == div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$,
asType<int>($\$\text{heap}_{funcstart\_719,1}.\text{p2}$),
asType<int>($\$\text{heap}_{funcstart\_719,1}.\text{a2}$))

(**asType<integer>**(**asType<int>**($\$\text{heap}_{funcstart\_719,1}.\text{p2}$)) /
asType<integer>(**asType<int>**($\$\text{heap}_{funcstart\_719,1}.\text{a2}$))) ==
asType<integer>(div2.quot)

(**asType<integer>**(**asType<int>**($\$\text{heap}_{funcstart\_719,1}.\text{p2}$)) %
asType<integer>(**asType<int>**($\$\text{heap}_{funcstart\_719,1}.\text{a2}$))) ==
asType<integer>(div2.rem)

div3 == div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$,
asType<int>($\$\text{heap}_{funcstart\_719,1}.\text{p3}$),
asType<int>($\$\text{heap}_{funcstart\_719,1}.\text{a3}$))

(**asType<integer>**(**asType<int>**($\$\text{heap}_{funcstart\_719,1}.\text{p3}$)) /
asType<integer>(**asType<int>**($\$\text{heap}_{funcstart\_719,1}.\text{a3}$))) ==
asType<integer>(div3.quot)

(**asType<integer>**(**asType<int>**($\$\text{heap}_{funcstart\_719,1}.\text{p3}$)) %
asType<integer>(**asType<int>**($\$\text{heap}_{funcstart\_719,1}.\text{a3}$))) ==
asType<integer>(div3.rem)

$\$\text{heap}_{719,1;729,8} == \$\text{heap}_{funcstart\_719,1}.$**replace**(p1 → **asType<short int>**((**asType<int>**(**asType<short int>**(div1.rem)) * **asType<int>**($\$\text{heap}_{funcstart\_719,1}.\text{r1}$)) − (**asType<int>**(**asType<short int>**(div1.quot)) * **asType<int>**($\$\text{heap}_{funcstart\_719,1}.\text{b1}$))))

Proof:

[Take given term]

[5.0] div1 == div(**heapIs** $\$heap_{funcstart\_719,1}$,
asType<int>($\$heap_{funcstart\_719,1}$.p1),
asType<int>($\$heap_{funcstart\_719,1}$.a1))

→ *[simplify]*

[5.1] div1 == div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1,
asType<int>($\$heap_{funcstart\_719,1}$.a1))

→ *[const static or extern object]*

[5.2] div1 == div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1,
asType<int>($\$heap_{init}$.a1))

→ *[expand definition of constant 'a1' at prang.c (16,20)]*

[5.3] div1 == div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1,
asType<int>(**asType<short int>**(**(int)**177)))

→ *[simplify]*

[5.6] div1 == div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177)

[Take given term]

[26.0] $\$heap_{719,1;729,8}$ == $\$heap_{funcstart\_719,1}$.**replace**(p1 → **asType<short
int>**((**asType<int>**(**asType<short int>**(div1.rem)) *
asType<int>($\$heap_{funcstart\_719,1}$.r1)) − (**asType<int>**(**asType<short
int>**(div1.quot)) * **asType<int>**($\$heap_{funcstart\_719,1}$.b1)))))

→ *[from term 5.6, div1 is equal to div(**heapIs** $\$heap_{funcstart\_719,1}$,
$\$heap_{funcstart\_719,1}$.p1, 177)]*

[26.1] $\$heap_{719,1;729,8}$ == $\$heap_{funcstart\_719,1}$.**replace**(p1 → **asType<short
int>**((**asType<int>**(**asType<short int>**(div(**heapIs** $\$heap_{funcstart\_719,1}$,
$\$heap_{funcstart\_719,1}$.p1, 177).rem)) * **asType<int>**($\$heap_{funcstart\_719,1}$.r1)) −
(**asType<int>**(**asType<short int>**(div1.quot)) *
asType<int>($\$heap_{funcstart\_719,1}$.b1)))))

→ *[simplify]*

[26.3] $\$heap_{719,1;729,8}$ == $\$heap_{funcstart\_719,1}$.**replace**(p1 → **asType<short
int>**((div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).rem *
asType<int>($\$heap_{funcstart\_719,1}$.r1)) − (**asType<int>**(**asType<short
int>**(div1.quot)) * **asType<int>**($\$heap_{funcstart\_719,1}$.b1)))))

→ *[const static or extern object]*

[26.4] $\$heap_{719,1;729,8}$ == $\$heap_{funcstart\_719,1}$.**replace**(p1 → **asType<short
int>**((div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).rem *
asType<int>($\$heap_{init}$.r1)) − (**asType<int>**(**asType<short
int>**(div1.quot)) * **asType<int>**($\$heap_{funcstart\_719,1}$.b1)))))

→ *[expand definition of constant 'r1' at prang.c (15,20)]*

[26.5] $\$heap_{719,1;729,8}$ == $\$heap_{funcstart\_719,1}$.**replace**(p1 → **asType**<**short int**>((div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).rem * **asType**<**int**>(**asType**<**short int**>((**int**)171))) − (**asType**<**int**>(**asType**<**short int**>(div1.quot)) * **asType**<**int**>($\$heap_{funcstart\_719,1}$.b1))))

→ *[simplify]*

[26.8] $\$heap_{719,1;729,8}$ == $\$heap_{funcstart\_719,1}$.**replace**(p1 → **asType**<**short int**>((div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).rem * 171) − (**asType**<**int**>(**asType**<**short int**>(div1.quot)) * **asType**<**int**>($\$heap_{funcstart\_719,1}$.b1))))

→ *[from term 5.6, div1 is equal to div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177)]*

[26.9] $\$heap_{719,1;729,8}$ == $\$heap_{funcstart\_719,1}$.**replace**(p1 → **asType**<**short int**>((171 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).rem) − (**asType**<**int**>(**asType**<**short int**>(div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot)) * **asType**<**int**>($\$heap_{funcstart\_719,1}$.b1))))

→ *[simplify]*

[26.11] $\$heap_{719,1;729,8}$ == $\$heap_{funcstart\_719,1}$.**replace**(p1 → **asType**<**short int**>((171 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).rem) − (div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot * **asType**<**int**>($\$heap_{funcstart\_719,1}$.b1))))

→ *[const static or extern object]*

[26.12] $\$heap_{719,1;729,8}$ == $\$heap_{funcstart\_719,1}$.**replace**(p1 → **asType**<**short int**>((171 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).rem) − (div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot * **asType**<**int**>($\$heap_{init}$.b1))))

→ *[expand definition of constant 'b1' at prang.c (17,20)]*

[26.13] $\$heap_{719,1;729,8}$ == $\$heap_{funcstart\_719,1}$.**replace**(p1 → **asType**<**short int**>((171 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).rem) − (div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot * **asType**<**int**>(**asType**<**short int**>((**int**)2)))))

→ *[simplify]*

[26.19] $\$heap_{719,1;729,8}$ == $\$heap_{funcstart\_719,1}$.**replace**(p1 → ((-2 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).rem)))

[Take goal term]

[1.0] $\$heap_{719,1;729,8}$.b2 ≤ **maxof**(**int**)

→ *[from term 26.19, $heap_{719,1;729,8}$ is equal to*
*$heap_{funcstart\_719,1}$._**replace**(p1 → (-2 * div(**heapIs** $heap_{funcstart\_719,1}$,*
*$heap_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs** $heap_{funcstart\_719,1}$,*
$heap_{funcstart\_719,1}$.p1, 177).rem))]

[1.1] $heap_{funcstart\_719,1}$._**replace**(p1 → ((-2 * div(**heapIs**
$heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs**
$heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p1, 177).rem))).b2 ≤ **maxof(int)**

→ *[const member of object with modified fields]*

[1.2] $heap_{funcstart\_719,1}$.b2 ≤ **maxof(int)**

→ *[const static or extern object]*

[1.3] $heap_{init}$.b2 ≤ **maxof(int)**

→ *[expand definition of constant 'b2' at prang.c (22,20)]*

[1.4] **asType\<short int\>((int)35) ≤ maxof(int)**

→ *[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 (48,38)

Condition defined at:

To prove: minof(int) ≤ (asType\<int\>(asType\<short int\>(div2.quot)) * asType\<int\>($heap_{719,1;729,8}$.b2))

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)

$heap_{init}$.M2 == **asType\<short int\>((int)**30307)

$heap_{init}$.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)

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

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

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

$\$heap_{init}.p1 == \mathbf{asType}\mathbf{<short\ int>}((\mathbf{int})1)$

$\$heap_{init}.p2 == \mathbf{asType}\mathbf{<short\ int>}((\mathbf{int})2)$

$\$heap_{init}.p3 == \mathbf{asType}\mathbf{<short\ int>}((\mathbf{int})3)$

$\mathrm{div1} == \mathrm{div}(\mathbf{heapIs}\ \$heap_{funcstart\_719,1},$
$\mathbf{asType}\mathbf{<int>}(\$heap_{funcstart\_719,1}.p1),$
$\mathbf{asType}\mathbf{<int>}(\$heap_{funcstart\_719,1}.a1))$

$(\mathbf{asType}\mathbf{<integer>}(\mathbf{asType}\mathbf{<int>}(\$heap_{funcstart\_719,1}.p1))\ /$
$\mathbf{asType}\mathbf{<integer>}(\mathbf{asType}\mathbf{<int>}(\$heap_{funcstart\_719,1}.a1))) ==$
$\mathbf{asType}\mathbf{<integer>}(\mathrm{div1.quot})$

$(\mathbf{asType}\mathbf{<integer>}(\mathbf{asType}\mathbf{<int>}(\$heap_{funcstart\_719,1}.p1))\ \%$
$\mathbf{asType}\mathbf{<integer>}(\mathbf{asType}\mathbf{<int>}(\$heap_{funcstart\_719,1}.a1))) ==$
$\mathbf{asType}\mathbf{<integer>}(\mathrm{div1.rem})$

$\mathrm{div2} == \mathrm{div}(\mathbf{heapIs}\ \$heap_{funcstart\_719,1},$
$\mathbf{asType}\mathbf{<int>}(\$heap_{funcstart\_719,1}.p2),$
$\mathbf{asType}\mathbf{<int>}(\$heap_{funcstart\_719,1}.a2))$

$(\mathbf{asType}\mathbf{<integer>}(\mathbf{asType}\mathbf{<int>}(\$heap_{funcstart\_719,1}.p2))\ /$
$\mathbf{asType}\mathbf{<integer>}(\mathbf{asType}\mathbf{<int>}(\$heap_{funcstart\_719,1}.a2))) ==$
$\mathbf{asType}\mathbf{<integer>}(\mathrm{div2.quot})$

$(\mathbf{asType}\mathbf{<integer>}(\mathbf{asType}\mathbf{<int>}(\$heap_{funcstart\_719,1}.p2))\ \%$
$\mathbf{asType}\mathbf{<integer>}(\mathbf{asType}\mathbf{<int>}(\$heap_{funcstart\_719,1}.a2))) ==$
$\mathbf{asType}\mathbf{<integer>}(\mathrm{div2.rem})$

$\mathrm{div3} == \mathrm{div}(\mathbf{heapIs}\ \$heap_{funcstart\_719,1},$
$\mathbf{asType}\mathbf{<int>}(\$heap_{funcstart\_719,1}.p3),$
$\mathbf{asType}\mathbf{<int>}(\$heap_{funcstart\_719,1}.a3))$

$(\mathbf{asType}\mathbf{<integer>}(\mathbf{asType}\mathbf{<int>}(\$heap_{funcstart\_719,1}.p3))\ /$
$\mathbf{asType}\mathbf{<integer>}(\mathbf{asType}\mathbf{<int>}(\$heap_{funcstart\_719,1}.a3))) ==$
$\mathbf{asType}\mathbf{<integer>}(\mathrm{div3.quot})$

$(\mathbf{asType}\mathbf{<integer>}(\mathbf{asType}\mathbf{<int>}(\$heap_{funcstart\_719,1}.p3))\ \%$
$\mathbf{asType}\mathbf{<integer>}(\mathbf{asType}\mathbf{<int>}(\$heap_{funcstart\_719,1}.a3))) ==$
$\mathbf{asType}\mathbf{<integer>}(\mathrm{div3.rem})$

$\$heap_{719,1;729,8} == \$heap_{funcstart\_719,1}.\mathbf{\_replace}(p1 \rightarrow \mathbf{asType}\mathbf{<short}$
$\mathbf{int>}((\mathbf{asType}\mathbf{<int>}(\mathbf{asType}\mathbf{<short\ int>}(\mathrm{div1.rem}))\ *$
$\mathbf{asType}\mathbf{<int>}(\$heap_{funcstart\_719,1}.r1)) - (\mathbf{asType}\mathbf{<int>}(\mathbf{asType}\mathbf{<short}$
$\mathbf{int>}(\mathrm{div1.quot}))\ *\ \mathbf{asType}\mathbf{<int>}(\$heap_{funcstart\_719,1}.b1))))$

Proof:

[Take given term]

[5.0] $\mathrm{div1} == \mathrm{div}(\mathbf{heapIs}\ \$heap_{funcstart\_719,1},$
$\mathbf{asType}\mathbf{<int>}(\$heap_{funcstart\_719,1}.p1),$

asType<int>($\text{heap}_{funcstart\_719,1}$.a1))

$\rightarrow$ *[simplify]*

[5.1] div1 == div(**heapIs** $\text{heap}_{funcstart\_719,1}$, $\text{heap}_{funcstart\_719,1}$.p1,
asType<int>($\text{heap}_{funcstart\_719,1}$.a1))

$\rightarrow$ *[const static or extern object]*

[5.2] div1 == div(**heapIs** $\text{heap}_{funcstart\_719,1}$, $\text{heap}_{funcstart\_719,1}$.p1,
asType<int>(heap_{init}.a1))

$\rightarrow$ *[expand definition of constant 'a1' at prang.c (16,20)]*

[5.3] div1 == div(**heapIs** $\text{heap}_{funcstart\_719,1}$, $\text{heap}_{funcstart\_719,1}$.p1,
asType<int>(**asType<short int>**((**int**)177)))

$\rightarrow$ *[simplify]*

[5.6] div1 == div(**heapIs** $\text{heap}_{funcstart\_719,1}$, $\text{heap}_{funcstart\_719,1}$.p1, 177)

[Take given term]

[12.0] div2 == div(**heapIs** $\text{heap}_{funcstart\_719,1}$,
asType<int>($\text{heap}_{funcstart\_719,1}$.p2),
asType<int>($\text{heap}_{funcstart\_719,1}$.a2))

$\rightarrow$ *[simplify]*

[12.1] div2 == div(**heapIs** $\text{heap}_{funcstart\_719,1}$, $\text{heap}_{funcstart\_719,1}$.p2,
asType<int>($\text{heap}_{funcstart\_719,1}$.a2))

$\rightarrow$ *[const static or extern object]*

[12.2] div2 == div(**heapIs** $\text{heap}_{funcstart\_719,1}$, $\text{heap}_{funcstart\_719,1}$.p2,
asType<int>(heap_{init}.a2))

$\rightarrow$ *[expand definition of constant 'a2' at prang.c (21,20)]*

[12.3] div2 == div(**heapIs** $\text{heap}_{funcstart\_719,1}$, $\text{heap}_{funcstart\_719,1}$.p2,
asType<int>(**asType<short int>**((**int**)176)))

$\rightarrow$ *[simplify]*

[12.6] div2 == div(**heapIs** $\text{heap}_{funcstart\_719,1}$, $\text{heap}_{funcstart\_719,1}$.p2, 176)

[Assume known post-assertion, class invariant or type constraint for term 12.6]

[15.0] **minof(short int)** $\leq$ $\text{heap}_{funcstart\_719,1}$.p2

$\rightarrow$ *[simplify]*

[15.3] -32769 $<$ $\text{heap}_{funcstart\_719,1}$.p2

[Assume known post-assertion, class invariant or type constraint for term 12.6]

[17.0] (**asType<integer>**($\text{heap}_{funcstart\_719,1}$.p2) /
asType<integer>(176)) == **asType<integer>**(div(**heapIs**
$\text{heap}_{funcstart\_719,1}$, $\text{heap}_{funcstart\_719,1}$.p2, 176).quot)

$\rightarrow$ *[simplify]*

[17.2] ($heap_{funcstart\_719,1}$.p2 / 176) == **asType<integer>**(div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p2, 176).quot)

$\rightarrow$ *[expand definition of operator './' in class 'int' at built in declaration]*

[17.3] ([**asType<integer>**($heap_{funcstart\_719,1}$.p2) < 0]: $-(-$**asType<integer>**($heap_{funcstart\_719,1}$.p2) / 176), []: **asType<integer>**($heap_{funcstart\_719,1}$.p2) / 176) == **asType<integer>**(div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p2, 176).quot)

$\rightarrow$ *[explicitly assert falsehood of skipped guards in subsequent guards]*

[17.4] ([**asType<integer>**($heap_{funcstart\_719,1}$.p2) < 0]: $-(-$**asType<integer>**($heap_{funcstart\_719,1}$.p2) / 176), [!(**asType<integer>**($heap_{funcstart\_719,1}$.p2) < 0)]: **asType<integer>**($heap_{funcstart\_719,1}$.p2) / 176) == **asType<integer>**(div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p2, 176).quot)

$\rightarrow$ *[simplify]*

[17.17] 0 == ($-$([0 < $-$$heap_{funcstart\_719,1}$.p2]: $-(-$$heap_{funcstart_719,1}$.p2 / 176), [-1 < $heap_{funcstart\_719,1}$.p2]: $heap_{funcstart\_719,1}$.p2 / 176) + div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p2, 176).quot)

$\rightarrow$ *[move guard outside expression]*

[17.18] 0 == (([0 < $-$$heap_{funcstart\_719,1}$.p2]: $-(-(-$$heap_{funcstart_719,1}$.p2 / 176)), [-1 < $heap_{funcstart\_719,1}$.p2]: $-$($heap_{funcstart\_719,1}$.p2 / 176)) + div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p2, 176).quot)

$\rightarrow$ *[simplify]*

[17.19] 0 == (([0 < $-$$heap_{funcstart\_719,1}$.p2]: $-$$heap_{funcstart_719,1}$.p2 / 176, [-1 < $heap_{funcstart\_719,1}$.p2]: $-$($heap_{funcstart\_719,1}$.p2 / 176)) + div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p2, 176).quot)

$\rightarrow$ *[move guard outside expression]*

[17.21] ([0 < $-$$heap_{funcstart\_719,1}$.p2]: 0 == (($-$$heap_{funcstart_719,1}$.p2 / 176) + div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p2, 176).quot), [-1 < $heap_{funcstart\_719,1}$.p2]: 0 == ($-$($heap_{funcstart\_719,1}$.p2 / 176) + div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p2, 176).quot))

[Take given term]

[26.0] $heap_{719,1;729,8}$ == $heap_{funcstart\_719,1}$.**replace**(p1 $\rightarrow$ **asType<short int>**((**asType<int>**(**asType<short int>**(div1.rem)) * **asType<int>**($heap_{funcstart\_719,1}$.r1)) $-$ (**asType<int>**(**asType<short int>**(div1.quot)) * **asType<int>**($heap_{funcstart\_719,1}$.b1))))

$\rightarrow$ *[from term 5.6, div1 is equal to div(**heapIs** $heap_{funcstart\_719,1}$,*

$heap_{funcstart_719,1}.p1, 177)]

[26.1] $heap_{719,1;729,8}$ == $heap_{funcstart\_719,1}.$**replace**(p1 → **asType<short int>**((**asType<int>**(**asType<short int>**(div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}.$p1, 177).rem)) * **asType<int>**($heap_{funcstart\_719,1}.$r1)) − (**asType<int>**(**asType<short int>**(div1.quot)) * **asType<int>**($heap_{funcstart\_719,1}.$b1))))

→ *[simplify]*

[26.3] $heap_{719,1;729,8}$ == $heap_{funcstart\_719,1}.$**replace**(p1 → **asType<short int>**((div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}.$p1, 177).rem * **asType<int>**($heap_{funcstart\_719,1}.$r1)) − (**asType<int>**(**asType<short int>**(div1.quot)) * **asType<int>**($heap_{funcstart\_719,1}.$b1))))

→ *[const static or extern object]*

[26.4] $heap_{719,1;729,8}$ == $heap_{funcstart\_719,1}.$**replace**(p1 → **asType<short int>**((div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}.$p1, 177).rem * **asType<int>**($heap_{init}.$r1)) − (**asType<int>**(**asType<short int>**(div1.quot)) * **asType<int>**($heap_{funcstart\_719,1}.$b1))))

→ *[expand definition of constant 'r1' at prang.c (15,20)]*

[26.5] $heap_{719,1;729,8}$ == $heap_{funcstart\_719,1}.$**replace**(p1 → **asType<short int>**((div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}.$p1, 177).rem * **asType<int>**(**asType<short int>**((**int**)171))) − (**asType<int>**(**asType<short int>**(div1.quot)) * **asType<int>**($heap_{funcstart\_719,1}.$b1))))

→ *[simplify]*

[26.8] $heap_{719,1;729,8}$ == $heap_{funcstart\_719,1}.$**replace**(p1 → **asType<short int>**((div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}.$p1, 177).rem * 171) − (**asType<int>**(**asType<short int>**(div1.quot)) * **asType<int>**($heap_{funcstart\_719,1}.$b1))))

→ *[from term 5.6, div1 is equal to div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}.$p1, 177)]*

[26.9] $heap_{719,1;729,8}$ == $heap_{funcstart\_719,1}.$**replace**(p1 → **asType<short int>**((171 * div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}.$p1, 177).rem) − (**asType<int>**(**asType<short int>**(div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}.$p1, 177).quot)) * **asType<int>**($heap_{funcstart\_719,1}.$b1))))

→ *[simplify]*

[26.11] $heap_{719,1;729,8}$ == $heap_{funcstart\_719,1}.$**replace**(p1 → **asType<short int>**((171 * div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}.$p1, 177).rem) − (div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}.$p1, 177).quot * **asType<int>**($heap_{funcstart\_719,1}.$b1))))

→ *[const static or extern object]*

[26.12] $heap_{719,1;729,8}$ == $heap_{funcstart\_719,1}$.__replace__(p1 → **asType<short int>**((171 * div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p1, 177).rem) − (div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p1, 177).quot * **asType<int>**($heap_{init}$.b1))))

→ *[expand definition of constant 'b1' at prang.c (17,20)]*

[26.13] $heap_{719,1;729,8}$ == $heap_{funcstart\_719,1}$.__replace__(p1 → **asType<short int>**((171 * div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p1, 177).rem) − (div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p1, 177).quot * **asType<int>**(**asType<short int>**((**int**)2)))))

→ *[simplify]*

[26.19] $heap_{719,1;729,8}$ == $heap_{funcstart\_719,1}$.__replace__(p1 → ((-2 * div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p1, 177).rem)))

[Take goal term]

[1.0] **minof(int)** ≤ (**asType<int>**(**asType<short int>**(div2.quot)) * **asType<int>**($heap_{719,1;729,8}$.b2))

→ *[simplify]*

[1.1] -32768 ≤ (**asType<int>**(**asType<short int>**(div2.quot)) * **asType<int>**($heap_{719,1;729,8}$.b2))

→ *[from term 12.6, div2 is equal to div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p2, 176)]*

[1.2] -32768 ≤ (**asType<int>**(**asType<short int>**(div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p2, 176).quot)) * **asType<int>**($heap_{719,1;729,8}$.b2))

→ *[simplify]*

[1.4] -32768 ≤ (div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p2, 176).quot * **asType<int>**($heap_{719,1;729,8}$.b2))

→ *[from term 26.19, $heap_{719,1;729,8}$ is equal to $heap_{funcstart\_719,1}$.__replace__(p1 → (-2 * div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p1, 177).rem))]*

[1.5] -32768 ≤ (div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p2, 176).quot * **asType<int>**($heap_{funcstart\_719,1}$.__replace__(p1 → ((-2 * div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p1, 177).rem))).b2))

→ *[const member of object with modified fields]*

[1.6] -32768 ≤ (div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p2, 176).quot * **asType<int>**($heap_{funcstart\_719,1}$.b2))

$\rightarrow$ *[const static or extern object]*

[1.7] -32768 $\leq$ (div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).quot * **asType**<**int**>($\$heap_{init}$.b2))

$\rightarrow$ *[expand definition of constant 'b2' at prang.c (22,20)]*

[1.8] -32768 $\leq$ (div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).quot * **asType**<**int**>(**asType**<**short int**>((**int**)35)))

$\rightarrow$ *[simplify]*

[1.13] -32769 < (35 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).quot)

$\rightarrow$ *[literal comparison of product]*

[1.14] ([35 < 0]: (-32769 / -35) < $-$div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).quot, [0 < 35]: (-32769 / 35) < div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).quot, [0 == 35]: -32769 < 0)

$\rightarrow$ *[explicitly assert falsehood of skipped guards in subsequent guards]*

[1.15] ([35 < 0]: (-32769 / -35) < $-$div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).quot, [(0 < 35) $\wedge$!(35 < 0)]: (-32769 / 35) < div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).quot, [(0 == 35) $\wedge$!(0 < 35) $\wedge$!(35 < 0)]: -32769 < 0)

$\rightarrow$ *[simplify]*

[1.23] -937 < div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).quot

$\rightarrow$ *[negate goal and search for contradiction]*

[1.24] !(-937 < div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).quot)

$\rightarrow$ *[simplify]*

[1.26] 936 < $-$div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).quot

[Branch on disjunction or conditional in term 17.21]

[38.0] (0 == (($-\$heap_{funcstart\_719,1}$.p2 / 176) + div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).quot)) $\vee$ (0 == ($-(\$heap_{funcstart\_719,1}$.p2 / 176) + div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).quot)) $\vee$ (-1 < $\$heap_{funcstart\_719,1}$.p2)

[Create new term from terms 1.26, 38.0 using rule: transitivity 16]

[50.0] ((0 + 936) < ($-\$heap_{funcstart\_719,1}$.p2 / 176)) $\vee$ (0 == ($-(\$heap_{funcstart\_719,1}$.p2 / 176) + div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).quot)) $\vee$ (-1 < $\$heap_{funcstart\_719,1}$.p2)

$\rightarrow$ *[simplify]*

[50.8] $(164911 < -\$\text{heap}_{funcstart\_719,1}.\text{p2}) \lor \ldots$

$\to$ *[from term 15.3, literala $< -\$heap_{funcstart\_719,1}.p2$ is false whenever -2 < (-32769 + literala)]*

Proof of rule precondition:

[50.8.0] -2 < (-32769 + 164911)

$\to$ *[simplify]*

[50.8.2] **true**

[50.9] **false** $\lor \ldots$

[Remove 'false' term 50.9 and fetch new term from containing clause]

[51.0] $0 == (-(\$\text{heap}_{funcstart\_719,1}.\text{p2} / 176) + \text{div}(\textbf{heapIs}$ $\$\text{heap}_{funcstart\_719,1}, \$\text{heap}_{funcstart\_719,1}.\text{p2}, 176).\text{quot})$

[Remove 'false' term 50.9 and fetch new term from containing clause]

[52.0] -1 $< \$\text{heap}_{funcstart\_719,1}.\text{p2}$

[Copy term 1.26]

[55.0] $936 < -\text{div}(\textbf{heapIs} \$\text{heap}_{funcstart\_719,1}, \$\text{heap}_{funcstart\_719,1}.\text{p2}, 176).\text{quot}$

$\to$ *[from term 51.0, div($\textbf{heapIs}$ $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}.p2$, 176).quot is equal to $\$heap_{funcstart\_719,1}.p2 / 176$]*

[55.1] $936 < -(\$\text{heap}_{funcstart\_719,1}.\text{p2} / 176)$

$\to$ *[simplify]*

[55.7] $164736 < -\$\text{heap}_{funcstart\_719,1}.\text{p2}$

$\to$ *[from term 52.0, literala $< -\$heap_{funcstart\_719,1}.p2$ is false whenever -2 < (-1 + literala)]*

Proof of rule precondition:

[55.7.0] -2 < (-1 + 164736)

$\to$ *[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 (48,38)

Condition defined at:

To prove: $(\textbf{asType}<\textbf{int}>(\textbf{asType}<\textbf{short int}>(\text{div2.quot})) *$ $\textbf{asType}<\textbf{int}>(\$\text{heap}_{719,1;729,8}.\text{b2})) \leq \textbf{maxof}(\textbf{int})$

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)

$\$heap_{init}$.M2 == **asType\<short int\>**((**int**)30307)

$\$heap_{init}$.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)

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

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

$\$heap_{init}$.b3 == **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)

div1 == div(**heapIs** $\$heap_{funcstart\_719,1}$,
asType\<int\>($\$heap_{funcstart\_719,1}$.p1),
asType\<int\>($\$heap_{funcstart\_719,1}$.a1))

(**asType\<integer\>**(**asType\<int\>**($\$heap_{funcstart\_719,1}$.p1)) /
asType\<integer\>(**asType\<int\>**($\$heap_{funcstart\_719,1}$.a1))) ==
asType\<integer\>(div1.quot)

(**asType\<integer\>**(**asType\<int\>**($\$heap_{funcstart\_719,1}$.p1)) %
asType\<integer\>(**asType\<int\>**($\$heap_{funcstart\_719,1}$.a1))) ==
asType\<integer\>(div1.rem)

div2 == div(**heapIs** $\$heap_{funcstart\_719,1}$,
asType\<int\>($\$heap_{funcstart\_719,1}$.p2),
asType\<int\>($\$heap_{funcstart\_719,1}$.a2))

(**asType\<integer\>**(**asType\<int\>**($\$heap_{funcstart\_719,1}$.p2)) /
asType\<integer\>(**asType\<int\>**($\$heap_{funcstart\_719,1}$.a2))) ==
asType\<integer\>(div2.quot)

(**asType\<integer\>**(**asType\<int\>**($\$heap_{funcstart\_719,1}$.p2)) %
asType\<integer\>(**asType\<int\>**($\$heap_{funcstart\_719,1}$.a2))) ==
asType\<integer\>(div2.rem)

div3 == div(**heapIs** $\$heap_{funcstart\_719,1}$,

asType\<int\>($\text{heap}_{funcstart\_719,1}$.p3),
asType\<int\>($\text{heap}_{funcstart\_719,1}$.a3))

(**asType\<integer\>**(**asType\<int\>**($\text{heap}_{funcstart\_719,1}$.p3)) /
asType\<integer\>(**asType\<int\>**($\text{heap}_{funcstart\_719,1}$.a3))) ==
asType\<integer\>(div3.quot)

(**asType\<integer\>**(**asType\<int\>**($\text{heap}_{funcstart\_719,1}$.p3)) %
asType\<integer\>(**asType\<int\>**($\text{heap}_{funcstart\_719,1}$.a3))) ==
asType\<integer\>(div3.rem)

$\text{heap}_{719,1;729,8}$ == $\text{heap}_{funcstart\_719,1}$._**replace**(p1 → **asType\<short
int\>**((**asType\<int\>**(**asType\<short int\>**(div1.rem)) *
asType\<int\>($\text{heap}_{funcstart\_719,1}$.r1)) − (**asType\<int\>**(**asType\<short
int\>**(div1.quot)) * **asType\<int\>**($\text{heap}_{funcstart\_719,1}$.b1))))

Proof:

[Take given term]

[5.0] div1 == div(**heapIs** $\text{heap}_{funcstart\_719,1}$,
asType\<int\>($\text{heap}_{funcstart\_719,1}$.p1),
asType\<int\>($\text{heap}_{funcstart\_719,1}$.a1))

→ *[simplify]*

[5.1] div1 == div(**heapIs** $\text{heap}_{funcstart\_719,1}$, $\text{heap}_{funcstart\_719,1}$.p1,
asType\<int\>($\text{heap}_{funcstart\_719,1}$.a1))

→ *[const static or extern object]*

[5.2] div1 == div(**heapIs** $\text{heap}_{funcstart\_719,1}$, $\text{heap}_{funcstart\_719,1}$.p1,
asType\<int\>(heap_{init}.a1))

→ *[expand definition of constant 'a1' at prang.c (16,20)]*

[5.3] div1 == div(**heapIs** $\text{heap}_{funcstart\_719,1}$, $\text{heap}_{funcstart\_719,1}$.p1,
asType\<int\>(**asType\<short int\>**((**int**)177)))

→ *[simplify]*

[5.6] div1 == div(**heapIs** $\text{heap}_{funcstart\_719,1}$, $\text{heap}_{funcstart\_719,1}$.p1, 177)

[Take given term]

[12.0] div2 == div(**heapIs** $\text{heap}_{funcstart\_719,1}$,
asType\<int\>($\text{heap}_{funcstart\_719,1}$.p2),
asType\<int\>($\text{heap}_{funcstart\_719,1}$.a2))

→ *[simplify]*

[12.1] div2 == div(**heapIs** $\text{heap}_{funcstart\_719,1}$, $\text{heap}_{funcstart\_719,1}$.p2,
asType\<int\>($\text{heap}_{funcstart\_719,1}$.a2))

→ *[const static or extern object]*

[12.2] div2 == div(**heapIs** $\text{heap}_{funcstart\_719,1}$, $\text{heap}_{funcstart\_719,1}$.p2,

asType<**int**>(heap_{init}.a2))

$\rightarrow$ *[expand definition of constant 'a2' at prang.c (21,20)]*

[12.3] div2 == div(**heapIs** $\text{heap}_{funcstart\_719,1}$, $\text{heap}_{funcstart\_719,1}$.p2, **asType**<**int**>(**asType**<**short int**>((**int**)176)))

$\rightarrow$ *[simplify]*

[12.6] div2 == div(**heapIs** $\text{heap}_{funcstart\_719,1}$, $\text{heap}_{funcstart\_719,1}$.p2, 176)

[Assume known post-assertion, class invariant or type constraint for term 12.6]

[16.0] $\text{heap}_{funcstart\_719,1}$.p2 $\leq$ **maxof**(**short int**)

$\rightarrow$ *[simplify]*

[16.9] -32768 $<$ $-\text{heap}_{funcstart\_719,1}$.p2

[Assume known post-assertion, class invariant or type constraint for term 12.6]

[17.0] (**asType**<**integer**>($\text{heap}_{funcstart\_719,1}$.p2) / **asType**<**integer**>(176)) == **asType**<**integer**>(div(**heapIs** $\text{heap}_{funcstart\_719,1}$, $\text{heap}_{funcstart\_719,1}$.p2, 176).quot)

$\rightarrow$ *[simplify]*

[17.2] ($\text{heap}_{funcstart\_719,1}$.p2 / 176) == **asType**<**integer**>(div(**heapIs** $\text{heap}_{funcstart\_719,1}$, $\text{heap}_{funcstart\_719,1}$.p2, 176).quot)

$\rightarrow$ *[expand definition of operator './' in class 'int' at built in declaration]*

[17.3] ([**asType**<**integer**>($\text{heap}_{funcstart\_719,1}$.p2) < 0]: $-(-$**asType**<**integer**>($\text{heap}_{funcstart\_719,1}$.p2) / 176), []: **asType**<**integer**>($\text{heap}_{funcstart\_719,1}$.p2) / 176) == **asType**<**integer**>(div(**heapIs** $\text{heap}_{funcstart\_719,1}$, $\text{heap}_{funcstart\_719,1}$.p2, 176).quot)

$\rightarrow$ *[explicitly assert falsehood of skipped guards in subsequent guards]*

[17.4] ([**asType**<**integer**>($\text{heap}_{funcstart\_719,1}$.p2) < 0]: $-(-$**asType**<**integer**>($\text{heap}_{funcstart\_719,1}$.p2) / 176), [!(**asType**<**integer**>($\text{heap}_{funcstart\_719,1}$.p2) < 0)]: **asType**<**integer**>($\text{heap}_{funcstart\_719,1}$.p2) / 176) == **asType**<**integer**>(div(**heapIs** $\text{heap}_{funcstart\_719,1}$, $\text{heap}_{funcstart\_719,1}$.p2, 176).quot)

$\rightarrow$ *[simplify]*

[17.17] 0 == ($-$([0 $< -\text{heap}_{funcstart\_719,1}$.p2]: $-(-\text{heap}_{funcstart\_719,1}$.p2 / 176), [-1 $< \text{heap}_{funcstart\_719,1}$.p2]: $\text{heap}_{funcstart\_719,1}$.p2 / 176) + div(**heapIs** $\text{heap}_{funcstart\_719,1}$, $\text{heap}_{funcstart\_719,1}$.p2, 176).quot)

$\rightarrow$ *[move guard outside expression]*

[17.18] 0 == (([0 $< -\text{heap}_{funcstart\_719,1}$.p2]: $-(-(-\text{heap}_{funcstart\_719,1}$.p2 / 176)), [-1 $< \text{heap}_{funcstart\_719,1}$.p2]: $-(\text{heap}_{funcstart\_719,1}$.p2 / 176)) +

div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).quot)

→ *[simplify]*

[17.19] 0 == ((([0 < −$\$heap_{funcstart\_719,1}$.p2]: −$\$heap_{funcstart\_719,1}$.p2 / 176, [-1 < $\$heap_{funcstart\_719,1}$.p2]: −($\$heap_{funcstart\_719,1}$.p2 / 176)) + div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).quot)

→ *[move guard outside expression]*

[17.21] ([0 < −$\$heap_{funcstart\_719,1}$.p2]: 0 == ((−$\$heap_{funcstart\_719,1}$.p2 / 176) + div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).quot), [-1 < $\$heap_{funcstart\_719,1}$.p2]: 0 == (−($\$heap_{funcstart\_719,1}$.p2 / 176) + div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).quot))

[Take given term]

[26.0] $\$heap_{719,1;729,8}$ == $\$heap_{funcstart\_719,1}$.**replace**(p1 → **asType\<short int\>**((**asType\<int\>**(**asType\<short int\>**(div1.rem)) * **asType\<int\>**($\$heap_{funcstart\_719,1}$.r1)) − (**asType\<int\>**(**asType\<short int\>**(div1.quot)) * **asType\<int\>**($\$heap_{funcstart\_719,1}$.b1))))

→ *[from term 5.6, div1 is equal to div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177)]*

[26.1] $\$heap_{719,1;729,8}$ == $\$heap_{funcstart\_719,1}$.**replace**(p1 → **asType\<short int\>**((**asType\<int\>**(**asType\<short int\>**(div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).rem)) * **asType\<int\>**($\$heap_{funcstart\_719,1}$.r1)) − (**asType\<int\>**(**asType\<short int\>**(div1.quot)) * **asType\<int\>**($\$heap_{funcstart\_719,1}$.b1))))

→ *[simplify]*

[26.3] $\$heap_{719,1;729,8}$ == $\$heap_{funcstart\_719,1}$.**replace**(p1 → **asType\<short int\>**((div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).rem * **asType\<int\>**($\$heap_{funcstart\_719,1}$.r1)) − (**asType\<int\>**(**asType\<short int\>**(div1.quot)) * **asType\<int\>**($\$heap_{funcstart\_719,1}$.b1))))

→ *[const static or extern object]*

[26.4] $\$heap_{719,1;729,8}$ == $\$heap_{funcstart\_719,1}$.**replace**(p1 → **asType\<short int\>**((div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).rem * **asType\<int\>**($\$heap_{init}$.r1)) − (**asType\<int\>**(**asType\<short int\>**(div1.quot)) * **asType\<int\>**($\$heap_{funcstart\_719,1}$.b1))))

→ *[expand definition of constant 'r1' at prang.c (15,20)]*

[26.5] $\$heap_{719,1;729,8}$ == $\$heap_{funcstart\_719,1}$.**replace**(p1 → **asType\<short int\>**((div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).rem * **asType\<int\>**(**asType\<short int\>**((**int**)171))) − (**asType\<int\>**(**asType\<short int\>**(div1.quot)) * **asType\<int\>**($\$heap_{funcstart\_719,1}$.b1))))

→ *[simplify]*

[26.8] $\$heap_{719,1;729,8}$ == $\$heap_{funcstart\_719,1}.\_\textbf{replace}(p1 \rightarrow \textbf{asType}<\textbf{short}$
$\textbf{int}>((\text{div}(\textbf{heapIs } \$heap_{funcstart\_719,1}, \$heap_{funcstart\_719,1}.p1, 177).\text{rem} * 171)$
$- (\textbf{asType}<\textbf{int}>(\textbf{asType}<\textbf{short int}>(\text{div1.quot})) *$
$\textbf{asType}<\textbf{int}>(\$heap_{funcstart\_719,1}.b1))))$

$\rightarrow$ *[from term 5.6, div1 is equal to div(**heapIs** $heap_{funcstart\_719,1}$,*
$heap_{funcstart_719,1}.p1, 177)]

[26.9] $\$heap_{719,1;729,8}$ == $\$heap_{funcstart\_719,1}.\_\textbf{replace}(p1 \rightarrow \textbf{asType}<\textbf{short}$
$\textbf{int}>((171 * \text{div}(\textbf{heapIs } \$heap_{funcstart\_719,1}, \$heap_{funcstart\_719,1}.p1, 177).\text{rem})$
$- (\textbf{asType}<\textbf{int}>(\textbf{asType}<\textbf{short int}>(\text{div}(\textbf{heapIs } \$heap_{funcstart\_719,1},$
$\$heap_{funcstart\_719,1}.p1, 177).\text{quot})) *$
$\textbf{asType}<\textbf{int}>(\$heap_{funcstart\_719,1}.b1))))$

$\rightarrow$ *[simplify]*

[26.11] $\$heap_{719,1;729,8}$ == $\$heap_{funcstart\_719,1}.\_\textbf{replace}(p1 \rightarrow \textbf{asType}<\textbf{short}$
$\textbf{int}>((171 * \text{div}(\textbf{heapIs } \$heap_{funcstart\_719,1}, \$heap_{funcstart\_719,1}.p1, 177).\text{rem})$
$- (\text{div}(\textbf{heapIs } \$heap_{funcstart\_719,1}, \$heap_{funcstart\_719,1}.p1, 177).\text{quot} *$
$\textbf{asType}<\textbf{int}>(\$heap_{funcstart\_719,1}.b1))))$

$\rightarrow$ *[const static or extern object]*

[26.12] $\$heap_{719,1;729,8}$ == $\$heap_{funcstart\_719,1}.\_\textbf{replace}(p1 \rightarrow \textbf{asType}<\textbf{short}$
$\textbf{int}>((171 * \text{div}(\textbf{heapIs } \$heap_{funcstart\_719,1}, \$heap_{funcstart\_719,1}.p1, 177).\text{rem})$
$- (\text{div}(\textbf{heapIs } \$heap_{funcstart\_719,1}, \$heap_{funcstart\_719,1}.p1, 177).\text{quot} *$
$\textbf{asType}<\textbf{int}>(\$heap_{init}.b1))))$

$\rightarrow$ *[expand definition of constant 'b1' at prang.c (17,20)]*

[26.13] $\$heap_{719,1;729,8}$ == $\$heap_{funcstart\_719,1}.\_\textbf{replace}(p1 \rightarrow \textbf{asType}<\textbf{short}$
$\textbf{int}>((171 * \text{div}(\textbf{heapIs } \$heap_{funcstart\_719,1}, \$heap_{funcstart\_719,1}.p1, 177).\text{rem})$
$- (\text{div}(\textbf{heapIs } \$heap_{funcstart\_719,1}, \$heap_{funcstart\_719,1}.p1, 177).\text{quot} *$
$\textbf{asType}<\textbf{int}>(\textbf{asType}<\textbf{short int}>((\textbf{int})2)))))$

$\rightarrow$ *[simplify]*

[26.19] $\$heap_{719,1;729,8}$ == $\$heap_{funcstart\_719,1}.\_\textbf{replace}(p1 \rightarrow ((-2 *$
$\text{div}(\textbf{heapIs } \$heap_{funcstart\_719,1}, \$heap_{funcstart\_719,1}.p1, 177).\text{quot}) + (171 *$
$\text{div}(\textbf{heapIs } \$heap_{funcstart\_719,1}, \$heap_{funcstart\_719,1}.p1, 177).\text{rem})))$

[Take goal term]

[1.0] $(\textbf{asType}<\textbf{int}>(\textbf{asType}<\textbf{short int}>(\text{div2.quot})) *$
$\textbf{asType}<\textbf{int}>(\$heap_{719,1;729,8}.b2)) \leq \textbf{maxof}(\textbf{int})$

$\rightarrow$ *[from term 12.6, div2 is equal to div(**heapIs** $heap_{funcstart\_719,1}$,*
$heap_{funcstart_719,1}.p2, 176)]

[1.1] $(\textbf{asType}<\textbf{int}>(\textbf{asType}<\textbf{short int}>(\text{div}(\textbf{heapIs } \$heap_{funcstart\_719,1},$
$\$heap_{funcstart\_719,1}.p2, 176).\text{quot})) * \textbf{asType}<\textbf{int}>(\$heap_{719,1;729,8}.b2)) \leq$
$\textbf{maxof}(\textbf{int})$

$\rightarrow$ *[simplify]*

[1.3] (div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).quot *
asType<**int**>($\$heap_{719,1;729,8}$.b2)) ≤ **maxof**(**int**)

→ *[from term 26.19, $\$heap_{719,1;729,8}$ is equal to*
*$\$heap_{funcstart\_719,1}$._**replace**(p1 → (-2 * div(**heapIs** $\$heap_{funcstart\_719,1}$,*
*$\$heap_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_719,1}$,*
$\$heap_{funcstart\_719,1}$.p1, 177).rem))]

[1.4] (div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).quot *
asType<**int**>($\$heap_{funcstart\_719,1}$._**replace**(p1 → ((-2 * div(**heapIs**
$\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs**
$\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).rem))).b2)) ≤ **maxof**(**int**)

→ *[const member of object with modified fields]*

[1.5] (div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).quot *
asType<**int**>($\$heap_{funcstart\_719,1}$.b2)) ≤ **maxof**(**int**)

→ *[const static or extern object]*

[1.6] (div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).quot *
asType<**int**>($\$heap_{init}$.b2)) ≤ **maxof**(**int**)

→ *[expand definition of constant 'b2' at prang.c (22,20)]*

[1.7] (div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).quot *
asType<**int**>(**asType**<**short int**>((**int**)35))) ≤ **maxof**(**int**)

→ *[simplify]*

[1.20] -32768 < (-35 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2,
176).quot)

→ *[literal comparison of product]*

[1.21] ([-35 < 0]: (-32768 / 35) < −div(**heapIs** $\$heap_{funcstart\_719,1}$,
$\$heap_{funcstart\_719,1}$.p2, 176).quot, [0 < -35]: (-32768 / -35) < div(**heapIs**
$\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).quot, [-35 == 0]: -32768 < 0)

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

[1.22] ([-35 < 0]: (-32768 / 35) < −div(**heapIs** $\$heap_{funcstart\_719,1}$,
$\$heap_{funcstart\_719,1}$.p2, 176).quot, [(0 < -35) ∧ !(-35 < 0)]: (-32768 / -35) <
div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).quot, [(-35 == 0)
∧ !(-35 < 0) ∧ !(0 < -35)]: -32768 < 0)

→ *[simplify]*

[1.26] -937 < −div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2,
176).quot

→ *[negate goal and search for contradiction]*

[1.27] !(-937 < −div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2,
176).quot)

→ *[simplify]*

[1.30] $936 < \text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_719,1}, \$\text{heap}_{funcstart\_719,1}.\text{p2}, 176).\text{quot}$

[Branch on disjunction or conditional in term 17.21]

[38.0] $(0 == ((-\$\text{heap}_{funcstart\_719,1}.\text{p2} \,/\, 176) + \text{div}(\textbf{heapIs}$
$\$\text{heap}_{funcstart\_719,1}, \$\text{heap}_{funcstart\_719,1}.\text{p2}, 176).\text{quot})) \vee (0 ==$
$(-(\$\text{heap}_{funcstart\_719,1}.\text{p2} \,/\, 176) + \text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_719,1},$
$\$\text{heap}_{funcstart\_719,1}.\text{p2}, 176).\text{quot})) \vee (\text{-1} < \$\text{heap}_{funcstart\_719,1}.\text{p2})$

[Branch on disjunction or conditional in term 17.21]

[39.0] $(0 < -\$\text{heap}_{funcstart\_719,1}.\text{p2}) \vee (0 == (-(\$\text{heap}_{funcstart\_719,1}.\text{p2} \,/\,$
$176) + \text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_719,1}, \$\text{heap}_{funcstart\_719,1}.\text{p2}, 176).\text{quot})) \vee$
$(\text{-1} < \$\text{heap}_{funcstart\_719,1}.\text{p2})$

[Create new term from terms 1.30, 38.0 using rule: transitivity 15]

[50.0] $((0 + 936) < -(-\$\text{heap}_{funcstart\_719,1}.\text{p2} \,/\, 176)) \vee (0 ==$
$(-(\$\text{heap}_{funcstart\_719,1}.\text{p2} \,/\, 176) + \text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_719,1},$
$\$\text{heap}_{funcstart\_719,1}.\text{p2}, 176).\text{quot})) \vee (\text{-1} < \$\text{heap}_{funcstart\_719,1}.\text{p2})$

$\rightarrow$ *[simplify]*

[50.8] $(164736 < \$\text{heap}_{funcstart\_719,1}.\text{p2}) \vee ...$

$\rightarrow$ *[from term 39.0, literala $< \$heap_{funcstart\_719,1}.p2$ is false whenever -2 $< (0$
$+ literala)]$*

> **Proof of rule precondition:**
>
> *[50.8.0]* $\text{-2} < (0 + 164736)$
>
> $\rightarrow$ *[simplify]*
>
> *[50.8.2]* **true**

[50.9] **false** $\vee ...$

[Remove 'false' term 50.9 and fetch new term from containing clause]

[51.0] $0 == (-(\$\text{heap}_{funcstart\_719,1}.\text{p2} \,/\, 176) + \text{div}(\textbf{heapIs}$
$\$\text{heap}_{funcstart\_719,1}, \$\text{heap}_{funcstart\_719,1}.\text{p2}, 176).\text{quot})$

[Copy term 1.30]

[55.0] $936 < \text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_719,1}, \$\text{heap}_{funcstart\_719,1}.\text{p2}, 176).\text{quot}$

$\rightarrow$ *[from term 51.0, div($\textbf{heapIs}$ $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}.p2$,
176).quot is equal to $\$heap_{funcstart\_719,1}.p2 \,/\, 176]$*

[55.1] $936 < (\$\text{heap}_{funcstart\_719,1}.\text{p2} \,/\, 176)$

$\rightarrow$ *[simplify]*

[55.8] $164911 < \$\text{heap}_{funcstart\_719,1}.\text{p2}$

$\rightarrow$ *[from term 16.9, literala $< \$heap_{funcstart\_719,1}.p2$ is false whenever -2 $<$
$(-32768 + literala)]$*

> **Proof of rule precondition:**

[55.8.0] -2 < (-32768 + 164911)

$\rightarrow$ *[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 (48,33)

Condition defined at:

To prove: minof(short int) $\leq$ **((asType<int>(asType<short int>(div2.rem)) * asType<int>($heap$_{719,1;729,8}$.r2)) $-$ (asType<int>(asType<short int>(div2.quot)) * asType<int>($heap$_{719,1;729,8}$.b2)))**

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)

$heap$_{init}$.M2 == **asType<short int>**((**int**)30307)

$heap$_{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)

$heap$_{init}$.r3 == **asType<short int>**((**int**)170)

$heap$_{init}$.a3 == **asType<short int>**((**int**)178)

$heap$_{init}$.b3 == **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)

div1 == div(**heapIs** $heap$_{funcstart_719,1}$, **asType<int>**($heap$_{funcstart\_719,1}$.p1), **asType<int>**($heap$_{funcstart_719,1}$.a1))

(**asType<integer>**(**asType<int>**($heap$_{funcstart_719,1}$.p1)) / **asType<integer>**(**asType<int>**($heap$_{funcstart\_719,1}$.a1))) ==

asType<integer>(div1.quot)

(asType<integer>(**asType<int>**($heap$_{funcstart_719,1}$.p1)) %
asType<integer>(**asType<int>**($heap$_{funcstart_719,1}$.a1))) ==
asType<integer>(div1.rem)

div2 == div(**heapIs** $heap$_{funcstart_719,1}$,
asType<int>($heap$_{funcstart_719,1}$.p2),
asType<int>($heap$_{funcstart_719,1}$.a2))

(asType<integer>(**asType<int>**($heap$_{funcstart_719,1}$.p2)) /
asType<integer>(**asType<int>**($heap$_{funcstart_719,1}$.a2))) ==
asType<integer>(div2.quot)

(asType<integer>(**asType<int>**($heap$_{funcstart_719,1}$.p2)) %
asType<integer>(**asType<int>**($heap$_{funcstart_719,1}$.a2))) ==
asType<integer>(div2.rem)

div3 == div(**heapIs** $heap$_{funcstart_719,1}$,
asType<int>($heap$_{funcstart_719,1}$.p3),
asType<int>($heap$_{funcstart_719,1}$.a3))

(asType<integer>(**asType<int>**($heap$_{funcstart_719,1}$.p3)) /
asType<integer>(**asType<int>**($heap$_{funcstart_719,1}$.a3))) ==
asType<integer>(div3.quot)

(asType<integer>(**asType<int>**($heap$_{funcstart_719,1}$.p3)) %
asType<integer>(**asType<int>**($heap$_{funcstart_719,1}$.a3))) ==
asType<integer>(div3.rem)

$heap$_{719,1;729,8}$ == $heap$_{funcstart_719,1}$._**replace**(p1 → **asType<short
int>**((**asType<int>**(**asType<short int>**(div1.rem)) *
asType<int>($heap$_{funcstart_719,1}$.r1)) − (**asType<int>**(**asType<short
int>**(div1.quot)) * **asType<int>**($heap$_{funcstart_719,1}$.b1))))

Proof:

[Take given term]

[5.0] div1 == div(**heapIs** $heap$_{funcstart_719,1}$,
asType<int>($heap$_{funcstart_719,1}$.p1),
asType<int>($heap$_{funcstart_719,1}$.a1))

→ *[simplify]*

[5.1] div1 == div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1,
asType<int>($heap$_{funcstart_719,1}$.a1))

→ *[const static or extern object]*

[5.2] div1 == div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1,
asType<int>($heap$_{init}$.a1))

→ *[expand definition of constant 'a1' at prang.c (16,20)]*

[5.3] div1 == div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1,
asType<int>(**asType<short int>**((**int**)177)))

$\rightarrow$ *[simplify]*

[5.6] div1 == div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177)

[Take given term]

[12.0] div2 == div(**heapIs** $\$heap_{funcstart\_719,1}$,
asType<int>($\$heap_{funcstart\_719,1}$.p2),
asType<int>($\$heap_{funcstart\_719,1}$.a2))

$\rightarrow$ *[simplify]*

[12.1] div2 == div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2,
asType<int>($\$heap_{funcstart\_719,1}$.a2))

$\rightarrow$ *[const static or extern object]*

[12.2] div2 == div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2,
asType<int>($\$heap_{init}$.a2))

$\rightarrow$ *[expand definition of constant 'a2' at prang.c (21,20)]*

[12.3] div2 == div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2,
asType<int>(**asType<short int>**((**int**)176)))

$\rightarrow$ *[simplify]*

[12.6] div2 == div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176)

[Assume known post-assertion, class invariant or type constraint for term 12.6]

[16.0] $\$heap_{funcstart\_719,1}$.p2 $\leq$ **maxof(short int)**

$\rightarrow$ *[simplify]*

[16.9] -32768 $< -\$heap_{funcstart\_719,1}$.p2

[Assume known post-assertion, class invariant or type constraint for term 12.6]

[17.0] (**asType<integer>**($\$heap_{funcstart\_719,1}$.p2) /
asType<integer>(176)) == **asType<integer>**(div(**heapIs**
$\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).quot)

$\rightarrow$ *[simplify]*

[17.2] ($\$heap_{funcstart\_719,1}$.p2 / 176) == **asType<integer>**(div(**heapIs**
$\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).quot)

$\rightarrow$ *[expand definition of operator './' in class 'int' at built in declaration]*

[17.3] ([**asType<integer>**($\$heap_{funcstart\_719,1}$.p2) < 0]:
$-(-$**asType<integer>**($\$heap_{funcstart\_719,1}$.p2) / 176), []:
asType<integer>($\$heap_{funcstart\_719,1}$.p2) / 176) ==
asType<integer>(div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2,
176).quot)

$\rightarrow$ *[explicitly assert falsehood of skipped guards in subsequent guards]*

[17.4] ([**asType<integer>**($\text{\$heap}_{funcstart\_719,1}$.p2) < 0]:
$-(-$**asType<integer>**($\text{\$heap}_{funcstart\_719,1}$.p2) / 176),
[!(**asType<integer>**($\text{\$heap}_{funcstart\_719,1}$.p2) < 0)]:
asType<integer>($\text{\$heap}_{funcstart\_719,1}$.p2) / 176) ==
asType<integer>(div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p2,
176).quot)

$\rightarrow$ *[simplify]*

[17.17] 0 == ($-$([0 < $-\text{\$heap}_{funcstart\_719,1}$.p2]: $-(-\text{\$heap}_{funcstart\_719,1}$.p2 /
176), [-1 < $\text{\$heap}_{funcstart\_719,1}$.p2]: $\text{\$heap}_{funcstart\_719,1}$.p2 / 176) +
div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p2, 176).quot)

$\rightarrow$ *[move guard outside expression]*

[17.18] 0 == ((([0 < $-\text{\$heap}_{funcstart\_719,1}$.p2]: $-(-(-\text{\$heap}_{funcstart\_719,1}$.p2 /
176)), [-1 < $\text{\$heap}_{funcstart\_719,1}$.p2]: $-(\text{\$heap}_{funcstart\_719,1}$.p2 / 176)) +
div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p2, 176).quot)

$\rightarrow$ *[simplify]*

[17.19] 0 == (([0 < $-\text{\$heap}_{funcstart\_719,1}$.p2]: $-\text{\$heap}_{funcstart\_719,1}$.p2 / 176,
[-1 < $\text{\$heap}_{funcstart\_719,1}$.p2]: $-(\text{\$heap}_{funcstart\_719,1}$.p2 / 176)) + div(**heapIs**
$\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p2, 176).quot)

$\rightarrow$ *[move guard outside expression]*

[17.21] ([0 < $-\text{\$heap}_{funcstart\_719,1}$.p2]: 0 == (($-\text{\$heap}_{funcstart\_719,1}$.p2 / 176)
+ div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p2, 176).quot), [-1 <
$\text{\$heap}_{funcstart\_719,1}$.p2]: 0 == ($-(\text{\$heap}_{funcstart\_719,1}$.p2 / 176) + div(**heapIs**
$\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p2, 176).quot))

[Assume known post-assertion, class invariant or type constraint for term 12.6]

[18.0] (**asType<integer>**($\text{\$heap}_{funcstart\_719,1}$.p2) %
asType<integer>(176)) == **asType<integer>**(div(**heapIs**
$\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p2, 176).rem)

$\rightarrow$ *[simplify]*

[18.2] ($\text{\$heap}_{funcstart\_719,1}$.p2 % 176) == **asType<integer>**(div(**heapIs**
$\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p2, 176).rem)

$\rightarrow$ *[expand definition of operator '.%' in class 'int' at built in declaration]*

[18.3] ([**asType<integer>**($\text{\$heap}_{funcstart\_719,1}$.p2) < 0]:
$-(-$**asType<integer>**($\text{\$heap}_{funcstart\_719,1}$.p2) % 176), []:
asType<integer>($\text{\$heap}_{funcstart\_719,1}$.p2) % 176) ==
asType<integer>(div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p2,
176).rem)

$\rightarrow$ *[explicitly assert falsehood of skipped guards in subsequent guards]*

[18.4] ([**asType**<**integer**>($heap$_{funcstart_719,1}$.p2) < 0]:
−(−**asType**<**integer**>($heap$_{funcstart_719,1}$.p2) % 176),
[!(**asType**<**integer**>($heap$_{funcstart_719,1}$.p2) < 0)]:
asType<**integer**>($heap$_{funcstart_719,1}$.p2) % 176) ==
asType<**integer**>(div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p2,
176).rem)

→ *[simplify]*

[18.14] ([0 < −$heap$_{funcstart_719,1}$.p2]: −(−$heap$_{funcstart\_719,1}$.p2 % 176), [-1
< $heap$_{funcstart_719,1}$.p2]: **asType**<**integer**>($heap$_{funcstart\_719,1}$.p2) % 176)
== **asType**<**integer**>(div(**heapIs** $heap$_{funcstart_719,1}$,
$heap$_{funcstart_719,1}$.p2, 176).rem)

→ *[remainder of negation]*

[18.15] ([0 < −$heap$_{funcstart_719,1}$.p2]: −([0 == ($heap$_{funcstart\_719,1}$.p2 %
176)]: 0, []: 176 + −($heap$_{funcstart_719,1}$.p2 % 176)), [-1 <
$heap$_{funcstart_719,1}$.p2]: **asType**<**integer**>($heap$_{funcstart\_719,1}$.p2) % 176)
== **asType**<**integer**>(div(**heapIs** $heap$_{funcstart_719,1}$,
$heap$_{funcstart_719,1}$.p2, 176).rem)

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

[18.16] ([0 < −$heap$_{funcstart_719,1}$.p2]: −([0 == ($heap$_{funcstart\_719,1}$.p2 %
176)]: 0, [!(0 == ($heap$_{funcstart_719,1}$.p2 % 176))]: 176 +
−($heap$_{funcstart_719,1}$.p2 % 176)), [-1 < $heap$_{funcstart_719,1}$.p2]:
asType<**integer**>($heap$_{funcstart_719,1}$.p2) % 176) ==
asType<**integer**>(div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p2,
176).rem)

→ *[move guard outside expression]*

[18.17] ([0 < −$heap$_{funcstart_719,1}$.p2]: ([0 == ($heap$_{funcstart\_719,1}$.p2 %
176)]: −0, [!(0 == ($heap$_{funcstart_719,1}$.p2 % 176))]: −(176 +
−($heap$_{funcstart_719,1}$.p2 % 176))), [-1 < $heap$_{funcstart_719,1}$.p2]:
asType<**integer**>($heap$_{funcstart_719,1}$.p2) % 176) ==
asType<**integer**>(div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p2,
176).rem)

→ *[simplify]*

[18.24] 0 == (−([0 < −$heap$_{funcstart_719,1}$.p2]: ([0 ==
($heap$_{funcstart_719,1}$.p2 % 176)]: 0, [!(0 == ($heap$_{funcstart\_719,1}$.p2 % 176))]:
-176 + ($heap$_{funcstart_719,1}$.p2 % 176)), [-1 < $heap$_{funcstart_719,1}$.p2]:
$heap$_{funcstart_719,1}$.p2 % 176) + div(**heapIs** $heap$_{funcstart_719,1}$,
$heap$_{funcstart_719,1}$.p2, 176).rem)

→ *[move guard outside expression]*

[18.26] 0 == (([0 < −$heap$_{funcstart_719,1}$.p2]: ([0 == ($heap$_{funcstart\_719,1}$.p2
% 176)]: −0, [!(0 == ($heap$_{funcstart_719,1}$.p2 % 176))]: −(-176 +
($heap$_{funcstart_719,1}$.p2 % 176))), [-1 < $heap$_{funcstart_719,1}$.p2]:

$-(\$\text{heap}_{funcstart\_719,1}.\text{p2 \% 176})) + \text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_719,1},$
$\$\text{heap}_{funcstart\_719,1}.\text{p2}, 176).\text{rem})$

$\rightarrow$ *[simplify]*

[18.29] $0 == (([0 < -\$\text{heap}_{funcstart\_719,1}.\text{p2}]: ([0 == (\$\text{heap}_{funcstart\_719,1}.\text{p2}$
$\text{\% 176})]: 0, [!(0 == (\$\text{heap}_{funcstart\_719,1}.\text{p2 \% 176}))]: 176 +$
$-(\$\text{heap}_{funcstart\_719,1}.\text{p2 \% 176})), [-1 < \$\text{heap}_{funcstart\_719,1}.\text{p2}]:$
$-(\$\text{heap}_{funcstart\_719,1}.\text{p2 \% 176})) + \text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_719,1},$
$\$\text{heap}_{funcstart\_719,1}.\text{p2}, 176).\text{rem})$

$\rightarrow$ *[move guard outside expression]*

[18.31] $0 == ([0 < -\$\text{heap}_{funcstart\_719,1}.\text{p2}]: ([0 == (\$\text{heap}_{funcstart\_719,1}.\text{p2 \%}$
$176)]: 0 + \text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_719,1}, \$\text{heap}_{funcstart\_719,1}.\text{p2}, 176).\text{rem},$
$[!(0 == (\$\text{heap}_{funcstart\_719,1}.\text{p2 \% 176}))]: (176 + -(\$\text{heap}_{funcstart\_719,1}.\text{p2 \%}$
$176)) + \text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_719,1}, \$\text{heap}_{funcstart\_719,1}.\text{p2}, 176).\text{rem}), [-1$
$< \$\text{heap}_{funcstart\_719,1}.\text{p2}]: -(\$\text{heap}_{funcstart\_719,1}.\text{p2 \% 176}) + \text{div}(\textbf{heapIs}$
$\$\text{heap}_{funcstart\_719,1}, \$\text{heap}_{funcstart\_719,1}.\text{p2}, 176).\text{rem})$

$\rightarrow$ *[simplify]*

[18.33] $0 == ([0 < -\$\text{heap}_{funcstart\_719,1}.\text{p2}]: ([0 == (\$\text{heap}_{funcstart\_719,1}.\text{p2}$
$\text{\% 176})]: \text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_719,1}, \$\text{heap}_{funcstart\_719,1}.\text{p2}, 176).\text{rem},$
$[!(0 == (\$\text{heap}_{funcstart\_719,1}.\text{p2 \% 176}))]: 176 + -(\$\text{heap}_{funcstart\_719,1}.\text{p2 \%}$
$176) + \text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_719,1}, \$\text{heap}_{funcstart\_719,1}.\text{p2}, 176).\text{rem}), [-1$
$< \$\text{heap}_{funcstart\_719,1}.\text{p2}]: -(\$\text{heap}_{funcstart\_719,1}.\text{p2 \% 176}) + \text{div}(\textbf{heapIs}$
$\$\text{heap}_{funcstart\_719,1}, \$\text{heap}_{funcstart\_719,1}.\text{p2}, 176).\text{rem})$

$\rightarrow$ *[move guard outside expression]*

[18.35] $([0 < -\$\text{heap}_{funcstart\_719,1}.\text{p2}]: ([0 == (\$\text{heap}_{funcstart\_719,1}.\text{p2 \% 176})]:$
$0 == \text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_719,1}, \$\text{heap}_{funcstart\_719,1}.\text{p2}, 176).\text{rem}, [!(0$
$== (\$\text{heap}_{funcstart\_719,1}.\text{p2 \% 176}))]: 0 == (176 + -(\$\text{heap}_{funcstart\_719,1}.\text{p2}$
$\text{\% 176}) + \text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_719,1}, \$\text{heap}_{funcstart\_719,1}.\text{p2}, 176).\text{rem})),$
$[-1 < \$\text{heap}_{funcstart\_719,1}.\text{p2}]: 0 == (-(\$\text{heap}_{funcstart\_719,1}.\text{p2 \% 176}) +$
$\text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_719,1}, \$\text{heap}_{funcstart\_719,1}.\text{p2}, 176).\text{rem}))$

$\rightarrow$ *[simplify]*

[18.40] $([0 < -\$\text{heap}_{funcstart\_719,1}.\text{p2}]: ([0 == (\$\text{heap}_{funcstart\_719,1}.\text{p2 \%}$
$176)]: 0 == \text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_719,1}, \$\text{heap}_{funcstart\_719,1}.\text{p2}, 176).\text{rem},$
$[!(0 == (\$\text{heap}_{funcstart\_719,1}.\text{p2 \% 176}))]: 176 == ((\$\text{heap}_{funcstart\_719,1}.\text{p2 \%}$
$176) + -\text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_719,1}, \$\text{heap}_{funcstart\_719,1}.\text{p2}, 176).\text{rem})),$
$[-1 < \$\text{heap}_{funcstart\_719,1}.\text{p2}]: 0 == (-(\$\text{heap}_{funcstart\_719,1}.\text{p2 \% 176}) +$
$\text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_719,1}, \$\text{heap}_{funcstart\_719,1}.\text{p2}, 176).\text{rem}))$

[Take given term]

[26.0] $\$\text{heap}_{719,1;729,8} == \$\text{heap}_{funcstart\_719,1}.\textbf{replace}(\text{p1} \rightarrow \textbf{asType<short}$
$\textbf{int>}((\textbf{asType<int>}(\textbf{asType<short int>}(\text{div1.rem})) *$
$\textbf{asType<int>}(\$\text{heap}_{funcstart\_719,1}.\text{r1})) - (\textbf{asType<int>}(\textbf{asType<short}$
$\textbf{int>}(\text{div1.quot})) * \textbf{asType<int>}(\$\text{heap}_{funcstart\_719,1}.\text{b1}))))$

$\rightarrow$ *[from term 5.6, div1 is equal to div($\textbf{heapIs}$ \$heap$_{funcstart\_719,1}$, \$heap$_{funcstart\_719,1}$.p1, 177)]*

[26.1] \$heap$_{719,1;729,8}$ == \$heap$_{funcstart\_719,1}$.$\textbf{\_replace}$(p1 $\rightarrow$ $\textbf{asType<short}$ $\textbf{int>}$(($\textbf{asType<int>}$($\textbf{asType<short int>}$(div($\textbf{heapIs}$ \$heap$_{funcstart\_719,1}$, \$heap$_{funcstart\_719,1}$.p1, 177).rem)) * $\textbf{asType<int>}$(\$heap$_{funcstart\_719,1}$.r1)) $-$ ($\textbf{asType<int>}$($\textbf{asType<short int>}$(div1.quot)) * $\textbf{asType<int>}$(\$heap$_{funcstart\_719,1}$.b1))))

$\rightarrow$ *[simplify]*

[26.3] \$heap$_{719,1;729,8}$ == \$heap$_{funcstart\_719,1}$.$\textbf{\_replace}$(p1 $\rightarrow$ $\textbf{asType<short}$ $\textbf{int>}$((div($\textbf{heapIs}$ \$heap$_{funcstart\_719,1}$, \$heap$_{funcstart\_719,1}$.p1, 177).rem * $\textbf{asType<int>}$(\$heap$_{funcstart\_719,1}$.r1)) $-$ ($\textbf{asType<int>}$($\textbf{asType<short}$ $\textbf{int>}$(div1.quot)) * $\textbf{asType<int>}$(\$heap$_{funcstart\_719,1}$.b1))))

$\rightarrow$ *[const static or extern object]*

[26.4] \$heap$_{719,1;729,8}$ == \$heap$_{funcstart\_719,1}$.$\textbf{\_replace}$(p1 $\rightarrow$ $\textbf{asType<short}$ $\textbf{int>}$((div($\textbf{heapIs}$ \$heap$_{funcstart\_719,1}$, \$heap$_{funcstart\_719,1}$.p1, 177).rem * $\textbf{asType<int>}$(\$heap$_{init}$.r1)) $-$ ($\textbf{asType<int>}$($\textbf{asType<short}$ $\textbf{int>}$(div1.quot)) * $\textbf{asType<int>}$(\$heap$_{funcstart\_719,1}$.b1))))

$\rightarrow$ *[expand definition of constant 'r1' at prang.c (15,20)]*

[26.5] \$heap$_{719,1;729,8}$ == \$heap$_{funcstart\_719,1}$.$\textbf{\_replace}$(p1 $\rightarrow$ $\textbf{asType<short}$ $\textbf{int>}$((div($\textbf{heapIs}$ \$heap$_{funcstart\_719,1}$, \$heap$_{funcstart\_719,1}$.p1, 177).rem * $\textbf{asType<int>}$($\textbf{asType<short int>}$(($\textbf{int}$)171))) $-$ ($\textbf{asType<int>}$($\textbf{asType<short int>}$(div1.quot)) * $\textbf{asType<int>}$(\$heap$_{funcstart\_719,1}$.b1))))

$\rightarrow$ *[simplify]*

[26.8] \$heap$_{719,1;729,8}$ == \$heap$_{funcstart\_719,1}$.$\textbf{\_replace}$(p1 $\rightarrow$ $\textbf{asType<short}$ $\textbf{int>}$((div($\textbf{heapIs}$ \$heap$_{funcstart\_719,1}$, \$heap$_{funcstart\_719,1}$.p1, 177).rem * 171) $-$ ($\textbf{asType<int>}$($\textbf{asType<short int>}$(div1.quot)) * $\textbf{asType<int>}$(\$heap$_{funcstart\_719,1}$.b1))))

$\rightarrow$ *[from term 5.6, div1 is equal to div($\textbf{heapIs}$ \$heap$_{funcstart\_719,1}$, \$heap$_{funcstart\_719,1}$.p1, 177)]*

[26.9] \$heap$_{719,1;729,8}$ == \$heap$_{funcstart\_719,1}$.$\textbf{\_replace}$(p1 $\rightarrow$ $\textbf{asType<short}$ $\textbf{int>}$((171 * div($\textbf{heapIs}$ \$heap$_{funcstart\_719,1}$, \$heap$_{funcstart\_719,1}$.p1, 177).rem) $-$ ($\textbf{asType<int>}$($\textbf{asType<short int>}$(div($\textbf{heapIs}$ \$heap$_{funcstart\_719,1}$, \$heap$_{funcstart\_719,1}$.p1, 177).quot)) * $\textbf{asType<int>}$(\$heap$_{funcstart\_719,1}$.b1))))

$\rightarrow$ *[simplify]*

[26.11] \$heap$_{719,1;729,8}$ == \$heap$_{funcstart\_719,1}$.$\textbf{\_replace}$(p1 $\rightarrow$ $\textbf{asType<short}$ $\textbf{int>}$((171 * div($\textbf{heapIs}$ \$heap$_{funcstart\_719,1}$, \$heap$_{funcstart\_719,1}$.p1, 177).rem) $-$ (div($\textbf{heapIs}$ \$heap$_{funcstart\_719,1}$, \$heap$_{funcstart\_719,1}$.p1, 177).quot * $\textbf{asType<int>}$(\$heap$_{funcstart\_719,1}$.b1))))

→ *[const static or extern object]*

[26.12] $heap_{719,1;729,8}$ == $heap_{funcstart\_719,1}$._**replace**(p1 → **asType**<**short int**>((171 * div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p1, 177).rem) − (div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p1, 177).quot * **asType**<**int**>($heap_{init}$.b1))))

→ *[expand definition of constant 'b1' at prang.c (17,20)]*

[26.13] $heap_{719,1;729,8}$ == $heap_{funcstart\_719,1}$._**replace**(p1 → **asType**<**short int**>((171 * div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p1, 177).rem) − (div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p1, 177).quot * **asType**<**int**>(**asType**<**short int**>((**int**)2)))))

→ *[simplify]*

[26.19] $heap_{719,1;729,8}$ == $heap_{funcstart\_719,1}$._**replace**(p1 → ((-2 * div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p1, 177).rem)))

[Take goal term]

[1.0] **minof**(**short int**) ≤ ((**asType**<**int**>(**asType**<**short int**>(div2.rem)) * **asType**<**int**>($heap_{719,1;729,8}$.r2)) − (**asType**<**int**>(**asType**<**short int**>(div2.quot)) * **asType**<**int**>($heap_{719,1;729,8}$.b2)))

→ *[simplify]*

[1.1] -32768 ≤ ((**asType**<**int**>(**asType**<**short int**>(div2.rem)) * **asType**<**int**>($heap_{719,1;729,8}$.r2)) − (**asType**<**int**>(**asType**<**short int**>(div2.quot)) * **asType**<**int**>($heap_{719,1;729,8}$.b2)))

→ *[from term 12.6, div2 is equal to div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p2, 176)]*

[1.2] -32768 ≤ ((**asType**<**int**>(**asType**<**short int**>(div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p2, 176).rem)) * **asType**<**int**>($heap_{719,1;729,8}$.r2)) − (**asType**<**int**>(**asType**<**short int**>(div2.quot)) * **asType**<**int**>($heap_{719,1;729,8}$.b2)))

→ *[simplify]*

[1.4] -32768 ≤ ((div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p2, 176).rem * **asType**<**int**>($heap_{719,1;729,8}$.r2)) − (**asType**<**int**>(**asType**<**short int**>(div2.quot)) * **asType**<**int**>($heap_{719,1;729,8}$.b2)))

→ *[from term 26.19, $heap_{719,1;729,8}$ is equal to $heap_{funcstart\_719,1}$._**replace**(p1 → (-2 * div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p1, 177).rem))]*

[1.5] -32768 ≤ ((div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p2, 176).rem * **asType**<**int**>($heap_{funcstart\_719,1}$._**replace**(p1 → ((-2 *

div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).rem))).r2)) −
(**asType\<int\>**(**asType\<short int\>**(div2.quot)) *
asType\<int\>($\$heap_{719,1;729,8}$.b2)))

→ *[const member of object with modified fields]*

[1.6] -32768 ≤ ((div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2,
176).rem * **asType\<int\>**($\$heap_{funcstart\_719,1}$.r2)) −
(**asType\<int\>**(**asType\<short int\>**(div2.quot)) *
asType\<int\>($\$heap_{719,1;729,8}$.b2)))

→ *[const static or extern object]*

[1.7] -32768 ≤ ((div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2,
176).rem * **asType\<int\>**($\$heap_{init}$.r2)) − (**asType\<int\>**(**asType\<short
int\>**(div2.quot)) * **asType\<int\>**($\$heap_{719,1;729,8}$.b2)))

→ *[expand definition of constant 'r2' at prang.c (20,20)]*

[1.8] -32768 ≤ ((div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2,
176).rem * **asType\<int\>**(**asType\<short int\>**((**int**)172))) −
(**asType\<int\>**(**asType\<short int\>**(div2.quot)) *
asType\<int\>($\$heap_{719,1;729,8}$.b2)))

→ *[simplify]*

[1.11] -32768 ≤ ((div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2,
176).rem * 172) − (**asType\<int\>**(**asType\<short int\>**(div2.quot)) *
asType\<int\>($\$heap_{719,1;729,8}$.b2)))

→ *[from term 12.6, div2 is equal to div(**heapIs** $\$heap_{funcstart\_719,1}$,
$\$heap_{funcstart\_719,1}$.p2, 176)]*

[1.12] -32768 ≤ ((172 * div(**heapIs** $\$heap_{funcstart\_719,1}$,
$\$heap_{funcstart\_719,1}$.p2, 176).rem) − (**asType\<int\>**(**asType\<short
int\>**(div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).quot)) *
asType\<int\>($\$heap_{719,1;729,8}$.b2)))

→ *[simplify]*

[1.14] -32768 ≤ ((172 * div(**heapIs** $\$heap_{funcstart\_719,1}$,
$\$heap_{funcstart\_719,1}$.p2, 176).rem) − (div(**heapIs** $\$heap_{funcstart\_719,1}$,
$\$heap_{funcstart\_719,1}$.p2, 176).quot * **asType\<int\>**($\$heap_{719,1;729,8}$.b2)))

→ *[from term 26.19, $\$heap_{719,1;729,8}$ is equal to
$\$heap_{funcstart\_719,1}$._**replace**(p1 → (-2 * div(**heapIs** $\$heap_{funcstart\_719,1}$,
$\$heap_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_719,1}$,
$\$heap_{funcstart\_719,1}$.p1, 177).rem))]*

[1.15] -32768 ≤ ((172 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2,
176).rem) − (div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2,
176).quot * **asType\<int\>**($\$heap_{funcstart\_719,1}$._**replace**(p1 → ((-2 *
div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot) + (171 *

div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).rem))).b2)))

→ *[const member of object with modified fields]*

[1.16] -32768 ≤ ((172 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).rem) − (div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).quot * **asType**<**int**>($\$heap_{funcstart\_719,1}$.b2)))

→ *[const static or extern object]*

[1.17] -32768 ≤ ((172 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).rem) − (div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).quot * **asType**<**int**>($\$heap_{init}$.b2)))

→ *[expand definition of constant 'b2' at prang.c (22,20)]*

[1.18] -32768 ≤ ((172 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).rem) − (div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).quot * **asType**<**int**>(**asType**<**short int**>((**int**)35))))

→ *[simplify]*

[1.25] -32769 < ((-35 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).quot) + (172 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).rem))

→ *[negate goal and search for contradiction]*

[1.26] !(-32769 < ((-35 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).quot) + (172 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).rem)))

→ *[simplify]*

[1.31] 32768 < ((35 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).quot) + (-172 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).rem))

[Branch on disjunction or conditional in term 17.21]

[41.0] (0 == ((−$\$heap_{funcstart\_719,1}$.p2 / 176) + div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).quot)) ∨ (0 == (−($\$heap_{funcstart\_719,1}$.p2 / 176) + div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).quot)) ∨ (-1 < $\$heap_{funcstart\_719,1}$.p2)

[Branch on disjunction or conditional in term 17.21]

[42.0] (0 < −$\$heap_{funcstart\_719,1}$.p2) ∨ (0 == (−($\$heap_{funcstart\_719,1}$.p2 / 176) + div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).quot)) ∨ (-1 < $\$heap_{funcstart\_719,1}$.p2)

[Copy term 18.40]

[43.0] ([0 < −$\$heap_{funcstart\_719,1}$.p2]: ([0 == ($\$heap_{funcstart\_719,1}$.p2 % 176)]: 0 == div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).rem, [!(0 == ($\$heap_{funcstart\_719,1}$.p2 % 176))]: 176 == (−div(**heapIs**

$\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}.\text{p2}$, 176).rem +
($\$\text{heap}_{funcstart\_719,1}.\text{p2} \% 176$))), [-1 < $\$\text{heap}_{funcstart\_719,1}.\text{p2}$]: 0 ==
($-(\$\text{heap}_{funcstart\_719,1}.\text{p2} \% 176$) + div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$,
$\$\text{heap}_{funcstart\_719,1}.\text{p2}$, 176).rem)) $\vee$ (0 == ($-(\$\text{heap}_{funcstart\_719,1}.\text{p2} / 176$)
+ div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}.\text{p2}$, 176).quot)) $\vee$ (-1 <
$\$\text{heap}_{funcstart\_719,1}.\text{p2}$)

$\rightarrow$ *[from term 42.0, literala $< -\$heap_{funcstart\_719,1}.p2$ is true whenever (-1 +
literala) < 0]*

Proof of rule precondition:

[43.0.0] (-1 + 0) < 0

$\rightarrow$ *[simplify]*

[43.0.2] **true**

[43.1] ([**true**]: ([0 == ($\$\text{heap}_{funcstart\_719,1}.\text{p2} \% 176$)]: 0 == div(**heapIs**
$\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}.\text{p2}$, 176).rem, [!(0 ==
($\$\text{heap}_{funcstart\_719,1}.\text{p2} \% 176$))]: 176 == ($-$div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$,
$\$\text{heap}_{funcstart\_719,1}.\text{p2}$, 176).rem + ($\$\text{heap}_{funcstart\_719,1}.\text{p2} \% 176$))), [-1 <
$\$\text{heap}_{funcstart\_719,1}.\text{p2}$]: 0 == ($-(\$\text{heap}_{funcstart\_719,1}.\text{p2} \% 176$) + div(**heapIs**
$\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}.\text{p2}$, 176).rem)) $\vee$ ...

$\rightarrow$ *[simplify]*

[43.3] ([0 == ($\$\text{heap}_{funcstart\_719,1}.\text{p2} \% 176$)]: 0 == div(**heapIs**
$\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}.\text{p2}$, 176).rem, [!(0 ==
($\$\text{heap}_{funcstart\_719,1}.\text{p2} \% 176$))]: 176 == ($-$div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$,
$\$\text{heap}_{funcstart\_719,1}.\text{p2}$, 176).rem + ($\$\text{heap}_{funcstart\_719,1}.\text{p2} \% 176$))) $\vee$ ...

[Branch on disjunction or conditional in term 43.3]

[44.0] (0 == div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}.\text{p2}$, 176).rem)
$\vee$ (0 == ($-(\$\text{heap}_{funcstart\_719,1}.\text{p2} / 176$) + div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$,
$\$\text{heap}_{funcstart\_719,1}.\text{p2}$, 176).quot)) $\vee$ (-1 < $\$\text{heap}_{funcstart\_719,1}.\text{p2}$) $\vee$ (176 ==
($-$div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}.\text{p2}$, 176).rem +
($\$\text{heap}_{funcstart\_719,1}.\text{p2} \% 176$))) $\vee$!(0 == ($\$\text{heap}_{funcstart\_719,1}.\text{p2} \% 176$))

[Copy term 1.31]

[46.0] (32768 < ((-172 * div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$,
$\$\text{heap}_{funcstart\_719,1}.\text{p2}$, 176).rem) + (35 * div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$,
$\$\text{heap}_{funcstart\_719,1}.\text{p2}$, 176).quot))) $\vee$ (0 == ($-(\$\text{heap}_{funcstart\_719,1}.\text{p2} / 176$)
+ div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}.\text{p2}$, 176).quot)) $\vee$ (-1 <
$\$\text{heap}_{funcstart\_719,1}.\text{p2}$) $\vee$ (176 == ($-$div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$,
$\$\text{heap}_{funcstart\_719,1}.\text{p2}$, 176).rem + ($\$\text{heap}_{funcstart\_719,1}.\text{p2} \% 176$))) $\vee$!(0 ==
($\$\text{heap}_{funcstart\_719,1}.\text{p2} \% 176$))

$\rightarrow$ *[from term 44.0, div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}.p2$,
176).rem is equal to 0]*

[46.1] (32768 < ((-172 * 0) + (35 * div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$,

$\text{\$heap}_{funcstart\_719,1}.\text{p2}, 176).\text{quot}))) \vee ...$

$\rightarrow$ *[simplify]*

[46.3] $(32768 < (35 * \text{div}(\textbf{heapIs } \text{\$heap}_{funcstart\_719,1}, \text{\$heap}_{funcstart\_719,1}.\text{p2}, 176).\text{quot})) \vee ...$

$\rightarrow$ *[literal comparison of product]*

[46.4] $([35 < 0]: (32768 / \text{-}35) < -\text{div}(\textbf{heapIs } \text{\$heap}_{funcstart\_719,1}, \text{\$heap}_{funcstart\_719,1}.\text{p2}, 176).\text{quot}, [0 < 35]: (32768 / 35) < \text{div}(\textbf{heapIs } \text{\$heap}_{funcstart\_719,1}, \text{\$heap}_{funcstart\_719,1}.\text{p2}, 176).\text{quot}, [0 == 35]: 32768 < 0) \vee ...$

$\rightarrow$ *[explicitly assert falsehood of skipped guards in subsequent guards]*

[46.5] $([35 < 0]: (32768 / \text{-}35) < -\text{div}(\textbf{heapIs } \text{\$heap}_{funcstart\_719,1}, \text{\$heap}_{funcstart\_719,1}.\text{p2}, 176).\text{quot}, [(0 < 35) \wedge !(35 < 0)]: (32768 / 35) < \text{div}(\textbf{heapIs } \text{\$heap}_{funcstart\_719,1}, \text{\$heap}_{funcstart\_719,1}.\text{p2}, 176).\text{quot}, [(0 == 35) \wedge !(0 < 35) \wedge !(35 < 0)]: 32768 < 0) \vee ...$

$\rightarrow$ *[simplify]*

[46.13] $(936 < \text{div}(\textbf{heapIs } \text{\$heap}_{funcstart\_719,1}, \text{\$heap}_{funcstart\_719,1}.\text{p2}, 176).\text{quot}) \vee ...$

[Create new term from terms 46.13, 41.0 using rule: transitivity 15]

[55.0] $((0 + 936) < -(-\text{\$heap}_{funcstart\_719,1}.\text{p2} / 176)) \vee (0 == (-(\text{\$heap}_{funcstart\_719,1}.\text{p2} / 176) + \text{div}(\textbf{heapIs } \text{\$heap}_{funcstart\_719,1}, \text{\$heap}_{funcstart\_719,1}.\text{p2}, 176).\text{quot})) \vee (\text{-1} < \text{\$heap}_{funcstart\_719,1}.\text{p2}) \vee (176 == (-\text{div}(\textbf{heapIs } \text{\$heap}_{funcstart\_719,1}, \text{\$heap}_{funcstart\_719,1}.\text{p2}, 176).\text{rem} + (\text{\$heap}_{funcstart\_719,1}.\text{p2} \% 176))) \vee !(0 == (\text{\$heap}_{funcstart\_719,1}.\text{p2} \% 176))$

$\rightarrow$ *[simplify]*

[55.8] $(164736 < \text{\$heap}_{funcstart\_719,1}.\text{p2}) \vee ...$

$\rightarrow$ *[from term 42.0, literala $< \text{\$heap}_{funcstart\_719,1}.p2$ is false whenever -2 $< (0 + literala)$]*

Proof of rule precondition:

[55.8.0] $\text{-2} < (0 + 164736)$

$\rightarrow$ *[simplify]*

[55.8.2] **true**

[55.9] **false** $\vee ...$

[Remove 'false' term 55.9 and fetch new term from containing clause]

[56.0] $(176 == (-\text{div}(\textbf{heapIs } \text{\$heap}_{funcstart\_719,1}, \text{\$heap}_{funcstart\_719,1}.\text{p2}, 176).\text{rem} + (\text{\$heap}_{funcstart\_719,1}.\text{p2} \% 176))) \vee (0 == (-(\text{\$heap}_{funcstart\_719,1}.\text{p2} / 176) + \text{div}(\textbf{heapIs } \text{\$heap}_{funcstart\_719,1}, \text{\$heap}_{funcstart\_719,1}.\text{p2}, 176).\text{quot})) \vee (\text{-1} < \text{\$heap}_{funcstart\_719,1}.\text{p2})$

[Remove 'false' term 55.9 and fetch new term from containing clause]

[57.0] !(0 == ($heap$_{funcstart_719,1}$.p2 % 176)) ∨ (0 == (−($heap$_{funcstart\_719,1}$.p2 / 176) + div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p2, 176).quot)) ∨ (-1 < $heap$_{funcstart_719,1}$.p2)

[Copy term 1.31]

[58.0] (32768 < ((-172 * div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p2, 176).rem) + (35 * div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p2, 176).quot))) ∨ (0 == (−($heap$_{funcstart\_719,1}$.p2 / 176) + div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p2, 176).quot)) ∨ (-1 < $heap$_{funcstart_719,1}$.p2)

→ *[from term 56.0, div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p2, 176).rem is equal to -176 + ($heap$_{funcstart\_719,1}$.p2 % 176)]*

[58.1] (32768 < ((-172 * (-176 + ($heap$_{funcstart_719,1}$.p2 % 176))) + (35 * div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p2, 176).quot))) ∨ ...

→ *[simplify]*

[58.6] (2496 < ((-172 * ($heap$_{funcstart_719,1}$.p2 % 176)) + (35 * div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p2, 176).quot))) ∨ ...

[Create new term from term 57.0 using rule: try to prove equality by contradiction]

[62.0] ((0 < ($heap$_{funcstart_719,1}$.p2 % 176)) ∨ (($heap$_{funcstart\_719,1}$.p2 % 176) < 0)) ∨ (0 == (−($heap$_{funcstart_719,1}$.p2 / 176) + div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p2, 176).quot)) ∨ (-1 < $heap$_{funcstart_719,1}$.p2)

→ *[simplify]*

[62.1] ((([-1 < 0]: ∃ **integer** n ● (0 < ($heap$_{funcstart_719,1}$.p2 + (176 * n))) ∧ (($heap$_{funcstart\_719,1}$.p2 + (176 * n)) < 176), []: **true**) ∨ (($heap$_{funcstart_719,1}$.p2 % 176) < 0)) ∨ ...

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

[62.2] ((([-1 < 0]: ∃ **integer** n ● (0 < ($heap$_{funcstart_719,1}$.p2 + (176 * n))) ∧ (($heap$_{funcstart\_719,1}$.p2 + (176 * n)) < 176), [!(-1 < 0)]: **true**) ∨ (($heap$_{funcstart_719,1}$.p2 % 176) < 0)) ∨ ...

→ *[simplify]*

[62.15] (∃ **integer** n ● (-176 < (−$heap$_{funcstart_719,1}$.p2 + (-176 * n))) ∧ (0 < ((176 * n) + $heap$_{funcstart_719,1}$.p2))) ∨ ...

→ *[introduce skolem term and eliminate 'exists']*

[62.16] ((-176 < (−$heap$_{funcstart_719,1}$.p2 + (-176 * $a_n))) ∧ (0 < ((176 * $a_n) + $heap$_{funcstart_719,1}$.p2))) ∨ ...

→ *[separate conjunction and work on first sub-term]*

[62.17] (-176 < ($-\text{heap}_{funcstart\_719,1}$.p2 + (-176 * \$a_n))) ∨ ...

[Work on sub-term 2 of conjunction in term 62.16]

[63.0] (0 < ((176 * \$a_n) + $\text{heap}_{funcstart\_719,1}$.p2)) ∨ (0 == ($-(\text{heap}_{funcstart\_719,1}$.p2 / 176) + div(**heapIs** $\text{heap}_{funcstart\_719,1}$, $\text{heap}_{funcstart\_719,1}$.p2, 176).quot)) ∨ (-1 < $\text{heap}_{funcstart\_719,1}$.p2)

[Create new term from terms 63.0, 42.0 using rule: transitivity 2]

[67.0] ((0 + 0 + 1) < (176 * \$a_n)) ∨ (0 == ($-(\text{heap}_{funcstart\_719,1}$.p2 / 176) + div(**heapIs** $\text{heap}_{funcstart\_719,1}$, $\text{heap}_{funcstart\_719,1}$.p2, 176).quot)) ∨ (-1 < $\text{heap}_{funcstart\_719,1}$.p2)

→ *[simplify]*

[67.1] (1 < (176 * \$a_n)) ∨ ...

→ *[literal comparison of product]*

[67.2] ([176 < 0]: (1 / -176) < −\$a_n, [0 < 176]: (1 / 176) < \$a_n, [0 == 176]: 1 < 0) ∨ ...

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

[67.3] ([176 < 0]: (1 / -176) < −\$a_n, [(0 < 176) ∧ !(176 < 0)]: (1 / 176) < \$a_n, [(0 == 176) ∧ !(0 < 176) ∧ !(176 < 0)]: 1 < 0) ∨ ...

→ *[simplify]*

[67.11] (0 < \$a_n) ∨ ...

[Create new term from term 41.0 using rule: condition for equality of division]

[68.0] (($-\text{heap}_{funcstart\_719,1}$.p2 < (176 * (0 + 1 + −div(**heapIs** $\text{heap}_{funcstart\_719,1}$, $\text{heap}_{funcstart\_719,1}$.p2, 176).quot))) ∧ ((176 * (0 + −div(**heapIs** $\text{heap}_{funcstart\_719,1}$, $\text{heap}_{funcstart\_719,1}$.p2, 176).quot)) < (1 + $-\text{heap}_{funcstart\_719,1}$.p2))) ∨ (0 == ($-(\text{heap}_{funcstart\_719,1}$.p2 / 176) + div(**heapIs** $\text{heap}_{funcstart\_719,1}$, $\text{heap}_{funcstart\_719,1}$.p2, 176).quot)) ∨ (-1 < $\text{heap}_{funcstart\_719,1}$.p2)

→ *[simplify]*

[68.18] ((-176 < ((-176 * div(**heapIs** $\text{heap}_{funcstart\_719,1}$, $\text{heap}_{funcstart\_719,1}$.p2, 176).quot) + $\text{heap}_{funcstart\_719,1}$.p2)) ∧ (-1 < ($-\text{heap}_{funcstart\_719,1}$.p2 + (176 * div(**heapIs** $\text{heap}_{funcstart\_719,1}$, $\text{heap}_{funcstart\_719,1}$.p2, 176).quot)))) ∨ ...

→ *[separate conjunction and work on first sub-term]*

[68.19] (-176 < ((-176 * div(**heapIs** $\text{heap}_{funcstart\_719,1}$, $\text{heap}_{funcstart\_719,1}$.p2, 176).quot) + $\text{heap}_{funcstart\_719,1}$.p2)) ∨ ...

[Create new term from terms 68.19, 62.17 using rule: transitivity 1]

[70.0] ((-176 + -176 + 1) < ((-176 * div(**heapIs** $\text{heap}_{funcstart\_719,1}$, $\text{heap}_{funcstart\_719,1}$.p2, 176).quot) + (-176 * \$a_n))) ∨ (0 ==

$(-(\$heap_{funcstart\_719,1}.p2 \;/\; 176) + div(\textbf{heapIs}\; \$heap_{funcstart\_719,1},$
$\$heap_{funcstart\_719,1}.p2, 176).quot)) \vee (\text{-}1 < \$heap_{funcstart\_719,1}.p2)$

$\rightarrow$ *[simplify]*

[70.1] (-351 < ((-176 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}.p2$,
176).quot) + (-176 * \$a_n))) $\vee$ ...

$\rightarrow$ *[cancel common factor]*

Proof of rule precondition 1:

[70.1.0.0] !(-176 == 0)

$\rightarrow$ *[simplify]*

[70.1.0.2] **true**

Proof of rule precondition 2:

[70.1.1.0] 1 < \$gcf(-176, -176)

$\rightarrow$ *[simplify]*

[70.1.1.2] **true**

[70.2] ((-351 / \$gcf(-176, -176)) < (((-176 / \$gcf(-176, -176)) * div(**heapIs**
$\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}.p2$, 176).quot) + ((-176 / \$gcf(-176,
-176)) * \$a_n))) $\vee$ ...

$\rightarrow$ *[simplify]*

[70.10] (-2 < ($-$div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}.p2$,
176).quot + $-$\$a_n)) $\vee$ ...

[Create new term from terms 67.11, 70.10 using rule: transitivity 3]

[72.0] ((-2 + 0 + 1) < $-$div(**heapIs** $\$heap_{funcstart\_719,1}$,
$\$heap_{funcstart\_719,1}.p2$, 176).quot) $\vee$ (0 == ($-($\$heap_{funcstart_719,1}.p2$ / 176)
+ div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}.p2$, 176).quot)) $\vee$ (-1 <
$\$heap_{funcstart\_719,1}.p2$)

$\rightarrow$ *[simplify]*

[72.1] (-1 < $-$div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}.p2$,
176).quot) $\vee$ ...

[Create new term from terms 72.1, 58.6 using rule: transitivity 5]

[78.0] (2496 < ((-172 * ($\$heap_{funcstart\_719,1}.p2$ % 176)) + (35 * $-$(-1 + 1)))) $\vee$
(0 == ($-($\$heap_{funcstart_719,1}.p2$ / 176) + div(**heapIs** $\$heap_{funcstart\_719,1}$,
$\$heap_{funcstart\_719,1}.p2$, 176).quot)) $\vee$ (-1 < $\$heap_{funcstart\_719,1}.p2$)

$\rightarrow$ *[simplify]*

[78.4] (2496 < (-172 * ($\$heap_{funcstart\_719,1}.p2$ % 176))) $\vee$ ...

$\rightarrow$ *[literal comparison of product]*

[78.5] ([-172 < 0]: (2496 / 172) < $-($\$heap_{funcstart_719,1}.p2$ % 176), [0 < -172]:

$(2496 \ / \ \text{-}172) < (\$\text{heap}_{funcstart\_719,1}.\text{p}2 \ \% \ 176)$, [-172 == 0]: $2496 < 0) \lor ...$

$\to$ *[explicitly assert falsehood of skipped guards in subsequent guards]*

[78.6] $([\text{-}172 < 0]: (2496 \ / \ 172) < -(\$\text{heap}_{funcstart\_719,1}.\text{p}2 \ \% \ 176), [(0 < \text{-}172) \land !(\text{-}172 < 0)]: (2496 \ / \ \text{-}172) < (\$\text{heap}_{funcstart\_719,1}.\text{p}2 \ \% \ 176), [(\text{-}172 == 0) \land !(\text{-}172 < 0) \land !(0 < \text{-}172)]: 2496 < 0) \lor ...$

$\to$ *[simplify]*

[78.11] **false** $\lor ...$

[Remove 'false' term 78.11 and fetch new term from containing clause]

[80.0] $0 == (-(\$\text{heap}_{funcstart\_719,1}.\text{p}2 \ / \ 176) + \text{div}(\textbf{heapIs}$ $\$\text{heap}_{funcstart\_719,1}, \$\text{heap}_{funcstart\_719,1}.\text{p}2, 176).\text{quot})$

[Remove 'false' term 78.11 and fetch new term from containing clause]

[81.0] $\text{-}1 < \$\text{heap}_{funcstart\_719,1}.\text{p}2$

[Assume known post-assertion, class invariant or type constraint for term 12.6]

[18.40] $([0 < -\$\text{heap}_{funcstart\_719,1}.\text{p}2]: ([0 == (\$\text{heap}_{funcstart\_719,1}.\text{p}2 \ \% \ 176)]: 0 == \text{div}(\textbf{heapIs} \ \$\text{heap}_{funcstart\_719,1}, \$\text{heap}_{funcstart\_719,1}.\text{p}2, 176).\text{rem}, [!(0 == (\$\text{heap}_{funcstart\_719,1}.\text{p}2 \ \% \ 176))]: 176 == ((\$\text{heap}_{funcstart\_719,1}.\text{p}2 \ \% \ 176) + -\text{div}(\textbf{heapIs} \ \$\text{heap}_{funcstart\_719,1}, \$\text{heap}_{funcstart\_719,1}.\text{p}2, 176).\text{rem})), [\text{-}1 < \$\text{heap}_{funcstart\_719,1}.\text{p}2]: 0 == (-(\$\text{heap}_{funcstart\_719,1}.\text{p}2 \ \% \ 176) + \text{div}(\textbf{heapIs} \ \$\text{heap}_{funcstart\_719,1}, \$\text{heap}_{funcstart\_719,1}.\text{p}2, 176).\text{rem}))$

$\to$ *[from term 81.0, literala $< -\$heap_{funcstart\_719,1}.p2$ is false whenever -2 $<$ (-1 + literala)]*

Proof of rule precondition:

[18.40.0] $\text{-}2 < (\text{-}1 + 0)$

$\to$ *[simplify]*

[18.40.2] **true**

[18.41] $([\textbf{false}]: ([0 == (\$\text{heap}_{funcstart\_719,1}.\text{p}2 \ \% \ 176)]: 0 == \text{div}(\textbf{heapIs} \ \$\text{heap}_{funcstart\_719,1}, \$\text{heap}_{funcstart\_719,1}.\text{p}2, 176).\text{rem}, [!(0 == (\$\text{heap}_{funcstart\_719,1}.\text{p}2 \ \% \ 176))]: 176 == (-\text{div}(\textbf{heapIs} \ \$\text{heap}_{funcstart\_719,1}, \$\text{heap}_{funcstart\_719,1}.\text{p}2, 176).\text{rem} + (\$\text{heap}_{funcstart\_719,1}.\text{p}2 \ \% \ 176))), [\text{-}1 < \$\text{heap}_{funcstart\_719,1}.\text{p}2]: 0 == (-(\$\text{heap}_{funcstart\_719,1}.\text{p}2 \ \% \ 176) + \text{div}(\textbf{heapIs} \ \$\text{heap}_{funcstart\_719,1}, \$\text{heap}_{funcstart\_719,1}.\text{p}2, 176).\text{rem}))$

$\to$ *[from term 81.0, literala $< \$heap_{funcstart\_719,1}.p2$ is true whenever (-1 + literala) $<$ -1]*

Proof of rule precondition:

[18.41.0] $(\text{-}1 + \text{-}1) < \text{-}1$

$\to$ *[simplify]*

[18.41.2] **true**

[18.42] ([**false**]: ([0 == ($heap$_{funcstart_719,1}$.p2 % 176)]: 0 == div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p2, 176).rem, [!(0 == ($heap$_{funcstart\_719,1}$.p2 % 176))]: 176 == (−div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p2, 176).rem + ($heap$_{funcstart\_719,1}$.p2 % 176))), [**true**]: 0 == (−($heap$_{funcstart_719,1}$.p2 % 176) + div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p2, 176).rem))

→ *[simplify]*

[18.44] 0 == (−($heap$_{funcstart_719,1}$.p2 % 176) + div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p2, 176).rem)

[Copy term 1.31]

[83.0] 32768 < ((-172 * div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p2, 176).rem) + (35 * div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p2, 176).quot))

→ *[from term 18.44, div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p2, 176).rem is equal to $heap$_{funcstart_719,1}$.p2 % 176]*

[83.1] 32768 < ((-172 * ($heap$_{funcstart_719,1}$.p2 % 176)) + (35 * div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p2, 176).quot))

[Create new term from term 80.0 using rule: condition for equality of division]

[89.0] (0 < (1 + (176 * (0 + −div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p2, 176).quot)) + $heap$_{funcstart_719,1}$.p2)) ∧ ($heap$_{funcstart\_719,1}$.p2 < (176 * (0 + 1 + div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p2, 176).quot)))

→ *[simplify]*

[89.12] (-1 < ((-176 * div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p2, 176).quot) + $heap$_{funcstart_719,1}$.p2)) ∧ (-176 < (−$heap$_{funcstart\_719,1}$.p2 + (176 * div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p2, 176).quot)))

[Work on sub-term 2 of conjunction in term 89.12]

[90.0] -1 < ((-176 * div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p2, 176).quot) + $heap$_{funcstart_719,1}$.p2)

[Create new term from terms 90.0, 16.9 using rule: transitivity 2]

[92.0] (-32768 + -1 + 1) < (-176 * div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p2, 176).quot)

→ *[simplify]*

[92.1] -32768 < (-176 * div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p2, 176).quot)

→ *[literal comparison of product]*

[92.2] ([-176 < 0]: (-32768 / 176) < −div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p2, 176).quot, [0 < -176]: (-32768 / -176) < div(**heapIs**

$\text{heap}_{funcstart\_719,1}$, $\text{heap}_{funcstart\_719,1}$.p2, 176).quot, [-176 == 0]: -32768 < 0)

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

[92.3] ([-176 < 0]: (-32768 / 176) < −div(**heapIs** $\text{heap}_{funcstart\_719,1}$, $\text{heap}_{funcstart\_719,1}$.p2, 176).quot, [(0 < -176) ∧ !(-176 < 0)]: (-32768 / -176) < div(**heapIs** $\text{heap}_{funcstart\_719,1}$, $\text{heap}_{funcstart\_719,1}$.p2, 176).quot, [(-176 == 0) ∧ !(-176 < 0) ∧ !(0 < -176)]: -32768 < 0)

→ [simplify]

[92.7] -187 < −div(**heapIs** $\text{heap}_{funcstart\_719,1}$, $\text{heap}_{funcstart\_719,1}$.p2, 176).quot

[Create new term from terms 92.7, 83.1 using rule: transitivity 5]

[94.0] 32768 < ((-172 * ($\text{heap}_{funcstart\_719,1}$.p2 % 176)) + (35 * −(-187 + 1)))

→ [simplify]

[94.5] 26258 < (-172 * ($\text{heap}_{funcstart\_719,1}$.p2 % 176))

→ [literal comparison of product]

[94.6] ([-172 < 0]: (26258 / 172) < −($\text{heap}_{funcstart\_719,1}$.p2 % 176), [0 < -172]: (26258 / -172) < ($\text{heap}_{funcstart\_719,1}$.p2 % 176), [-172 == 0]: 26258 < 0)

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

[94.7] ([-172 < 0]: (26258 / 172) < −($\text{heap}_{funcstart\_719,1}$.p2 % 176), [(0 < -172) ∧ !(-172 < 0)]: (26258 / -172) < ($\text{heap}_{funcstart\_719,1}$.p2 % 176), [(-172 == 0) ∧ !(-172 < 0) ∧ !(0 < -172)]: 26258 < 0)

→ [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 (48,33)

Condition defined at:

To prove: ((**asType**<**int**>(**asType**<**short int**>(div2.rem)) * **asType**<**int**>($\text{heap}_{719,1;729,8}$.r2)) − (**asType**<**int**>(**asType**<**short int**>(div2.quot)) * **asType**<**int**>($\text{heap}_{719,1;729,8}$.b2))) ≤ **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)

$\$heap_{init}.a1 == \mathbf{asType}\mathbf{<short\ int>}((\mathbf{int})177)$

$\$heap_{init}.b1 == \mathbf{asType}\mathbf{<short\ int>}((\mathbf{int})2)$

$\$heap_{init}.M2 == \mathbf{asType}\mathbf{<short\ int>}((\mathbf{int})30307)$

$\$heap_{init}.r2 == \mathbf{asType}\mathbf{<short\ int>}((\mathbf{int})172)$

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

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

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

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

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

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

$\$heap_{init}.p1 == \mathbf{asType}\mathbf{<short\ int>}((\mathbf{int})1)$

$\$heap_{init}.p2 == \mathbf{asType}\mathbf{<short\ int>}((\mathbf{int})2)$

$\$heap_{init}.p3 == \mathbf{asType}\mathbf{<short\ int>}((\mathbf{int})3)$

$\text{div1} == \text{div}(\mathbf{heapIs}\ \$heap_{funcstart\_719,1},$
$\mathbf{asType}\mathbf{<int>}(\$heap_{funcstart\_719,1}.p1),$
$\mathbf{asType}\mathbf{<int>}(\$heap_{funcstart\_719,1}.a1))$

$(\mathbf{asType}\mathbf{<integer>}(\mathbf{asType}\mathbf{<int>}(\$heap_{funcstart\_719,1}.p1))\ /$
$\mathbf{asType}\mathbf{<integer>}(\mathbf{asType}\mathbf{<int>}(\$heap_{funcstart\_719,1}.a1))) ==$
$\mathbf{asType}\mathbf{<integer>}(\text{div1.quot})$

$(\mathbf{asType}\mathbf{<integer>}(\mathbf{asType}\mathbf{<int>}(\$heap_{funcstart\_719,1}.p1))\ \%$
$\mathbf{asType}\mathbf{<integer>}(\mathbf{asType}\mathbf{<int>}(\$heap_{funcstart\_719,1}.a1))) ==$
$\mathbf{asType}\mathbf{<integer>}(\text{div1.rem})$

$\text{div2} == \text{div}(\mathbf{heapIs}\ \$heap_{funcstart\_719,1},$
$\mathbf{asType}\mathbf{<int>}(\$heap_{funcstart\_719,1}.p2),$
$\mathbf{asType}\mathbf{<int>}(\$heap_{funcstart\_719,1}.a2))$

$(\mathbf{asType}\mathbf{<integer>}(\mathbf{asType}\mathbf{<int>}(\$heap_{funcstart\_719,1}.p2))\ /$
$\mathbf{asType}\mathbf{<integer>}(\mathbf{asType}\mathbf{<int>}(\$heap_{funcstart\_719,1}.a2))) ==$
$\mathbf{asType}\mathbf{<integer>}(\text{div2.quot})$

$(\mathbf{asType}\mathbf{<integer>}(\mathbf{asType}\mathbf{<int>}(\$heap_{funcstart\_719,1}.p2))\ \%$
$\mathbf{asType}\mathbf{<integer>}(\mathbf{asType}\mathbf{<int>}(\$heap_{funcstart\_719,1}.a2))) ==$
$\mathbf{asType}\mathbf{<integer>}(\text{div2.rem})$

$\text{div3} == \text{div}(\mathbf{heapIs}\ \$heap_{funcstart\_719,1},$
$\mathbf{asType}\mathbf{<int>}(\$heap_{funcstart\_719,1}.p3),$
$\mathbf{asType}\mathbf{<int>}(\$heap_{funcstart\_719,1}.a3))$

$(\mathbf{asType}\mathbf{<integer>}(\mathbf{asType}\mathbf{<int>}(\$heap_{funcstart\_719,1}.p3))\ /$
$\mathbf{asType}\mathbf{<integer>}(\mathbf{asType}\mathbf{<int>}(\$heap_{funcstart\_719,1}.a3))) ==$
$\mathbf{asType}\mathbf{<integer>}(\text{div3.quot})$

(**asType**<**integer**>(**asType**<**int**>($\text{heap}_{funcstart\_719,1}$.p3)) %
asType<**integer**>(**asType**<**int**>($\text{heap}_{funcstart\_719,1}$.a3))) ==
asType<**integer**>(div3.rem)

$\text{heap}_{719,1;729,8}$ == $\text{heap}_{funcstart\_719,1}$.**replace**(p1 → **asType**<**short int**>((**asType**<**int**>(**asType**<**short int**>(div1.rem)) *
asType<**int**>($\text{heap}_{funcstart\_719,1}$.r1)) − (**asType**<**int**>(**asType**<**short int**>(div1.quot)) * **asType**<**int**>($\text{heap}_{funcstart\_719,1}$.b1))))

Proof:

[Take given term]

[5.0] div1 == div(**heapIs** $\text{heap}_{funcstart\_719,1}$,
asType<**int**>($\text{heap}_{funcstart\_719,1}$.p1),
asType<**int**>($\text{heap}_{funcstart\_719,1}$.a1))

→ *[simplify]*

[5.1] div1 == div(**heapIs** $\text{heap}_{funcstart\_719,1}$, $\text{heap}_{funcstart\_719,1}$.p1,
asType<**int**>($\text{heap}_{funcstart\_719,1}$.a1))

→ *[const static or extern object]*

[5.2] div1 == div(**heapIs** $\text{heap}_{funcstart\_719,1}$, $\text{heap}_{funcstart\_719,1}$.p1,
asType<**int**>(heap_{init}.a1))

→ *[expand definition of constant 'a1' at prang.c (16,20)]*

[5.3] div1 == div(**heapIs** $\text{heap}_{funcstart\_719,1}$, $\text{heap}_{funcstart\_719,1}$.p1,
asType<**int**>(**asType**<**short int**>((**int**)177)))

→ *[simplify]*

[5.6] div1 == div(**heapIs** $\text{heap}_{funcstart\_719,1}$, $\text{heap}_{funcstart\_719,1}$.p1, 177)

[Take given term]

[12.0] div2 == div(**heapIs** $\text{heap}_{funcstart\_719,1}$,
asType<**int**>($\text{heap}_{funcstart\_719,1}$.p2),
asType<**int**>($\text{heap}_{funcstart\_719,1}$.a2))

→ *[simplify]*

[12.1] div2 == div(**heapIs** $\text{heap}_{funcstart\_719,1}$, $\text{heap}_{funcstart\_719,1}$.p2,
asType<**int**>($\text{heap}_{funcstart\_719,1}$.a2))

→ *[const static or extern object]*

[12.2] div2 == div(**heapIs** $\text{heap}_{funcstart\_719,1}$, $\text{heap}_{funcstart\_719,1}$.p2,
asType<**int**>(heap_{init}.a2))

→ *[expand definition of constant 'a2' at prang.c (21,20)]*

[12.3] div2 == div(**heapIs** $\text{heap}_{funcstart\_719,1}$, $\text{heap}_{funcstart\_719,1}$.p2,
asType<**int**>(**asType**<**short int**>((**int**)176)))

→ *[simplify]*

[12.6] div2 == div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176)

[Assume known post-assertion, class invariant or type constraint for term 12.6]

[15.0] **minof**(**short int**) $\leq$ $\$heap_{funcstart\_719,1}$.p2

$\rightarrow$ *[simplify]*

[15.3] -32769 < $\$heap_{funcstart\_719,1}$.p2

[Assume known post-assertion, class invariant or type constraint for term 12.6]

[17.0] (**asType**<**integer**>($\$heap_{funcstart\_719,1}$.p2) / **asType**<**integer**>(176)) == **asType**<**integer**>(div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).quot)

$\rightarrow$ *[simplify]*

[17.2] ($\$heap_{funcstart\_719,1}$.p2 / 176) == **asType**<**integer**>(div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).quot)

$\rightarrow$ *[expand definition of operator './' in class 'int' at built in declaration]*

[17.3] ([**asType**<**integer**>($\$heap_{funcstart\_719,1}$.p2) < 0]: $-(-$**asType**<**integer**>($\$heap_{funcstart\_719,1}$.p2) / 176), []: **asType**<**integer**>($\$heap_{funcstart\_719,1}$.p2) / 176) == **asType**<**integer**>(div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).quot)

$\rightarrow$ *[explicitly assert falsehood of skipped guards in subsequent guards]*

[17.4] ([**asType**<**integer**>($\$heap_{funcstart\_719,1}$.p2) < 0]: $-(-$**asType**<**integer**>($\$heap_{funcstart\_719,1}$.p2) / 176), [!(**asType**<**integer**>($\$heap_{funcstart\_719,1}$.p2) < 0)]: **asType**<**integer**>($\$heap_{funcstart\_719,1}$.p2) / 176) == **asType**<**integer**>(div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).quot)

$\rightarrow$ *[simplify]*

[17.17] 0 == ($-($[0 < $-\$heap_{funcstart\_719,1}$.p2]: $-(-\$heap_{funcstart\_719,1}$.p2 / 176), [-1 < $\$heap_{funcstart\_719,1}$.p2]: $\$heap_{funcstart\_719,1}$.p2 / 176) + div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).quot)

$\rightarrow$ *[move guard outside expression]*

[17.18] 0 == (([0 < $-\$heap_{funcstart\_719,1}$.p2]: $-(-(-\$heap_{funcstart\_719,1}$.p2 / 176)), [-1 < $\$heap_{funcstart\_719,1}$.p2]: $-(\$heap_{funcstart\_719,1}$.p2 / 176)) + div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).quot)

$\rightarrow$ *[simplify]*

[17.19] 0 == (([0 < $-\$heap_{funcstart\_719,1}$.p2]: $-\$heap_{funcstart\_719,1}$.p2 / 176, [-1 < $\$heap_{funcstart\_719,1}$.p2]: $-(\$heap_{funcstart\_719,1}$.p2 / 176)) + div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).quot)

$\rightarrow$ *[move guard outside expression]*

[17.21] ($[0 < -\$\text{heap}_{funcstart\_719,1}.\text{p2}]$: $0 == ((-\$\text{heap}_{funcstart\_719,1}.\text{p2} \ / \ 176)$ + div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}.\text{p2}, 176).\text{quot}$), $[-1 <$ $\$\text{heap}_{funcstart\_719,1}.\text{p2}]$: $0 == (-(\$\text{heap}_{funcstart\_719,1}.\text{p2} \ / \ 176)$ + div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}.\text{p2}, 176).\text{quot}$))

[Assume known post-assertion, class invariant or type constraint for term 12.6]

[18.0] (**asType**<**integer**>($\$\text{heap}_{funcstart\_719,1}.\text{p2}$) % **asType**<**integer**>(176)) == **asType**<**integer**>(div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}.\text{p2}, 176).\text{rem}$)

$\rightarrow$ *[simplify]*

[18.2] ($\$\text{heap}_{funcstart\_719,1}.\text{p2}$ % 176) == **asType**<**integer**>(div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}.\text{p2}, 176).\text{rem}$)

$\rightarrow$ *[expand definition of operator '.%' in class 'int' at built in declaration]*

[18.3] ($[$**asType**<**integer**>($\$\text{heap}_{funcstart\_719,1}.\text{p2}$) $< 0]$: $-(-$**asType**<**integer**>($\$\text{heap}_{funcstart\_719,1}.\text{p2}$) % 176), $[]$: **asType**<**integer**>($\$\text{heap}_{funcstart\_719,1}.\text{p2}$) % 176) == **asType**<**integer**>(div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}.\text{p2}$, 176).rem)

$\rightarrow$ *[explicitly assert falsehood of skipped guards in subsequent guards]*

[18.4] ($[$**asType**<**integer**>($\$\text{heap}_{funcstart\_719,1}.\text{p2}$) $< 0]$: $-(-$**asType**<**integer**>($\$\text{heap}_{funcstart\_719,1}.\text{p2}$) % 176), $[!($**asType**<**integer**>($\$\text{heap}_{funcstart\_719,1}.\text{p2}$) $< 0)]$: **asType**<**integer**>($\$\text{heap}_{funcstart\_719,1}.\text{p2}$) % 176) == **asType**<**integer**>(div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}.\text{p2}$, 176).rem)

$\rightarrow$ *[simplify]*

[18.14] ($[0 < -\$\text{heap}_{funcstart\_719,1}.\text{p2}]$: $-(-\$\text{heap}_{funcstart\_719,1}.\text{p2}$ % 176), $[-1 < \$\text{heap}_{funcstart\_719,1}.\text{p2}]$: **asType**<**integer**>($\$\text{heap}_{funcstart\_719,1}.\text{p2}$) % 176) == **asType**<**integer**>(div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}.\text{p2}, 176).\text{rem}$)

$\rightarrow$ *[remainder of negation]*

[18.15] ($[0 < -\$\text{heap}_{funcstart\_719,1}.\text{p2}]$: $-([0 == (\$\text{heap}_{funcstart\_719,1}.\text{p2}$ % 176)]$: 0, $[]$: $176 + -(\$\text{heap}_{funcstart\_719,1}.\text{p2}$ % 176)), $[-1 <$ $\$\text{heap}_{funcstart\_719,1}.\text{p2}]$: **asType**<**integer**>($\$\text{heap}_{funcstart\_719,1}.\text{p2}$) % 176) == **asType**<**integer**>(div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}.\text{p2}, 176).\text{rem}$)

$\rightarrow$ *[explicitly assert falsehood of skipped guards in subsequent guards]*

[18.16] ($[0 < -\$\text{heap}_{funcstart\_719,1}.\text{p2}]$: $-([0 == (\$\text{heap}_{funcstart\_719,1}.\text{p2}$ % 176)]$: 0, $[!(0 == (\$\text{heap}_{funcstart\_719,1}.\text{p2}$ % 176))]$: $176 +$ $-(\$\text{heap}_{funcstart\_719,1}.\text{p2}$ % 176)), $[-1 < \$\text{heap}_{funcstart\_719,1}.\text{p2}]$: **asType**<**integer**>($\$\text{heap}_{funcstart\_719,1}.\text{p2}$) % 176) ==

asType<**integer**>(div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}.\text{p2}$, 176).rem)

$\rightarrow$ *[move guard outside expression]*

[18.17] ([0 < $-\$\text{heap}_{funcstart\_719,1}.\text{p2}$]: ([0 == ($\$\text{heap}_{funcstart\_719,1}.\text{p2}$ % 176)]: -0, [!(0 == ($\$\text{heap}_{funcstart\_719,1}.\text{p2}$ % 176))]: $-(176 + -(\$\text{heap}_{funcstart\_719,1}.\text{p2}$ % 176))), [-1 < $\$\text{heap}_{funcstart\_719,1}.\text{p2}$]:
asType<**integer**>($\$\text{heap}_{funcstart\_719,1}.\text{p2}$) % 176) ==
asType<**integer**>(div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}.\text{p2}$, 176).rem)

$\rightarrow$ *[simplify]*

[18.24] 0 == ($-$([0 < $-\$\text{heap}_{funcstart\_719,1}.\text{p2}$]: ([0 == ($\$\text{heap}_{funcstart\_719,1}.\text{p2}$ % 176)]: 0, [!(0 == ($\$\text{heap}_{funcstart\_719,1}.\text{p2}$ % 176))]: -176 + ($\$\text{heap}_{funcstart\_719,1}.\text{p2}$ % 176)), [-1 < $\$\text{heap}_{funcstart\_719,1}.\text{p2}$]: $\$\text{heap}_{funcstart\_719,1}.\text{p2}$ % 176) + div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}.\text{p2}$, 176).rem)

$\rightarrow$ *[move guard outside expression]*

[18.26] 0 == (([0 < $-\$\text{heap}_{funcstart\_719,1}.\text{p2}$]: ([0 == ($\$\text{heap}_{funcstart\_719,1}.\text{p2}$ % 176)]: -0, [!(0 == ($\$\text{heap}_{funcstart\_719,1}.\text{p2}$ % 176))]: $-(-176 + (\$\text{heap}_{funcstart\_719,1}.\text{p2}$ % 176))), [-1 < $\$\text{heap}_{funcstart\_719,1}.\text{p2}$]: $-(\$\text{heap}_{funcstart\_719,1}.\text{p2}$ % 176)) + div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}.\text{p2}$, 176).rem)

$\rightarrow$ *[simplify]*

[18.29] 0 == (([0 < $-\$\text{heap}_{funcstart\_719,1}.\text{p2}$]: ([0 == ($\$\text{heap}_{funcstart\_719,1}.\text{p2}$ % 176)]: 0, [!(0 == ($\$\text{heap}_{funcstart\_719,1}.\text{p2}$ % 176))]: 176 + $-(\$\text{heap}_{funcstart\_719,1}.\text{p2}$ % 176)), [-1 < $\$\text{heap}_{funcstart\_719,1}.\text{p2}$]: $-(\$\text{heap}_{funcstart\_719,1}.\text{p2}$ % 176)) + div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}.\text{p2}$, 176).rem)

$\rightarrow$ *[move guard outside expression]*

[18.31] 0 == ([0 < $-\$\text{heap}_{funcstart\_719,1}.\text{p2}$]: ([0 == ($\$\text{heap}_{funcstart\_719,1}.\text{p2}$ % 176)]: 0 + div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}.\text{p2}$, 176).rem, [!(0 == ($\$\text{heap}_{funcstart\_719,1}.\text{p2}$ % 176))]: (176 + $-\$\text{heap}_{funcstart\_719,1}.\text{p2}$ % 176)) + div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}.\text{p2}$, 176).rem), [-1 < $\$\text{heap}_{funcstart\_719,1}.\text{p2}$]: $-(\$\text{heap}_{funcstart\_719,1}.\text{p2}$ % 176) + div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}.\text{p2}$, 176).rem)

$\rightarrow$ *[simplify]*

[18.33] 0 == ([0 < $-\$\text{heap}_{funcstart\_719,1}.\text{p2}$]: ([0 == ($\$\text{heap}_{funcstart\_719,1}.\text{p2}$ % 176)]: div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}.\text{p2}$, 176).rem, [!(0 == ($\$\text{heap}_{funcstart\_719,1}.\text{p2}$ % 176))]: 176 + $-(\$\text{heap}_{funcstart\_719,1}.\text{p2}$ % 176) + div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}.\text{p2}$, 176).rem), [-1 < $\$\text{heap}_{funcstart\_719,1}.\text{p2}$]: $-(\$\text{heap}_{funcstart\_719,1}.\text{p2}$ % 176) + div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}.\text{p2}$, 176).rem)

$\rightarrow$ *[move guard outside expression]*

[18.35] ($[0 < -\$heap_{funcstart\_719,1}.p2]$: ($[0 == (\$heap_{funcstart\_719,1}.p2 \% 176)]$: $0 == \text{div}(\textbf{heapIs } \$heap_{funcstart\_719,1}, \$heap_{funcstart\_719,1}.p2, 176).\text{rem}$, $[!(0 == (\$heap_{funcstart\_719,1}.p2 \% 176))]$: $0 == (176 + -\$heap_{funcstart\_719,1}.p2 \% 176) + \text{div}(\textbf{heapIs } \$heap_{funcstart\_719,1}, \$heap_{funcstart\_719,1}.p2, 176).\text{rem}))$, $[-1 < \$heap_{funcstart\_719,1}.p2]$: $0 == (-(\$heap_{funcstart\_719,1}.p2 \% 176) + \text{div}(\textbf{heapIs } \$heap_{funcstart\_719,1}, \$heap_{funcstart\_719,1}.p2, 176).\text{rem}))$

$\rightarrow$ *[simplify]*

[18.40] ($[0 < -\$heap_{funcstart\_719,1}.p2]$: ($[0 == (\$heap_{funcstart\_719,1}.p2 \% 176)]$: $0 == \text{div}(\textbf{heapIs } \$heap_{funcstart\_719,1}, \$heap_{funcstart\_719,1}.p2, 176).\text{rem}$, $[!(0 == (\$heap_{funcstart\_719,1}.p2 \% 176))]$: $176 == ((\$heap_{funcstart\_719,1}.p2 \% 176) + -\text{div}(\textbf{heapIs } \$heap_{funcstart\_719,1}, \$heap_{funcstart\_719,1}.p2, 176).\text{rem}))$, $[-1 < \$heap_{funcstart\_719,1}.p2]$: $0 == (-(\$heap_{funcstart\_719,1}.p2 \% 176) + \text{div}(\textbf{heapIs } \$heap_{funcstart\_719,1}, \$heap_{funcstart\_719,1}.p2, 176).\text{rem}))$

[Take given term]

[26.0] $\$heap_{719,1;729,8} == \$heap_{funcstart\_719,1}.\textbf{replace}(p1 \rightarrow \textbf{asType}<\textbf{short int}>((\textbf{asType}<\textbf{int}>(\textbf{asType}<\textbf{short int}>(div1.\text{rem})) * \textbf{asType}<\textbf{int}>(\$heap_{funcstart\_719,1}.r1)) - (\textbf{asType}<\textbf{int}>(\textbf{asType}<\textbf{short int}>(div1.\text{quot})) * \textbf{asType}<\textbf{int}>(\$heap_{funcstart\_719,1}.b1))))$

$\rightarrow$ *[from term 5.6, div1 is equal to div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}.p1$, 177)]*

[26.1] $\$heap_{719,1;729,8} == \$heap_{funcstart\_719,1}.\textbf{replace}(p1 \rightarrow \textbf{asType}<\textbf{short int}>((\textbf{asType}<\textbf{int}>(\textbf{asType}<\textbf{short int}>(div(\textbf{heapIs } \$heap_{funcstart\_719,1}, \$heap_{funcstart\_719,1}.p1, 177).\text{rem})) * \textbf{asType}<\textbf{int}>(\$heap_{funcstart\_719,1}.r1)) - (\textbf{asType}<\textbf{int}>(\textbf{asType}<\textbf{short int}>(div1.\text{quot})) * \textbf{asType}<\textbf{int}>(\$heap_{funcstart\_719,1}.b1))))$

$\rightarrow$ *[simplify]*

[26.3] $\$heap_{719,1;729,8} == \$heap_{funcstart\_719,1}.\textbf{replace}(p1 \rightarrow \textbf{asType}<\textbf{short int}>((div(\textbf{heapIs } \$heap_{funcstart\_719,1}, \$heap_{funcstart\_719,1}.p1, 177).\text{rem} * \textbf{asType}<\textbf{int}>(\$heap_{funcstart\_719,1}.r1)) - (\textbf{asType}<\textbf{int}>(\textbf{asType}<\textbf{short int}>(div1.\text{quot})) * \textbf{asType}<\textbf{int}>(\$heap_{funcstart\_719,1}.b1))))$

$\rightarrow$ *[const static or extern object]*

[26.4] $\$heap_{719,1;729,8} == \$heap_{funcstart\_719,1}.\textbf{replace}(p1 \rightarrow \textbf{asType}<\textbf{short int}>((div(\textbf{heapIs } \$heap_{funcstart\_719,1}, \$heap_{funcstart\_719,1}.p1, 177).\text{rem} * \textbf{asType}<\textbf{int}>(\$heap_{init}.r1)) - (\textbf{asType}<\textbf{int}>(\textbf{asType}<\textbf{short int}>(div1.\text{quot})) * \textbf{asType}<\textbf{int}>(\$heap_{funcstart\_719,1}.b1))))$

$\rightarrow$ *[expand definition of constant 'r1' at prang.c (15,20)]*

[26.5] $\$heap_{719,1;729,8} == \$heap_{funcstart\_719,1}.\textbf{replace}(p1 \rightarrow \textbf{asType}<\textbf{short int}>((div(\textbf{heapIs } \$heap_{funcstart\_719,1}, \$heap_{funcstart\_719,1}.p1, 177).\text{rem} * \textbf{asType}<\textbf{int}>(\textbf{asType}<\textbf{short int}>((\textbf{int})171))) -$

($\mathbf{asType}$<$\mathbf{int}$>($\mathbf{asType}$<$\mathbf{short\ int}$>(div1.quot)) *
$\mathbf{asType}$<$\mathbf{int}$>($\$\mathrm{heap}_{funcstart\_719,1}$.b1))))

$\rightarrow$ *[simplify]*

[26.8] $\$\mathrm{heap}_{719,1;729,8}$ == $\$\mathrm{heap}_{funcstart\_719,1}$._$\mathbf{replace}$(p1 $\rightarrow$ $\mathbf{asType}$<$\mathbf{short}$
$\mathbf{int}$>((div($\mathbf{heapIs}$ $\$\mathrm{heap}_{funcstart\_719,1}$, $\$\mathrm{heap}_{funcstart\_719,1}$.p1, 177).rem * 171)
$-$ ($\mathbf{asType}$<$\mathbf{int}$>($\mathbf{asType}$<$\mathbf{short\ int}$>(div1.quot)) *
$\mathbf{asType}$<$\mathbf{int}$>($\$\mathrm{heap}_{funcstart\_719,1}$.b1))))

$\rightarrow$ *[from term 5.6, div1 is equal to div($\mathbf{heapIs}$ $\$heap_{funcstart\_719,1}$,*
$\$heap_{funcstart\_719,1}$.p1, 177)]

[26.9] $\$\mathrm{heap}_{719,1;729,8}$ == $\$\mathrm{heap}_{funcstart\_719,1}$._$\mathbf{replace}$(p1 $\rightarrow$ $\mathbf{asType}$<$\mathbf{short}$
$\mathbf{int}$>((171 * div($\mathbf{heapIs}$ $\$\mathrm{heap}_{funcstart\_719,1}$, $\$\mathrm{heap}_{funcstart\_719,1}$.p1, 177).rem)
$-$ ($\mathbf{asType}$<$\mathbf{int}$>($\mathbf{asType}$<$\mathbf{short\ int}$>(div($\mathbf{heapIs}$ $\$\mathrm{heap}_{funcstart\_719,1}$,
$\$\mathrm{heap}_{funcstart\_719,1}$.p1, 177).quot)) *
$\mathbf{asType}$<$\mathbf{int}$>($\$\mathrm{heap}_{funcstart\_719,1}$.b1))))

$\rightarrow$ *[simplify]*

[26.11] $\$\mathrm{heap}_{719,1;729,8}$ == $\$\mathrm{heap}_{funcstart\_719,1}$._$\mathbf{replace}$(p1 $\rightarrow$ $\mathbf{asType}$<$\mathbf{short}$
$\mathbf{int}$>((171 * div($\mathbf{heapIs}$ $\$\mathrm{heap}_{funcstart\_719,1}$, $\$\mathrm{heap}_{funcstart\_719,1}$.p1, 177).rem)
$-$ (div($\mathbf{heapIs}$ $\$\mathrm{heap}_{funcstart\_719,1}$, $\$\mathrm{heap}_{funcstart\_719,1}$.p1, 177).quot *
$\mathbf{asType}$<$\mathbf{int}$>($\$\mathrm{heap}_{funcstart\_719,1}$.b1))))

$\rightarrow$ *[const static or extern object]*

[26.12] $\$\mathrm{heap}_{719,1;729,8}$ == $\$\mathrm{heap}_{funcstart\_719,1}$._$\mathbf{replace}$(p1 $\rightarrow$ $\mathbf{asType}$<$\mathbf{short}$
$\mathbf{int}$>((171 * div($\mathbf{heapIs}$ $\$\mathrm{heap}_{funcstart\_719,1}$, $\$\mathrm{heap}_{funcstart\_719,1}$.p1, 177).rem)
$-$ (div($\mathbf{heapIs}$ $\$\mathrm{heap}_{funcstart\_719,1}$, $\$\mathrm{heap}_{funcstart\_719,1}$.p1, 177).quot *
$\mathbf{asType}$<$\mathbf{int}$>($\$\mathrm{heap}_{init}$.b1))))

$\rightarrow$ *[expand definition of constant 'b1' at prang.c (17,20)]*

[26.13] $\$\mathrm{heap}_{719,1;729,8}$ == $\$\mathrm{heap}_{funcstart\_719,1}$._$\mathbf{replace}$(p1 $\rightarrow$ $\mathbf{asType}$<$\mathbf{short}$
$\mathbf{int}$>((171 * div($\mathbf{heapIs}$ $\$\mathrm{heap}_{funcstart\_719,1}$, $\$\mathrm{heap}_{funcstart\_719,1}$.p1, 177).rem)
$-$ (div($\mathbf{heapIs}$ $\$\mathrm{heap}_{funcstart\_719,1}$, $\$\mathrm{heap}_{funcstart\_719,1}$.p1, 177).quot *
$\mathbf{asType}$<$\mathbf{int}$>($\mathbf{asType}$<$\mathbf{short\ int}$>((int)2)))))

$\rightarrow$ *[simplify]*

[26.19] $\$\mathrm{heap}_{719,1;729,8}$ == $\$\mathrm{heap}_{funcstart\_719,1}$._$\mathbf{replace}$(p1 $\rightarrow$ ((-2 *
div($\mathbf{heapIs}$ $\$\mathrm{heap}_{funcstart\_719,1}$, $\$\mathrm{heap}_{funcstart\_719,1}$.p1, 177).quot) + (171 *
div($\mathbf{heapIs}$ $\$\mathrm{heap}_{funcstart\_719,1}$, $\$\mathrm{heap}_{funcstart\_719,1}$.p1, 177).rem)))

[Take goal term]

[1.0] (($\mathbf{asType}$<$\mathbf{int}$>($\mathbf{asType}$<$\mathbf{short\ int}$>(div2.rem)) *
$\mathbf{asType}$<$\mathbf{int}$>($\$\mathrm{heap}_{719,1;729,8}$.r2)) $-$ ($\mathbf{asType}$<$\mathbf{int}$>($\mathbf{asType}$<$\mathbf{short}$
$\mathbf{int}$>(div2.quot)) * $\mathbf{asType}$<$\mathbf{int}$>($\$\mathrm{heap}_{719,1;729,8}$.b2))) $\leq$ $\mathbf{maxof}$($\mathbf{short\ int}$)

$\rightarrow$ *[from term 12.6, div2 is equal to div($\mathbf{heapIs}$ $\$heap_{funcstart\_719,1}$,*
$\$heap_{funcstart\_719,1}$.p2, 176)]

[1.1] $((\textbf{asType}\textless\textbf{int}\textgreater(\textbf{asType}\textless\textbf{short int}\textgreater(\text{div}(\textbf{heapIs}\ \$\text{heap}_{funcstart\_719,1},$
$\$\text{heap}_{funcstart\_719,1}.\text{p2}, 176).\text{rem})) * \textbf{asType}\textless\textbf{int}\textgreater(\$\text{heap}_{719,1;729,8}.\text{r2})) -$
$(\textbf{asType}\textless\textbf{int}\textgreater(\textbf{asType}\textless\textbf{short int}\textgreater(\text{div2.quot})) *$
$\textbf{asType}\textless\textbf{int}\textgreater(\$\text{heap}_{719,1;729,8}.\text{b2}))) \leq \textbf{maxof}(\textbf{short int})$

$\rightarrow$ *[simplify]*

[1.3] $((\text{div}(\textbf{heapIs}\ \$\text{heap}_{funcstart\_719,1}, \$\text{heap}_{funcstart\_719,1}.\text{p2}, 176).\text{rem} *$
$\textbf{asType}\textless\textbf{int}\textgreater(\$\text{heap}_{719,1;729,8}.\text{r2})) - (\textbf{asType}\textless\textbf{int}\textgreater(\textbf{asType}\textless\textbf{short}$
$\textbf{int}\textgreater(\text{div2.quot})) * \textbf{asType}\textless\textbf{int}\textgreater(\$\text{heap}_{719,1;729,8}.\text{b2}))) \leq \textbf{maxof}(\textbf{short int})$

$\rightarrow$ *[from term 26.19, $\$\text{heap}_{719,1;729,8}$ is equal to*
$\$\text{heap}_{funcstart\_719,1}.\textbf{replace}(p1 \rightarrow$ (-2 * div($\textbf{heapIs}\ \$\text{heap}_{funcstart\_719,1},$
$\$\text{heap}_{funcstart\_719,1}.\text{p1}, 177).quot) + (171 * div($\textbf{heapIs}\ \$\text{heap}_{funcstart_719,1},$
$\$\text{heap}_{funcstart_719,1}.\text{p1}, 177).rem))]

[1.4] $((\text{div}(\textbf{heapIs}\ \$\text{heap}_{funcstart\_719,1}, \$\text{heap}_{funcstart\_719,1}.\text{p2}, 176).\text{rem} *$
$\textbf{asType}\textless\textbf{int}\textgreater(\$\text{heap}_{funcstart\_719,1}.\textbf{replace}(\text{p1} \rightarrow ((\text{-2} * \text{div}(\textbf{heapIs}$
$\$\text{heap}_{funcstart\_719,1}, \$\text{heap}_{funcstart\_719,1}.\text{p1}, 177).\text{quot}) + (171 * \text{div}(\textbf{heapIs}$
$\$\text{heap}_{funcstart\_719,1}, \$\text{heap}_{funcstart\_719,1}.\text{p1}, 177).\text{rem}))).\text{r2})) -$
$(\textbf{asType}\textless\textbf{int}\textgreater(\textbf{asType}\textless\textbf{short int}\textgreater(\text{div2.quot})) *$
$\textbf{asType}\textless\textbf{int}\textgreater(\$\text{heap}_{719,1;729,8}.\text{b2}))) \leq \textbf{maxof}(\textbf{short int})$

$\rightarrow$ *[const member of object with modified fields]*

[1.5] $((\text{div}(\textbf{heapIs}\ \$\text{heap}_{funcstart\_719,1}, \$\text{heap}_{funcstart\_719,1}.\text{p2}, 176).\text{rem} *$
$\textbf{asType}\textless\textbf{int}\textgreater(\$\text{heap}_{funcstart\_719,1}.\text{r2})) - (\textbf{asType}\textless\textbf{int}\textgreater(\textbf{asType}\textless\textbf{short}$
$\textbf{int}\textgreater(\text{div2.quot})) * \textbf{asType}\textless\textbf{int}\textgreater(\$\text{heap}_{719,1;729,8}.\text{b2}))) \leq \textbf{maxof}(\textbf{short int})$

$\rightarrow$ *[const static or extern object]*

[1.6] $((\text{div}(\textbf{heapIs}\ \$\text{heap}_{funcstart\_719,1}, \$\text{heap}_{funcstart\_719,1}.\text{p2}, 176).\text{rem} *$
$\textbf{asType}\textless\textbf{int}\textgreater(\$\text{heap}_{init}.\text{r2})) - (\textbf{asType}\textless\textbf{int}\textgreater(\textbf{asType}\textless\textbf{short}$
$\textbf{int}\textgreater(\text{div2.quot})) * \textbf{asType}\textless\textbf{int}\textgreater(\$\text{heap}_{719,1;729,8}.\text{b2}))) \leq \textbf{maxof}(\textbf{short int})$

$\rightarrow$ *[expand definition of constant 'r2' at prang.c (20,20)]*

[1.7] $((\text{div}(\textbf{heapIs}\ \$\text{heap}_{funcstart\_719,1}, \$\text{heap}_{funcstart\_719,1}.\text{p2}, 176).\text{rem} *$
$\textbf{asType}\textless\textbf{int}\textgreater(\textbf{asType}\textless\textbf{short int}\textgreater((\textbf{int})172))) -$
$(\textbf{asType}\textless\textbf{int}\textgreater(\textbf{asType}\textless\textbf{short int}\textgreater(\text{div2.quot})) *$
$\textbf{asType}\textless\textbf{int}\textgreater(\$\text{heap}_{719,1;729,8}.\text{b2}))) \leq \textbf{maxof}(\textbf{short int})$

$\rightarrow$ *[simplify]*

[1.10] $((\text{div}(\textbf{heapIs}\ \$\text{heap}_{funcstart\_719,1}, \$\text{heap}_{funcstart\_719,1}.\text{p2}, 176).\text{rem} *$
$172) - (\textbf{asType}\textless\textbf{int}\textgreater(\textbf{asType}\textless\textbf{short int}\textgreater(\text{div2.quot})) *$
$\textbf{asType}\textless\textbf{int}\textgreater(\$\text{heap}_{719,1;729,8}.\text{b2}))) \leq \textbf{maxof}(\textbf{short int})$

$\rightarrow$ *[from term 12.6, div2 is equal to div($\textbf{heapIs}\ \$heap_{funcstart\_719,1},$*
$\$heap_{funcstart_719,1}.\text{p2}, 176)]

[1.11] $((172 * \text{div}(\textbf{heapIs}\ \$\text{heap}_{funcstart\_719,1}, \$\text{heap}_{funcstart\_719,1}.\text{p2},$
$176).\text{rem}) - (\textbf{asType}\textless\textbf{int}\textgreater(\textbf{asType}\textless\textbf{short int}\textgreater(\text{div}(\textbf{heapIs}$
$\$\text{heap}_{funcstart\_719,1}, \$\text{heap}_{funcstart\_719,1}.\text{p2}, 176).\text{quot})) *$

asType<int>($\text{heap}_{719,1;729,8}$.b2))) ≤ **maxof**(**short int**)

→ *[simplify]*

[1.13] ((172 * div(**heapIs** $\text{heap}_{funcstart\_719,1}$, $\text{heap}_{funcstart\_719,1}$.p2, 176).rem) − (div(**heapIs** $\text{heap}_{funcstart\_719,1}$, $\text{heap}_{funcstart\_719,1}$.p2, 176).quot * **asType<int>**($\text{heap}_{719,1;729,8}$.b2))) ≤ **maxof**(**short int**)

→ *[from term 26.19, \$heap$_{719,1;729,8}$ is equal to \$heap$_{funcstart\_719,1}$.**replace**(p1 → (-2 * div(**heapIs** \$heap$_{funcstart\_719,1}$, \$heap$_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs** \$heap$_{funcstart\_719,1}$, \$heap$_{funcstart\_719,1}$.p1, 177).rem))]*

[1.14] ((172 * div(**heapIs** $\text{heap}_{funcstart\_719,1}$, $\text{heap}_{funcstart\_719,1}$.p2, 176).rem) − (div(**heapIs** $\text{heap}_{funcstart\_719,1}$, $\text{heap}_{funcstart\_719,1}$.p2, 176).quot * **asType<int>**($\text{heap}_{funcstart\_719,1}$.**replace**(p1 → ((-2 * div(**heapIs** $\text{heap}_{funcstart\_719,1}$, $\text{heap}_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs** $\text{heap}_{funcstart\_719,1}$, $\text{heap}_{funcstart\_719,1}$.p1, 177).rem))).b2))) ≤ **maxof**(**short int**)

→ *[const member of object with modified fields]*

[1.15] ((172 * div(**heapIs** $\text{heap}_{funcstart\_719,1}$, $\text{heap}_{funcstart\_719,1}$.p2, 176).rem) − (div(**heapIs** $\text{heap}_{funcstart\_719,1}$, $\text{heap}_{funcstart\_719,1}$.p2, 176).quot * **asType<int>**($\text{heap}_{funcstart\_719,1}$.b2))) ≤ **maxof**(**short int**)

→ *[const static or extern object]*

[1.16] ((172 * div(**heapIs** $\text{heap}_{funcstart\_719,1}$, $\text{heap}_{funcstart\_719,1}$.p2, 176).rem) − (div(**heapIs** $\text{heap}_{funcstart\_719,1}$, $\text{heap}_{funcstart\_719,1}$.p2, 176).quot * **asType<int>**(heap_{init}.b2))) ≤ **maxof**(**short int**)

→ *[expand definition of constant 'b2' at prang.c (22,20)]*

[1.17] ((172 * div(**heapIs** $\text{heap}_{funcstart\_719,1}$, $\text{heap}_{funcstart\_719,1}$.p2, 176).rem) − (div(**heapIs** $\text{heap}_{funcstart\_719,1}$, $\text{heap}_{funcstart\_719,1}$.p2, 176).quot * **asType<int>**(**asType<short int>**((int)35)))) ≤ **maxof**(**short int**)

→ *[simplify]*

[1.36] -32768 < ((-172 * div(**heapIs** $\text{heap}_{funcstart\_719,1}$, $\text{heap}_{funcstart\_719,1}$.p2, 176).rem) + (35 * div(**heapIs** $\text{heap}_{funcstart\_719,1}$, $\text{heap}_{funcstart\_719,1}$.p2, 176).quot))

→ *[negate goal and search for contradiction]*

[1.37] !(-32768 < ((-172 * div(**heapIs** $\text{heap}_{funcstart\_719,1}$, $\text{heap}_{funcstart\_719,1}$.p2, 176).rem) + (35 * div(**heapIs** $\text{heap}_{funcstart\_719,1}$, $\text{heap}_{funcstart\_719,1}$.p2, 176).quot)))

→ *[simplify]*

[1.42] 32767 < ((172 * div(**heapIs** $\text{heap}_{funcstart\_719,1}$, $\text{heap}_{funcstart\_719,1}$.p2, 176).rem) + (-35 * div(**heapIs** $\text{heap}_{funcstart\_719,1}$, $\text{heap}_{funcstart\_719,1}$.p2,

176).quot))

[Branch on disjunction or conditional in term 17.21]

[41.0] $(0 == ((-\$heap_{funcstart\_719,1}.p2\ /\ 176) + \mathrm{div}(\textbf{heapIs}\ \$heap_{funcstart\_719,1}, \$heap_{funcstart\_719,1}.p2, 176).quot)) \lor (0 == (-(\$heap_{funcstart\_719,1}.p2\ /\ 176) + \mathrm{div}(\textbf{heapIs}\ \$heap_{funcstart\_719,1}, \$heap_{funcstart\_719,1}.p2, 176).quot)) \lor$ (-1 $<$ $\$heap_{funcstart\_719,1}.p2$)

[Branch on disjunction or conditional in term 17.21]

[42.0] $(0 < -\$heap_{funcstart\_719,1}.p2) \lor (0 == (-(\$heap_{funcstart\_719,1}.p2\ /\ 176) + \mathrm{div}(\textbf{heapIs}\ \$heap_{funcstart\_719,1}, \$heap_{funcstart\_719,1}.p2, 176).quot)) \lor$ (-1 $<$ $\$heap_{funcstart\_719,1}.p2$)

[Copy term 18.40]

[43.0] ([0 $< -\$heap_{funcstart\_719,1}.p2$]: ([0 $== (\$heap_{funcstart\_719,1}.p2\ \%\ 176)$]: 0 $== \mathrm{div}(\textbf{heapIs}\ \$heap_{funcstart\_719,1}, \$heap_{funcstart\_719,1}.p2, 176).rem$, [!(0 $== (\$heap_{funcstart\_719,1}.p2\ \%\ 176))$]: 176 $== (-\mathrm{div}(\textbf{heapIs}\ \$heap_{funcstart\_719,1}, \$heap_{funcstart\_719,1}.p2, 176).rem + (\$heap_{funcstart\_719,1}.p2\ \%\ 176)))$, [-1 $< \$heap_{funcstart\_719,1}.p2$]: 0 $== (-(\$heap_{funcstart\_719,1}.p2\ \%\ 176) + \mathrm{div}(\textbf{heapIs}\ \$heap_{funcstart\_719,1}, \$heap_{funcstart\_719,1}.p2, 176).rem)) \lor (0 == (-(\$heap_{funcstart\_719,1}.p2\ /\ 176) + \mathrm{div}(\textbf{heapIs}\ \$heap_{funcstart\_719,1}, \$heap_{funcstart\_719,1}.p2, 176).quot)) \lor$ (-1 $< \$heap_{funcstart\_719,1}.p2$)

$\rightarrow$ *[from term 42.0, literala $< -\$heap_{funcstart\_719,1}.p2$ is true whenever (-1 + literala) $<$ 0]*

Proof of rule precondition:

[43.0.0] (-1 + 0) $<$ 0

$\rightarrow$ *[simplify]*

[43.0.2] **true**

[43.1] ([**true**]: ([0 $== (\$heap_{funcstart\_719,1}.p2\ \%\ 176)$]: 0 $== \mathrm{div}(\textbf{heapIs}\ \$heap_{funcstart\_719,1}, \$heap_{funcstart\_719,1}.p2, 176).rem$, [!(0 $== (\$heap_{funcstart\_719,1}.p2\ \%\ 176))$]: 176 $== (-\mathrm{div}(\textbf{heapIs}\ \$heap_{funcstart\_719,1}, \$heap_{funcstart\_719,1}.p2, 176).rem + (\$heap_{funcstart\_719,1}.p2\ \%\ 176)))$, [-1 $< \$heap_{funcstart\_719,1}.p2$]: 0 $== (-(\$heap_{funcstart\_719,1}.p2\ \%\ 176) + \mathrm{div}(\textbf{heapIs}\ \$heap_{funcstart\_719,1}, \$heap_{funcstart\_719,1}.p2, 176).rem)) \lor$ ...

$\rightarrow$ *[simplify]*

[43.3] ([0 $== (\$heap_{funcstart\_719,1}.p2\ \%\ 176)$]: 0 $== \mathrm{div}(\textbf{heapIs}\ \$heap_{funcstart\_719,1}, \$heap_{funcstart\_719,1}.p2, 176).rem$, [!(0 $== (\$heap_{funcstart\_719,1}.p2\ \%\ 176))$]: 176 $== (-\mathrm{div}(\textbf{heapIs}\ \$heap_{funcstart\_719,1}, \$heap_{funcstart\_719,1}.p2, 176).rem + (\$heap_{funcstart\_719,1}.p2\ \%\ 176))) \lor$ ...

[Branch on disjunction or conditional in term 43.3]

[44.0] (0 $== \mathrm{div}(\textbf{heapIs}\ \$heap_{funcstart\_719,1}, \$heap_{funcstart\_719,1}.p2, 176).rem$)

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$\lor$ (0 == ($-$($\$heap_{funcstart\_719,1}$.p2 / 176) + div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).quot)) $\lor$ (-1 < $\$heap_{funcstart\_719,1}$.p2) $\lor$ (176 == ($-$div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).rem + ($\$heap_{funcstart\_719,1}$.p2 % 176))) $\lor$!(0 == ($\$heap_{funcstart\_719,1}$.p2 % 176))

[Copy term 1.42]

[46.0] (32767 < ((-35 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).quot) + (172 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).rem))) $\lor$ (0 == ($-$($\$heap_{funcstart\_719,1}$.p2 / 176) + div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).quot)) $\lor$ (-1 < $\$heap_{funcstart\_719,1}$.p2) $\lor$ (176 == ($-$div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).rem + ($\$heap_{funcstart\_719,1}$.p2 % 176))) $\lor$!(0 == ($\$heap_{funcstart\_719,1}$.p2 % 176))

$\rightarrow$ *[from term 44.0, div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).rem is equal to 0]*

[46.1] (32767 < ((-35 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).quot) + (172 * 0))) $\lor$ ...

$\rightarrow$ *[simplify]*

[46.3] (32767 < (-35 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).quot)) $\lor$ ...

$\rightarrow$ *[literal comparison of product]*

[46.4] ([-35 < 0]: (32767 / 35) < $-$div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).quot, [0 < -35]: (32767 / -35) < div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).quot, [-35 == 0]: 32767 < 0) $\lor$ ...

$\rightarrow$ *[explicitly assert falsehood of skipped guards in subsequent guards]*

[46.5] ([-35 < 0]: (32767 / 35) < $-$div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).quot, [(0 < -35) $\land$!(-35 < 0)]: (32767 / -35) < div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).quot, [(-35 == 0) $\land$!(-35 < 0) $\land$!(0 < -35)]: 32767 < 0) $\lor$ ...

$\rightarrow$ *[simplify]*

[46.9] (936 < $-$div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).quot) $\lor$ ...

[Create new term from terms 46.9, 41.0 using rule: transitivity 16]

[54.0] ((0 + 936) < ($-\$heap_{funcstart\_719,1}$.p2 / 176)) $\lor$ (0 == ($-$($\$heap_{funcstart\_719,1}$.p2 / 176) + div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).quot)) $\lor$ (-1 < $\$heap_{funcstart\_719,1}$.p2) $\lor$ (176 == ($-$div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).rem + ($\$heap_{funcstart\_719,1}$.p2 % 176))) $\lor$!(0 == ($\$heap_{funcstart\_719,1}$.p2 % 176))

$\rightarrow$ *[simplify]*

[54.8] $(164911 < -\$\text{heap}_{funcstart\_719,1}.\text{p2}) \lor \ldots$

$\rightarrow$ *[from term 15.3, literala $< -\$\text{heap}_{funcstart\_719,1}.p2$ is false whenever -2 $<$ (-32769 + literala)]*

Proof of rule precondition:

[54.8.0] -2 $<$ (-32769 + 164911)

$\rightarrow$ *[simplify]*

[54.8.2] **true**

[54.9] **false** $\lor \ldots$

[Remove 'false' term 54.9 and fetch new term from containing clause]

[55.0] $(176 == (-\text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_719,1}, \$\text{heap}_{funcstart\_719,1}.\text{p2},$ $176).\text{rem} + (\$\text{heap}_{funcstart\_719,1}.\text{p2} \% 176))) \lor (0 ==$ $(-(\$\text{heap}_{funcstart\_719,1}.\text{p2} / 176) + \text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_719,1},$ $\$\text{heap}_{funcstart\_719,1}.\text{p2}, 176).\text{quot})) \lor (\text{-1} < \$\text{heap}_{funcstart\_719,1}.\text{p2})$

[Remove 'false' term 54.9 and fetch new term from containing clause]

[56.0] $!(0 == (\$\text{heap}_{funcstart\_719,1}.\text{p2} \% 176)) \lor (0 ==$ $(-(\$\text{heap}_{funcstart\_719,1}.\text{p2} / 176) + \text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_719,1},$ $\$\text{heap}_{funcstart\_719,1}.\text{p2}, 176).\text{quot})) \lor (\text{-1} < \$\text{heap}_{funcstart\_719,1}.\text{p2})$

[Copy term 1.42]

[58.0] $(32767 < ((\text{-35} * \text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_719,1},$ $\$\text{heap}_{funcstart\_719,1}.\text{p2}, 176).\text{quot}) + (172 * \text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_719,1},$ $\$\text{heap}_{funcstart\_719,1}.\text{p2}, 176).\text{rem}))) \lor (0 == (-(\$\text{heap}_{funcstart\_719,1}.\text{p2} / 176)$ $+ \text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_719,1}, \$\text{heap}_{funcstart\_719,1}.\text{p2}, 176).\text{quot})) \lor (\text{-1} <$ $\$\text{heap}_{funcstart\_719,1}.\text{p2})$

$\rightarrow$ *[from term 55.0, div($\textbf{heapIs}$ $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}.p2$, 176).rem is equal to -176 + ($\$\text{heap}_{funcstart\_719,1}.p2 \% 176$)]*

[58.1] $(32767 < ((\text{-35} * \text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_719,1}, \$\text{heap}_{funcstart\_719,1}.\text{p2},$ $176).\text{quot}) + (172 * (\text{-176} + (\$\text{heap}_{funcstart\_719,1}.\text{p2} \% 176))))) \lor \ldots$

$\rightarrow$ *[simplify]*

[58.6] $(63039 < ((\text{-35} * \text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_719,1}, \$\text{heap}_{funcstart\_719,1}.\text{p2},$ $176).\text{quot}) + (172 * (\$\text{heap}_{funcstart\_719,1}.\text{p2} \% 176)))) \lor \ldots$

[Create new term from term 56.0 using rule: try to prove equality by contradiction]

[62.0] $((0 < (\$\text{heap}_{funcstart\_719,1}.\text{p2} \% 176)) \lor ((\$\text{heap}_{funcstart\_719,1}.\text{p2} \% 176)$ $< 0)) \lor (0 == (-(\$\text{heap}_{funcstart\_719,1}.\text{p2} / 176) + \text{div}(\textbf{heapIs}$ $\$\text{heap}_{funcstart\_719,1}, \$\text{heap}_{funcstart\_719,1}.\text{p2}, 176).\text{quot})) \lor (\text{-1} <$ $\$\text{heap}_{funcstart\_719,1}.\text{p2})$

$\rightarrow$ *[simplify]*

[62.1] ((([-1 < 0]: ∃ **integer** n • (0 < ($heap$_{funcstart_719,1}$.p2 + (176 * n))) ∧
(($heap$_{funcstart_719,1}$.p2 + (176 * n)) < 176), []: **true**) ∨
(($heap$_{funcstart_719,1}$.p2 % 176) < 0)) ∨ ...

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

[62.2] ((([-1 < 0]: ∃ **integer** n • (0 < ($heap$_{funcstart_719,1}$.p2 + (176 * n))) ∧
(($heap$_{funcstart_719,1}$.p2 + (176 * n)) < 176), [!(-1 < 0)]: **true**) ∨
(($heap$_{funcstart_719,1}$.p2 % 176) < 0)) ∨ ...

→ *[simplify]*

[62.15] (∃ **integer** n • (-176 < (−$heap$_{funcstart_719,1}$.p2 + (-176 * n))) ∧ (0 <
((176 * n) + $heap$_{funcstart_719,1}$.p2))) ∨ ...

→ *[introduce skolem term and eliminate 'exists']*

[62.16] ((-176 < (−$heap$_{funcstart_719,1}$.p2 + (-176 * $a_n))) ∧ (0 < ((176 *
$a_n) + $heap$_{funcstart_719,1}$.p2))) ∨ ...

→ *[separate conjunction and work on first sub-term]*

[62.17] (-176 < (−$heap$_{funcstart_719,1}$.p2 + (-176 * $a_n))) ∨ ...

[Work on sub-term 2 of conjunction in term 62.16]

[63.0] (0 < ((176 * $a_n) + $heap$_{funcstart_719,1}$.p2)) ∨ (0 ==
(−($heap$_{funcstart_719,1}$.p2 / 176) + div(**heapIs** $heap$_{funcstart_719,1}$,
$heap$_{funcstart_719,1}$.p2, 176).quot)) ∨ (-1 < $heap$_{funcstart_719,1}$.p2)

[Create new term from term 41.0 using rule: condition for equality of division]

[68.0] ((−$heap$_{funcstart_719,1}$.p2 < (176 * (0 + 1 + −div(**heapIs**
$heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p2, 176).quot))) ∧ ((176 * (0 +
−div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p2, 176).quot)) < (1 +
−$heap$_{funcstart_719,1}$.p2))) ∨ (0 == (−($heap$_{funcstart\_719,1}$.p2 / 176) +
div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p2, 176).quot)) ∨ (-1 <
$heap$_{funcstart_719,1}$.p2)

→ *[simplify]*

[68.18] ((-176 < ((-176 * div(**heapIs** $heap$_{funcstart_719,1}$,
$heap$_{funcstart_719,1}$.p2, 176).quot) + $heap$_{funcstart_719,1}$.p2)) ∧ (-1 <
(−$heap$_{funcstart_719,1}$.p2 + (176 * div(**heapIs** $heap$_{funcstart_719,1}$,
$heap$_{funcstart_719,1}$.p2, 176).quot)))) ∨ ...

→ *[separate conjunction and work on first sub-term]*

[68.19] (-176 < ((-176 * div(**heapIs** $heap$_{funcstart_719,1}$,
$heap$_{funcstart_719,1}$.p2, 176).quot) + $heap$_{funcstart_719,1}$.p2)) ∨ ...

[Work on sub-term 2 of conjunction in term 68.18]

[69.0] (-1 < (−$heap$_{funcstart_719,1}$.p2 + (176 * div(**heapIs**
$heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p2, 176).quot))) ∨ (0 ==
(−($heap$_{funcstart_719,1}$.p2 / 176) + div(**heapIs** $heap$_{funcstart_719,1}$,

$\text{\$heap}_{funcstart\_719,1}.\text{p2}, 176).\text{quot})) \lor (\text{-1} < \text{\$heap}_{funcstart\_719,1}.\text{p2})$

[Create new term from terms 68.19, 62.17 using rule: transitivity 1]

[71.0] $((\text{-176} + \text{-176} + 1) < ((\text{-176} * \text{div}(\textbf{heapIs } \text{\$heap}_{funcstart\_719,1},$ $\text{\$heap}_{funcstart\_719,1}.\text{p2}, 176).\text{quot}) + (\text{-176} * \text{\$a\_n}))) \lor (0 ==$ $(-(\text{\$heap}_{funcstart\_719,1}.\text{p2} / 176) + \text{div}(\textbf{heapIs } \text{\$heap}_{funcstart\_719,1},$ $\text{\$heap}_{funcstart\_719,1}.\text{p2}, 176).\text{quot})) \lor (\text{-1} < \text{\$heap}_{funcstart\_719,1}.\text{p2})$

$\rightarrow$ *[simplify]*

[71.1] $(\text{-351} < ((\text{-176} * \text{div}(\textbf{heapIs } \text{\$heap}_{funcstart\_719,1}, \text{\$heap}_{funcstart\_719,1}.\text{p2},$ $176).\text{quot}) + (\text{-176} * \text{\$a\_n}))) \lor ...$

$\rightarrow$ *[cancel common factor]*

Proof of rule precondition 1:

[71.1.0.0] $!(\text{-176} == 0)$

$\rightarrow$ *[simplify]*

[71.1.0.2] **true**

Proof of rule precondition 2:

[71.1.1.0] $1 < \text{\$gcf}(\text{-176}, \text{-176})$

$\rightarrow$ *[simplify]*

[71.1.1.2] **true**

[71.2] $((\text{-351} / \text{\$gcf}(\text{-176}, \text{-176})) < (((\text{-176} / \text{\$gcf}(\text{-176}, \text{-176})) * \text{div}(\textbf{heapIs }$ $\text{\$heap}_{funcstart\_719,1}, \text{\$heap}_{funcstart\_719,1}.\text{p2}, 176).\text{quot}) + ((\text{-176} / \text{\$gcf}(\text{-176},$ $\text{-176})) * \text{\$a\_n}))) \lor ...$

$\rightarrow$ *[simplify]*

[71.10] $(\text{-2} < (-\text{div}(\textbf{heapIs } \text{\$heap}_{funcstart\_719,1}, \text{\$heap}_{funcstart\_719,1}.\text{p2},$ $176).\text{quot} + -\text{\$a\_n})) \lor ...$

[Create new term from terms 69.0, 63.0 using rule: transitivity 1]

[73.0] $((\text{-1} + 0 + 1) < ((176 * \text{div}(\textbf{heapIs } \text{\$heap}_{funcstart\_719,1},$ $\text{\$heap}_{funcstart\_719,1}.\text{p2}, 176).\text{quot}) + (176 * \text{\$a\_n}))) \lor (0 ==$ $(-(\text{\$heap}_{funcstart\_719,1}.\text{p2} / 176) + \text{div}(\textbf{heapIs } \text{\$heap}_{funcstart\_719,1},$ $\text{\$heap}_{funcstart\_719,1}.\text{p2}, 176).\text{quot})) \lor (\text{-1} < \text{\$heap}_{funcstart\_719,1}.\text{p2})$

$\rightarrow$ *[simplify]*

[73.1] $(0 < ((176 * \text{div}(\textbf{heapIs } \text{\$heap}_{funcstart\_719,1}, \text{\$heap}_{funcstart\_719,1}.\text{p2},$ $176).\text{quot}) + (176 * \text{\$a\_n}))) \lor ...$

$\rightarrow$ *[cancel common factor]*

Proof of rule precondition 1:

[73.1.0.0] $!(0 == 176)$

$\rightarrow$ *[simplify]*

[73.1.0.2] **true**

Proof of rule precondition 2:

[73.1.1.0] $1 <$ \$gcf(176, 176)

$\rightarrow$ *[simplify]*

[73.1.1.2] **true**

[73.2] $((0 \,/\,$ \$gcf(176, 176)$) < (((176 \,/\,$ \$gcf(176, 176)$) *$ div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}.\text{p2}, 176).\text{quot}) + ((176 \,/\,$ \$gcf(176, 176)$) *$ \$a_n$))) \lor$ ...

$\rightarrow$ *[simplify]*

[73.10] $(0 <$ (div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}.\text{p2}, 176).\text{quot} +$ \$a_n$)) \lor$ ...

$\rightarrow$ *[from term 71.10, $0 <$ (div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}.p2, 176).quot +$ \$a_n) is true if and only if $-1 ==$ ($-$div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}.p2, 176).quot +$ $-$\$a_n)]*

[73.11] $(-1 ==$ ($-$div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}.\text{p2}, 176).\text{quot} +$ $-$\$a_n$)) \lor$ ...

$\rightarrow$ *[simplify]*

[73.15] $(1 ==$ (div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}.\text{p2}, 176).\text{quot} +$ \$a_n$)) \lor$ ...

[Create new term from terms 62.17, 15.3 using rule: transitivity 2]

[66.0] $(($-32769 + -176 + 1$) < ($-176 $*$ \$a_n$)) \lor (0 ==$ ($-$($\text{\$heap}_{funcstart\_719,1}.\text{p2} \,/\, 176) +$ div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}.\text{p2}, 176).\text{quot})) \lor ($-1 <$ $\text{\$heap}_{funcstart\_719,1}.\text{p2})$

$\rightarrow$ *[simplify]*

[66.1] $(-32944 < ($-176 $*$ \$a_n$)) \lor$ ...

$\rightarrow$ *[literal comparison of product]*

[66.2] $([$-176 $< 0]: ($-32944 $/\, 176) <$ $-$\$a_n, $[0 <$ -176$]: ($-32944 $/\,$ -176$) <$ \$a_n, $[$-176 $== 0]: $-32944 $< 0) \lor$ ...

$\rightarrow$ *[explicitly assert falsehood of skipped guards in subsequent guards]*

[66.3] $([$-176 $< 0]: ($-32944 $/\, 176) <$ $-$\$a_n, $[(0 <$ -176$) \land !($-176 $< 0)]: ($-32944 $/\,$ -176$) <$ \$a_n, $[($-176 $== 0) \land !($-176 $< 0) \land !(0 <$ -176$)]: $-32944 $< 0) \lor$ ...

$\rightarrow$ *[simplify]*

[66.7] $(-188 <$ $-$\$a_n$) \lor$ ...

$\rightarrow$ *[from term 73.15, \$a_n is equal to $1 +$ $-$div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart_719,1}.p2, 176).quot]*

[66.8] (-188 < −(1 + −div(**heapIs** \$heap$_{funcstart\_719,1}$, \$heap$_{funcstart\_719,1}$.p2, 176).quot)) ∨ ...

→ *[simplify]*

[66.13] (-187 < div(**heapIs** \$heap$_{funcstart\_719,1}$, \$heap$_{funcstart\_719,1}$.p2, 176).quot) ∨ ...

[Create new term from terms 66.13, 58.6 using rule: transitivity 11]

[79.0] ((1 + 63039 + (-187 * 35)) < (172 * (\$heap$_{funcstart\_719,1}$.p2 % 176))) ∨ (0 == (−(\$heap$_{funcstart\_719,1}$.p2 / 176) + div(**heapIs** \$heap$_{funcstart\_719,1}$, \$heap$_{funcstart\_719,1}$.p2, 176).quot)) ∨ (-1 < \$heap$_{funcstart\_719,1}$.p2)

→ *[simplify]*

[79.2] (56495 < (172 * (\$heap$_{funcstart\_719,1}$.p2 % 176))) ∨ ...

→ *[literal comparison of product]*

[79.3] ([172 < 0]: (56495 / -172) < −(\$heap$_{funcstart\_719,1}$.p2 % 176), [0 < 172]: (56495 / 172) < (\$heap$_{funcstart\_719,1}$.p2 % 176), [0 == 172]: 56495 < 0) ∨ ...

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

[79.4] ([172 < 0]: (56495 / -172) < −(\$heap$_{funcstart\_719,1}$.p2 % 176), [(0 < 172) ∧ !(172 < 0)]: (56495 / 172) < (\$heap$_{funcstart\_719,1}$.p2 % 176), [(0 == 172) ∧ !(0 < 172) ∧ !(172 < 0)]: 56495 < 0) ∨ ...

→ *[simplify]*

[79.13] **false** ∨ ...

[Remove 'false' term 79.13 and fetch new term from containing clause]

[80.0] 0 == (−(\$heap$_{funcstart\_719,1}$.p2 / 176) + div(**heapIs** \$heap$_{funcstart\_719,1}$, \$heap$_{funcstart\_719,1}$.p2, 176).quot)

[Remove 'false' term 79.13 and fetch new term from containing clause]

[81.0] -1 < \$heap$_{funcstart\_719,1}$.p2

[Assume known post-assertion, class invariant or type constraint for term 12.6]

[18.40] ([0 < −\$heap$_{funcstart\_719,1}$.p2]: ([0 == (\$heap$_{funcstart\_719,1}$.p2 % 176)]: 0 == div(**heapIs** \$heap$_{funcstart\_719,1}$, \$heap$_{funcstart\_719,1}$.p2, 176).rem, [!(0 == (\$heap$_{funcstart\_719,1}$.p2 % 176))]: 176 == ((\$heap$_{funcstart\_719,1}$.p2 % 176) + −div(**heapIs** \$heap$_{funcstart\_719,1}$, \$heap$_{funcstart\_719,1}$.p2, 176).rem)), [-1 < \$heap$_{funcstart\_719,1}$.p2]: 0 == (−(\$heap$_{funcstart\_719,1}$.p2 % 176) + div(**heapIs** \$heap$_{funcstart\_719,1}$, \$heap$_{funcstart\_719,1}$.p2, 176).rem))

→ *[from term 81.0, literala < −\$heap$_{funcstart\_719,1}$.p2 is false whenever -2 < (-1 + literala)]*

Proof of rule precondition:

[18.40.0] -2 < (-1 + 0)

$\rightarrow$ *[simplify]*

[18.40.2] **true**

[18.41] ([**false**]: ([0 == ($\text{heap}_{funcstart\_719,1}$.p2 % 176)]: 0 == div(**heapIs** $\text{heap}_{funcstart\_719,1}$, $\text{heap}_{funcstart\_719,1}$.p2, 176).rem, [!(0 == ($\text{heap}_{funcstart\_719,1}$.p2 % 176))]: 176 == ($-$div(**heapIs** $\text{heap}_{funcstart\_719,1}$, $\text{heap}_{funcstart\_719,1}$.p2, 176).rem + ($\text{heap}_{funcstart\_719,1}$.p2 % 176))), [-1 < $\text{heap}_{funcstart\_719,1}$.p2]: 0 == ($-$($\text{heap}_{funcstart\_719,1}$.p2 % 176) + div(**heapIs** $\text{heap}_{funcstart\_719,1}$, $\text{heap}_{funcstart\_719,1}$.p2, 176).rem))

$\rightarrow$ *[from term 81.0, literala < $heap_{funcstart\_719,1}$.p2 is true whenever (-1 + literala) < -1]*

Proof of rule precondition:

[18.41.0] (-1 + -1) < -1

$\rightarrow$ *[simplify]*

[18.41.2] **true**

[18.42] ([**false**]: ([0 == ($\text{heap}_{funcstart\_719,1}$.p2 % 176)]: 0 == div(**heapIs** $\text{heap}_{funcstart\_719,1}$, $\text{heap}_{funcstart\_719,1}$.p2, 176).rem, [!(0 == ($\text{heap}_{funcstart\_719,1}$.p2 % 176))]: 176 == ($-$div(**heapIs** $\text{heap}_{funcstart\_719,1}$, $\text{heap}_{funcstart\_719,1}$.p2, 176).rem + ($\text{heap}_{funcstart\_719,1}$.p2 % 176))), [**true**]: 0 == ($-$($\text{heap}_{funcstart\_719,1}$.p2 % 176) + div(**heapIs** $\text{heap}_{funcstart\_719,1}$, $\text{heap}_{funcstart\_719,1}$.p2, 176).rem))

$\rightarrow$ *[simplify]*

[18.44] 0 == ($-$($\text{heap}_{funcstart\_719,1}$.p2 % 176) + div(**heapIs** $\text{heap}_{funcstart\_719,1}$, $\text{heap}_{funcstart\_719,1}$.p2, 176).rem)

[Copy term 1.42]

[82.0] 32767 < ((-35 * div(**heapIs** $\text{heap}_{funcstart\_719,1}$, $\text{heap}_{funcstart\_719,1}$.p2, 176).quot) + (172 * div(**heapIs** $\text{heap}_{funcstart\_719,1}$, $\text{heap}_{funcstart\_719,1}$.p2, 176).rem))

$\rightarrow$ *[from term 18.44, div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p2, 176).rem is equal to $heap_{funcstart\_719,1}$.p2 % 176]*

[82.1] 32767 < ((-35 * div(**heapIs** $\text{heap}_{funcstart\_719,1}$, $\text{heap}_{funcstart\_719,1}$.p2, 176).quot) + (172 * ($\text{heap}_{funcstart\_719,1}$.p2 % 176)))

[Create new term from term 80.0 using rule: condition for equality of division]

[87.0] (0 < (1 + (176 * (0 + $-$div(**heapIs** $\text{heap}_{funcstart\_719,1}$, $\text{heap}_{funcstart\_719,1}$.p2, 176).quot)) + $\text{heap}_{funcstart\_719,1}$.p2)) $\wedge$ ($\text{heap}_{funcstart\_719,1}$.p2 < (176 * (0 + 1 + div(**heapIs** $\text{heap}_{funcstart\_719,1}$, $\text{heap}_{funcstart\_719,1}$.p2, 176).quot)))

$\rightarrow$ *[simplify]*

[87.12] (-1 < ((-176 * div(**heapIs** $\text{heap}_{funcstart\_719,1}$, $\text{heap}_{funcstart\_719,1}$.p2,

176).quot) + $\$heap_{funcstart\_719,1}$.p2)) $\land$ (-176 < ($-\$heap_{funcstart\_719,1}$.p2 + (176 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).quot)))

$\rightarrow$ *[separate conjunction and work on first sub-term]*

[87.13] -176 < ($-\$heap_{funcstart\_719,1}$.p2 + (176 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).quot))

[Create new term from terms 87.13, 81.0 using rule: transitivity 2]

[89.0] (-176 + -1 + 1) < (176 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).quot)

$\rightarrow$ *[simplify]*

[89.1] -176 < (176 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).quot)

$\rightarrow$ *[literal comparison of product]*

[89.2] ([176 < 0]: (-176 / -176) < $-$div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).quot, [0 < 176]: (-176 / 176) < div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).quot, [0 == 176]: -176 < 0)

$\rightarrow$ *[explicitly assert falsehood of skipped guards in subsequent guards]*

[89.3] ([176 < 0]: (-176 / -176) < $-$div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).quot, [(0 < 176) $\land$!(176 < 0)]: (-176 / 176) < div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).quot, [(0 == 176) $\land$!(0 < 176) $\land$!(176 < 0)]: -176 < 0)

$\rightarrow$ *[simplify]*

[89.11] -1 < div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).quot

[Create new term from terms 89.11, 82.1 using rule: transitivity 11]

[91.0] (1 + 32767 + (-1 * 35)) < (172 * ($\$heap_{funcstart\_719,1}$.p2 % 176))

$\rightarrow$ *[simplify]*

[91.2] 32733 < (172 * ($\$heap_{funcstart\_719,1}$.p2 % 176))

$\rightarrow$ *[literal comparison of product]*

[91.3] ([172 < 0]: (32733 / -172) < $-$($\$heap_{funcstart\_719,1}$.p2 % 176), [0 < 172]: (32733 / 172) < ($\$heap_{funcstart\_719,1}$.p2 % 176), [0 == 172]: 32733 < 0)

$\rightarrow$ *[explicitly assert falsehood of skipped guards in subsequent guards]*

[91.4] ([172 < 0]: (32733 / -172) < $-$($\$heap_{funcstart\_719,1}$.p2 % 176), [(0 < 172) $\land$!(172 < 0)]: (32733 / 172) < ($\$heap_{funcstart\_719,1}$.p2 % 176), [(0 == 172) $\land$!(0 < 172) $\land$!(172 < 0)]: 32733 < 0)

$\rightarrow$ *[simplify]*

[91.13] **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 (49,15)

Condition defined at:

To prove: minof(short int) $\leq$ div3.rem

Given:

$\text{\$heap}_{init}.\text{LIMIT} == (\textbf{int})80$

$\text{\$heap}_{init}.\text{M1} == \textbf{asType}\textbf{<short int>}((\textbf{int})30269)$

$\text{\$heap}_{init}.\text{r1} == \textbf{asType}\textbf{<short int>}((\textbf{int})171)$

$\text{\$heap}_{init}.\text{a1} == \textbf{asType}\textbf{<short int>}((\textbf{int})177)$

$\text{\$heap}_{init}.\text{b1} == \textbf{asType}\textbf{<short int>}((\textbf{int})2)$

$\text{\$heap}_{init}.\text{M2} == \textbf{asType}\textbf{<short int>}((\textbf{int})30307)$

$\text{\$heap}_{init}.\text{r2} == \textbf{asType}\textbf{<short int>}((\textbf{int})172)$

$\text{\$heap}_{init}.\text{a2} == \textbf{asType}\textbf{<short int>}((\textbf{int})176)$

$\text{\$heap}_{init}.\text{b2} == \textbf{asType}\textbf{<short int>}((\textbf{int})35)$

$\text{\$heap}_{init}.\text{M3} == \textbf{asType}\textbf{<short int>}((\textbf{int})30323)$

$\text{\$heap}_{init}.\text{r3} == \textbf{asType}\textbf{<short int>}((\textbf{int})170)$

$\text{\$heap}_{init}.\text{a3} == \textbf{asType}\textbf{<short int>}((\textbf{int})178)$

$\text{\$heap}_{init}.\text{b3} == \textbf{asType}\textbf{<short int>}((\textbf{int})63)$

$\text{\$heap}_{init}.\text{p1} == \textbf{asType}\textbf{<short int>}((\textbf{int})1)$

$\text{\$heap}_{init}.\text{p2} == \textbf{asType}\textbf{<short int>}((\textbf{int})2)$

$\text{\$heap}_{init}.\text{p3} == \textbf{asType}\textbf{<short int>}((\textbf{int})3)$

div1 == div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$,
asType<int>($\text{\$heap}_{funcstart\_719,1}.\text{p1}$),
asType<int>($\text{\$heap}_{funcstart\_719,1}.\text{a1}$))

(**asType<integer>**(**asType<int>**($\text{\$heap}_{funcstart\_719,1}.\text{p1}$)) /
asType<integer>(**asType<int>**($\text{\$heap}_{funcstart\_719,1}.\text{a1}$))) ==
asType<integer>(div1.quot)

(**asType<integer>**(**asType<int>**($\text{\$heap}_{funcstart\_719,1}.\text{p1}$)) %
asType<integer>(**asType<int>**($\text{\$heap}_{funcstart\_719,1}.\text{a1}$))) ==
asType<integer>(div1.rem)

div2 == div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$,
asType<int>($\text{\$heap}_{funcstart\_719,1}.\text{p2}$),
asType<int>($\text{\$heap}_{funcstart\_719,1}.\text{a2}$))

(**asType<integer>**(**asType<int>**($\text{\$heap}_{funcstart\_719,1}.\text{p2}$)) /

asType\<integer\>(**asType\<int\>**($\text{heap}_{funcstart\_719,1}$.a2))) ==
asType\<integer\>(div2.quot)

(**asType\<integer\>**(**asType\<int\>**($\text{heap}_{funcstart\_719,1}$.p2)) %
asType\<integer\>(**asType\<int\>**($\text{heap}_{funcstart\_719,1}$.a2))) ==
asType\<integer\>(div2.rem)

div3 == div(**heapIs** $\text{heap}_{funcstart\_719,1}$,
asType\<int\>($\text{heap}_{funcstart\_719,1}$.p3),
asType\<int\>($\text{heap}_{funcstart\_719,1}$.a3))

(**asType\<integer\>**(**asType\<int\>**($\text{heap}_{funcstart\_719,1}$.p3)) /
asType\<integer\>(**asType\<int\>**($\text{heap}_{funcstart\_719,1}$.a3))) ==
asType\<integer\>(div3.quot)

(**asType\<integer\>**(**asType\<int\>**($\text{heap}_{funcstart\_719,1}$.p3)) %
asType\<integer\>(**asType\<int\>**($\text{heap}_{funcstart\_719,1}$.a3))) ==
asType\<integer\>(div3.rem)

$\text{heap}_{719,1;729,8}$ == $\text{heap}_{funcstart\_719,1}$.**replace**(p1 → **asType\<short
int\>**((**asType\<int\>**(**asType\<short int\>**(div1.rem)) *
asType\<int\>($\text{heap}_{funcstart\_719,1}$.r1)) − (**asType\<int\>**(**asType\<short
int\>**(div1.quot)) * **asType\<int\>**($\text{heap}_{funcstart\_719,1}$.b1)))))

$\text{heap}_{719,1;730,8}$ == $\text{heap}_{719,1;729,8}$.**replace**(p2 → **asType\<short
int\>**((**asType\<int\>**(**asType\<short int\>**(div2.rem)) *
asType\<int\>($\text{heap}_{719,1;729,8}$.r2)) − (**asType\<int\>**(**asType\<short
int\>**(div2.quot)) * **asType\<int\>**($\text{heap}_{719,1;729,8}$.b2)))))

Proof:

[Take given term]

[19.0] div3 == div(**heapIs** $\text{heap}_{funcstart\_719,1}$,
asType\<int\>($\text{heap}_{funcstart\_719,1}$.p3),
asType\<int\>($\text{heap}_{funcstart\_719,1}$.a3))

→ *[simplify]*

[19.1] div3 == div(**heapIs** $\text{heap}_{funcstart\_719,1}$, $\text{heap}_{funcstart\_719,1}$.p3,
asType\<int\>($\text{heap}_{funcstart\_719,1}$.a3))

→ *[const static or extern object]*

[19.2] div3 == div(**heapIs** $\text{heap}_{funcstart\_719,1}$, $\text{heap}_{funcstart\_719,1}$.p3,
asType\<int\>(heap_{init}.a3))

→ *[expand definition of constant 'a3' at prang.c (26,20)]*

[19.3] div3 == div(**heapIs** $\text{heap}_{funcstart\_719,1}$, $\text{heap}_{funcstart\_719,1}$.p3,
asType\<int\>(**asType\<short int\>**((**int**)178)))

→ *[simplify]*

[19.6] div3 == div(**heapIs** $\text{heap}_{funcstart\_719,1}$, $\text{heap}_{funcstart\_719,1}$.p3, 178)

[Take goal term]

[1.0] **minof**(**short int**) $\leq$ div3.rem

$\rightarrow$ *[simplify]*

[1.1] -32768 $\leq$ div3.rem

$\rightarrow$ *[from term 19.6, div3 is equal to div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p3, 178)]*

[1.2] -32768 $\leq$ div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p3, 178).rem

$\rightarrow$ *[simplify]*

[1.4] -32769 $<$ div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p3, 178).rem

$\rightarrow$ *[negate goal and search for contradiction]*

[1.5] !(-32769 $<$ div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p3, 178).rem)

$\rightarrow$ *[simplify]*

[1.7] 32768 $< -$div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p3, 178).rem

[Assume known post-assertion, class invariant or type constraint for term 1.7]

[36.0] **minof**(**int**) $\leq$ div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p3, 178).rem

$\rightarrow$ *[simplify]*

[36.3] -32769 $<$ div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p3, 178).rem

$\rightarrow$ *[from term 1.7, literala $<$ div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p3, 178).rem is false whenever -2 $<$ (32768 + literala)]*

Proof of rule precondition:

[36.3.0] -2 $<$ (-32769 + 32768)

$\rightarrow$ *[simplify]*

[36.3.2] **true**

[36.4] **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 (49,15)

Condition defined at:

To prove: div3.rem $\leq$ **maxof(short int)**

Given:

$\text{\$heap}_{init}.\text{LIMIT} == (\textbf{int})80$

$\text{\$heap}_{init}.\text{M1} == \textbf{asType}\textbf{<short int>}((\textbf{int})30269)$

$\text{\$heap}_{init}.\text{r1} == \textbf{asType}\textbf{<short int>}((\textbf{int})171)$

$\text{\$heap}_{init}.\text{a1} == \textbf{asType}\textbf{<short int>}((\textbf{int})177)$

$\text{\$heap}_{init}.\text{b1} == \textbf{asType}\textbf{<short int>}((\textbf{int})2)$

$\text{\$heap}_{init}.\text{M2} == \textbf{asType}\textbf{<short int>}((\textbf{int})30307)$

$\text{\$heap}_{init}.\text{r2} == \textbf{asType}\textbf{<short int>}((\textbf{int})172)$

$\text{\$heap}_{init}.\text{a2} == \textbf{asType}\textbf{<short int>}((\textbf{int})176)$

$\text{\$heap}_{init}.\text{b2} == \textbf{asType}\textbf{<short int>}((\textbf{int})35)$

$\text{\$heap}_{init}.\text{M3} == \textbf{asType}\textbf{<short int>}((\textbf{int})30323)$

$\text{\$heap}_{init}.\text{r3} == \textbf{asType}\textbf{<short int>}((\textbf{int})170)$

$\text{\$heap}_{init}.\text{a3} == \textbf{asType}\textbf{<short int>}((\textbf{int})178)$

$\text{\$heap}_{init}.\text{b3} == \textbf{asType}\textbf{<short int>}((\textbf{int})63)$

$\text{\$heap}_{init}.\text{p1} == \textbf{asType}\textbf{<short int>}((\textbf{int})1)$

$\text{\$heap}_{init}.\text{p2} == \textbf{asType}\textbf{<short int>}((\textbf{int})2)$

$\text{\$heap}_{init}.\text{p3} == \textbf{asType}\textbf{<short int>}((\textbf{int})3)$

div1 == div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$,
asType<int>$(\text{\$heap}_{funcstart\_719,1}.\text{p1})$,
asType<int>$(\text{\$heap}_{funcstart\_719,1}.\text{a1}))$

$(\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<int>}(\text{\$heap}_{funcstart\_719,1}.\text{p1}))\ /$
$\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<int>}(\text{\$heap}_{funcstart\_719,1}.\text{a1}))) ==$
$\textbf{asType}\textbf{<integer>}(\text{div1.quot})$

$(\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<int>}(\text{\$heap}_{funcstart\_719,1}.\text{p1}))\ \%$
$\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<int>}(\text{\$heap}_{funcstart\_719,1}.\text{a1}))) ==$
$\textbf{asType}\textbf{<integer>}(\text{div1.rem})$

div2 == div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$,
asType<int>$(\text{\$heap}_{funcstart\_719,1}.\text{p2})$,
asType<int>$(\text{\$heap}_{funcstart\_719,1}.\text{a2}))$

$(\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<int>}(\text{\$heap}_{funcstart\_719,1}.\text{p2}))\ /$
$\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<int>}(\text{\$heap}_{funcstart\_719,1}.\text{a2}))) ==$
$\textbf{asType}\textbf{<integer>}(\text{div2.quot})$

$(\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<int>}(\text{\$heap}_{funcstart\_719,1}.\text{p2}))\ \%$
$\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<int>}(\text{\$heap}_{funcstart\_719,1}.\text{a2}))) ==$
$\textbf{asType}\textbf{<integer>}(\text{div2.rem})$

div3 == div(**heapIs** $\$heap_{funcstart\_719,1}$,
asType\<int\>($\$heap_{funcstart\_719,1}$.p3),
asType\<int\>($\$heap_{funcstart\_719,1}$.a3))

(**asType\<integer\>**(**asType\<int\>**($\$heap_{funcstart\_719,1}$.p3)) /
asType\<integer\>(**asType\<int\>**($\$heap_{funcstart\_719,1}$.a3))) ==
asType\<integer\>(div3.quot)

(**asType\<integer\>**(**asType\<int\>**($\$heap_{funcstart\_719,1}$.p3)) %
asType\<integer\>(**asType\<int\>**($\$heap_{funcstart\_719,1}$.a3))) ==
asType\<integer\>(div3.rem)

$\$heap_{719,1;729,8}$ == $\$heap_{funcstart\_719,1}$.**_replace**(p1 → **asType\<short
int\>**((**asType\<int\>**(**asType\<short int\>**(div1.rem)) *
asType\<int\>($\$heap_{funcstart\_719,1}$.r1)) − (**asType\<int\>**(**asType\<short
int\>**(div1.quot)) * **asType\<int\>**($\$heap_{funcstart\_719,1}$.b1)))))

$\$heap_{719,1;730,8}$ == $\$heap_{719,1;729,8}$.**_replace**(p2 → **asType\<short
int\>**((**asType\<int\>**(**asType\<short int\>**(div2.rem)) *
asType\<int\>($\$heap_{719,1;729,8}$.r2)) − (**asType\<int\>**(**asType\<short
int\>**(div2.quot)) * **asType\<int\>**($\$heap_{719,1;729,8}$.b2)))))

Proof:

[Take given term]

[19.0] div3 == div(**heapIs** $\$heap_{funcstart\_719,1}$,
asType\<int\>($\$heap_{funcstart\_719,1}$.p3),
asType\<int\>($\$heap_{funcstart\_719,1}$.a3))

→ *[simplify]*

[19.1] div3 == div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p3,
asType\<int\>($\$heap_{funcstart\_719,1}$.a3))

→ *[const static or extern object]*

[19.2] div3 == div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p3,
asType\<int\>($\$heap_{init}$.a3))

→ *[expand definition of constant 'a3' at prang.c (26,20)]*

[19.3] div3 == div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p3,
asType\<int\>(**asType\<short int\>**((**int**)178)))

→ *[simplify]*

[19.6] div3 == div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p3, 178)

[Take goal term]

[1.0] div3.rem ≤ **maxof**(**short int**)

→ *[from term 19.6, div3 is equal to div(**heapIs** $\$heap_{funcstart\_719,1}$,
$\$heap_{funcstart\_719,1}$.p3, 178)]*

[1.1] div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p3, 178).rem ≤

maxof(short int)

→ *[simplify]*

[1.10] -32768 < −div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}$.p3, 178).rem

→ *[negate goal and search for contradiction]*

[1.11] !(-32768 < −div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}$.p3, 178).rem)

→ *[simplify]*

[1.14] 32767 < div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}$.p3, 178).rem

[Assume known post-assertion, class invariant or type constraint for term 1.14]

[36.0] div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}$.p3, 178).rem ≤ **maxof(int**)

→ *[simplify]*

[36.9] -32768 < −div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}$.p3, 178).rem

→ *[from term 1.14, literala < −div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p3, 178).rem is false whenever -2 < (32767 + literala)]*

   Proof of rule precondition:

   [36.9.0] -2 < (-32768 + 32767)

   → *[simplify]*

   [36.9.2] **true**

[36.10] **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 (49,15)

Condition defined at:

To prove: minof(int) ≤ **asType<short int>**(div3.rem)

Given:

$\$\text{heap}_{init}$.LIMIT == (**int**)80

$\$\text{heap}_{init}$.M1 == **asType<short int>**((**int**)30269)

$\$\text{heap}_{init}$.r1 == **asType<short int>**((**int**)171)

$\$\text{heap}_{init}$.a1 == **asType<short int>**((**int**)177)

$\$\text{heap}_{init}$.b1 == **asType<short int>**((**int**)2)

$\text{\$heap}_{init}.\text{M2} == \textbf{asType}\textbf{<short int>}((\textbf{int})30307)$

$\text{\$heap}_{init}.\text{r2} == \textbf{asType}\textbf{<short int>}((\textbf{int})172)$

$\text{\$heap}_{init}.\text{a2} == \textbf{asType}\textbf{<short int>}((\textbf{int})176)$

$\text{\$heap}_{init}.\text{b2} == \textbf{asType}\textbf{<short int>}((\textbf{int})35)$

$\text{\$heap}_{init}.\text{M3} == \textbf{asType}\textbf{<short int>}((\textbf{int})30323)$

$\text{\$heap}_{init}.\text{r3} == \textbf{asType}\textbf{<short int>}((\textbf{int})170)$

$\text{\$heap}_{init}.\text{a3} == \textbf{asType}\textbf{<short int>}((\textbf{int})178)$

$\text{\$heap}_{init}.\text{b3} == \textbf{asType}\textbf{<short int>}((\textbf{int})63)$

$\text{\$heap}_{init}.\text{p1} == \textbf{asType}\textbf{<short int>}((\textbf{int})1)$

$\text{\$heap}_{init}.\text{p2} == \textbf{asType}\textbf{<short int>}((\textbf{int})2)$

$\text{\$heap}_{init}.\text{p3} == \textbf{asType}\textbf{<short int>}((\textbf{int})3)$

div1 == div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$,
asType<int>$(\text{\$heap}_{funcstart\_719,1}.\text{p1})$,
asType<int>$(\text{\$heap}_{funcstart\_719,1}.\text{a1}))$

(asType<integer>(asType<int>$(\text{\$heap}_{funcstart\_719,1}.\text{p1}))$ /
asType<integer>(asType<int>$(\text{\$heap}_{funcstart\_719,1}.\text{a1}))) ==$
asType<integer>(div1.quot)

(asType<integer>(asType<int>$(\text{\$heap}_{funcstart\_719,1}.\text{p1}))$ %
asType<integer>(asType<int>$(\text{\$heap}_{funcstart\_719,1}.\text{a1}))) ==$
asType<integer>(div1.rem)

div2 == div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$,
asType<int>$(\text{\$heap}_{funcstart\_719,1}.\text{p2})$,
asType<int>$(\text{\$heap}_{funcstart\_719,1}.\text{a2}))$

(asType<integer>(asType<int>$(\text{\$heap}_{funcstart\_719,1}.\text{p2}))$ /
asType<integer>(asType<int>$(\text{\$heap}_{funcstart\_719,1}.\text{a2}))) ==$
asType<integer>(div2.quot)

(asType<integer>(asType<int>$(\text{\$heap}_{funcstart\_719,1}.\text{p2}))$ %
asType<integer>(asType<int>$(\text{\$heap}_{funcstart\_719,1}.\text{a2}))) ==$
asType<integer>(div2.rem)

div3 == div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$,
asType<int>$(\text{\$heap}_{funcstart\_719,1}.\text{p3})$,
asType<int>$(\text{\$heap}_{funcstart\_719,1}.\text{a3}))$

(asType<integer>(asType<int>$(\text{\$heap}_{funcstart\_719,1}.\text{p3}))$ /
asType<integer>(asType<int>$(\text{\$heap}_{funcstart\_719,1}.\text{a3}))) ==$
asType<integer>(div3.quot)

(asType<integer>(asType<int>$(\text{\$heap}_{funcstart\_719,1}.\text{p3}))$ %
asType<integer>(asType<int>$(\text{\$heap}_{funcstart\_719,1}.\text{a3}))) ==$
asType<integer>(div3.rem)

$\$\text{heap}_{719,1;729,8}$ == $\$\text{heap}_{funcstart\_719,1}$._**replace**(p1 → **asType<short int>**((**asType<int>**(**asType<short int>**(div1.rem)) * **asType<int>**($\$\text{heap}_{funcstart\_719,1}$.r1)) − (**asType<int>**(**asType<short int>**(div1.quot)) * **asType<int>**($\$\text{heap}_{funcstart\_719,1}$.b1))))

$\$\text{heap}_{719,1;730,8}$ == $\$\text{heap}_{719,1;729,8}$._**replace**(p2 → **asType<short int>**((**asType<int>**(**asType<short int>**(div2.rem)) * **asType<int>**($\$\text{heap}_{719,1;729,8}$.r2)) − (**asType<int>**(**asType<short int>**(div2.quot)) * **asType<int>**($\$\text{heap}_{719,1;729,8}$.b2))))

Proof:

[Take given term]

[19.0] div3 == div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, **asType<int>**($\$\text{heap}_{funcstart\_719,1}$.p3), **asType<int>**($\$\text{heap}_{funcstart\_719,1}$.a3))

→ *[simplify]*

[19.1] div3 == div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}$.p3, **asType<int>**($\$\text{heap}_{funcstart\_719,1}$.a3))

→ *[const static or extern object]*

[19.2] div3 == div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}$.p3, **asType<int>**($\$\text{heap}_{init}$.a3))

→ *[expand definition of constant 'a3' at prang.c (26,20)]*

[19.3] div3 == div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}$.p3, **asType<int>**(**asType<short int>**((**int**)178)))

→ *[simplify]*

[19.6] div3 == div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}$.p3, 178)

[Take goal term]

[1.0] **minof(int)** ≤ **asType<short int>**(div3.rem)

→ *[simplify]*

[1.1] -32768 ≤ **asType<short int>**(div3.rem)

→ *[from term 19.6, div3 is equal to div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p3, 178)]*

[1.2] -32768 ≤ **asType<short int>**(div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}$.p3, 178).rem)

→ *[simplify]*

[1.5] -32769 < div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}$.p3, 178).rem

→ *[negate goal and search for contradiction]*

[1.6] !(-32769 < div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p3, 178).rem)

→ *[simplify]*

[1.8] 32768 < −div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p3, 178).rem

[Assume known post-assertion, class invariant or type constraint for term 1.8]

[36.0] **minof**(**int**) ≤ div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p3, 178).rem

→ *[simplify]*

[36.3] -32769 < div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p3, 178).rem

→ *[from term 1.8, literala < div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p3, 178).rem is false whenever -2 < (32768 + literala)]*

    Proof of rule precondition:

    [36.3.0] -2 < (-32769 + 32768)

    → *[simplify]*

    [36.3.2] **true**

[36.4] **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 (49,15)

Condition defined at:

To prove: asType<**short int**>(div3.rem) ≤ **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)

$\$heap_{init}$.b1 == **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)

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

$\text{\$heap}_{init}.\text{M3} == \textbf{asType}\textbf{<short int>}((\textbf{int})30323)$

$\text{\$heap}_{init}.\text{r3} == \textbf{asType}\textbf{<short int>}((\textbf{int})170)$

$\text{\$heap}_{init}.\text{a3} == \textbf{asType}\textbf{<short int>}((\textbf{int})178)$

$\text{\$heap}_{init}.\text{b3} == \textbf{asType}\textbf{<short int>}((\textbf{int})63)$

$\text{\$heap}_{init}.\text{p1} == \textbf{asType}\textbf{<short int>}((\textbf{int})1)$

$\text{\$heap}_{init}.\text{p2} == \textbf{asType}\textbf{<short int>}((\textbf{int})2)$

$\text{\$heap}_{init}.\text{p3} == \textbf{asType}\textbf{<short int>}((\textbf{int})3)$

div1 == div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$,
asType<int>($\text{\$heap}_{funcstart\_719,1}.\text{p1}$),
asType<int>($\text{\$heap}_{funcstart\_719,1}.\text{a1}$))

(**asType<integer>**(**asType<int>**($\text{\$heap}_{funcstart\_719,1}.\text{p1}$)) /
asType<integer>(**asType<int>**($\text{\$heap}_{funcstart\_719,1}.\text{a1}$))) ==
asType<integer>(div1.quot)

(**asType<integer>**(**asType<int>**($\text{\$heap}_{funcstart\_719,1}.\text{p1}$)) %
asType<integer>(**asType<int>**($\text{\$heap}_{funcstart\_719,1}.\text{a1}$))) ==
asType<integer>(div1.rem)

div2 == div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$,
asType<int>($\text{\$heap}_{funcstart\_719,1}.\text{p2}$),
asType<int>($\text{\$heap}_{funcstart\_719,1}.\text{a2}$))

(**asType<integer>**(**asType<int>**($\text{\$heap}_{funcstart\_719,1}.\text{p2}$)) /
asType<integer>(**asType<int>**($\text{\$heap}_{funcstart\_719,1}.\text{a2}$))) ==
asType<integer>(div2.quot)

(**asType<integer>**(**asType<int>**($\text{\$heap}_{funcstart\_719,1}.\text{p2}$)) %
asType<integer>(**asType<int>**($\text{\$heap}_{funcstart\_719,1}.\text{a2}$))) ==
asType<integer>(div2.rem)

div3 == div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$,
asType<int>($\text{\$heap}_{funcstart\_719,1}.\text{p3}$),
asType<int>($\text{\$heap}_{funcstart\_719,1}.\text{a3}$))

(**asType<integer>**(**asType<int>**($\text{\$heap}_{funcstart\_719,1}.\text{p3}$)) /
asType<integer>(**asType<int>**($\text{\$heap}_{funcstart\_719,1}.\text{a3}$))) ==
asType<integer>(div3.quot)

(**asType<integer>**(**asType<int>**($\text{\$heap}_{funcstart\_719,1}.\text{p3}$)) %
asType<integer>(**asType<int>**($\text{\$heap}_{funcstart\_719,1}.\text{a3}$))) ==
asType<integer>(div3.rem)

$\text{\$heap}_{719,1;729,8} == \text{\$heap}_{funcstart\_719,1}.\_$**replace**(p1 → **asType<short int>**((**asType<int>**(**asType<short int>**(div1.rem)) *
asType<int>($\text{\$heap}_{funcstart\_719,1}.\text{r1}$)) − (**asType<int>**(**asType<short int>**(div1.quot)) * **asType<int>**($\text{\$heap}_{funcstart\_719,1}.\text{b1}$))))

$\$heap_{719,1;730,8} == \$heap_{719,1;729,8}.\_$**replace**$(p2 \rightarrow$ **asType**$<$**short int**$>$$((\textbf{asType}<\textbf{int}>(\textbf{asType}<\textbf{short int}>(div2.rem))$ * **asType**$<$**int**$>$$(\$heap_{719,1;729,8}.r2)) - (\textbf{asType}<\textbf{int}>(\textbf{asType}<\textbf{short int}>(div2.quot))$ * **asType**$<$**int**$>$$(\$heap_{719,1;729,8}.b2))))$

Proof:

[Take given term]

[19.0] div3 == div(**heapIs** $\$heap_{funcstart\_719,1}$,
asType$<$**int**$>$$(\$heap_{funcstart\_719,1}.p3)$,
asType$<$**int**$>$$(\$heap_{funcstart_719,1}.a3))$

$\rightarrow$ *[simplify]*

[19.1] div3 == div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}.p3$,
asType$<$**int**$>$$(\$heap_{funcstart_719,1}.a3))$

$\rightarrow$ *[const static or extern object]*

[19.2] div3 == div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}.p3$,
asType$<$**int**$>$$(\$heap_{init}.a3))$

$\rightarrow$ *[expand definition of constant 'a3' at prang.c (26,20)]*

[19.3] div3 == div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}.p3$,
asType$<$**int**$>$$(\textbf{asType}<\textbf{short int}>((\textbf{int})178)))$

$\rightarrow$ *[simplify]*

[19.6] div3 == div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}.p3$, 178)

[Take goal term]

[1.0] **asType**$<$**short int**$>$(div3.rem) $\leq$ **maxof**(**int**)

$\rightarrow$ *[from term 19.6, div3 is equal to div(**heapIs** $\$heap_{funcstart\_719,1}$,
$\$heap_{funcstart\_719,1}.p3$, 178)]*

[1.1] **asType**$<$**short int**$>$(div(**heapIs** $\$heap_{funcstart\_719,1}$,
$\$heap_{funcstart\_719,1}.p3$, 178).rem) $\leq$ **maxof**(**int**)

$\rightarrow$ *[simplify]*

[1.11] -32768 $< -$div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}.p3$,
178).rem

$\rightarrow$ *[negate goal and search for contradiction]*

[1.12] !(-32768 $< -$div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}.p3$,
178).rem)

$\rightarrow$ *[simplify]*

[1.15] 32767 $<$ div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}.p3$,
178).rem

[Assume known post-assertion, class invariant or type constraint for term 1.15]

[36.0] div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p3, 178).rem $\leq$ **maxof(int)**

$\rightarrow$ *[simplify]*

[36.9] -32768 $< -$div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p3, 178).rem

$\rightarrow$ *[from term 1.15, literala $< -$div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p3, 178).rem is false whenever -2 < (32767 + literala)]*

> **Proof of rule precondition:**
>
> *[36.9.0]* -2 < (-32768 + 32767)
>
> $\rightarrow$ *[simplify]*
>
> *[36.9.2]* **true**

[36.10] **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 (49,10)

Condition defined at:

To prove: minof(int) $\leq \$heap_{719,1;730,8}$.r3

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)

$\$heap_{init}$.M2 == **asType<short int>((int)**30307)

$\$heap_{init}$.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)

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

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

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

$\$heap_{init}$.p1 == **asType<short int>((int)**1)

$\$heap_{init}$.p2 == **asType<short int>((int)**2)

$\$heap_{init}.p3 == \textbf{asType}\textbf{<short int>}((\textbf{int})3)$

$div1 == div(\textbf{heapIs } \$heap_{funcstart\_719,1},$
$\textbf{asType}\textbf{<int>}(\$heap_{funcstart\_719,1}.p1),$
$\textbf{asType}\textbf{<int>}(\$heap_{funcstart\_719,1}.a1))$

$(\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<int>}(\$heap_{funcstart\_719,1}.p1))$ /
$\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<int>}(\$heap_{funcstart\_719,1}.a1))) ==$
$\textbf{asType}\textbf{<integer>}(div1.quot)$

$(\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<int>}(\$heap_{funcstart\_719,1}.p1))$ %
$\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<int>}(\$heap_{funcstart\_719,1}.a1))) ==$
$\textbf{asType}\textbf{<integer>}(div1.rem)$

$div2 == div(\textbf{heapIs } \$heap_{funcstart\_719,1},$
$\textbf{asType}\textbf{<int>}(\$heap_{funcstart\_719,1}.p2),$
$\textbf{asType}\textbf{<int>}(\$heap_{funcstart\_719,1}.a2))$

$(\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<int>}(\$heap_{funcstart\_719,1}.p2))$ /
$\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<int>}(\$heap_{funcstart\_719,1}.a2))) ==$
$\textbf{asType}\textbf{<integer>}(div2.quot)$

$(\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<int>}(\$heap_{funcstart\_719,1}.p2))$ %
$\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<int>}(\$heap_{funcstart\_719,1}.a2))) ==$
$\textbf{asType}\textbf{<integer>}(div2.rem)$

$div3 == div(\textbf{heapIs } \$heap_{funcstart\_719,1},$
$\textbf{asType}\textbf{<int>}(\$heap_{funcstart\_719,1}.p3),$
$\textbf{asType}\textbf{<int>}(\$heap_{funcstart\_719,1}.a3))$

$(\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<int>}(\$heap_{funcstart\_719,1}.p3))$ /
$\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<int>}(\$heap_{funcstart\_719,1}.a3))) ==$
$\textbf{asType}\textbf{<integer>}(div3.quot)$

$(\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<int>}(\$heap_{funcstart\_719,1}.p3))$ %
$\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<int>}(\$heap_{funcstart\_719,1}.a3))) ==$
$\textbf{asType}\textbf{<integer>}(div3.rem)$

$\$heap_{719,1;729,8} == \$heap_{funcstart\_719,1}.\textbf{\_replace}(p1 \rightarrow \textbf{asType}\textbf{<short}$
$\textbf{int>}((\textbf{asType}\textbf{<int>}(\textbf{asType}\textbf{<short int>}(div1.rem)) \text{ *}$
$\textbf{asType}\textbf{<int>}(\$heap_{funcstart\_719,1}.r1)) - (\textbf{asType}\textbf{<int>}(\textbf{asType}\textbf{<short}$
$\textbf{int>}(div1.quot)) \text{ * } \textbf{asType}\textbf{<int>}(\$heap_{funcstart\_719,1}.b1))))$

$\$heap_{719,1;730,8} == \$heap_{719,1;729,8}.\textbf{\_replace}(p2 \rightarrow \textbf{asType}\textbf{<short}$
$\textbf{int>}((\textbf{asType}\textbf{<int>}(\textbf{asType}\textbf{<short int>}(div2.rem)) \text{ *}$
$\textbf{asType}\textbf{<int>}(\$heap_{719,1;729,8}.r2)) - (\textbf{asType}\textbf{<int>}(\textbf{asType}\textbf{<short}$
$\textbf{int>}(div2.quot)) \text{ * } \textbf{asType}\textbf{<int>}(\$heap_{719,1;729,8}.b2))))$

Proof:

[Take given term]

[5.0] $div1 == div(\textbf{heapIs } \$heap_{funcstart\_719,1},$
$\textbf{asType}\textbf{<int>}(\$heap_{funcstart\_719,1}.p1),$

asType<int>($heap$_{funcstart_719,1}$.a1))

→ [simplify]

[5.1] div1 == div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1,
asType<int>($heap$_{funcstart_719,1}$.a1))

→ [const static or extern object]

[5.2] div1 == div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1,
asType<int>($heap$_{init}$.a1))

→ [expand definition of constant 'a1' at prang.c (16,20)]

[5.3] div1 == div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1,
asType<int>(**asType<short int>**((**int**)177)))

→ [simplify]

[5.6] div1 == div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1, 177)

[Take given term]

[12.0] div2 == div(**heapIs** $heap$_{funcstart_719,1}$,
asType<int>($heap$_{funcstart_719,1}$.p2),
asType<int>($heap$_{funcstart_719,1}$.a2))

→ [simplify]

[12.1] div2 == div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p2,
asType<int>($heap$_{funcstart_719,1}$.a2))

→ [const static or extern object]

[12.2] div2 == div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p2,
asType<int>($heap$_{init}$.a2))

→ [expand definition of constant 'a2' at prang.c (21,20)]

[12.3] div2 == div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p2,
asType<int>(**asType<short int>**((**int**)176)))

→ [simplify]

[12.6] div2 == div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p2, 176)

[Take given term]

[26.0] $heap$_{719,1;729,8}$ == $heap$_{funcstart_719,1}$._**replace**(p1 → **asType<short
int>**((**asType<int>**(**asType<short int>**(div1.rem)) *
asType<int>($heap$_{funcstart_719,1}$.r1)) − (**asType<int>**(**asType<short
int>**(div1.quot)) * **asType<int>**($heap$_{funcstart_719,1}$.b1))))

→ [from term 5.6, div1 is equal to div(**heapIs** $heap$_{funcstart_719,1}$,
$heap$_{funcstart_719,1}$.p1, 177)]

[26.1] $heap$_{719,1;729,8}$ == $heap$_{funcstart_719,1}$._**replace**(p1 → **asType<short
int>**((**asType<int>**(**asType<short int>**(div(**heapIs** $heap$_{funcstart_719,1}$,

$\$\text{heap}_{funcstart\_719,1}$.p1, 177).rem)) * **asType**<**int**>($\$\text{heap}_{funcstart\_719,1}$.r1)) − (**asType**<**int**>(**asType**<**short int**>(div1.quot)) * **asType**<**int**>($\$\text{heap}_{funcstart\_719,1}$.b1))))

→ *[simplify]*

[26.3] $\$\text{heap}_{719,1;729,8}$ == $\$\text{heap}_{funcstart\_719,1}$.**replace**(p1 → **asType**<**short int**>((div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}$.p1, 177).rem * **asType**<**int**>($\$\text{heap}_{funcstart\_719,1}$.r1)) − (**asType**<**int**>(**asType**<**short int**>(div1.quot)) * **asType**<**int**>($\$\text{heap}_{funcstart\_719,1}$.b1))))

→ *[const static or extern object]*

[26.4] $\$\text{heap}_{719,1;729,8}$ == $\$\text{heap}_{funcstart\_719,1}$.**replace**(p1 → **asType**<**short int**>((div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}$.p1, 177).rem * **asType**<**int**>($\$\text{heap}_{init}$.r1)) − (**asType**<**int**>(**asType**<**short int**>(div1.quot)) * **asType**<**int**>($\$\text{heap}_{funcstart\_719,1}$.b1))))

→ *[expand definition of constant 'r1' at prang.c (15,20)]*

[26.5] $\$\text{heap}_{719,1;729,8}$ == $\$\text{heap}_{funcstart\_719,1}$.**replace**(p1 → **asType**<**short int**>((div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}$.p1, 177).rem * **asType**<**int**>(**asType**<**short int**>((**int**)171))) − (**asType**<**int**>(**asType**<**short int**>(div1.quot)) * **asType**<**int**>($\$\text{heap}_{funcstart\_719,1}$.b1))))

→ *[simplify]*

[26.8] $\$\text{heap}_{719,1;729,8}$ == $\$\text{heap}_{funcstart\_719,1}$.**replace**(p1 → **asType**<**short int**>((div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}$.p1, 177).rem * 171) − (**asType**<**int**>(**asType**<**short int**>(div1.quot)) * **asType**<**int**>($\$\text{heap}_{funcstart\_719,1}$.b1))))

→ *[from term 5.6, div1 is equal to div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177)]*

[26.9] $\$\text{heap}_{719,1;729,8}$ == $\$\text{heap}_{funcstart\_719,1}$.**replace**(p1 → **asType**<**short int**>((171 * div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}$.p1, 177).rem) − (**asType**<**int**>(**asType**<**short int**>(div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}$.p1, 177).quot)) * **asType**<**int**>($\$\text{heap}_{funcstart\_719,1}$.b1))))

→ *[simplify]*

[26.11] $\$\text{heap}_{719,1;729,8}$ == $\$\text{heap}_{funcstart\_719,1}$.**replace**(p1 → **asType**<**short int**>((171 * div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}$.p1, 177).rem) − (div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}$.p1, 177).quot * **asType**<**int**>($\$\text{heap}_{funcstart\_719,1}$.b1))))

→ *[const static or extern object]*

[26.12] $\$\text{heap}_{719,1;729,8}$ == $\$\text{heap}_{funcstart\_719,1}$.**replace**(p1 → **asType**<**short int**>((171 * div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}$.p1, 177).rem) − (div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}$.p1, 177).quot *

asType$<$int$>$(heap_{init}.b1))))

$\rightarrow$ *[expand definition of constant 'b1' at prang.c (17,20)]*

[26.13] $\text{heap}_{719,1;729,8}$ == $\text{heap}_{funcstart\_719,1}$._**replace**(p1 $\rightarrow$ **asType$<$short int$>$**((171 * div(**heapIs** $\text{heap}_{funcstart\_719,1}$, $\text{heap}_{funcstart\_719,1}$.p1, 177).rem) $-$ (div(**heapIs** $\text{heap}_{funcstart\_719,1}$, $\text{heap}_{funcstart\_719,1}$.p1, 177).quot * **asType$<$int$>$**(**asType$<$short int$>$**((**int**)2)))))

$\rightarrow$ *[simplify]*

[26.19] $\text{heap}_{719,1;729,8}$ == $\text{heap}_{funcstart\_719,1}$._**replace**(p1 $\rightarrow$ ((-2 * div(**heapIs** $\text{heap}_{funcstart\_719,1}$, $\text{heap}_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs** $\text{heap}_{funcstart\_719,1}$, $\text{heap}_{funcstart\_719,1}$.p1, 177).rem)))

[Take given term]

[31.0] $\text{heap}_{719,1;730,8}$ == $\text{heap}_{719,1;729,8}$._**replace**(p2 $\rightarrow$ **asType$<$short int$>$**((**asType$<$int$>$**(**asType$<$short int$>$**(div2.rem)) * **asType$<$int$>$**($\text{heap}_{719,1;729,8}$.r2)) $-$ (**asType$<$int$>$**(**asType$<$short int$>$**(div2.quot)) * **asType$<$int$>$**($\text{heap}_{719,1;729,8}$.b2))))

$\rightarrow$ *[from term 26.19, $\text{heap}_{719,1;729,8}$ is equal to $\text{heap}_{funcstart\_719,1}$._**replace**(p1 $\rightarrow$ (-2 * div(**heapIs** $\text{heap}_{funcstart\_719,1}$, $\text{heap}_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs** $\text{heap}_{funcstart\_719,1}$, $\text{heap}_{funcstart\_719,1}$.p1, 177).rem))]*

[31.1] $\text{heap}_{719,1;730,8}$ == $\text{heap}_{funcstart\_719,1}$._**replace**(p1 $\rightarrow$ ((-2 * div(**heapIs** $\text{heap}_{funcstart\_719,1}$, $\text{heap}_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs** $\text{heap}_{funcstart\_719,1}$, $\text{heap}_{funcstart\_719,1}$.p1, 177).rem)))._**replace**(p2 $\rightarrow$ **asType$<$short int$>$**((**asType$<$int$>$**(**asType$<$short int$>$**(div2.rem)) * **asType$<$int$>$**($\text{heap}_{719,1;729,8}$.r2)) $-$ (**asType$<$int$>$**(**asType$<$short int$>$**(div2.quot)) * **asType$<$int$>$**($\text{heap}_{719,1;729,8}$.b2))))

$\rightarrow$ *[from term 12.6, div2 is equal to div(**heapIs** $\text{heap}_{funcstart\_719,1}$, $\text{heap}_{funcstart\_719,1}$.p2, 176)]*

[31.2] $\text{heap}_{719,1;730,8}$ == $\text{heap}_{funcstart\_719,1}$._**replace**(p1 $\rightarrow$ ((-2 * div(**heapIs** $\text{heap}_{funcstart\_719,1}$, $\text{heap}_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs** $\text{heap}_{funcstart\_719,1}$, $\text{heap}_{funcstart\_719,1}$.p1, 177).rem)))._**replace**(p2 $\rightarrow$ **asType$<$short int$>$**((**asType$<$int$>$**(**asType$<$short int$>$**(div(**heapIs** $\text{heap}_{funcstart\_719,1}$, $\text{heap}_{funcstart\_719,1}$.p2, 176).rem)) * **asType$<$int$>$**($\text{heap}_{719,1;729,8}$.r2)) $-$ (**asType$<$int$>$**(**asType$<$short int$>$**(div2.quot)) * **asType$<$int$>$**($\text{heap}_{719,1;729,8}$.b2))))

$\rightarrow$ *[simplify]*

[31.4] $\text{heap}_{719,1;730,8}$ == $\text{heap}_{funcstart\_719,1}$._**replace**(p1 $\rightarrow$ ((-2 * div(**heapIs** $\text{heap}_{funcstart\_719,1}$, $\text{heap}_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs** $\text{heap}_{funcstart\_719,1}$, $\text{heap}_{funcstart\_719,1}$.p1, 177).rem)))._**replace**(p2 $\rightarrow$ **asType$<$short int$>$**((div(**heapIs**

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$\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).rem * **asType$<int>$**($\$heap_{719,1;729,8}$.r2)) $-$ (**asType$<$int$>$**(**asType$<$short int$>$**(div2.quot)) * **asType$<$int$>$**($\$heap_{719,1;729,8}$.b2))))

$\rightarrow$ *[from term 26.19, $\$heap_{719,1;729,8}$ is equal to $\$heap_{funcstart\_719,1}$.__replace__(p1 $\rightarrow$ (-2 * div(__heapIs__ $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(__heapIs__ $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).rem))]*

[31.5] $\$heap_{719,1;730,8}$ == $\$heap_{funcstart\_719,1}$.__replace__(p1 $\rightarrow$ ((-2 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).rem))).__replace__(p2 $\rightarrow$ **asType$<$short int$>$**((div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).rem * **asType$<int>$**($\$heap_{funcstart\_719,1}$.__replace__(p1 $\rightarrow$ ((-2 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).rem))).r2)) $-$ (**asType$<$int$>$**(**asType$<$short int$>$**(div2.quot)) * **asType$<$int$>$**($\$heap_{719,1;729,8}$.b2))))

$\rightarrow$ *[const member of object with modified fields]*

[31.6] $\$heap_{719,1;730,8}$ == $\$heap_{funcstart\_719,1}$.__replace__(p1 $\rightarrow$ ((-2 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).rem))).__replace__(p2 $\rightarrow$ **asType$<$short int$>$**((div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).rem * **asType$<int>$**($\$heap_{funcstart\_719,1}$.r2)) $-$ (**asType$<$int$>$**(**asType$<$short int$>$**(div2.quot)) * **asType$<$int$>$**($\$heap_{719,1;729,8}$.b2))))

$\rightarrow$ *[const static or extern object]*

[31.7] $\$heap_{719,1;730,8}$ == $\$heap_{funcstart\_719,1}$.__replace__(p1 $\rightarrow$ ((-2 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).rem))).__replace__(p2 $\rightarrow$ **asType$<$short int$>$**((div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).rem * **asType$<int>$**($\$heap_{init}$.r2)) $-$ (**asType$<$int$>$**(**asType$<$short int$>$**(div2.quot)) * **asType$<$int$>$**($\$heap_{719,1;729,8}$.b2))))

$\rightarrow$ *[expand definition of constant 'r2' at prang.c (20,20)]*

[31.8] $\$heap_{719,1;730,8}$ == $\$heap_{funcstart\_719,1}$.__replace__(p1 $\rightarrow$ ((-2 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).rem))).__replace__(p2 $\rightarrow$ **asType$<$short int$>$**((div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).rem * **asType$<int>$**(**asType$<$short int$>$**((**int**)172))) $-$ (**asType$<$int$>$**(**asType$<$short int$>$**(div2.quot)) * **asType$<$int$>$**($\$heap_{719,1;729,8}$.b2))))

→ *[simplify]*

[31.11] $\$heap_{719,1;730,8}$ == $\$heap_{funcstart\_719,1}$.**replace**(p1 → ((-2 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).rem))).**replace**(p2 → **asType**<**short int**>((div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).rem * 172) − (**asType**<**int**>(**asType**<**short int**>(div2.quot)) * **asType**<**int**>($\$heap_{719,1;729,8}$.b2))))

→ *[from term 12.6, div2 is equal to div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176)]*

[31.12] $\$heap_{719,1;730,8}$ == $\$heap_{funcstart\_719,1}$.**replace**(p1 → ((-2 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).rem))).**replace**(p2 → **asType**<**short int**>((172 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).rem) − (**asType**<**int**>(**asType**<**short int**>(div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).quot)) * **asType**<**int**>($\$heap_{719,1;729,8}$.b2))))

→ *[simplify]*

[31.14] $\$heap_{719,1;730,8}$ == $\$heap_{funcstart\_719,1}$.**replace**(p1 → ((-2 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).rem))).**replace**(p2 → **asType**<**short int**>((172 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).rem) − (div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).quot * **asType**<**int**>($\$heap_{719,1;729,8}$.b2))))

→ *[from term 26.19, $\$heap_{719,1;729,8}$ is equal to $\$heap_{funcstart\_719,1}$.**replace**(p1 → (-2 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).rem))]*

[31.15] $\$heap_{719,1;730,8}$ == $\$heap_{funcstart\_719,1}$.**replace**(p1 → ((-2 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).rem))).**replace**(p2 → **asType**<**short int**>((172 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).rem) − (div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).quot * **asType**<**int**>($\$heap_{funcstart\_719,1}$.**replace**(p1 → ((-2 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).rem))).b2))))

→ *[const member of object with modified fields]*

[31.16] $\$heap_{719,1;730,8}$ == $\$heap_{funcstart\_719,1}$.**replace**(p1 → ((-2 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1,

177).rem))).**replace**(p2 → **asType<short int>**((172 * div(**heapIs**
$\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}$.p2, 176).rem) − (div(**heapIs**
$\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}$.p2, 176).quot *
asType<int>($\$\text{heap}_{funcstart\_719,1}$.b2))))

→ *[const static or extern object]*

[31.17] $\$\text{heap}_{719,1;730,8}$ == $\$\text{heap}_{funcstart\_719,1}$.**replace**(p1 → ((-2 *
div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}$.p1,
177).rem))).**replace**(p2 → **asType<short int>**((172 * div(**heapIs**
$\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}$.p2, 176).rem) − (div(**heapIs**
$\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}$.p2, 176).quot *
asType<int>($\$\text{heap}_{init}$.b2))))

→ *[expand definition of constant 'b2' at prang.c (22,20)]*

[31.18] $\$\text{heap}_{719,1;730,8}$ == $\$\text{heap}_{funcstart\_719,1}$.**replace**(p1 → ((-2 *
div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}$.p1,
177).rem))).**replace**(p2 → **asType<short int>**((172 * div(**heapIs**
$\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}$.p2, 176).rem) − (div(**heapIs**
$\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}$.p2, 176).quot *
asType<int>(**asType<short int>**((**int**)35)))))

→ *[simplify]*

[31.24] $\$\text{heap}_{719,1;730,8}$ == $\$\text{heap}_{funcstart\_719,1}$.**replace**(p1 → ((-2 *
div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}$.p1,
177).rem))).**replace**(p2 → ((-35 * div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$,
$\$\text{heap}_{funcstart\_719,1}$.p2, 176).quot) + (172 * div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$,
$\$\text{heap}_{funcstart\_719,1}$.p2, 176).rem)))

[Take goal term]

[1.0] **minof(int)** ≤ $\$\text{heap}_{719,1;730,8}$.r3

→ *[simplify]*

[1.1] -32768 ≤ $\$\text{heap}_{719,1;730,8}$.r3

→ *[from term 31.24, $\$heap_{719,1;730,8}$ is equal to*
*$\$heap_{funcstart\_719,1}$.__replace__(p1 → ((-2 * div(__heapIs__ $\$heap_{funcstart\_719,1}$,*
*$\$heap_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(__heapIs__ $\$heap_{funcstart\_719,1}$,*
*$\$heap_{funcstart\_719,1}$.p1, 177).rem))).__replace__(p2 → (-35 * div(__heapIs__*
*$\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).quot) + (172 * div(__heapIs__*
$\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).rem))]

[1.2] -32768 ≤ $\$\text{heap}_{funcstart\_719,1}$.**replace**(p1 → ((-2 * div(**heapIs**
$\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs**
$\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}$.p1, 177).rem))).**replace**(p2 → ((-35
* div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}$.p2, 176).quot) + (172 *

div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p2, 176).rem))).r3

$\rightarrow$ *[const member of object with modified fields]*

[1.4] -32768 $\leq$ $\text{\$heap}_{funcstart\_719,1}$.r3

$\rightarrow$ *[const static or extern object]*

[1.5] -32768 $\leq$ $\text{\$heap}_{init}$.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 (49,10)

Condition defined at:

To prove: $\text{\$heap}_{719,1;730,8}$.r3 $\leq$ **maxof(int)**

Given:

$\text{\$heap}_{init}$.LIMIT == (**int**)80

$\text{\$heap}_{init}$.M1 == **asType<short int>**((**int**)30269)

$\text{\$heap}_{init}$.r1 == **asType<short int>**((**int**)171)

$\text{\$heap}_{init}$.a1 == **asType<short int>**((**int**)177)

$\text{\$heap}_{init}$.b1 == **asType<short int>**((**int**)2)

$\text{\$heap}_{init}$.M2 == **asType<short int>**((**int**)30307)

$\text{\$heap}_{init}$.r2 == **asType<short int>**((**int**)172)

$\text{\$heap}_{init}$.a2 == **asType<short int>**((**int**)176)

$\text{\$heap}_{init}$.b2 == **asType<short int>**((**int**)35)

$\text{\$heap}_{init}$.M3 == **asType<short int>**((**int**)30323)

$\text{\$heap}_{init}$.r3 == **asType<short int>**((**int**)170)

$\text{\$heap}_{init}$.a3 == **asType<short int>**((**int**)178)

$\text{\$heap}_{init}$.b3 == **asType<short int>**((**int**)63)

$\text{\$heap}_{init}$.p1 == **asType<short int>**((**int**)1)

$\text{\$heap}_{init}$.p2 == **asType<short int>**((**int**)2)

$\text{\$heap}_{init}$.p3 == **asType<short int>**((**int**)3)

div1 == div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$,

asType$<$int$>$($\$heap_{funcstart\_719,1}$.p1),
asType$<$int$>$($\$heap_{funcstart\_719,1}$.a1))

(**asType$<$integer$>$**(**asType$<$int$>$**($\$heap_{funcstart\_719,1}$.p1)) /
asType$<$integer$>$(**asType$<$int$>$**($\$heap_{funcstart\_719,1}$.a1))) ==
asType$<$integer$>$(div1.quot)

(**asType$<$integer$>$**(**asType$<$int$>$**($\$heap_{funcstart\_719,1}$.p1)) %
asType$<$integer$>$(**asType$<$int$>$**($\$heap_{funcstart\_719,1}$.a1))) ==
asType$<$integer$>$(div1.rem)

div2 == div(**heapIs** $\$heap_{funcstart\_719,1}$,
asType$<$int$>$($\$heap_{funcstart\_719,1}$.p2),
asType$<$int$>$($\$heap_{funcstart\_719,1}$.a2))

(**asType$<$integer$>$**(**asType$<$int$>$**($\$heap_{funcstart\_719,1}$.p2)) /
asType$<$integer$>$(**asType$<$int$>$**($\$heap_{funcstart\_719,1}$.a2))) ==
asType$<$integer$>$(div2.quot)

(**asType$<$integer$>$**(**asType$<$int$>$**($\$heap_{funcstart\_719,1}$.p2)) %
asType$<$integer$>$(**asType$<$int$>$**($\$heap_{funcstart\_719,1}$.a2))) ==
asType$<$integer$>$(div2.rem)

div3 == div(**heapIs** $\$heap_{funcstart\_719,1}$,
asType$<$int$>$($\$heap_{funcstart\_719,1}$.p3),
asType$<$int$>$($\$heap_{funcstart\_719,1}$.a3))

(**asType$<$integer$>$**(**asType$<$int$>$**($\$heap_{funcstart\_719,1}$.p3)) /
asType$<$integer$>$(**asType$<$int$>$**($\$heap_{funcstart\_719,1}$.a3))) ==
asType$<$integer$>$(div3.quot)

(**asType$<$integer$>$**(**asType$<$int$>$**($\$heap_{funcstart\_719,1}$.p3)) %
asType$<$integer$>$(**asType$<$int$>$**($\$heap_{funcstart\_719,1}$.a3))) ==
asType$<$integer$>$(div3.rem)

$\$heap_{719,1;729,8}$ == $\$heap_{funcstart\_719,1}$.**replace**(p1 $\rightarrow$ **asType$<$short
int$>$**((**asType$<$int$>$**(**asType$<$short int$>$**(div1.rem)) *
asType$<$int$>$($\$heap_{funcstart\_719,1}$.r1)) $-$ (**asType$<$int$>$**(**asType$<$short
int$>$**(div1.quot)) * **asType$<$int$>$**($\$heap_{funcstart\_719,1}$.b1)))))

$\$heap_{719,1;730,8}$ == $\$heap_{719,1;729,8}$.**replace**(p2 $\rightarrow$ **asType$<$short
int$>$**((**asType$<$int$>$**(**asType$<$short int$>$**(div2.rem)) *
asType$<$int$>$($\$heap_{719,1;729,8}$.r2)) $-$ (**asType$<$int$>$**(**asType$<$short
int$>$**(div2.quot)) * **asType$<$int$>$**($\$heap_{719,1;729,8}$.b2)))))

Proof:

[Take given term]

[5.0] div1 == div(**heapIs** $\$heap_{funcstart\_719,1}$,
asType$<$int$>$($\$heap_{funcstart\_719,1}$.p1),
asType$<$int$>$($\$heap_{funcstart\_719,1}$.a1))

$\rightarrow$ *[simplify]*

[5.1] div1 == div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, **asType**<**int**>($\$heap_{funcstart\_719,1}$.a1))

$\rightarrow$ *[const static or extern object]*

[5.2] div1 == div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, **asType**<**int**>($\$heap_{init}$.a1))

$\rightarrow$ *[expand definition of constant 'a1' at prang.c (16,20)]*

[5.3] div1 == div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, **asType**<**int**>(**asType**<**short int**>((**int**)177)))

$\rightarrow$ *[simplify]*

[5.6] div1 == div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177)

[Take given term]

[12.0] div2 == div(**heapIs** $\$heap_{funcstart\_719,1}$, **asType**<**int**>($\$heap_{funcstart\_719,1}$.p2), **asType**<**int**>($\$heap_{funcstart\_719,1}$.a2))

$\rightarrow$ *[simplify]*

[12.1] div2 == div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, **asType**<**int**>($\$heap_{funcstart\_719,1}$.a2))

$\rightarrow$ *[const static or extern object]*

[12.2] div2 == div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, **asType**<**int**>($\$heap_{init}$.a2))

$\rightarrow$ *[expand definition of constant 'a2' at prang.c (21,20)]*

[12.3] div2 == div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, **asType**<**int**>(**asType**<**short int**>((**int**)176)))

$\rightarrow$ *[simplify]*

[12.6] div2 == div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176)

[Take given term]

[26.0] $\$heap_{719,1;729,8}$ == $\$heap_{funcstart\_719,1}$.**replace**(p1 $\rightarrow$ **asType**<**short int**>((**asType**<**int**>(**asType**<**short int**>(div1.rem)) * **asType**<**int**>($\$heap_{funcstart\_719,1}$.r1)) $-$ (**asType**<**int**>(**asType**<**short int**>(div1.quot)) * **asType**<**int**>($\$heap_{funcstart\_719,1}$.b1))))

$\rightarrow$ *[from term 5.6, div1 is equal to div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177)]*

[26.1] $\$heap_{719,1;729,8}$ == $\$heap_{funcstart\_719,1}$.**replace**(p1 $\rightarrow$ **asType**<**short int**>((**asType**<**int**>(**asType**<**short int**>(div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).rem)) * **asType**<**int**>($\$heap_{funcstart\_719,1}$.r1)) $-$ (**asType**<**int**>(**asType**<**short int**>(div1.quot)) * **asType**<**int**>($\$heap_{funcstart\_719,1}$.b1))))

$\rightarrow$ *[simplify]*

[26.3] $\$heap_{719,1;729,8}$ == $\$heap_{funcstart\_719,1}$._**replace**$(p1 \rightarrow$ **asType**<**short int**>$((div($**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).rem * **asType**<**int**>$(\$heap_{funcstart\_719,1}$.r1)$) - ($**asType**<**int**>$($**asType**<**short int**>$(div1.quot)) *$ **asType**<**int**>$(\$heap_{funcstart\_719,1}$.b1))))

$\rightarrow$ *[const static or extern object]*

[26.4] $\$heap_{719,1;729,8}$ == $\$heap_{funcstart\_719,1}$._**replace**$(p1 \rightarrow$ **asType**<**short int**>$((div($**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).rem * **asType**<**int**>$(\$heap_{init}$.r1)$) - ($**asType**<**int**>$($**asType**<**short int**>$(div1.quot)) *$ **asType**<**int**>$(\$heap_{funcstart\_719,1}$.b1))))

$\rightarrow$ *[expand definition of constant 'r1' at prang.c (15,20)]*

[26.5] $\$heap_{719,1;729,8}$ == $\$heap_{funcstart\_719,1}$._**replace**$(p1 \rightarrow$ **asType**<**short int**>$((div($**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).rem * **asType**<**int**>$($**asType**<**short int**>$(($**int**$)171))) - ($**asType**<**int**>$($**asType**<**short int**>$(div1.quot)) *$ **asType**<**int**>$(\$heap_{funcstart\_719,1}$.b1))))

$\rightarrow$ *[simplify]*

[26.8] $\$heap_{719,1;729,8}$ == $\$heap_{funcstart\_719,1}$._**replace**$(p1 \rightarrow$ **asType**<**short int**>$((div($**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).rem * 171) $- ($**asType**<**int**>$($**asType**<**short int**>$(div1.quot)) *$ **asType**<**int**>$(\$heap_{funcstart\_719,1}$.b1))))

$\rightarrow$ *[from term 5.6, div1 is equal to div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177)]*

[26.9] $\$heap_{719,1;729,8}$ == $\$heap_{funcstart\_719,1}$._**replace**$(p1 \rightarrow$ **asType**<**short int**>$((171 * div($**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).rem) $- ($**asType**<**int**>$($**asType**<**short int**>$(div($**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot)) *$ **asType**<**int**>$(\$heap_{funcstart\_719,1}$.b1))))

$\rightarrow$ *[simplify]*

[26.11] $\$heap_{719,1;729,8}$ == $\$heap_{funcstart\_719,1}$._**replace**$(p1 \rightarrow$ **asType**<**short int**>$((171 * div($**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).rem) $- (div($**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot * **asType**<**int**>$(\$heap_{funcstart\_719,1}$.b1))))

$\rightarrow$ *[const static or extern object]*

[26.12] $\$heap_{719,1;729,8}$ == $\$heap_{funcstart\_719,1}$._**replace**$(p1 \rightarrow$ **asType**<**short int**>$((171 * div($**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).rem) $- (div($**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot * **asType**<**int**>$(\$heap_{init}$.b1))))

$\rightarrow$ *[expand definition of constant 'b1' at prang.c (17,20)]*

[26.13] $\$heap_{719,1;729,8}$ == $\$heap_{funcstart\_719,1}$.**replace**(p1 → **asType<short int>**((171 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).rem) − (div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot * **asType<int>(asType<short int>((int)2)**)))))

→ *[simplify]*

[26.19] $\$heap_{719,1;729,8}$ == $\$heap_{funcstart\_719,1}$.**replace**(p1 → ((-2 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).rem)))

[Take given term]

[31.0] $\$heap_{719,1;730,8}$ == $\$heap_{719,1;729,8}$.**replace**(p2 → **asType<short int>**((**asType<int>(asType<short int>**(div2.rem)) * **asType<int>**($\$heap_{719,1;729,8}$.r2)) − (**asType<int>(asType<short int>**(div2.quot)) * **asType<int>**($\$heap_{719,1;729,8}$.b2)))))

→ *[from term 26.19, $heap_{719,1;729,8}$ is equal to $heap_{funcstart\_719,1}$.**replace***(p1 → (-2 * div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p1, 177).rem))]*

[31.1] $\$heap_{719,1;730,8}$ == $\$heap_{funcstart\_719,1}$.**replace**(p1 → ((-2 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).rem))).**replace**(p2 → **asType<short int>**((**asType<int>(asType<short int>**(div2.rem)) * **asType<int>**($\$heap_{719,1;729,8}$.r2)) − (**asType<int>(asType<short int>**(div2.quot)) * **asType<int>**($\$heap_{719,1;729,8}$.b2)))))

→ *[from term 12.6, div2 is equal to div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p2, 176)]*

[31.2] $\$heap_{719,1;730,8}$ == $\$heap_{funcstart\_719,1}$.**replace**(p1 → ((-2 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).rem))).**replace**(p2 → **asType<short int>**((**asType<int>(asType<short int>**(div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).rem)) * **asType<int>**($\$heap_{719,1;729,8}$.r2)) − (**asType<int>(asType<short int>**(div2.quot)) * **asType<int>**($\$heap_{719,1;729,8}$.b2)))))

→ *[simplify]*

[31.4] $\$heap_{719,1;730,8}$ == $\$heap_{funcstart\_719,1}$.**replace**(p1 → ((-2 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).rem))).**replace**(p2 → **asType<short int>**((div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).rem * **asType<int>**($\$heap_{719,1;729,8}$.r2)) − (**asType<int>(asType<short**

int>(div2.quot)) * **asType**<**int**>($heap$_{719,1;729,8}$.b2))))

$\rightarrow$ *[from term 26.19, $heap$_{719,1;729,8}$ is equal to*
*$heap$_{funcstart_719,1}$.***replace***(p1 \rightarrow (-2 * div(***heapIs*** $heap$_{funcstart_719,1}$,*
*$heap$_{funcstart_719,1}$.p1, 177).quot) + (171 * div(***heapIs*** $heap$_{funcstart_719,1}$,*
$heap$_{funcstart_719,1}$.p1, 177).rem))]

[31.5] $heap$_{719,1;730,8}$ == $heap$_{funcstart_719,1}$.**replace**(p1 $\rightarrow$ ((-2 *
div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1, 177).quot) + (171 *
div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1,
177).rem))).**replace**(p2 $\rightarrow$ **asType**<**short int**>((div(**heapIs**
$heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p2, 176).rem *
asType<**int**>($heap$_{funcstart_719,1}$.**replace**(p1 $\rightarrow$ ((-2 * div(**heapIs**
$heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1, 177).quot) + (171 * div(**heapIs**
$heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1, 177).rem))).r2)) −
(**asType**<**int**>(**asType**<**short int**>(div2.quot)) *
asType<**int**>($heap$_{719,1;729,8}$.b2))))

$\rightarrow$ *[const member of object with modified fields]*

[31.6] $heap$_{719,1;730,8}$ == $heap$_{funcstart_719,1}$.**replace**(p1 $\rightarrow$ ((-2 *
div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1, 177).quot) + (171 *
div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1,
177).rem))).**replace**(p2 $\rightarrow$ **asType**<**short int**>((div(**heapIs**
$heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p2, 176).rem *
asType<**int**>($heap$_{funcstart_719,1}$.r2)) − (**asType**<**int**>(**asType**<**short**
int>(div2.quot)) * **asType**<**int**>($heap$_{719,1;729,8}$.b2))))

$\rightarrow$ *[const static or extern object]*

[31.7] $heap$_{719,1;730,8}$ == $heap$_{funcstart_719,1}$.**replace**(p1 $\rightarrow$ ((-2 *
div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1, 177).quot) + (171 *
div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1,
177).rem))).**replace**(p2 $\rightarrow$ **asType**<**short int**>((div(**heapIs**
$heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p2, 176).rem *
asType<**int**>($heap$_{init}$.r2)) − (**asType**<**int**>(**asType**<**short**
int>(div2.quot)) * **asType**<**int**>($heap$_{719,1;729,8}$.b2))))

$\rightarrow$ *[expand definition of constant 'r2' at prang.c (20,20)]*

[31.8] $heap$_{719,1;730,8}$ == $heap$_{funcstart_719,1}$.**replace**(p1 $\rightarrow$ ((-2 *
div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1, 177).quot) + (171 *
div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1,
177).rem))).**replace**(p2 $\rightarrow$ **asType**<**short int**>((div(**heapIs**
$heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p2, 176).rem *
asType<**int**>(**asType**<**short int**>((**int**)172))) −
(**asType**<**int**>(**asType**<**short int**>(div2.quot)) *
asType<**int**>($heap$_{719,1;729,8}$.b2))))

$\rightarrow$ *[simplify]*

[31.11] $\$heap_{719,1;730,8}$ == $\$heap_{funcstart\_719,1}$.**replace**(p1 → ((-2 *
div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1,
177).rem))).**replace**(p2 → **asType<short int>**((div(**heapIs**
$\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).rem * 172) −
(**asType<int>**(**asType<short int>**(div2.quot)) *
asType<int>($\$heap_{719,1;729,8}$.b2))))

→ *[from term 12.6, div2 is equal to div(**heapIs** $\$heap_{funcstart\_719,1}$,*
$\$heap_{funcstart\_719,1}$.p2, 176)]

[31.12] $\$heap_{719,1;730,8}$ == $\$heap_{funcstart\_719,1}$.**replace**(p1 → ((-2 *
div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1,
177).rem))).**replace**(p2 → **asType<short int>**((172 * div(**heapIs**
$\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).rem) −
(**asType<int>**(**asType<short int>**(div(**heapIs** $\$heap_{funcstart\_719,1}$,
$\$heap_{funcstart\_719,1}$.p2, 176).quot)) * **asType<int>**($\$heap_{719,1;729,8}$.b2))))

→ *[simplify]*

[31.14] $\$heap_{719,1;730,8}$ == $\$heap_{funcstart\_719,1}$.**replace**(p1 → ((-2 *
div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1,
177).rem))).**replace**(p2 → **asType<short int>**((172 * div(**heapIs**
$\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).rem) − (div(**heapIs**
$\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).quot *
asType<int>($\$heap_{719,1;729,8}$.b2))))

→ *[from term 26.19, $\$heap_{719,1;729,8}$ is equal to*
*$\$heap_{funcstart\_719,1}$.**replace**(p1 → (-2 * div(**heapIs** $\$heap_{funcstart\_719,1}$,*
*$\$heap_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_719,1}$,*
$\$heap_{funcstart\_719,1}$.p1, 177).rem))]

[31.15] $\$heap_{719,1;730,8}$ == $\$heap_{funcstart\_719,1}$.**replace**(p1 → ((-2 *
div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1,
177).rem))).**replace**(p2 → **asType<short int>**((172 * div(**heapIs**
$\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).rem) − (div(**heapIs**
$\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).quot *
asType<int>($\$heap_{funcstart\_719,1}$.**replace**(p1 → ((-2 * div(**heapIs**
$\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs**
$\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).rem))).b2))))

→ *[const member of object with modified fields]*

[31.16] $\$heap_{719,1;730,8}$ == $\$heap_{funcstart\_719,1}$.**replace**(p1 → ((-2 *
div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1,
177).rem))).**replace**(p2 → **asType<short int>**((172 * div(**heapIs**

$\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}.\text{p2}, 176).\text{rem}) - (\text{div}(\textbf{heapIs}$
$\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}.\text{p2}, 176).\text{quot} *$
$\textbf{asType}\textbf{<int>}(\text{\$heap}_{funcstart\_719,1}.\text{b2}))))$

$\rightarrow$ *[const static or extern object]*

[31.17] $\text{\$heap}_{719,1;730,8} == \text{\$heap}_{funcstart\_719,1}.\textbf{replace}(\text{p1} \rightarrow ((\text{-2} *$
$\text{div}(\textbf{heapIs}\ \text{\$heap}_{funcstart\_719,1}, \text{\$heap}_{funcstart\_719,1}.\text{p1}, 177).\text{quot}) + (171 *$
$\text{div}(\textbf{heapIs}\ \text{\$heap}_{funcstart\_719,1}, \text{\$heap}_{funcstart\_719,1}.\text{p1},$
$177).\text{rem}))).\textbf{replace}(\text{p2} \rightarrow \textbf{asType}\textbf{<short int>}((172 * \text{div}(\textbf{heapIs}$
$\text{\$heap}_{funcstart\_719,1}, \text{\$heap}_{funcstart\_719,1}.\text{p2}, 176).\text{rem}) - (\text{div}(\textbf{heapIs}$
$\text{\$heap}_{funcstart\_719,1}, \text{\$heap}_{funcstart\_719,1}.\text{p2}, 176).\text{quot} *$
$\textbf{asType}\textbf{<int>}(\text{\$heap}_{init}.\text{b2}))))$

$\rightarrow$ *[expand definition of constant 'b2' at prang.c (22,20)]*

[31.18] $\text{\$heap}_{719,1;730,8} == \text{\$heap}_{funcstart\_719,1}.\textbf{replace}(\text{p1} \rightarrow ((\text{-2} *$
$\text{div}(\textbf{heapIs}\ \text{\$heap}_{funcstart\_719,1}, \text{\$heap}_{funcstart\_719,1}.\text{p1}, 177).\text{quot}) + (171 *$
$\text{div}(\textbf{heapIs}\ \text{\$heap}_{funcstart\_719,1}, \text{\$heap}_{funcstart\_719,1}.\text{p1},$
$177).\text{rem}))).\textbf{replace}(\text{p2} \rightarrow \textbf{asType}\textbf{<short int>}((172 * \text{div}(\textbf{heapIs}$
$\text{\$heap}_{funcstart\_719,1}, \text{\$heap}_{funcstart\_719,1}.\text{p2}, 176).\text{rem}) - (\text{div}(\textbf{heapIs}$
$\text{\$heap}_{funcstart\_719,1}, \text{\$heap}_{funcstart\_719,1}.\text{p2}, 176).\text{quot} *$
$\textbf{asType}\textbf{<int>}(\textbf{asType}\textbf{<short int>}((\textbf{int})35)))))$

$\rightarrow$ *[simplify]*

[31.24] $\text{\$heap}_{719,1;730,8} == \text{\$heap}_{funcstart\_719,1}.\textbf{replace}(\text{p1} \rightarrow ((\text{-2} *$
$\text{div}(\textbf{heapIs}\ \text{\$heap}_{funcstart\_719,1}, \text{\$heap}_{funcstart\_719,1}.\text{p1}, 177).\text{quot}) + (171 *$
$\text{div}(\textbf{heapIs}\ \text{\$heap}_{funcstart\_719,1}, \text{\$heap}_{funcstart\_719,1}.\text{p1},$
$177).\text{rem}))).\textbf{replace}(\text{p2} \rightarrow ((\text{-35} * \text{div}(\textbf{heapIs}\ \text{\$heap}_{funcstart\_719,1},$
$\text{\$heap}_{funcstart\_719,1}.\text{p2}, 176).\text{quot}) + (172 * \text{div}(\textbf{heapIs}\ \text{\$heap}_{funcstart\_719,1},$
$\text{\$heap}_{funcstart\_719,1}.\text{p2}, 176).\text{rem})))$

[Take goal term]

[1.0] $\text{\$heap}_{719,1;730,8}.\text{r3} \leq \textbf{maxof}(\textbf{int})$

$\rightarrow$ *[from term 31.24, $heap_{719,1;730,8}$ is equal to*
*$heap_{funcstart\_719,1}.\textbf{replace}(p1 \rightarrow ((\text{-2} * div(\textbf{heapIs}\ \$heap_{funcstart\_719,1},$*
*$\$heap_{funcstart\_719,1}.p1, 177).quot) + (171 * div(\textbf{heapIs}\ \$heap_{funcstart\_719,1},$*
*$\$heap_{funcstart\_719,1}.p1, 177).rem))).\textbf{replace}(p2 \rightarrow (\text{-35} * div(\textbf{heapIs}$*
*$\$heap_{funcstart\_719,1}, \$heap_{funcstart\_719,1}.p2, 176).quot) + (172 * div(\textbf{heapIs}$*
$\$heap_{funcstart_719,1}, \$heap_{funcstart_719,1}.p2, 176).rem))]

[1.1] $\text{\$heap}_{funcstart\_719,1}.\textbf{replace}(\text{p1} \rightarrow ((\text{-2} * \text{div}(\textbf{heapIs}\ \text{\$heap}_{funcstart\_719,1},$
$\text{\$heap}_{funcstart\_719,1}.\text{p1}, 177).\text{quot}) + (171 * \text{div}(\textbf{heapIs}\ \text{\$heap}_{funcstart\_719,1},$
$\text{\$heap}_{funcstart\_719,1}.\text{p1}, 177).\text{rem}))).\textbf{replace}(\text{p2} \rightarrow ((\text{-35} * \text{div}(\textbf{heapIs}$
$\text{\$heap}_{funcstart\_719,1}, \text{\$heap}_{funcstart\_719,1}.\text{p2}, 176).\text{quot}) + (172 * \text{div}(\textbf{heapIs}$
$\text{\$heap}_{funcstart\_719,1}, \text{\$heap}_{funcstart\_719,1}.\text{p2}, 176).\text{rem}))).\text{r3} \leq \textbf{maxof}(\textbf{int})$

$\rightarrow$ *[const member of object with modified fields]*

[1.3] $\text{\$heap}_{funcstart\_719,1}.\text{r3} \leq \textbf{maxof}(\textbf{int})$

$\rightarrow$ *[const static or extern object]*

[1.4] $\text{\$heap}_{init}.\text{r3} \leq \mathbf{maxof(int)}$

$\rightarrow$ *[expand definition of constant 'r3' at prang.c (25,20)]*

[1.5] $\mathbf{asType{<}short\ int{>}}((\mathbf{int})170) \leq \mathbf{maxof(int)}$

$\rightarrow$ *[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 (49,13)

Condition defined at:

To prove: minof(int) $\leq$ **(asType$<$int$>$(asType$<$short int$>$(div3.rem)) * asType$<$int$>$($\text{\$heap}_{719,1;730,8}$.r3))**

Given:

$\text{\$heap}_{init}.\text{LIMIT} == (\mathbf{int})80$

$\text{\$heap}_{init}.\text{M1} == \mathbf{asType{<}short\ int{>}}((\mathbf{int})30269)$

$\text{\$heap}_{init}.\text{r1} == \mathbf{asType{<}short\ int{>}}((\mathbf{int})171)$

$\text{\$heap}_{init}.\text{a1} == \mathbf{asType{<}short\ int{>}}((\mathbf{int})177)$

$\text{\$heap}_{init}.\text{b1} == \mathbf{asType{<}short\ int{>}}((\mathbf{int})2)$

$\text{\$heap}_{init}.\text{M2} == \mathbf{asType{<}short\ int{>}}((\mathbf{int})30307)$

$\text{\$heap}_{init}.\text{r2} == \mathbf{asType{<}short\ int{>}}((\mathbf{int})172)$

$\text{\$heap}_{init}.\text{a2} == \mathbf{asType{<}short\ int{>}}((\mathbf{int})176)$

$\text{\$heap}_{init}.\text{b2} == \mathbf{asType{<}short\ int{>}}((\mathbf{int})35)$

$\text{\$heap}_{init}.\text{M3} == \mathbf{asType{<}short\ int{>}}((\mathbf{int})30323)$

$\text{\$heap}_{init}.\text{r3} == \mathbf{asType{<}short\ int{>}}((\mathbf{int})170)$

$\text{\$heap}_{init}.\text{a3} == \mathbf{asType{<}short\ int{>}}((\mathbf{int})178)$

$\text{\$heap}_{init}.\text{b3} == \mathbf{asType{<}short\ int{>}}((\mathbf{int})63)$

$\text{\$heap}_{init}.\text{p1} == \mathbf{asType{<}short\ int{>}}((\mathbf{int})1)$

$\text{\$heap}_{init}.\text{p2} == \mathbf{asType{<}short\ int{>}}((\mathbf{int})2)$

$\text{\$heap}_{init}.\text{p3} == \mathbf{asType{<}short\ int{>}}((\mathbf{int})3)$

$\text{div1} == \text{div}(\mathbf{heapIs}\ \text{\$heap}_{funcstart\_719,1},$
$\mathbf{asType{<}int{>}}(\text{\$heap}_{funcstart\_719,1}.\text{p1}),$
$\mathbf{asType{<}int{>}}(\text{\$heap}_{funcstart\_719,1}.\text{a1}))$

$(\mathbf{asType{<}integer{>}}(\mathbf{asType{<}int{>}}(\text{\$heap}_{funcstart\_719,1}.\text{p1}))$ /

**asType<integer>(asType<int>($heap$_{funcstart_719,1}$.a1))) ==
asType<integer>**(div1.quot)

**(asType<integer>(asType<int>($heap$_{funcstart_719,1}$.p1)) %
asType<integer>(asType<int>($heap$_{funcstart_719,1}$.a1))) ==
asType<integer>**(div1.rem)

div2 == div(**heapIs** $heap$_{funcstart_719,1}$,
asType<int>($heap$_{funcstart_719,1}$.p2),
asType<int>($heap$_{funcstart_719,1}$.a2))

**(asType<integer>(asType<int>($heap$_{funcstart_719,1}$.p2)) /
asType<integer>(asType<int>($heap$_{funcstart_719,1}$.a2))) ==
asType<integer>**(div2.quot)

**(asType<integer>(asType<int>($heap$_{funcstart_719,1}$.p2)) %
asType<integer>(asType<int>($heap$_{funcstart_719,1}$.a2))) ==
asType<integer>**(div2.rem)

div3 == div(**heapIs** $heap$_{funcstart_719,1}$,
asType<int>($heap$_{funcstart_719,1}$.p3),
asType<int>($heap$_{funcstart_719,1}$.a3))

**(asType<integer>(asType<int>($heap$_{funcstart_719,1}$.p3)) /
asType<integer>(asType<int>($heap$_{funcstart_719,1}$.a3))) ==
asType<integer>**(div3.quot)

**(asType<integer>(asType<int>($heap$_{funcstart_719,1}$.p3)) %
asType<integer>(asType<int>($heap$_{funcstart_719,1}$.a3))) ==
asType<integer>**(div3.rem)

$heap$_{719,1;729,8}$ == $heap$_{funcstart_719,1}$.**replace**(p1 → **asType<short
int>((asType<int>(asType<short int>**(div1.rem)) *
asType<int>($heap$_{funcstart_719,1}$.r1)) − (**asType<int>(asType<short
int>**(div1.quot)) * **asType<int>**($heap$_{funcstart_719,1}$.b1))))

$heap$_{719,1;730,8}$ == $heap$_{719,1;729,8}$.**replace**(p2 → **asType<short
int>((asType<int>(asType<short int>**(div2.rem)) *
asType<int>($heap$_{719,1;729,8}$.r2)) − (**asType<int>(asType<short
int>**(div2.quot)) * **asType<int>**($heap$_{719,1;729,8}$.b2))))

Proof:

[Take given term]

[5.0] div1 == div(**heapIs** $heap$_{funcstart_719,1}$,
asType<int>($heap$_{funcstart_719,1}$.p1),
asType<int>($heap$_{funcstart_719,1}$.a1))

→ *[simplify]*

[5.1] div1 == div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1,
asType<int>($heap$_{funcstart_719,1}$.a1))

$\rightarrow$ *[const static or extern object]*

[5.2] div1 == div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}$.p1, **asType**<**int**>($\$\text{heap}_{init}$.a1))

$\rightarrow$ *[expand definition of constant 'a1' at prang.c (16,20)]*

[5.3] div1 == div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}$.p1, **asType**<**int**>(**asType**<**short int**>((**int**)177)))

$\rightarrow$ *[simplify]*

[5.6] div1 == div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}$.p1, 177)

[Take given term]

[12.0] div2 == div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, **asType**<**int**>($\$\text{heap}_{funcstart\_719,1}$.p2), **asType**<**int**>($\$\text{heap}_{funcstart\_719,1}$.a2))

$\rightarrow$ *[simplify]*

[12.1] div2 == div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}$.p2, **asType**<**int**>($\$\text{heap}_{funcstart\_719,1}$.a2))

$\rightarrow$ *[const static or extern object]*

[12.2] div2 == div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}$.p2, **asType**<**int**>($\$\text{heap}_{init}$.a2))

$\rightarrow$ *[expand definition of constant 'a2' at prang.c (21,20)]*

[12.3] div2 == div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}$.p2, **asType**<**int**>(**asType**<**short int**>((**int**)176)))

$\rightarrow$ *[simplify]*

[12.6] div2 == div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}$.p2, 176)

[Take given term]

[19.0] div3 == div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, **asType**<**int**>($\$\text{heap}_{funcstart\_719,1}$.p3), **asType**<**int**>($\$\text{heap}_{funcstart\_719,1}$.a3))

$\rightarrow$ *[simplify]*

[19.1] div3 == div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}$.p3, **asType**<**int**>($\$\text{heap}_{funcstart\_719,1}$.a3))

$\rightarrow$ *[const static or extern object]*

[19.2] div3 == div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}$.p3, **asType**<**int**>($\$\text{heap}_{init}$.a3))

$\rightarrow$ *[expand definition of constant 'a3' at prang.c (26,20)]*

[19.3] div3 == div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}$.p3, **asType**<**int**>(**asType**<**short int**>((**int**)178)))

$\rightarrow$ *[simplify]*

[19.6] div3 == div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}$.p3, 178)

[Take given term]

[26.0] $\$\text{heap}_{719,1;729,8}$ == $\$\text{heap}_{funcstart\_719,1}$.__replace__(p1 $\rightarrow$ **asType<short int>**((**asType<int>**(**asType<short int>**(div1.rem)) * **asType<int>**($\$\text{heap}_{funcstart\_719,1}$.r1)) $-$ (**asType<int>**(**asType<short int>**(div1.quot)) * **asType<int>**($\$\text{heap}_{funcstart\_719,1}$.b1))))

$\rightarrow$ *[from term 5.6, div1 is equal to div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}$.p1, 177)]*

[26.1] $\$\text{heap}_{719,1;729,8}$ == $\$\text{heap}_{funcstart\_719,1}$.__replace__(p1 $\rightarrow$ **asType<short int>**((**asType<int>**(**asType<short int>**(div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}$.p1, 177).rem)) * **asType<int>**($\$\text{heap}_{funcstart\_719,1}$.r1)) $-$ (**asType<int>**(**asType<short int>**(div1.quot)) * **asType<int>**($\$\text{heap}_{funcstart\_719,1}$.b1))))

$\rightarrow$ *[simplify]*

[26.3] $\$\text{heap}_{719,1;729,8}$ == $\$\text{heap}_{funcstart\_719,1}$.__replace__(p1 $\rightarrow$ **asType<short int>**((div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}$.p1, 177).rem * **asType<int>**($\$\text{heap}_{funcstart\_719,1}$.r1)) $-$ (**asType<int>**(**asType<short int>**(div1.quot)) * **asType<int>**($\$\text{heap}_{funcstart\_719,1}$.b1))))

$\rightarrow$ *[const static or extern object]*

[26.4] $\$\text{heap}_{719,1;729,8}$ == $\$\text{heap}_{funcstart\_719,1}$.__replace__(p1 $\rightarrow$ **asType<short int>**((div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}$.p1, 177).rem * **asType<int>**($\$\text{heap}_{init}$.r1)) $-$ (**asType<int>**(**asType<short int>**(div1.quot)) * **asType<int>**($\$\text{heap}_{funcstart\_719,1}$.b1))))

$\rightarrow$ *[expand definition of constant 'r1' at prang.c (15,20)]*

[26.5] $\$\text{heap}_{719,1;729,8}$ == $\$\text{heap}_{funcstart\_719,1}$.__replace__(p1 $\rightarrow$ **asType<short int>**((div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}$.p1, 177).rem * **asType<int>**(**asType<short int>**((int)171))) $-$ (**asType<int>**(**asType<short int>**(div1.quot)) * **asType<int>**($\$\text{heap}_{funcstart\_719,1}$.b1))))

$\rightarrow$ *[simplify]*

[26.8] $\$\text{heap}_{719,1;729,8}$ == $\$\text{heap}_{funcstart\_719,1}$.__replace__(p1 $\rightarrow$ **asType<short int>**((div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}$.p1, 177).rem * 171) $-$ (**asType<int>**(**asType<short int>**(div1.quot)) * **asType<int>**($\$\text{heap}_{funcstart\_719,1}$.b1))))

$\rightarrow$ *[from term 5.6, div1 is equal to div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}$.p1, 177)]*

[26.9] $\$\text{heap}_{719,1;729,8}$ == $\$\text{heap}_{funcstart\_719,1}$.__replace__(p1 $\rightarrow$ **asType<short int>**((171 * div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}$.p1, 177).rem)

− (**asType**<**int**>(**asType**<**short int**>(div(**heapIs** $\$heap_{funcstart\_719,1}$,
$\$heap_{funcstart\_719,1}$.p1, 177).quot)) *
asType<**int**>($\$heap_{funcstart\_719,1}$.b1))))

→ *[simplify]*

[26.11] $\$heap_{719,1;729,8}$ == $\$heap_{funcstart\_719,1}$.**replace**(p1 → **asType**<**short int**>((171 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).rem)
− (div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot *
asType<**int**>($\$heap_{funcstart\_719,1}$.b1))))

→ *[const static or extern object]*

[26.12] $\$heap_{719,1;729,8}$ == $\$heap_{funcstart\_719,1}$.**replace**(p1 → **asType**<**short int**>((171 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).rem)
− (div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot *
asType<**int**>($\$heap_{init}$.b1))))

→ *[expand definition of constant 'b1' at prang.c (17,20)]*

[26.13] $\$heap_{719,1;729,8}$ == $\$heap_{funcstart\_719,1}$.**replace**(p1 → **asType**<**short int**>((171 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).rem)
− (div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot *
asType<**int**>(**asType**<**short int**>((**int**)2)))))

→ *[simplify]*

[26.19] $\$heap_{719,1;729,8}$ == $\$heap_{funcstart\_719,1}$.**replace**(p1 → ((-2 *
div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).rem)))

[Take given term]

[31.0] $\$heap_{719,1;730,8}$ == $\$heap_{719,1;729,8}$.**replace**(p2 → **asType**<**short int**>((**asType**<**int**>(**asType**<**short int**>(div2.rem)) *
asType<**int**>($\$heap_{719,1;729,8}$.r2)) − (**asType**<**int**>(**asType**<**short int**>(div2.quot)) * **asType**<**int**>($\$heap_{719,1;729,8}$.b2))))

→ *[from term 26.19, $\$heap_{719,1;729,8}$ is equal to*
*$\$heap_{funcstart\_719,1}$.**replace**(p1 → (-2 * div(**heapIs** $\$heap_{funcstart\_719,1}$,*
*$\$heap_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_719,1}$,*
$\$heap_{funcstart\_719,1}$.p1, 177).rem))]

[31.1] $\$heap_{719,1;730,8}$ == $\$heap_{funcstart\_719,1}$.**replace**(p1 → ((-2 *
div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1,
177).rem))).**replace**(p2 → **asType**<**short int**>((**asType**<**int**>(**asType**<**short int**>(div2.rem)) *
asType<**int**>($\$heap_{719,1;729,8}$.r2)) − (**asType**<**int**>(**asType**<**short int**>(div2.quot)) * **asType**<**int**>($\$heap_{719,1;729,8}$.b2))))

→ *[from term 12.6, div2 is equal to div(**heapIs** $\$heap_{funcstart\_719,1}$,*
$\$heap_{funcstart\_719,1}$.p2, 176)]

[31.2] $\text{\$heap}_{719,1;730,8}$ == $\text{\$heap}_{funcstart\_719,1}$.**replace**(p1 → ((-2 * div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p1, 177).rem))).**replace**(p2 → **asType\<short int\>**((**asType\<int\>**(**asType\<short int\>**(div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p2, 176).rem)) * **asType\<int\>**($\text{\$heap}_{719,1;729,8}$.r2)) − (**asType\<int\>**(**asType\<short int\>**(div2.quot)) * **asType\<int\>**($\text{\$heap}_{719,1;729,8}$.b2)))))

→ *[simplify]*

[31.4] $\text{\$heap}_{719,1;730,8}$ == $\text{\$heap}_{funcstart\_719,1}$.**replace**(p1 → ((-2 * div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p1, 177).rem))).**replace**(p2 → **asType\<short int\>**((div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p2, 176).rem * **asType\<int\>**($\text{\$heap}_{719,1;729,8}$.r2)) − (**asType\<int\>**(**asType\<short int\>**(div2.quot)) * **asType\<int\>**($\text{\$heap}_{719,1;729,8}$.b2)))))

→ *[from term 26.19, $\text{\$heap}_{719,1;729,8}$ is equal to $\text{\$heap}_{funcstart\_719,1}$.**replace**(p1 → (-2 * div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p1, 177).rem))]*

[31.5] $\text{\$heap}_{719,1;730,8}$ == $\text{\$heap}_{funcstart\_719,1}$.**replace**(p1 → ((-2 * div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p1, 177).rem))).**replace**(p2 → **asType\<short int\>**((div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p2, 176).rem * **asType\<int\>**($\text{\$heap}_{funcstart\_719,1}$.**replace**(p1 → ((-2 * div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p1, 177).rem))).r2)) − (**asType\<int\>**(**asType\<short int\>**(div2.quot)) * **asType\<int\>**($\text{\$heap}_{719,1;729,8}$.b2)))))

→ *[const member of object with modified fields]*

[31.6] $\text{\$heap}_{719,1;730,8}$ == $\text{\$heap}_{funcstart\_719,1}$.**replace**(p1 → ((-2 * div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p1, 177).rem))).**replace**(p2 → **asType\<short int\>**((div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p2, 176).rem * **asType\<int\>**($\text{\$heap}_{funcstart\_719,1}$.r2)) − (**asType\<int\>**(**asType\<short int\>**(div2.quot)) * **asType\<int\>**($\text{\$heap}_{719,1;729,8}$.b2)))))

→ *[const static or extern object]*

[31.7] $\text{\$heap}_{719,1;730,8}$ == $\text{\$heap}_{funcstart\_719,1}$.**replace**(p1 → ((-2 * div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p1,

177).rem))).**replace**(p2 → **asType<short int>**((div(**heapIs**
$\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).rem *
asType<int>($\$heap_{init}$.r2)) − (**asType<int>**(**asType<short**
int>(div2.quot)) * **asType<int>**($\$heap_{719,1;729,8}$.b2))))

→ *[expand definition of constant 'r2' at prang.c (20,20)]*

[31.8] $\$heap_{719,1;730,8}$ == $\$heap_{funcstart\_719,1}$.**replace**(p1 → ((-2 *
div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1,
177).rem))).**replace**(p2 → **asType<short int>**((div(**heapIs**
$\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).rem *
asType<int>(**asType<short int>**((**int**)172))) −
(**asType<int>**(**asType<short int>**(div2.quot)) *
asType<int>($\$heap_{719,1;729,8}$.b2))))

→ *[simplify]*

[31.11] $\$heap_{719,1;730,8}$ == $\$heap_{funcstart\_719,1}$.**replace**(p1 → ((-2 *
div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1,
177).rem))).**replace**(p2 → **asType<short int>**((div(**heapIs**
$\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).rem * 172) −
(**asType<int>**(**asType<short int>**(div2.quot)) *
asType<int>($\$heap_{719,1;729,8}$.b2))))

→ *[from term 12.6, div2 is equal to div(**heapIs** $heap_{funcstart\_719,1}$,*
$heap_{funcstart\_719,1}$.p2, 176)]

[31.12] $\$heap_{719,1;730,8}$ == $\$heap_{funcstart\_719,1}$.**replace**(p1 → ((-2 *
div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1,
177).rem))).**replace**(p2 → **asType<short int>**((172 * div(**heapIs**
$\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).rem) −
(**asType<int>**(**asType<short int>**(div(**heapIs** $\$heap_{funcstart\_719,1}$,
$\$heap_{funcstart\_719,1}$.p2, 176).quot)) * **asType<int>**($\$heap_{719,1;729,8}$.b2))))

→ *[simplify]*

[31.14] $\$heap_{719,1;730,8}$ == $\$heap_{funcstart\_719,1}$.**replace**(p1 → ((-2 *
div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1,
177).rem))).**replace**(p2 → **asType<short int>**((172 * div(**heapIs**
$\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).rem) − (div(**heapIs**
$\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).quot *
asType<int>($\$heap_{719,1;729,8}$.b2))))

→ *[from term 26.19, $heap_{719,1;729,8}$ is equal to*
*$heap_{funcstart\_719,1}$.**replace**(p1 → (-2 * div(**heapIs** $heap_{funcstart\_719,1}$,*
*$heap_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs** $heap_{funcstart\_719,1}$,*
$heap_{funcstart\_719,1}$.p1, 177).rem))]

[31.15] $\$heap_{719,1;730,8}$ == $\$heap_{funcstart\_719,1}$.**replace**(p1 → ((-2 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).rem))).**replace**(p2 → **asType\<short int\>**((172 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).rem) − (div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).quot * **asType\<int\>**($\$heap_{funcstart\_719,1}$.**replace**(p1 → ((-2 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).rem))).b2))))

→ *[const member of object with modified fields]*

[31.16] $\$heap_{719,1;730,8}$ == $\$heap_{funcstart\_719,1}$.**replace**(p1 → ((-2 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).rem))).**replace**(p2 → **asType\<short int\>**((172 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).rem) − (div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).quot * **asType\<int\>**($\$heap_{funcstart\_719,1}$.b2))))

→ *[const static or extern object]*

[31.17] $\$heap_{719,1;730,8}$ == $\$heap_{funcstart\_719,1}$.**replace**(p1 → ((-2 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).rem))).**replace**(p2 → **asType\<short int\>**((172 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).rem) − (div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).quot * **asType\<int\>**($\$heap_{init}$.b2))))

→ *[expand definition of constant 'b2' at prang.c (22,20)]*

[31.18] $\$heap_{719,1;730,8}$ == $\$heap_{funcstart\_719,1}$.**replace**(p1 → ((-2 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).rem))).**replace**(p2 → **asType\<short int\>**((172 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).rem) − (div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).quot * **asType\<int\>**(**asType\<short int\>**((**int**)35)))))

→ *[simplify]*

[31.24] $\$heap_{719,1;730,8}$ == $\$heap_{funcstart\_719,1}$.**replace**(p1 → ((-2 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).rem))).**replace**(p2 → ((-35 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).quot) + (172 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).rem)))

[Take goal term]

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[1.0] **minof(int)** $\leq$ (**asType\<int\>**(**asType\<short int\>**(div3.rem)) * **asType\<int\>**($\text{heap}_{719,1;730,8}$.r3))

$\rightarrow$ *[simplify]*

[1.1] -32768 $\leq$ (**asType\<int\>**(**asType\<short int\>**(div3.rem)) * **asType\<int\>**($\text{heap}_{719,1;730,8}$.r3))

$\rightarrow$ *[from term 19.6, div3 is equal to div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p3, 178)]*

[1.2] -32768 $\leq$ (**asType\<int\>**(**asType\<short int\>**(div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p3, 178).rem)) * **asType\<int\>**($\text{heap}_{719,1;730,8}$.r3))

$\rightarrow$ *[simplify]*

[1.4] -32768 $\leq$ (div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p3, 178).rem * **asType\<int\>**($\text{heap}_{719,1;730,8}$.r3))

$\rightarrow$ *[from term 31.24, $\$heap_{719,1;730,8}$ is equal to $\$heap_{funcstart\_719,1}$.**replace**(p1 $\rightarrow$ ((-2 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).rem))).**replace**(p2 $\rightarrow$ (-35 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).quot) + (172 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).rem))]*

[1.5] -32768 $\leq$ (div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p3, 178).rem * **asType\<int\>**($\$heap_{funcstart\_719,1}$.**replace**(p1 $\rightarrow$ ((-2 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).rem))).**replace**(p2 $\rightarrow$ ((-35 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).quot) + (172 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).rem)))).r3))

$\rightarrow$ *[const member of object with modified fields]*

[1.7] -32768 $\leq$ (div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p3, 178).rem * **asType\<int\>**($\$heap_{funcstart\_719,1}$.r3))

$\rightarrow$ *[const static or extern object]*

[1.8] -32768 $\leq$ (div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p3, 178).rem * **asType\<int\>**($\$heap_{init}$.r3))

$\rightarrow$ *[expand definition of constant 'r3' at prang.c (25,20)]*

[1.9] -32768 $\leq$ (div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p3, 178).rem * **asType\<int\>**(**asType\<short int\>**((**int**)170)))

$\rightarrow$ *[simplify]*

[1.14] -32769 < (170 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p3, 178).rem)

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→ *[literal comparison of product]*

[1.15] ([170 < 0]: (-32769 / -170) < −div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}$.p3, 178).rem, [0 < 170]: (-32769 / 170) < div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}$.p3, 178).rem, [0 == 170]: -32769 < 0)

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

[1.16] ([170 < 0]: (-32769 / -170) < −div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}$.p3, 178).rem, [(0 < 170) ∧ !(170 < 0)]: (-32769 / 170) < div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}$.p3, 178).rem, [(0 == 170) ∧ !(0 < 170) ∧ !(170 < 0)]: -32769 < 0)

→ *[simplify]*

[1.24] -193 < div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}$.p3, 178).rem

→ *[negate goal and search for contradiction]*

[1.25] !(-193 < div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}$.p3, 178).rem)

→ *[simplify]*

[1.27] 192 < −div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}$.p3, 178).rem

[Assume known post-assertion, class invariant or type constraint for term 19.6]

[25.0] (**asType\<integer\>**($\$\text{heap}_{funcstart\_719,1}$.p3) % **asType\<integer\>**(178)) == **asType\<integer\>**(div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}$.p3, 178).rem)

→ *[simplify]*

[25.2] ($\$\text{heap}_{funcstart\_719,1}$.p3 % 178) == **asType\<integer\>**(div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}$.p3, 178).rem)

→ *[expand definition of operator '.%' in class 'int' at built in declaration]*

[25.3] ([**asType\<integer\>**($\$\text{heap}_{funcstart\_719,1}$.p3) < 0]: −(−**asType\<integer\>**($\$\text{heap}_{funcstart\_719,1}$.p3) % 178), []: **asType\<integer\>**($\$\text{heap}_{funcstart\_719,1}$.p3) % 178) == **asType\<integer\>**(div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}$.p3, 178).rem)

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

[25.4] ([**asType\<integer\>**($\$\text{heap}_{funcstart\_719,1}$.p3) < 0]: −(−**asType\<integer\>**($\$\text{heap}_{funcstart\_719,1}$.p3) % 178), [!(**asType\<integer\>**($\$\text{heap}_{funcstart\_719,1}$.p3) < 0)]: **asType\<integer\>**($\$\text{heap}_{funcstart\_719,1}$.p3) % 178) == **asType\<integer\>**(div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}$.p3, 178).rem)

→ *[simplify]*

[25.14] ($[0 < -\$heap_{funcstart\_719,1}.p3]$: $-(-\$heap_{funcstart\_719,1}.p3 \% 178)$, $[-1 < \$heap_{funcstart\_719,1}.p3]$: **asType<integer>**($\$heap_{funcstart\_719,1}.p3$) $\% 178$) == **asType<integer>**(div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}.p3$, 178).rem)

$\rightarrow$ *[remainder of negation]*

[25.15] ($[0 < -\$heap_{funcstart\_719,1}.p3]$: $-([0 == (\$heap_{funcstart\_719,1}.p3 \% 178)]$: 0, []: 178 + $-(\$heap_{funcstart\_719,1}.p3 \% 178))$, $[-1 < \$heap_{funcstart\_719,1}.p3]$: **asType<integer>**($\$heap_{funcstart\_719,1}.p3$) $\% 178$) == **asType<integer>**(div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}.p3$, 178).rem)

$\rightarrow$ *[explicitly assert falsehood of skipped guards in subsequent guards]*

[25.16] ($[0 < -\$heap_{funcstart\_719,1}.p3]$: $-([0 == (\$heap_{funcstart\_719,1}.p3 \% 178)]$: 0, $[!(0 == (\$heap_{funcstart\_719,1}.p3 \% 178))]$: 178 + $-(\$heap_{funcstart\_719,1}.p3 \% 178))$, $[-1 < \$heap_{funcstart\_719,1}.p3]$: **asType<integer>**($\$heap_{funcstart\_719,1}.p3$) $\% 178$) == **asType<integer>**(div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}.p3$, 178).rem)

$\rightarrow$ *[move guard outside expression]*

[25.17] ($[0 < -\$heap_{funcstart\_719,1}.p3]$: $([0 == (\$heap_{funcstart\_719,1}.p3 \% 178)]$: -0, $[!(0 == (\$heap_{funcstart\_719,1}.p3 \% 178))]$: $-(178 + -(\$heap_{funcstart\_719,1}.p3 \% 178)))$, $[-1 < \$heap_{funcstart\_719,1}.p3]$: **asType<integer>**($\$heap_{funcstart\_719,1}.p3$) $\% 178$) == **asType<integer>**(div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}.p3$, 178).rem)

$\rightarrow$ *[simplify]*

[25.24] 0 == ($-([0 < -\$heap_{funcstart\_719,1}.p3]$: $([0 == (\$heap_{funcstart\_719,1}.p3 \% 178)]$: 0, $[!(0 == (\$heap_{funcstart\_719,1}.p3 \% 178))]$: -178 + $(\$heap_{funcstart\_719,1}.p3 \% 178))$, $[-1 < \$heap_{funcstart\_719,1}.p3]$: $\$heap_{funcstart\_719,1}.p3 \% 178$) + div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}.p3$, 178).rem)

$\rightarrow$ *[move guard outside expression]*

[25.26] 0 == (($[0 < -\$heap_{funcstart\_719,1}.p3]$: $([0 == (\$heap_{funcstart\_719,1}.p3 \% 178)]$: -0, $[!(0 == (\$heap_{funcstart\_719,1}.p3 \% 178))]$: $-(-178 + (\$heap_{funcstart\_719,1}.p3 \% 178)))$, $[-1 < \$heap_{funcstart\_719,1}.p3]$: $-(\$heap_{funcstart_719,1}.p3 \% 178)) + $ div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}.p3$, 178).rem)

$\rightarrow$ *[simplify]*

[25.29] 0 == (($[0 < -\$heap_{funcstart\_719,1}.p3]$: $([0 == (\$heap_{funcstart\_719,1}.p3 \% 178)]$: 0, $[!(0 == (\$heap_{funcstart\_719,1}.p3 \% 178))]$: 178 + $-(\$heap_{funcstart\_719,1}.p3 \% 178))$, $[-1 < \$heap_{funcstart\_719,1}.p3]$: $-(\$heap_{funcstart_719,1}.p3 \% 178)) + $ div(**heapIs** $\$heap_{funcstart\_719,1}$,

$heap$_{funcstart_719,1}$.p3, 178).rem)

→ *[move guard outside expression]*

[25.31] 0 == ([0 < −$heap$_{funcstart_719,1}$.p3]: ([0 == ($heap$_{funcstart\_719,1}$.p3 % 178)]: 0 + div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p3, 178).rem, [!(0 == ($heap$_{funcstart\_719,1}$.p3 % 178))]: (178 + −($heap$_{funcstart_719,1}$.p3 % 178)) + div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p3, 178).rem), [-1 < $heap$_{funcstart_719,1}$.p3]: −($heap$_{funcstart\_719,1}$.p3 % 178) + div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p3, 178).rem)

→ *[simplify]*

[25.33] 0 == ([0 < −$heap$_{funcstart_719,1}$.p3]: ([0 == ($heap$_{funcstart\_719,1}$.p3 % 178)]: div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p3, 178).rem, [!(0 == ($heap$_{funcstart\_719,1}$.p3 % 178))]: 178 + −($heap$_{funcstart_719,1}$.p3 % 178) + div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p3, 178).rem), [-1 < $heap$_{funcstart_719,1}$.p3]: −($heap$_{funcstart\_719,1}$.p3 % 178) + div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p3, 178).rem)

→ *[move guard outside expression]*

[25.35] ([0 < −$heap$_{funcstart_719,1}$.p3]: ([0 == ($heap$_{funcstart\_719,1}$.p3 % 178)]: 0 == div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p3, 178).rem, [!(0 == ($heap$_{funcstart\_719,1}$.p3 % 178))]: 0 == (178 + −($heap$_{funcstart_719,1}$.p3 % 178) + div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p3, 178).rem)), [-1 < $heap$_{funcstart_719,1}$.p3]: 0 == (−($heap$_{funcstart\_719,1}$.p3 % 178) + div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p3, 178).rem))

→ *[simplify]*

[25.40] ([0 < −$heap$_{funcstart_719,1}$.p3]: ([0 == ($heap$_{funcstart\_719,1}$.p3 % 178)]: 0 == div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p3, 178).rem, [!(0 == ($heap$_{funcstart\_719,1}$.p3 % 178))]: 178 == (($heap$_{funcstart_719,1}$.p3 % 178) + −div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p3, 178).rem)), [-1 < $heap$_{funcstart_719,1}$.p3]: 0 == (−($heap$_{funcstart\_719,1}$.p3 % 178) + div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p3, 178).rem))

→ *[from term 1.27, div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p3, 178).rem == literala is false whenever -1 < (192 + literala)]*

Proof of rule precondition:

[25.40.0] -1 < (0 + 192)

→ *[simplify]*

[25.40.2] **true**

[25.41] ([0 < −$heap$_{funcstart_719,1}$.p3]: ([0 == ($heap$_{funcstart\_719,1}$.p3 % 178)]: **false**, [!(0 == ($heap$_{funcstart_719,1}$.p3 % 178))]: 178 == (−div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p3, 178).rem + ($heap$_{funcstart\_719,1}$.p3 % 178))), [-1 < $heap$_{funcstart_719,1}$.p3]: 0 == (−($heap$_{funcstart\_719,1}$.p3 % 178) + div(**heapIs** $heap$_{funcstart_719,1}$,

$heap_{funcstart\_719,1}$.p3, 178).rem))

→ *[simplify]*

[25.43] ([0 < −$heap_{funcstart\_719,1}$.p3]: (178 == (−div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p3, 178).rem + ($heap_{funcstart\_719,1}$.p3 % 178))) ∧ !(0 == ($heap_{funcstart\_719,1}$.p3 % 178)), [-1 < $heap_{funcstart\_719,1}$.p3]: 0 == (−($heap_{funcstart\_719,1}$.p3 % 178) + div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p3, 178).rem))

[Branch on disjunction or conditional in term 25.43]

[37.0] ((178 == (−div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p3, 178).rem + ($heap_{funcstart\_719,1}$.p3 % 178))) ∧ !(0 == ($heap_{funcstart\_719,1}$.p3 % 178))) ∨ (0 == (−($heap_{funcstart\_719,1}$.p3 % 178) + div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p3, 178).rem)) ∨ (-1 < $heap_{funcstart\_719,1}$.p3)

→ *[separate conjunction and work on first sub-term]*

[37.1] (178 == (−div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p3, 178).rem + ($heap_{funcstart\_719,1}$.p3 % 178))) ∨ ...

[Create new term from terms 37.1, 1.27 using rule: transitivity 15r]

[57.0] ((-178 + 192) < −($heap_{funcstart\_719,1}$.p3 % 178)) ∨ (0 == (−($heap_{funcstart\_719,1}$.p3 % 178) + div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p3, 178).rem)) ∨ (-1 < $heap_{funcstart\_719,1}$.p3)

→ *[simplify]*

[57.2] **false** ∨ ...

[Remove 'false' term 57.2 and fetch new term from containing clause]

[58.0] 0 == (−($heap_{funcstart\_719,1}$.p3 % 178) + div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p3, 178).rem)

[Create new term from terms 1.27, 58.0 using rule: transitivity 16]

[62.0] (0 + 192) < −($heap_{funcstart\_719,1}$.p3 % 178)

→ *[simplify]*

[62.2] **false**

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

Condition generated at: C:\Escher\Customers\prang\prang.c (49,13)

Condition defined at:

To prove: (**asType\<int\>**(**asType\<short int\>**(div3.rem)) * **asType\<int\>**($heap_{719,1;730,8}$.r3)) ≤ **maxof(int)**

Given:

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

$\$heap_{init}.M1 == \mathbf{asType}\mathbf{<short\ int>}((\mathbf{int})30269)$

$\$heap_{init}.r1 == \mathbf{asType}\mathbf{<short\ int>}((\mathbf{int})171)$

$\$heap_{init}.a1 == \mathbf{asType}\mathbf{<short\ int>}((\mathbf{int})177)$

$\$heap_{init}.b1 == \mathbf{asType}\mathbf{<short\ int>}((\mathbf{int})2)$

$\$heap_{init}.M2 == \mathbf{asType}\mathbf{<short\ int>}((\mathbf{int})30307)$

$\$heap_{init}.r2 == \mathbf{asType}\mathbf{<short\ int>}((\mathbf{int})172)$

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

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

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

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

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

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

$\$heap_{init}.p1 == \mathbf{asType}\mathbf{<short\ int>}((\mathbf{int})1)$

$\$heap_{init}.p2 == \mathbf{asType}\mathbf{<short\ int>}((\mathbf{int})2)$

$\$heap_{init}.p3 == \mathbf{asType}\mathbf{<short\ int>}((\mathbf{int})3)$

$\text{div1} == \text{div}(\mathbf{heapIs}\ \$heap_{funcstart\_719,1},$
$\mathbf{asType}\mathbf{<int>}(\$heap_{funcstart\_719,1}.p1),$
$\mathbf{asType}\mathbf{<int>}(\$heap_{funcstart\_719,1}.a1))$

$(\mathbf{asType}\mathbf{<integer>}(\mathbf{asType}\mathbf{<int>}(\$heap_{funcstart\_719,1}.p1))\ /$
$\mathbf{asType}\mathbf{<integer>}(\mathbf{asType}\mathbf{<int>}(\$heap_{funcstart\_719,1}.a1))) ==$
$\mathbf{asType}\mathbf{<integer>}(\text{div1.quot})$

$(\mathbf{asType}\mathbf{<integer>}(\mathbf{asType}\mathbf{<int>}(\$heap_{funcstart\_719,1}.p1))\ \%$
$\mathbf{asType}\mathbf{<integer>}(\mathbf{asType}\mathbf{<int>}(\$heap_{funcstart\_719,1}.a1))) ==$
$\mathbf{asType}\mathbf{<integer>}(\text{div1.rem})$

$\text{div2} == \text{div}(\mathbf{heapIs}\ \$heap_{funcstart\_719,1},$
$\mathbf{asType}\mathbf{<int>}(\$heap_{funcstart\_719,1}.p2),$
$\mathbf{asType}\mathbf{<int>}(\$heap_{funcstart\_719,1}.a2))$

$(\mathbf{asType}\mathbf{<integer>}(\mathbf{asType}\mathbf{<int>}(\$heap_{funcstart\_719,1}.p2))\ /$
$\mathbf{asType}\mathbf{<integer>}(\mathbf{asType}\mathbf{<int>}(\$heap_{funcstart\_719,1}.a2))) ==$
$\mathbf{asType}\mathbf{<integer>}(\text{div2.quot})$

$(\mathbf{asType}\mathbf{<integer>}(\mathbf{asType}\mathbf{<int>}(\$heap_{funcstart\_719,1}.p2))\ \%$
$\mathbf{asType}\mathbf{<integer>}(\mathbf{asType}\mathbf{<int>}(\$heap_{funcstart\_719,1}.a2))) ==$
$\mathbf{asType}\mathbf{<integer>}(\text{div2.rem})$

$\text{div3} == \text{div}(\mathbf{heapIs}\ \$heap_{funcstart\_719,1},$
$\mathbf{asType}\mathbf{<int>}(\$heap_{funcstart\_719,1}.p3),$

asType<int>($heap$_{funcstart_719,1}$.a3))

(**asType<integer>**(**asType<int>**($heap$_{funcstart_719,1}$.p3)) /
asType<integer>(**asType<int>**($heap$_{funcstart_719,1}$.a3))) ==
asType<integer>(div3.quot)

(**asType<integer>**(**asType<int>**($heap$_{funcstart_719,1}$.p3)) %
asType<integer>(**asType<int>**($heap$_{funcstart_719,1}$.a3))) ==
asType<integer>(div3.rem)

$heap$_{719,1;729,8}$ == $heap$_{funcstart_719,1}$._**replace**(p1 → **asType<short
int>**((**asType<int>**(**asType<short int>**(div1.rem)) *
asType<int>($heap$_{funcstart_719,1}$.r1)) − (**asType<int>**(**asType<short
int>**(div1.quot)) * **asType<int>**($heap$_{funcstart_719,1}$.b1))))

$heap$_{719,1;730,8}$ == $heap$_{719,1;729,8}$._**replace**(p2 → **asType<short
int>**((**asType<int>**(**asType<short int>**(div2.rem)) *
asType<int>($heap$_{719,1;729,8}$.r2)) − (**asType<int>**(**asType<short
int>**(div2.quot)) * **asType<int>**($heap$_{719,1;729,8}$.b2))))

Proof:

[Take given term]

[5.0] div1 == div(**heapIs** $heap$_{funcstart_719,1}$,
asType<int>($heap$_{funcstart_719,1}$.p1),
asType<int>($heap$_{funcstart_719,1}$.a1))

→ *[simplify]*

[5.1] div1 == div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1,
asType<int>($heap$_{funcstart_719,1}$.a1))

→ *[const static or extern object]*

[5.2] div1 == div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1,
asType<int>($heap$_{init}$.a1))

→ *[expand definition of constant 'a1' at prang.c (16,20)]*

[5.3] div1 == div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1,
asType<int>(**asType<short int>**((**int**)177)))

→ *[simplify]*

[5.6] div1 == div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1, 177)

[Take given term]

[12.0] div2 == div(**heapIs** $heap$_{funcstart_719,1}$,
asType<int>($heap$_{funcstart_719,1}$.p2),
asType<int>($heap$_{funcstart_719,1}$.a2))

→ *[simplify]*

[12.1] div2 == div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p2,
asType<int>($heap$_{funcstart_719,1}$.a2))

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$\rightarrow$ *[const static or extern object]*

[12.2] div2 == div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, **asType<int>**($\$heap_{init}$.a2))

$\rightarrow$ *[expand definition of constant 'a2' at prang.c (21,20)]*

[12.3] div2 == div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, **asType<int>**(**asType<short int>**(**(int)**176)))

$\rightarrow$ *[simplify]*

[12.6] div2 == div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176)

[Take given term]

[19.0] div3 == div(**heapIs** $\$heap_{funcstart\_719,1}$, **asType<int>**($\$heap_{funcstart\_719,1}$.p3), **asType<int>**($\$heap_{funcstart\_719,1}$.a3))

$\rightarrow$ *[simplify]*

[19.1] div3 == div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p3, **asType<int>**($\$heap_{funcstart\_719,1}$.a3))

$\rightarrow$ *[const static or extern object]*

[19.2] div3 == div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p3, **asType<int>**($\$heap_{init}$.a3))

$\rightarrow$ *[expand definition of constant 'a3' at prang.c (26,20)]*

[19.3] div3 == div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p3, **asType<int>**(**asType<short int>**(**(int)**178)))

$\rightarrow$ *[simplify]*

[19.6] div3 == div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p3, 178)

[Take given term]

[26.0] $\$heap_{719,1;729,8}$ == $\$heap_{funcstart\_719,1}$.**replace**(p1 $\rightarrow$ **asType<short int>**((**asType<int>**(**asType<short int>**(div1.rem)) * **asType<int>**($\$heap_{funcstart\_719,1}$.r1)) $-$ (**asType<int>**(**asType<short int>**(div1.quot)) * **asType<int>**($\$heap_{funcstart\_719,1}$.b1))))

$\rightarrow$ *[from term 5.6, div1 is equal to div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p1, 177)]*

[26.1] $\$heap_{719,1;729,8}$ == $\$heap_{funcstart\_719,1}$.**replace**(p1 $\rightarrow$ **asType<short int>**((**asType<int>**(**asType<short int>**(div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).rem)) * **asType<int>**($\$heap_{funcstart\_719,1}$.r1)) $-$ (**asType<int>**(**asType<short int>**(div1.quot)) * **asType<int>**($\$heap_{funcstart\_719,1}$.b1))))

$\rightarrow$ *[simplify]*

[26.3] $\$heap_{719,1;729,8}$ == $\$heap_{funcstart\_719,1}$.**replace**(p1 $\rightarrow$ **asType<short**

int>((div(**heapIs** \$heap$_{funcstart\_719,1}$, \$heap$_{funcstart\_719,1}$.p1, 177).rem *
asType<**int**>(\$heap$_{funcstart\_719,1}$.r1)) − (**asType**<**int**>(**asType**<**short
int**>(div1.quot)) * **asType**<**int**>(\$heap$_{funcstart\_719,1}$.b1))))

→ *[const static or extern object]*

[26.4] \$heap$_{719,1;729,8}$ == \$heap$_{funcstart\_719,1}$._**replace**(p1 → **asType**<**short
int**>((div(**heapIs** \$heap$_{funcstart\_719,1}$, \$heap$_{funcstart\_719,1}$.p1, 177).rem *
asType<**int**>(\$heap$_{init}$.r1)) − (**asType**<**int**>(**asType**<**short
int**>(div1.quot)) * **asType**<**int**>(\$heap$_{funcstart\_719,1}$.b1))))

→ *[expand definition of constant 'r1' at prang.c (15,20)]*

[26.5] \$heap$_{719,1;729,8}$ == \$heap$_{funcstart\_719,1}$._**replace**(p1 → **asType**<**short
int**>((div(**heapIs** \$heap$_{funcstart\_719,1}$, \$heap$_{funcstart\_719,1}$.p1, 177).rem *
asType<**int**>(**asType**<**short int**>((**int**)171))) −
(**asType**<**int**>(**asType**<**short int**>(div1.quot)) *
asType<**int**>(\$heap$_{funcstart\_719,1}$.b1))))

→ *[simplify]*

[26.8] \$heap$_{719,1;729,8}$ == \$heap$_{funcstart\_719,1}$._**replace**(p1 → **asType**<**short
int**>((div(**heapIs** \$heap$_{funcstart\_719,1}$, \$heap$_{funcstart\_719,1}$.p1, 177).rem * 171)
− (**asType**<**int**>(**asType**<**short int**>(div1.quot)) *
asType<**int**>(\$heap$_{funcstart\_719,1}$.b1))))

→ *[from term 5.6, div1 is equal to div(**heapIs** \$heap$_{funcstart\_719,1}$,
\$heap$_{funcstart\_719,1}$.p1, 177)]*

[26.9] \$heap$_{719,1;729,8}$ == \$heap$_{funcstart\_719,1}$._**replace**(p1 → **asType**<**short
int**>((171 * div(**heapIs** \$heap$_{funcstart\_719,1}$, \$heap$_{funcstart\_719,1}$.p1, 177).rem)
− (**asType**<**int**>(**asType**<**short int**>(div(**heapIs** \$heap$_{funcstart\_719,1}$,
\$heap$_{funcstart\_719,1}$.p1, 177).quot)) *
asType<**int**>(\$heap$_{funcstart\_719,1}$.b1))))

→ *[simplify]*

[26.11] \$heap$_{719,1;729,8}$ == \$heap$_{funcstart\_719,1}$._**replace**(p1 → **asType**<**short
int**>((171 * div(**heapIs** \$heap$_{funcstart\_719,1}$, \$heap$_{funcstart\_719,1}$.p1, 177).rem)
− (div(**heapIs** \$heap$_{funcstart\_719,1}$, \$heap$_{funcstart\_719,1}$.p1, 177).quot *
asType<**int**>(\$heap$_{funcstart\_719,1}$.b1))))

→ *[const static or extern object]*

[26.12] \$heap$_{719,1;729,8}$ == \$heap$_{funcstart\_719,1}$._**replace**(p1 → **asType**<**short
int**>((171 * div(**heapIs** \$heap$_{funcstart\_719,1}$, \$heap$_{funcstart\_719,1}$.p1, 177).rem)
− (div(**heapIs** \$heap$_{funcstart\_719,1}$, \$heap$_{funcstart\_719,1}$.p1, 177).quot *
asType<**int**>(\$heap$_{init}$.b1))))

→ *[expand definition of constant 'b1' at prang.c (17,20)]*

[26.13] \$heap$_{719,1;729,8}$ == \$heap$_{funcstart\_719,1}$._**replace**(p1 → **asType**<**short
int**>((171 * div(**heapIs** \$heap$_{funcstart\_719,1}$, \$heap$_{funcstart\_719,1}$.p1, 177).rem)
− (div(**heapIs** \$heap$_{funcstart\_719,1}$, \$heap$_{funcstart\_719,1}$.p1, 177).quot *

asType\<int\>(asType\<short int\>((int)2)))))

→ *[simplify]*

[26.19] $\$heap_{719,1;729,8}$ == $\$heap_{funcstart\_719,1}$.**replace**(p1 → ((-2 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).rem)))

[Take given term]

[31.0] $\$heap_{719,1;730,8}$ == $\$heap_{719,1;729,8}$.**replace**(p2 → **asType\<short int\>**((**asType\<int\>**(**asType\<short int\>**(div2.rem)) * **asType\<int\>**($\$heap_{719,1;729,8}$.r2)) − (**asType\<int\>**(**asType\<short int\>**(div2.quot)) * **asType\<int\>**($\$heap_{719,1;729,8}$.b2))))

→ *[from term 26.19, $\$heap_{719,1;729,8}$ is equal to*
*$\$heap_{funcstart\_719,1}$.**replace**(p1 → (-2 * div(**heapIs** $\$heap_{funcstart\_719,1}$,*
*$\$heap_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_719,1}$,*
$\$heap_{funcstart\_719,1}$.p1, 177).rem))]

[31.1] $\$heap_{719,1;730,8}$ == $\$heap_{funcstart\_719,1}$.**replace**(p1 → ((-2 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).rem))).**replace**(p2 → **asType\<short int\>**((**asType\<int\>**(**asType\<short int\>**(div2.rem)) * **asType\<int\>**($\$heap_{719,1;729,8}$.r2)) − (**asType\<int\>**(**asType\<short int\>**(div2.quot)) * **asType\<int\>**($\$heap_{719,1;729,8}$.b2))))

→ *[from term 12.6, div2 is equal to div(**heapIs** $\$heap_{funcstart\_719,1}$,*
$\$heap_{funcstart\_719,1}$.p2, 176)]

[31.2] $\$heap_{719,1;730,8}$ == $\$heap_{funcstart\_719,1}$.**replace**(p1 → ((-2 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).rem))).**replace**(p2 → **asType\<short int\>**((**asType\<int\>**(**asType\<short int\>**(div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).rem)) * **asType\<int\>**($\$heap_{719,1;729,8}$.r2)) − (**asType\<int\>**(**asType\<short int\>**(div2.quot)) * **asType\<int\>**($\$heap_{719,1;729,8}$.b2))))

→ *[simplify]*

[31.4] $\$heap_{719,1;730,8}$ == $\$heap_{funcstart\_719,1}$.**replace**(p1 → ((-2 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).rem))).**replace**(p2 → **asType\<short int\>**((div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).rem * **asType\<int\>**($\$heap_{719,1;729,8}$.r2)) − (**asType\<int\>**(**asType\<short int\>**(div2.quot)) * **asType\<int\>**($\$heap_{719,1;729,8}$.b2))))

→ *[from term 26.19, $\$heap_{719,1;729,8}$ is equal to*
*$\$heap_{funcstart\_719,1}$.**replace**(p1 → (-2 * div(**heapIs** $\$heap_{funcstart\_719,1}$,*

$heap_{funcstart_719,1}.p1, 177).quot) + (171 * div(\textbf{heapIs} $heap_{funcstart\_719,1},$
$heap_{funcstart\_719,1}.p1, 177).rem))]$

[31.5] $heap_{719,1;730,8}$ == $heap_{funcstart\_719,1}$._**replace**(p1 → ((-2 *
div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}.$p1, 177).quot) + (171 *
div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}.$p1,
177).rem)))._**replace**(p2 → **asType<short int>**((div(**heapIs**
$heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}.$p2, 176).rem *
asType<int>($heap_{funcstart\_719,1}$._**replace**(p1 → ((-2 * div(**heapIs**
$heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}.$p1, 177).quot) + (171 * div(**heapIs**
$heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}.$p1, 177).rem))).r2)) −
(**asType<int>**(**asType<short int>**(div2.quot)) *
asType<int>($heap_{719,1;729,8}.$b2)))))

→ [const member of object with modified fields]

[31.6] $heap_{719,1;730,8}$ == $heap_{funcstart\_719,1}$._**replace**(p1 → ((-2 *
div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}.$p1, 177).quot) + (171 *
div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}.$p1,
177).rem)))._**replace**(p2 → **asType<short int>**((div(**heapIs**
$heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}.$p2, 176).rem *
asType<int>($heap_{funcstart\_719,1}.$r2)) − (**asType<int>**(**asType<short
int>**(div2.quot)) * **asType<int>**($heap_{719,1;729,8}.$b2)))))

→ [const static or extern object]

[31.7] $heap_{719,1;730,8}$ == $heap_{funcstart\_719,1}$._**replace**(p1 → ((-2 *
div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}.$p1, 177).quot) + (171 *
div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}.$p1,
177).rem)))._**replace**(p2 → **asType<short int>**((div(**heapIs**
$heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}.$p2, 176).rem *
asType<int>($heap_{init}.$r2)) − (**asType<int>**(**asType<short
int>**(div2.quot)) * **asType<int>**($heap_{719,1;729,8}.$b2)))))

→ [expand definition of constant 'r2' at prang.c (20,20)]

[31.8] $heap_{719,1;730,8}$ == $heap_{funcstart\_719,1}$._**replace**(p1 → ((-2 *
div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}.$p1, 177).quot) + (171 *
div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}.$p1,
177).rem)))._**replace**(p2 → **asType<short int>**((div(**heapIs**
$heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}.$p2, 176).rem *
asType<int>(**asType<short int>**((int)172))) −
(**asType<int>**(**asType<short int>**(div2.quot)) *
asType<int>($heap_{719,1;729,8}.$b2)))))

→ [simplify]

[31.11] $heap_{719,1;730,8}$ == $heap_{funcstart\_719,1}$._**replace**(p1 → ((-2 *
div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}.$p1, 177).quot) + (171 *
div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}.$p1,
177).rem)))._**replace**(p2 → **asType<short int>**((div(**heapIs**

$\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}$.p2, 176).rem * 172) −
(**asType**<**int**>(**asType**<**short int**>(div2.quot)) *
asType<**int**>($\$\text{heap}_{719,1;729,8}$.b2))))

→ *[from term 12.6, div2 is equal to* **heapIs** *$\$\text{heap}_{funcstart\_719,1}$,*
$\$\text{heap}_{funcstart\_719,1}$.p2, 176)]

[31.12] $\$\text{heap}_{719,1;730,8}$ == $\$\text{heap}_{funcstart\_719,1}$._**replace**(p1 → ((-2 *
div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}$.p1,
177).rem)))._**replace**(p2 → **asType**<**short int**>((172 * div(**heapIs**
$\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}$.p2, 176).rem) −
(**asType**<**int**>(**asType**<**short int**>(div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$,
$\$\text{heap}_{funcstart\_719,1}$.p2, 176).quot)) * **asType**<**int**>($\$\text{heap}_{719,1;729,8}$.b2))))

→ *[simplify]*

[31.14] $\$\text{heap}_{719,1;730,8}$ == $\$\text{heap}_{funcstart\_719,1}$._**replace**(p1 → ((-2 *
div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}$.p1,
177).rem)))._**replace**(p2 → **asType**<**short int**>((172 * div(**heapIs**
$\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}$.p2, 176).rem) − (div(**heapIs**
$\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}$.p2, 176).quot *
asType<**int**>($\$\text{heap}_{719,1;729,8}$.b2))))

→ *[from term 26.19, $\$\text{heap}_{719,1;729,8}$ is equal to*
*$\$\text{heap}_{funcstart\_719,1}$._**replace**(p1 → (-2 * div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$,*
*$\$\text{heap}_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$,*
$\$\text{heap}_{funcstart\_719,1}$.p1, 177).rem))]

[31.15] $\$\text{heap}_{719,1;730,8}$ == $\$\text{heap}_{funcstart\_719,1}$._**replace**(p1 → ((-2 *
div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}$.p1,
177).rem)))._**replace**(p2 → **asType**<**short int**>((172 * div(**heapIs**
$\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}$.p2, 176).rem) − (div(**heapIs**
$\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}$.p2, 176).quot *
asType<**int**>($\$\text{heap}_{funcstart\_719,1}$._**replace**(p1 → ((-2 * div(**heapIs**
$\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs**
$\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}$.p1, 177).rem))).b2))))

→ *[const member of object with modified fields]*

[31.16] $\$\text{heap}_{719,1;730,8}$ == $\$\text{heap}_{funcstart\_719,1}$._**replace**(p1 → ((-2 *
div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}$.p1,
177).rem)))._**replace**(p2 → **asType**<**short int**>((172 * div(**heapIs**
$\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}$.p2, 176).rem) − (div(**heapIs**
$\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}$.p2, 176).quot *
asType<**int**>($\$\text{heap}_{funcstart\_719,1}$.b2))))

→ *[const static or extern object]*

[31.17] $heap_{719,1;730,8}$ == $heap_{funcstart\_719,1}$.__replace__(p1 → ((-2 *
div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p1, 177).quot) + (171 *
div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p1,
177).rem))).__replace__(p2 → **asType<short int>**((172 * div(**heapIs**
$heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p2, 176).rem) − (div(**heapIs**
$heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p2, 176).quot *
asType<int>($heap_{init}$.b2))))

→ *[expand definition of constant 'b2' at prang.c (22,20)]*

[31.18] $heap_{719,1;730,8}$ == $heap_{funcstart\_719,1}$.__replace__(p1 → ((-2 *
div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p1, 177).quot) + (171 *
div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p1,
177).rem))).__replace__(p2 → **asType<short int>**((172 * div(**heapIs**
$heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p2, 176).rem) − (div(**heapIs**
$heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p2, 176).quot *
asType<int>(**asType<short int>**((**int**)35)))))

→ *[simplify]*

[31.24] $heap_{719,1;730,8}$ == $heap_{funcstart\_719,1}$.__replace__(p1 → ((-2 *
div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p1, 177).quot) + (171 *
div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p1,
177).rem))).__replace__(p2 → ((-35 * div(**heapIs** $heap_{funcstart\_719,1}$,
$heap_{funcstart\_719,1}$.p2, 176).quot) + (172 * div(**heapIs** $heap_{funcstart\_719,1}$,
$heap_{funcstart\_719,1}$.p2, 176).rem)))

[Take goal term]

[1.0] (**asType<int>**(**asType<short int>**(div3.rem)) *
asType<int>($heap_{719,1;730,8}$.r3)) ≤ **maxof(int)**

→ *[from term 19.6, div3 is equal to div(**heapIs** $heap_{funcstart\_719,1}$,
$heap_{funcstart\_719,1}$.p3, 178)]*

[1.1] (**asType<int>**(**asType<short int>**(div(**heapIs** $heap_{funcstart\_719,1}$,
$heap_{funcstart\_719,1}$.p3, 178).rem)) * **asType<int>**($heap_{719,1;730,8}$.r3)) ≤
maxof(int)

→ *[simplify]*

[1.3] (div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p3, 178).rem *
asType<int>($heap_{719,1;730,8}$.r3)) ≤ **maxof(int)**

→ *[from term 31.24, $heap_{719,1;730,8}$ is equal to
$heap_{funcstart\_719,1}$.__replace__(p1 → ((-2 * div(**heapIs** $heap_{funcstart\_719,1}$,
$heap_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs** $heap_{funcstart\_719,1}$,
$heap_{funcstart\_719,1}$.p1, 177).rem))).__replace__(p2 → (-35 * div(**heapIs**
$heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p2, 176).quot) + (172 * div(**heapIs**
$heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p2, 176).rem))]*

[1.4] (div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p3, 178).rem *
asType<int>($heap_{funcstart\_719,1}$.__replace__(p1 → ((-2 * div(**heapIs**

$heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p1, 177).rem)))._**replace**(p2 → ((-35 * div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p2, 176).quot) + (172 * div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p2, 176).rem))).r3)) ≤ **maxof**(**int**)

→ *[const member of object with modified fields]*

[1.6] (div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p3, 178).rem * **asType**<**int**>($heap_{funcstart\_719,1}$.r3)) ≤ **maxof**(**int**)

→ *[const static or extern object]*

[1.7] (div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p3, 178).rem * **asType**<**int**>($heap_{init}$.r3)) ≤ **maxof**(**int**)

→ *[expand definition of constant 'r3' at prang.c (25,20)]*

[1.8] (div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p3, 178).rem * **asType**<**int**>(**asType**<**short int**>((**int**)170))) ≤ **maxof**(**int**)

→ *[simplify]*

[1.21] -32768 < (-170 * div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p3, 178).rem)

→ *[literal comparison of product]*

[1.22] ([-170 < 0]: (-32768 / 170) < −div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p3, 178).rem, [0 < -170]: (-32768 / -170) < div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p3, 178).rem, [-170 == 0]: -32768 < 0)

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

[1.23] ([-170 < 0]: (-32768 / 170) < −div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p3, 178).rem, [(0 < -170) ∧ !(-170 < 0)]: (-32768 / -170) < div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p3, 178).rem, [(-170 == 0) ∧ !(-170 < 0) ∧ !(0 < -170)]: -32768 < 0)

→ *[simplify]*

[1.27] -193 < −div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p3, 178).rem

→ *[negate goal and search for contradiction]*

[1.28] !(-193 < −div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p3, 178).rem)

→ *[simplify]*

[1.31] 192 < div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p3, 178).rem

[Assume known post-assertion, class invariant or type constraint for term 19.6]

[25.0] (**asType**<**integer**>($heap_{funcstart\_719,1}$.p3) %

asType<**integer**>(178)) == **asType**<**integer**>(div(**heapIs**
$\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p3, 178).rem)

$\rightarrow$ *[simplify]*

[25.2] ($\$heap_{funcstart\_719,1}$.p3 % 178) == **asType**<**integer**>(div(**heapIs**
$\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p3, 178).rem)

$\rightarrow$ *[expand definition of operator '.%' in class 'int' at built in declaration]*

[25.3] ([**asType**<**integer**>($\$heap_{funcstart\_719,1}$.p3) < 0]:
$-(-$**asType**<**integer**>($\$heap_{funcstart\_719,1}$.p3) % 178), []:
asType<**integer**>($\$heap_{funcstart\_719,1}$.p3) % 178) ==
asType<**integer**>(div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p3,
178).rem)

$\rightarrow$ *[explicitly assert falsehood of skipped guards in subsequent guards]*

[25.4] ([**asType**<**integer**>($\$heap_{funcstart\_719,1}$.p3) < 0]:
$-(-$**asType**<**integer**>($\$heap_{funcstart\_719,1}$.p3) % 178),
[!(**asType**<**integer**>($\$heap_{funcstart\_719,1}$.p3) < 0)]:
asType<**integer**>($\$heap_{funcstart\_719,1}$.p3) % 178) ==
asType<**integer**>(div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p3,
178).rem)

$\rightarrow$ *[simplify]*

[25.14] ([0 < $-\$heap_{funcstart\_719,1}$.p3]: $-(-\$heap_{funcstart\_719,1}$.p3 % 178), [-1
< $\$heap_{funcstart\_719,1}$.p3]: **asType**<**integer**>($\$heap_{funcstart\_719,1}$.p3) % 178)
== **asType**<**integer**>(div(**heapIs** $\$heap_{funcstart\_719,1}$,
$\$heap_{funcstart\_719,1}$.p3, 178).rem)

$\rightarrow$ *[remainder of negation]*

[25.15] ([0 < $-\$heap_{funcstart\_719,1}$.p3]: $-([0 == (\$heap_{funcstart\_719,1}$.p3 %
178)]: 0, []: 178 + $-(\$heap_{funcstart\_719,1}$.p3 % 178)), [-1 <
$\$heap_{funcstart\_719,1}$.p3]: **asType**<**integer**>($\$heap_{funcstart\_719,1}$.p3) % 178)
== **asType**<**integer**>(div(**heapIs** $\$heap_{funcstart\_719,1}$,
$\$heap_{funcstart\_719,1}$.p3, 178).rem)

$\rightarrow$ *[explicitly assert falsehood of skipped guards in subsequent guards]*

[25.16] ([0 < $-\$heap_{funcstart\_719,1}$.p3]: $-([0 == (\$heap_{funcstart\_719,1}$.p3 %
178)]: 0, [!(0 == ($\$heap_{funcstart\_719,1}$.p3 % 178))]: 178 +
$-(\$heap_{funcstart\_719,1}$.p3 % 178)), [-1 < $\$heap_{funcstart\_719,1}$.p3]:
asType<**integer**>($\$heap_{funcstart\_719,1}$.p3) % 178) ==
asType<**integer**>(div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p3,
178).rem)

$\rightarrow$ *[move guard outside expression]*

[25.17] ([0 < $-\$heap_{funcstart\_719,1}$.p3]: ([0 == ($\$heap_{funcstart\_719,1}$.p3 %
178)]: -0, [!(0 == ($\$heap_{funcstart\_719,1}$.p3 % 178))]: $-(178 +$
$-(\$heap_{funcstart\_719,1}$.p3 % 178))), [-1 < $\$heap_{funcstart\_719,1}$.p3]:

asType<integer>($\text{heap}_{funcstart\_719,1}.\text{p3}$) % 178) ==
asType<integer>(div(**heapIs** $\text{heap}_{funcstart\_719,1}$, $\text{heap}_{funcstart\_719,1}.\text{p3}$, 178).rem)

$\rightarrow$ *[simplify]*

[25.24] 0 == ($-$([0 < $-\text{heap}_{funcstart\_719,1}.\text{p3}$]: ([0 == ($\text{heap}_{funcstart\_719,1}.\text{p3}$ % 178)]: 0, [!(0 == ($\text{heap}_{funcstart\_719,1}.\text{p3}$ % 178))]: -178 + ($\text{heap}_{funcstart\_719,1}.\text{p3}$ % 178)), [-1 < $\text{heap}_{funcstart\_719,1}.\text{p3}$]: $\text{heap}_{funcstart\_719,1}.\text{p3}$ % 178) + div(**heapIs** $\text{heap}_{funcstart\_719,1}$, $\text{heap}_{funcstart\_719,1}.\text{p3}$, 178).rem)

$\rightarrow$ *[move guard outside expression]*

[25.26] 0 == (([0 < $-\text{heap}_{funcstart\_719,1}.\text{p3}$]: ([0 == ($\text{heap}_{funcstart\_719,1}.\text{p3}$ % 178)]: $-$0, [!(0 == ($\text{heap}_{funcstart_719,1}.\text{p3}$ % 178))]: $-$(-178 + ($\text{heap}_{funcstart\_719,1}.\text{p3}$ % 178))), [-1 < $\text{heap}_{funcstart\_719,1}.\text{p3}$]: $-$($\text{heap}_{funcstart\_719,1}.\text{p3}$ % 178)) + div(**heapIs** $\text{heap}_{funcstart\_719,1}$, $\text{heap}_{funcstart\_719,1}.\text{p3}$, 178).rem)

$\rightarrow$ *[simplify]*

[25.29] 0 == (([0 < $-\text{heap}_{funcstart\_719,1}.\text{p3}$]: ([0 == ($\text{heap}_{funcstart\_719,1}.\text{p3}$ % 178)]: 0, [!(0 == ($\text{heap}_{funcstart\_719,1}.\text{p3}$ % 178))]: 178 + $-$($\text{heap}_{funcstart\_719,1}.\text{p3}$ % 178)), [-1 < $\text{heap}_{funcstart\_719,1}.\text{p3}$]: $-$($\text{heap}_{funcstart\_719,1}.\text{p3}$ % 178)) + div(**heapIs** $\text{heap}_{funcstart\_719,1}$, $\text{heap}_{funcstart\_719,1}.\text{p3}$, 178).rem)

$\rightarrow$ *[move guard outside expression]*

[25.31] 0 == ([0 < $-\text{heap}_{funcstart\_719,1}.\text{p3}$]: ([0 == ($\text{heap}_{funcstart\_719,1}.\text{p3}$ % 178)]: 0 + div(**heapIs** $\text{heap}_{funcstart\_719,1}$, $\text{heap}_{funcstart\_719,1}.\text{p3}$, 178).rem, [!(0 == ($\text{heap}_{funcstart\_719,1}.\text{p3}$ % 178))]: (178 + $-$($\text{heap}_{funcstart\_719,1}.\text{p3}$ % 178)) + div(**heapIs** $\text{heap}_{funcstart\_719,1}$, $\text{heap}_{funcstart\_719,1}.\text{p3}$, 178).rem), [-1 < $\text{heap}_{funcstart\_719,1}.\text{p3}$]: $-$($\text{heap}_{funcstart\_719,1}.\text{p3}$ % 178) + div(**heapIs** $\text{heap}_{funcstart\_719,1}$, $\text{heap}_{funcstart\_719,1}.\text{p3}$, 178).rem)

$\rightarrow$ *[simplify]*

[25.33] 0 == ([0 < $-\text{heap}_{funcstart\_719,1}.\text{p3}$]: ([0 == ($\text{heap}_{funcstart\_719,1}.\text{p3}$ % 178)]: div(**heapIs** $\text{heap}_{funcstart\_719,1}$, $\text{heap}_{funcstart\_719,1}.\text{p3}$, 178).rem, [!(0 == ($\text{heap}_{funcstart\_719,1}.\text{p3}$ % 178))]: 178 + $-$($\text{heap}_{funcstart\_719,1}.\text{p3}$ % 178) + div(**heapIs** $\text{heap}_{funcstart\_719,1}$, $\text{heap}_{funcstart\_719,1}.\text{p3}$, 178).rem), [-1 < $\text{heap}_{funcstart\_719,1}.\text{p3}$]: $-$($\text{heap}_{funcstart\_719,1}.\text{p3}$ % 178) + div(**heapIs** $\text{heap}_{funcstart\_719,1}$, $\text{heap}_{funcstart\_719,1}.\text{p3}$, 178).rem)

$\rightarrow$ *[move guard outside expression]*

[25.35] ([0 < $-\text{heap}_{funcstart\_719,1}.\text{p3}$]: ([0 == ($\text{heap}_{funcstart\_719,1}.\text{p3}$ % 178)]: 0 == div(**heapIs** $\text{heap}_{funcstart\_719,1}$, $\text{heap}_{funcstart\_719,1}.\text{p3}$, 178).rem, [!(0 == ($\text{heap}_{funcstart\_719,1}.\text{p3}$ % 178))]: 0 == (178 + $-$($\text{heap}_{funcstart\_719,1}.\text{p3}$ % 178) + div(**heapIs** $\text{heap}_{funcstart\_719,1}$, $\text{heap}_{funcstart\_719,1}.\text{p3}$, 178).rem)), [-1 < $\text{heap}_{funcstart\_719,1}.\text{p3}$]: 0 == ($-$($\text{heap}_{funcstart\_719,1}.\text{p3}$ % 178) +

div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p3, 178).rem))

→ *[simplify]*

[25.40] ([0 < −$\$heap_{funcstart\_719,1}$.p3]: ([0 == ($\$heap_{funcstart\_719,1}$.p3 % 178)]: 0 == div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p3, 178).rem, [!(0 == ($\$heap_{funcstart\_719,1}$.p3 % 178))]: 178 == (($\$heap_{funcstart\_719,1}$.p3 % 178) + −div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p3, 178).rem)), [-1 < $\$heap_{funcstart\_719,1}$.p3]: 0 == (−($\$heap_{funcstart\_719,1}$.p3 % 178) + div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p3, 178).rem))

→ *[from term 1.31, div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p3, 178).rem == literala is false whenever (-1 + literala) < 192]*

Proof of rule precondition:

[25.40.0] (-1 + 0) < 192

→ *[simplify]*

[25.40.2] **true**

[25.41] ([0 < −$\$heap_{funcstart\_719,1}$.p3]: ([0 == ($\$heap_{funcstart\_719,1}$.p3 % 178)]: **false**, [!(0 == ($\$heap_{funcstart\_719,1}$.p3 % 178))]: 178 == (−div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p3, 178).rem + ($\$heap_{funcstart\_719,1}$.p3 % 178))), [-1 < $\$heap_{funcstart\_719,1}$.p3]: 0 == (−($\$heap_{funcstart\_719,1}$.p3 % 178) + div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p3, 178).rem))

→ *[remainder is less than divisor]*

Proof of rule precondition:

[25.41.0] (178 + −div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p3, 178).rem) ≤ 178

→ *[simplify]*

[25.41.11] -1 < div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p3, 178).rem

→ *[from term 1.31, literala < div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p3, 178).rem is true whenever (-1 + literala) < 192]*

Proof of rule precondition:

[25.41.11.0] (-1 + -1) < 192

→ *[simplify]*

[25.41.11.2] **true**

[25.41.12] **true**

[25.42] ([0 < −$\$heap_{funcstart\_719,1}$.p3]: ([0 == ($\$heap_{funcstart\_719,1}$.p3 % 178)]: **false**, [!(0 == ($\$heap_{funcstart\_719,1}$.p3 % 178))]: **false**), [-1 < $\$heap_{funcstart\_719,1}$.p3]: 0 == (−($\$heap_{funcstart\_719,1}$.p3 % 178) + div(**heapIs**

$\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}$.p3, 178).rem))

$\rightarrow$ *[all guards have equal guarded terms]*

[25.43] ([0 < $-\$\text{heap}_{funcstart\_719,1}$.p3]: **false**, [-1 < $\$\text{heap}_{funcstart\_719,1}$.p3]: 0 == ($-(\$\text{heap}_{funcstart\_719,1}$.p3 % 178) + div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}$.p3, 178).rem))

$\rightarrow$ *[remainder is less than divisor]*

Proof of rule precondition:

[25.43.0] (0 + 178) $\leq$ div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}$.p3, 178).rem

$\rightarrow$ *[simplify]*

[25.43.3] 177 < div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}$.p3, 178).rem

$\rightarrow$ *[from term 1.31, literala < div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}$.p3, 178).rem is true whenever (-1 + literala) < 192]*

Proof of rule precondition:

[25.43.3.0] (-1 + 177) < 192

$\rightarrow$ *[simplify]*

[25.43.3.2] **true**

[25.43.4] **true**

[25.44] ([0 < $-\$\text{heap}_{funcstart\_719,1}$.p3]: **false**, [-1 < $\$\text{heap}_{funcstart\_719,1}$.p3]: **false**)

$\rightarrow$ *[all guards have equal guarded terms]*

[25.45] **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 (49,40)

Condition defined at:

To prove: minof(short int) $\leq$ div3.quot

Given:

$\$\text{heap}_{init}$.LIMIT == (**int**)80

$\$\text{heap}_{init}$.M1 == **asType**<**short int**>((**int**)30269)

$\$\text{heap}_{init}$.r1 == **asType**<**short int**>((**int**)171)

$\$\text{heap}_{init}$.a1 == **asType**<**short int**>((**int**)177)

$\$\text{heap}_{init}$.b1 == **asType**<**short int**>((**int**)2)

$\$heap_{init}.M2 == \textbf{asType}\textbf{<short int>}((\textbf{int})30307)$

$\$heap_{init}.r2 == \textbf{asType}\textbf{<short int>}((\textbf{int})172)$

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

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

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

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

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

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

$\$heap_{init}.p1 == \textbf{asType}\textbf{<short int>}((\textbf{int})1)$

$\$heap_{init}.p2 == \textbf{asType}\textbf{<short int>}((\textbf{int})2)$

$\$heap_{init}.p3 == \textbf{asType}\textbf{<short int>}((\textbf{int})3)$

div1 == div(**heapIs** $\$heap_{funcstart\_719,1}$,
asType\<int\>($\$heap_{funcstart\_719,1}$.p1),
asType\<int\>($\$heap_{funcstart\_719,1}$.a1))

(**asType\<integer\>**(**asType\<int\>**($\$heap_{funcstart\_719,1}$.p1)) /
asType\<integer\>(**asType\<int\>**($\$heap_{funcstart\_719,1}$.a1))) ==
asType\<integer\>(div1.quot)

(**asType\<integer\>**(**asType\<int\>**($\$heap_{funcstart\_719,1}$.p1)) %
asType\<integer\>(**asType\<int\>**($\$heap_{funcstart\_719,1}$.a1))) ==
asType\<integer\>(div1.rem)

div2 == div(**heapIs** $\$heap_{funcstart\_719,1}$,
asType\<int\>($\$heap_{funcstart\_719,1}$.p2),
asType\<int\>($\$heap_{funcstart\_719,1}$.a2))

(**asType\<integer\>**(**asType\<int\>**($\$heap_{funcstart\_719,1}$.p2)) /
asType\<integer\>(**asType\<int\>**($\$heap_{funcstart\_719,1}$.a2))) ==
asType\<integer\>(div2.quot)

(**asType\<integer\>**(**asType\<int\>**($\$heap_{funcstart\_719,1}$.p2)) %
asType\<integer\>(**asType\<int\>**($\$heap_{funcstart\_719,1}$.a2))) ==
asType\<integer\>(div2.rem)

div3 == div(**heapIs** $\$heap_{funcstart\_719,1}$,
asType\<int\>($\$heap_{funcstart\_719,1}$.p3),
asType\<int\>($\$heap_{funcstart\_719,1}$.a3))

(**asType\<integer\>**(**asType\<int\>**($\$heap_{funcstart\_719,1}$.p3)) /
asType\<integer\>(**asType\<int\>**($\$heap_{funcstart\_719,1}$.a3))) ==
asType\<integer\>(div3.quot)

(**asType\<integer\>**(**asType\<int\>**($\$heap_{funcstart\_719,1}$.p3)) %
asType\<integer\>(**asType\<int\>**($\$heap_{funcstart\_719,1}$.a3))) ==
asType\<integer\>(div3.rem)

$\text{\$heap}_{719,1;729,8} == \text{\$heap}_{funcstart\_719,1}.\textbf{\_replace}(p1 \rightarrow \textbf{asType<short}$
$\textbf{int>}((\textbf{asType<int>}(\textbf{asType<short int>}(\text{div1.rem})) *$
$\textbf{asType<int>}(\text{\$heap}_{funcstart\_719,1}.\text{r1})) - (\textbf{asType<int>}(\textbf{asType<short}$
$\textbf{int>}(\text{div1.quot})) * \textbf{asType<int>}(\text{\$heap}_{funcstart\_719,1}.\text{b1}))))$

$\text{\$heap}_{719,1;730,8} == \text{\$heap}_{719,1;729,8}.\textbf{\_replace}(p2 \rightarrow \textbf{asType<short}$
$\textbf{int>}((\textbf{asType<int>}(\textbf{asType<short int>}(\text{div2.rem})) *$
$\textbf{asType<int>}(\text{\$heap}_{719,1;729,8}.\text{r2})) - (\textbf{asType<int>}(\textbf{asType<short}$
$\textbf{int>}(\text{div2.quot})) * \textbf{asType<int>}(\text{\$heap}_{719,1;729,8}.\text{b2}))))$

Proof:

[Take given term]

[19.0] div3 == div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$,
$\textbf{asType<int>}(\text{\$heap}_{funcstart\_719,1}.\text{p3})$,
$\textbf{asType<int>}(\text{\$heap}_{funcstart\_719,1}.\text{a3}))$

$\rightarrow$ *[simplify]*

[19.1] div3 == div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}.\text{p3}$,
$\textbf{asType<int>}(\text{\$heap}_{funcstart\_719,1}.\text{a3}))$

$\rightarrow$ *[const static or extern object]*

[19.2] div3 == div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}.\text{p3}$,
$\textbf{asType<int>}(\text{\$heap}_{init}.\text{a3}))$

$\rightarrow$ *[expand definition of constant 'a3' at prang.c (26,20)]*

[19.3] div3 == div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}.\text{p3}$,
$\textbf{asType<int>}(\textbf{asType<short int>}((\textbf{int})178)))$

$\rightarrow$ *[simplify]*

[19.6] div3 == div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}.\text{p3}$, 178)

[Take goal term]

[1.0] **minof**(**short int**) $\leq$ div3.quot

$\rightarrow$ *[simplify]*

[1.1] -32768 $\leq$ div3.quot

$\rightarrow$ *[from term 19.6, div3 is equal to div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$,
$\text{\$heap}_{funcstart\_719,1}.\text{p3}$, 178)]*

[1.2] -32768 $\leq$ div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}.\text{p3}$,
178).quot

$\rightarrow$ *[simplify]*

[1.4] -32769 $<$ div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}.\text{p3}$,
178).quot

$\rightarrow$ *[negate goal and search for contradiction]*

[1.5] !(-32769 < div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p3, 178).quot)

→ *[simplify]*

[1.7] 32768 < −div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p3, 178).quot

[Assume known post-assertion, class invariant or type constraint for term 1.7]

[36.0] **minof(int)** ≤ div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p3, 178).quot

→ *[simplify]*

[36.3] -32769 < div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p3, 178).quot

→ *[from term 1.7, literala < div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p3, 178).quot is false whenever -2 < (32768 + literala)]*

Proof of rule precondition:

[36.3.0] -2 < (-32769 + 32768)

→ *[simplify]*

[36.3.2] **true**

[36.4] **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 (49,40)

Condition defined at:

To prove: div3.quot ≤ **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)

$\$heap_{init}$.M2 == **asType<short int>**((**int**)30307)

$\$heap_{init}$.r2 == **asType<short int>**((**int**)172)

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

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

$\$\text{heap}_{init}.\text{M3} == \textbf{asType}\textbf{<short int>}((\textbf{int})30323)$

$\$\text{heap}_{init}.\text{r3} == \textbf{asType}\textbf{<short int>}((\textbf{int})170)$

$\$\text{heap}_{init}.\text{a3} == \textbf{asType}\textbf{<short int>}((\textbf{int})178)$

$\$\text{heap}_{init}.\text{b3} == \textbf{asType}\textbf{<short int>}((\textbf{int})63)$

$\$\text{heap}_{init}.\text{p1} == \textbf{asType}\textbf{<short int>}((\textbf{int})1)$

$\$\text{heap}_{init}.\text{p2} == \textbf{asType}\textbf{<short int>}((\textbf{int})2)$

$\$\text{heap}_{init}.\text{p3} == \textbf{asType}\textbf{<short int>}((\textbf{int})3)$

$\text{div1} == \text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_719,1},$
$\textbf{asType}\textbf{<int>}(\$\text{heap}_{funcstart\_719,1}.\text{p1}),$
$\textbf{asType}\textbf{<int>}(\$\text{heap}_{funcstart\_719,1}.\text{a1}))$

$(\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<int>}(\$\text{heap}_{funcstart\_719,1}.\text{p1})) \;/$
$\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<int>}(\$\text{heap}_{funcstart\_719,1}.\text{a1}))) ==$
$\textbf{asType}\textbf{<integer>}(\text{div1.quot})$

$(\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<int>}(\$\text{heap}_{funcstart\_719,1}.\text{p1})) \;\%$
$\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<int>}(\$\text{heap}_{funcstart\_719,1}.\text{a1}))) ==$
$\textbf{asType}\textbf{<integer>}(\text{div1.rem})$

$\text{div2} == \text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_719,1},$
$\textbf{asType}\textbf{<int>}(\$\text{heap}_{funcstart\_719,1}.\text{p2}),$
$\textbf{asType}\textbf{<int>}(\$\text{heap}_{funcstart\_719,1}.\text{a2}))$

$(\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<int>}(\$\text{heap}_{funcstart\_719,1}.\text{p2})) \;/$
$\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<int>}(\$\text{heap}_{funcstart\_719,1}.\text{a2}))) ==$
$\textbf{asType}\textbf{<integer>}(\text{div2.quot})$

$(\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<int>}(\$\text{heap}_{funcstart\_719,1}.\text{p2})) \;\%$
$\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<int>}(\$\text{heap}_{funcstart\_719,1}.\text{a2}))) ==$
$\textbf{asType}\textbf{<integer>}(\text{div2.rem})$

$\text{div3} == \text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_719,1},$
$\textbf{asType}\textbf{<int>}(\$\text{heap}_{funcstart\_719,1}.\text{p3}),$
$\textbf{asType}\textbf{<int>}(\$\text{heap}_{funcstart\_719,1}.\text{a3}))$

$(\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<int>}(\$\text{heap}_{funcstart\_719,1}.\text{p3})) \;/$
$\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<int>}(\$\text{heap}_{funcstart\_719,1}.\text{a3}))) ==$
$\textbf{asType}\textbf{<integer>}(\text{div3.quot})$

$(\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<int>}(\$\text{heap}_{funcstart\_719,1}.\text{p3})) \;\%$
$\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<int>}(\$\text{heap}_{funcstart\_719,1}.\text{a3}))) ==$
$\textbf{asType}\textbf{<integer>}(\text{div3.rem})$

$\$\text{heap}_{719,1;729,8} == \$\text{heap}_{funcstart\_719,1}.\textbf{replace}(\text{p1} \to \textbf{asType}\textbf{<short}$
$\textbf{int>}((\textbf{asType}\textbf{<int>}(\textbf{asType}\textbf{<short int>}(\text{div1.rem})) \;^*$
$\textbf{asType}\textbf{<int>}(\$\text{heap}_{funcstart\_719,1}.\text{r1})) - (\textbf{asType}\textbf{<int>}(\textbf{asType}\textbf{<short}$
$\textbf{int>}(\text{div1.quot})) \;^* \textbf{asType}\textbf{<int>}(\$\text{heap}_{funcstart\_719,1}.\text{b1}))))$

$\text{\$heap}_{719,1;730,8} == \text{\$heap}_{719,1;729,8}.\_\textbf{replace}(p2 \rightarrow \textbf{asType}\textbf{<short int>}((\textbf{asType}\textbf{<int>}(\textbf{asType}\textbf{<short int>}(\text{div2.rem})) * \textbf{asType}\textbf{<int>}(\text{\$heap}_{719,1;729,8}.\text{r2})) - (\textbf{asType}\textbf{<int>}(\textbf{asType}\textbf{<short int>}(\text{div2.quot})) * \textbf{asType}\textbf{<int>}(\text{\$heap}_{719,1;729,8}.\text{b2}))))$

Proof:

[Take given term]

[19.0] div3 == div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, **asType<int>**($\text{\$heap}_{funcstart\_719,1}.$p3), **asType<int>**($\text{\$heap}_{funcstart\_719,1}.$a3))

$\rightarrow$ *[simplify]*

[19.1] div3 == div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}.$p3, **asType<int>**($\text{\$heap}_{funcstart\_719,1}.$a3))

$\rightarrow$ *[const static or extern object]*

[19.2] div3 == div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}.$p3, **asType<int>**($\text{\$heap}_{init}.$a3))

$\rightarrow$ *[expand definition of constant 'a3' at prang.c (26,20)]*

[19.3] div3 == div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}.$p3, **asType<int>**(**asType<short int>**((**int**)178)))

$\rightarrow$ *[simplify]*

[19.6] div3 == div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}.$p3, 178)

[Take goal term]

[1.0] div3.quot $\leq$ **maxof(short int)**

$\rightarrow$ *[from term 19.6, div3 is equal to div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}.$p3, 178)]*

[1.1] div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}.$p3, 178).quot $\leq$ **maxof(short int)**

$\rightarrow$ *[simplify]*

[1.10] -32768 $< -$div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}.$p3, 178).quot

$\rightarrow$ *[negate goal and search for contradiction]*

[1.11] !(-32768 $< -$div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}.$p3, 178).quot)

$\rightarrow$ *[simplify]*

[1.14] 32767 $<$ div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}.$p3, 178).quot

[Assume known post-assertion, class invariant or type constraint for term 1.14]

[36.0] div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p3, 178).quot $\leq$ **maxof(int)**

$\rightarrow$ *[simplify]*

[36.9] -32768 < $-$div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p3, 178).quot

$\rightarrow$ *[from term 1.14, literala $< -$div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p3, 178).quot is false whenever -2 < (32767 + literala)]*

   Proof of rule precondition:

   [36.9.0] -2 < (-32768 + 32767)

   $\rightarrow$ *[simplify]*

   [36.9.2] **true**

[36.10] **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 (49,40)

Condition defined at:

To prove: minof(int) $\leq$ **asType<short int>**(div3.quot)

Given:

$\text{\$heap}_{init}$.LIMIT == (**int**)80

$\text{\$heap}_{init}$.M1 == **asType<short int>**((**int**)30269)

$\text{\$heap}_{init}$.r1 == **asType<short int>**((**int**)171)

$\text{\$heap}_{init}$.a1 == **asType<short int>**((**int**)177)

$\text{\$heap}_{init}$.b1 == **asType<short int>**((**int**)2)

$\text{\$heap}_{init}$.M2 == **asType<short int>**((**int**)30307)

$\text{\$heap}_{init}$.r2 == **asType<short int>**((**int**)172)

$\text{\$heap}_{init}$.a2 == **asType<short int>**((**int**)176)

$\text{\$heap}_{init}$.b2 == **asType<short int>**((**int**)35)

$\text{\$heap}_{init}$.M3 == **asType<short int>**((**int**)30323)

$\text{\$heap}_{init}$.r3 == **asType<short int>**((**int**)170)

$\text{\$heap}_{init}$.a3 == **asType<short int>**((**int**)178)

$\text{\$heap}_{init}$.b3 == **asType<short int>**((**int**)63)

$\text{\$heap}_{init}$.p1 == **asType<short int>**((**int**)1)

$\text{\$heap}_{init}$.p2 == **asType<short int>**((**int**)2)

$\text{\$heap}_{init}.\text{p3} == \textbf{asType}\textbf{<short int>}((\textbf{int})3)$

$\text{div1} == \text{div}(\textbf{heapIs } \text{\$heap}_{funcstart\_719,1},$
$\textbf{asType}\textbf{<int>}(\text{\$heap}_{funcstart\_719,1}.\text{p1}),$
$\textbf{asType}\textbf{<int>}(\text{\$heap}_{funcstart\_719,1}.\text{a1}))$

$(\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<int>}(\text{\$heap}_{funcstart_719,1}.\text{p1})) \, / $
$\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<int>}(\text{\$heap}_{funcstart_719,1}.\text{a1}))) == $
$\textbf{asType}\textbf{<integer>}(\text{div1.quot})$

$(\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<int>}(\text{\$heap}_{funcstart_719,1}.\text{p1})) \, \% $
$\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<int>}(\text{\$heap}_{funcstart_719,1}.\text{a1}))) == $
$\textbf{asType}\textbf{<integer>}(\text{div1.rem})$

$\text{div2} == \text{div}(\textbf{heapIs } \text{\$heap}_{funcstart\_719,1},$
$\textbf{asType}\textbf{<int>}(\text{\$heap}_{funcstart\_719,1}.\text{p2}),$
$\textbf{asType}\textbf{<int>}(\text{\$heap}_{funcstart\_719,1}.\text{a2}))$

$(\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<int>}(\text{\$heap}_{funcstart_719,1}.\text{p2})) \, / $
$\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<int>}(\text{\$heap}_{funcstart_719,1}.\text{a2}))) == $
$\textbf{asType}\textbf{<integer>}(\text{div2.quot})$

$(\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<int>}(\text{\$heap}_{funcstart_719,1}.\text{p2})) \, \% $
$\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<int>}(\text{\$heap}_{funcstart_719,1}.\text{a2}))) == $
$\textbf{asType}\textbf{<integer>}(\text{div2.rem})$

$\text{div3} == \text{div}(\textbf{heapIs } \text{\$heap}_{funcstart\_719,1},$
$\textbf{asType}\textbf{<int>}(\text{\$heap}_{funcstart\_719,1}.\text{p3}),$
$\textbf{asType}\textbf{<int>}(\text{\$heap}_{funcstart\_719,1}.\text{a3}))$

$(\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<int>}(\text{\$heap}_{funcstart_719,1}.\text{p3})) \, / $
$\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<int>}(\text{\$heap}_{funcstart_719,1}.\text{a3}))) == $
$\textbf{asType}\textbf{<integer>}(\text{div3.quot})$

$(\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<int>}(\text{\$heap}_{funcstart_719,1}.\text{p3})) \, \% $
$\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<int>}(\text{\$heap}_{funcstart_719,1}.\text{a3}))) == $
$\textbf{asType}\textbf{<integer>}(\text{div3.rem})$

$\text{\$heap}_{719,1;729,8} == \text{\$heap}_{funcstart\_719,1}.\_\textbf{replace}(\text{p1} \rightarrow \textbf{asType}\textbf{<short}$
$\textbf{int>}((\textbf{asType}\textbf{<int>}(\textbf{asType}\textbf{<short int>}(\text{div1.rem})) \, * $
$\textbf{asType}\textbf{<int>}(\text{\$heap}_{funcstart\_719,1}.\text{r1})) - (\textbf{asType}\textbf{<int>}(\textbf{asType}\textbf{<short}$
$\textbf{int>}(\text{div1.quot})) \, * \, \textbf{asType}\textbf{<int>}(\text{\$heap}_{funcstart\_719,1}.\text{b1}))))$

$\text{\$heap}_{719,1;730,8} == \text{\$heap}_{719,1;729,8}.\_\textbf{replace}(\text{p2} \rightarrow \textbf{asType}\textbf{<short}$
$\textbf{int>}((\textbf{asType}\textbf{<int>}(\textbf{asType}\textbf{<short int>}(\text{div2.rem})) \, * $
$\textbf{asType}\textbf{<int>}(\text{\$heap}_{719,1;729,8}.\text{r2})) - (\textbf{asType}\textbf{<int>}(\textbf{asType}\textbf{<short}$
$\textbf{int>}(\text{div2.quot})) \, * \, \textbf{asType}\textbf{<int>}(\text{\$heap}_{719,1;729,8}.\text{b2}))))$

Proof:

[Take given term]

[19.0] $\text{div3} == \text{div}(\textbf{heapIs } \text{\$heap}_{funcstart\_719,1},$
$\textbf{asType}\textbf{<int>}(\text{\$heap}_{funcstart\_719,1}.\text{p3}),$

asType<**int**>($heap$_{funcstart_719,1}$.a3))

$\rightarrow$ *[simplify]*

[19.1] div3 == div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p3, **asType**<**int**>($heap$_{funcstart\_719,1}$.a3))

$\rightarrow$ *[const static or extern object]*

[19.2] div3 == div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p3, **asType**<**int**>($heap$_{init}$.a3))

$\rightarrow$ *[expand definition of constant 'a3' at prang.c (26,20)]*

[19.3] div3 == div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p3, **asType**<**int**>(**asType**<**short int**>((**int**)178)))

$\rightarrow$ *[simplify]*

[19.6] div3 == div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p3, 178)

[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 19.6, div3 is equal to div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p3, 178)]*

[1.2] -32768 $\leq$ **asType**<**short int**>(div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p3, 178).quot)

$\rightarrow$ *[simplify]*

[1.5] -32769 < div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p3, 178).quot

$\rightarrow$ *[negate goal and search for contradiction]*

[1.6] !(-32769 < div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p3, 178).quot)

$\rightarrow$ *[simplify]*

[1.8] 32768 < $-$div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p3, 178).quot

[Assume known post-assertion, class invariant or type constraint for term 1.8]

[36.0] **minof**(**int**) $\leq$ div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p3, 178).quot

$\rightarrow$ *[simplify]*

[36.3] -32769 < div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p3, 178).quot

$\rightarrow$ *[from term 1.8, literala < div(**heapIs** $\$heap_{funcstart\_719,1}$,*
$\$heap_{funcstart\_719,1}$.p3, 178).quot is false whenever -2 < (32768 + literala)]

    Proof of rule precondition:

    [36.3.0] -2 < (-32769 + 32768)

    $\rightarrow$ *[simplify]*

    [36.3.2] **true**

[36.4] **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 (49,40)

Condition defined at:

To prove: asType<short int>(div3.quot) $\leq$ **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)

$\$heap_{init}$.b1 == **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)

$\$heap_{init}$.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)

$\$heap_{init}$.b3 == **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)

div1 == div(**heapIs** $\$heap_{funcstart\_719,1}$,
asType<int>($\$heap_{funcstart\_719,1}$.p1),
asType<int>($\$heap_{funcstart\_719,1}$.a1))

(**asType<integer>**(**asType<int>**($\$heap_{funcstart\_719,1}$.p1)) /

asType<**integer**>(**asType**<**int**>($heap$_{funcstart_719,1}$.a1))) == **asType**<**integer**>(div1.quot)

(**asType**<**integer**>(**asType**<**int**>($heap$_{funcstart_719,1}$.p1)) % **asType**<**integer**>(**asType**<**int**>($heap$_{funcstart\_719,1}$.a1))) == **asType**<**integer**>(div1.rem)

div2 == div(**heapIs** $heap$_{funcstart_719,1}$, **asType**<**int**>($heap$_{funcstart\_719,1}$.p2), **asType**<**int**>($heap$_{funcstart_719,1}$.a2))

(**asType**<**integer**>(**asType**<**int**>($heap$_{funcstart_719,1}$.p2)) / **asType**<**integer**>(**asType**<**int**>($heap$_{funcstart\_719,1}$.a2))) == **asType**<**integer**>(div2.quot)

(**asType**<**integer**>(**asType**<**int**>($heap$_{funcstart_719,1}$.p2)) % **asType**<**integer**>(**asType**<**int**>($heap$_{funcstart\_719,1}$.a2))) == **asType**<**integer**>(div2.rem)

div3 == div(**heapIs** $heap$_{funcstart_719,1}$, **asType**<**int**>($heap$_{funcstart\_719,1}$.p3), **asType**<**int**>($heap$_{funcstart_719,1}$.a3))

(**asType**<**integer**>(**asType**<**int**>($heap$_{funcstart_719,1}$.p3)) / **asType**<**integer**>(**asType**<**int**>($heap$_{funcstart\_719,1}$.a3))) == **asType**<**integer**>(div3.quot)

(**asType**<**integer**>(**asType**<**int**>($heap$_{funcstart_719,1}$.p3)) % **asType**<**integer**>(**asType**<**int**>($heap$_{funcstart\_719,1}$.a3))) == **asType**<**integer**>(div3.rem)

$heap$_{719,1;729,8}$ == $heap$_{funcstart_719,1}$.**replace**(p1 → **asType**<**short int**>((**asType**<**int**>(**asType**<**short int**>(div1.rem)) * **asType**<**int**>($heap$_{funcstart\_719,1}$.r1)) − (**asType**<**int**>(**asType**<**short int**>(div1.quot)) * **asType**<**int**>($heap$_{funcstart_719,1}$.b1))))

$heap$_{719,1;730,8}$ == $heap$_{719,1;729,8}$.**replace**(p2 → **asType**<**short int**>((**asType**<**int**>(**asType**<**short int**>(div2.rem)) * **asType**<**int**>($heap$_{719,1;729,8}$.r2)) − (**asType**<**int**>(**asType**<**short int**>(div2.quot)) * **asType**<**int**>($heap$_{719,1;729,8}$.b2))))

Proof:

[Take given term]

[19.0] div3 == div(**heapIs** $heap$_{funcstart_719,1}$, **asType**<**int**>($heap$_{funcstart\_719,1}$.p3), **asType**<**int**>($heap$_{funcstart_719,1}$.a3))

→ *[simplify]*

[19.1] div3 == div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p3, **asType**<**int**>($heap$_{funcstart\_719,1}$.a3))

$\to$ *[const static or extern object]*

[19.2] div3 == div(**heapIs** \$heap$_{funcstart\_719,1}$, \$heap$_{funcstart\_719,1}$.p3, **asType<int>**(\$heap$_{init}$.a3))

$\to$ *[expand definition of constant 'a3' at prang.c (26,20)]*

[19.3] div3 == div(**heapIs** \$heap$_{funcstart\_719,1}$, \$heap$_{funcstart\_719,1}$.p3, **asType<int>**(**asType<short int>**((**int**)178)))

$\to$ *[simplify]*

[19.6] div3 == div(**heapIs** \$heap$_{funcstart\_719,1}$, \$heap$_{funcstart\_719,1}$.p3, 178)

[Take goal term]

[1.0] **asType<short int>**(div3.quot) $\leq$ **maxof(int)**

$\to$ *[from term 19.6, div3 is equal to div(**heapIs** \$heap$_{funcstart\_719,1}$, \$heap$_{funcstart\_719,1}$.p3, 178)]*

[1.1] **asType<short int>**(div(**heapIs** \$heap$_{funcstart\_719,1}$, \$heap$_{funcstart\_719,1}$.p3, 178).quot) $\leq$ **maxof(int)**

$\to$ *[simplify]*

[1.11] -32768 < $-$div(**heapIs** \$heap$_{funcstart\_719,1}$, \$heap$_{funcstart\_719,1}$.p3, 178).quot

$\to$ *[negate goal and search for contradiction]*

[1.12] !(-32768 < $-$div(**heapIs** \$heap$_{funcstart\_719,1}$, \$heap$_{funcstart\_719,1}$.p3, 178).quot)

$\to$ *[simplify]*

[1.15] 32767 < div(**heapIs** \$heap$_{funcstart\_719,1}$, \$heap$_{funcstart\_719,1}$.p3, 178).quot

[Assume known post-assertion, class invariant or type constraint for term 1.15]

[36.0] div(**heapIs** \$heap$_{funcstart\_719,1}$, \$heap$_{funcstart\_719,1}$.p3, 178).quot $\leq$ **maxof(int)**

$\to$ *[simplify]*

[36.9] -32768 < $-$div(**heapIs** \$heap$_{funcstart\_719,1}$, \$heap$_{funcstart\_719,1}$.p3, 178).quot

$\to$ *[from term 1.15, literala < $-$div(**heapIs** \$heap$_{funcstart\_719,1}$, \$heap$_{funcstart\_719,1}$.p3, 178).quot is false whenever -2 < (32767 + literala)]*

Proof of rule precondition:

[36.9.0] -2 < (-32768 + 32767)

$\to$ *[simplify]*

[36.9.2] **true**

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[36.10] **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 (49,35)

Condition defined at:

To prove: minof(int) $\leq$ \$heap$_{719,1;730,8}$.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)

\$heap$_{init}$.b1 == **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)

\$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)

\$heap$_{init}$.b3 == **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)

div1 == div(**heapIs** \$heap$_{funcstart\_719,1}$,
asType<**int**>(\$heap$_{funcstart\_719,1}$.p1),
asType<**int**>(\$heap$_{funcstart\_719,1}$.a1))

(**asType**<**integer**>(**asType**<**int**>(\$heap$_{funcstart\_719,1}$.p1)) /
asType<**integer**>(**asType**<**int**>(\$heap$_{funcstart\_719,1}$.a1))) ==
asType<**integer**>(div1.quot)

(**asType**<**integer**>(**asType**<**int**>(\$heap$_{funcstart\_719,1}$.p1)) %
asType<**integer**>(**asType**<**int**>(\$heap$_{funcstart\_719,1}$.a1))) ==
asType<**integer**>(div1.rem)

div2 == div(**heapIs** \$heap$_{funcstart\_719,1}$,
asType<**int**>(\$heap$_{funcstart\_719,1}$.p2),

asType\<int\>($\text{heap}_{funcstart\_719,1}$.a2))

(**asType\<integer\>**(**asType\<int\>**($\text{heap}_{funcstart\_719,1}$.p2)) /
asType\<integer\>(**asType\<int\>**($\text{heap}_{funcstart\_719,1}$.a2))) ==
asType\<integer\>(div2.quot)

(**asType\<integer\>**(**asType\<int\>**($\text{heap}_{funcstart\_719,1}$.p2)) %
asType\<integer\>(**asType\<int\>**($\text{heap}_{funcstart\_719,1}$.a2))) ==
asType\<integer\>(div2.rem)

div3 == div(**heapIs** $\text{heap}_{funcstart\_719,1}$,
asType\<int\>($\text{heap}_{funcstart\_719,1}$.p3),
asType\<int\>($\text{heap}_{funcstart\_719,1}$.a3))

(**asType\<integer\>**(**asType\<int\>**($\text{heap}_{funcstart\_719,1}$.p3)) /
asType\<integer\>(**asType\<int\>**($\text{heap}_{funcstart\_719,1}$.a3))) ==
asType\<integer\>(div3.quot)

(**asType\<integer\>**(**asType\<int\>**($\text{heap}_{funcstart\_719,1}$.p3)) %
asType\<integer\>(**asType\<int\>**($\text{heap}_{funcstart\_719,1}$.a3))) ==
asType\<integer\>(div3.rem)

$\text{heap}_{719,1;729,8}$ == $\text{heap}_{funcstart\_719,1}$.**replace**(p1 → **asType\<short
int\>**((**asType\<int\>**(**asType\<short int\>**(div1.rem)) *
asType\<int\>($\text{heap}_{funcstart\_719,1}$.r1)) − (**asType\<int\>**(**asType\<short
int\>**(div1.quot)) * **asType\<int\>**($\text{heap}_{funcstart\_719,1}$.b1)))))

$\text{heap}_{719,1;730,8}$ == $\text{heap}_{719,1;729,8}$.**replace**(p2 → **asType\<short
int\>**((**asType\<int\>**(**asType\<short int\>**(div2.rem)) *
asType\<int\>($\text{heap}_{719,1;729,8}$.r2)) − (**asType\<int\>**(**asType\<short
int\>**(div2.quot)) * **asType\<int\>**($\text{heap}_{719,1;729,8}$.b2)))))

Proof:

[Take given term]

[5.0] div1 == div(**heapIs** $\text{heap}_{funcstart\_719,1}$,
asType\<int\>($\text{heap}_{funcstart\_719,1}$.p1),
asType\<int\>($\text{heap}_{funcstart\_719,1}$.a1))

→ *[simplify]*

[5.1] div1 == div(**heapIs** $\text{heap}_{funcstart\_719,1}$, $\text{heap}_{funcstart\_719,1}$.p1,
asType\<int\>($\text{heap}_{funcstart\_719,1}$.a1))

→ *[const static or extern object]*

[5.2] div1 == div(**heapIs** $\text{heap}_{funcstart\_719,1}$, $\text{heap}_{funcstart\_719,1}$.p1,
asType\<int\>(heap_{init}.a1))

→ *[expand definition of constant 'a1' at prang.c (16,20)]*

[5.3] div1 == div(**heapIs** $\text{heap}_{funcstart\_719,1}$, $\text{heap}_{funcstart\_719,1}$.p1,
asType\<int\>(**asType\<short int\>**((**int**)177)))

$\rightarrow$ *[simplify]*

[5.6] div1 == div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177)

[Take given term]

[12.0] div2 == div(**heapIs** $\$heap_{funcstart\_719,1}$,
asType<int>($\$heap_{funcstart\_719,1}$.p2),
asType<int>($\$heap_{funcstart\_719,1}$.a2))

$\rightarrow$ *[simplify]*

[12.1] div2 == div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2,
asType<int>($\$heap_{funcstart\_719,1}$.a2))

$\rightarrow$ *[const static or extern object]*

[12.2] div2 == div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2,
asType<int>($\$heap_{init}$.a2))

$\rightarrow$ *[expand definition of constant 'a2' at prang.c (21,20)]*

[12.3] div2 == div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2,
asType<int>(**asType<short int>**((**int**)176)))

$\rightarrow$ *[simplify]*

[12.6] div2 == div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176)

[Take given term]

[26.0] $\$heap_{719,1;729,8}$ == $\$heap_{funcstart\_719,1}$.**replace**(p1 $\rightarrow$ **asType<short
int>**((**asType<int>**(**asType<short int>**(div1.rem)) *
asType<int>($\$heap_{funcstart\_719,1}$.r1)) $-$ (**asType<int>**(**asType<short
int>**(div1.quot)) * **asType<int>**($\$heap_{funcstart\_719,1}$.b1))))

$\rightarrow$ *[from term 5.6, div1 is equal to div(**heapIs** $\$heap_{funcstart\_719,1}$,*
$\$heap_{funcstart\_719,1}$.p1, 177)]

[26.1] $\$heap_{719,1;729,8}$ == $\$heap_{funcstart\_719,1}$.**replace**(p1 $\rightarrow$ **asType<short
int>**((**asType<int>**(**asType<short int>**(div(**heapIs** $\$heap_{funcstart\_719,1}$,
$\$heap_{funcstart\_719,1}$.p1, 177).rem)) * **asType<int>**($\$heap_{funcstart\_719,1}$.r1)) $-$
(**asType<int>**(**asType<short int>**(div1.quot)) *
asType<int>($\$heap_{funcstart\_719,1}$.b1))))

$\rightarrow$ *[simplify]*

[26.3] $\$heap_{719,1;729,8}$ == $\$heap_{funcstart\_719,1}$.**replace**(p1 $\rightarrow$ **asType<short
int>**((div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).rem *
asType<int>($\$heap_{funcstart\_719,1}$.r1)) $-$ (**asType<int>**(**asType<short
int>**(div1.quot)) * **asType<int>**($\$heap_{funcstart\_719,1}$.b1))))

$\rightarrow$ *[const static or extern object]*

[26.4] $\$heap_{719,1;729,8}$ == $\$heap_{funcstart\_719,1}$.**replace**(p1 $\rightarrow$ **asType<short
int>**((div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).rem *
asType<int>($\$heap_{init}$.r1)) $-$ (**asType<int>**(**asType<short

int>(div1.quot)) * **asType<int>**($heap$_{funcstart_719,1}$.b1))))

$\rightarrow$ *[expand definition of constant 'r1' at prang.c (15,20)]*

[26.5] $heap$_{719,1;729,8}$ == $heap$_{funcstart_719,1}$._**replace**(p1 $\rightarrow$ **asType<short int>**((div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1, 177).rem * **asType<int>**(**asType<short int>**((**int**)171))) − (**asType<int>**(**asType<short int>**(div1.quot)) * **asType<int>**($heap$_{funcstart\_719,1}$.b1))))

$\rightarrow$ *[simplify]*

[26.8] $heap$_{719,1;729,8}$ == $heap$_{funcstart_719,1}$._**replace**(p1 $\rightarrow$ **asType<short int>**((div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1, 177).rem * 171) − (**asType<int>**(**asType<short int>**(div1.quot)) * **asType<int>**($heap$_{funcstart\_719,1}$.b1))))

$\rightarrow$ *[from term 5.6, div1 is equal to div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1, 177)]*

[26.9] $heap$_{719,1;729,8}$ == $heap$_{funcstart_719,1}$._**replace**(p1 $\rightarrow$ **asType<short int>**((171 * div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1, 177).rem) − (**asType<int>**(**asType<short int>**(div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1, 177).quot)) * **asType<int>**($heap$_{funcstart\_719,1}$.b1))))

$\rightarrow$ *[simplify]*

[26.11] $heap$_{719,1;729,8}$ == $heap$_{funcstart_719,1}$._**replace**(p1 $\rightarrow$ **asType<short int>**((171 * div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1, 177).rem) − (div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1, 177).quot * **asType<int>**($heap$_{funcstart\_719,1}$.b1))))

$\rightarrow$ *[const static or extern object]*

[26.12] $heap$_{719,1;729,8}$ == $heap$_{funcstart_719,1}$._**replace**(p1 $\rightarrow$ **asType<short int>**((171 * div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1, 177).rem) − (div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1, 177).quot * **asType<int>**($heap$_{init}$.b1))))

$\rightarrow$ *[expand definition of constant 'b1' at prang.c (17,20)]*

[26.13] $heap$_{719,1;729,8}$ == $heap$_{funcstart_719,1}$._**replace**(p1 $\rightarrow$ **asType<short int>**((171 * div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1, 177).rem) − (div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1, 177).quot * **asType<int>**(**asType<short int>**((**int**)2)))))

$\rightarrow$ *[simplify]*

[26.19] $heap$_{719,1;729,8}$ == $heap$_{funcstart_719,1}$._**replace**(p1 $\rightarrow$ ((-2 * div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1, 177).quot) + (171 * div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1, 177).rem)))

[Take given term]

[31.0] $\$heap_{719,1;730,8}$ == $\$heap_{719,1;729,8}$.**_replace**(p2 → **asType<short int>**((**asType<int>**(**asType<short int>**(div2.rem)) * **asType<int>**($\$heap_{719,1;729,8}$.r2)) − (**asType<int>**(**asType<short int>**(div2.quot)) * **asType<int>**($\$heap_{719,1;729,8}$.b2))))

→ *[from term 26.19, $\$heap_{719,1;729,8}$ is equal to $\$heap_{funcstart\_719,1}$.**_replace**(p1 → (-2 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).rem))]*

[31.1] $\$heap_{719,1;730,8}$ == $\$heap_{funcstart\_719,1}$.**_replace**(p1 → ((-2 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).rem))).**_replace**(p2 → **asType<short int>**((**asType<int>**(**asType<short int>**(div2.rem)) * **asType<int>**($\$heap_{719,1;729,8}$.r2)) − (**asType<int>**(**asType<short int>**(div2.quot)) * **asType<int>**($\$heap_{719,1;729,8}$.b2))))

→ *[from term 12.6, div2 is equal to div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176)]*

[31.2] $\$heap_{719,1;730,8}$ == $\$heap_{funcstart\_719,1}$.**_replace**(p1 → ((-2 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).rem))).**_replace**(p2 → **asType<short int>**((**asType<int>**(**asType<short int>**(div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).rem)) * **asType<int>**($\$heap_{719,1;729,8}$.r2)) − (**asType<int>**(**asType<short int>**(div2.quot)) * **asType<int>**($\$heap_{719,1;729,8}$.b2))))

→ *[simplify]*

[31.4] $\$heap_{719,1;730,8}$ == $\$heap_{funcstart\_719,1}$.**_replace**(p1 → ((-2 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).rem))).**_replace**(p2 → **asType<short int>**((div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).rem * **asType<int>**($\$heap_{719,1;729,8}$.r2)) − (**asType<int>**(**asType<short int>**(div2.quot)) * **asType<int>**($\$heap_{719,1;729,8}$.b2))))

→ *[from term 26.19, $\$heap_{719,1;729,8}$ is equal to $\$heap_{funcstart\_719,1}$.**_replace**(p1 → (-2 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).rem))]*

[31.5] $\$heap_{719,1;730,8}$ == $\$heap_{funcstart\_719,1}$.**_replace**(p1 → ((-2 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).rem))).**_replace**(p2 → **asType<short int>**((div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).rem *

asType<int>($heap$_{funcstart_719,1}$.**replace**(p1 → ((-2 * div(**heapIs**
$heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1, 177).quot) + (171 * div(**heapIs**
$heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1, 177).rem))).r2)) −
(**asType<int>**(**asType<short int>**(div2.quot)) *
asType<int>($heap$_{719,1;729,8}$.b2)))))

→ *[const member of object with modified fields]*

[31.6] $heap$_{719,1;730,8}$ == $heap$_{funcstart_719,1}$.**replace**(p1 → ((-2 *
div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1, 177).quot) + (171 *
div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1,
177).rem))).**replace**(p2 → **asType<short int>**((div(**heapIs**
$heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p2, 176).rem *
asType<int>($heap$_{funcstart_719,1}$.r2)) − (**asType<int>**(**asType<short
int>**(div2.quot)) * **asType<int>**($heap$_{719,1;729,8}$.b2)))))

→ *[const static or extern object]*

[31.7] $heap$_{719,1;730,8}$ == $heap$_{funcstart_719,1}$.**replace**(p1 → ((-2 *
div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1, 177).quot) + (171 *
div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1,
177).rem))).**replace**(p2 → **asType<short int>**((div(**heapIs**
$heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p2, 176).rem *
asType<int>($heap$_{init}$.r2)) − (**asType<int>**(**asType<short
int>**(div2.quot)) * **asType<int>**($heap$_{719,1;729,8}$.b2)))))

→ *[expand definition of constant 'r2' at prang.c (20,20)]*

[31.8] $heap$_{719,1;730,8}$ == $heap$_{funcstart_719,1}$.**replace**(p1 → ((-2 *
div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1, 177).quot) + (171 *
div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1,
177).rem))).**replace**(p2 → **asType<short int>**((div(**heapIs**
$heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p2, 176).rem *
asType<int>(**asType<short int>**((**int**)172))) −
(**asType<int>**(**asType<short int>**(div2.quot)) *
asType<int>($heap$_{719,1;729,8}$.b2)))))

→ *[simplify]*

[31.11] $heap$_{719,1;730,8}$ == $heap$_{funcstart_719,1}$.**replace**(p1 → ((-2 *
div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1, 177).quot) + (171 *
div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1,
177).rem))).**replace**(p2 → **asType<short int>**((div(**heapIs**
$heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p2, 176).rem * 172) −
(**asType<int>**(**asType<short int>**(div2.quot)) *
asType<int>($heap$_{719,1;729,8}$.b2)))))

→ *[from term 12.6, div2 is equal to div(**heapIs** $heap$_{funcstart_719,1}$,
$heap$_{funcstart_719,1}$.p2, 176)]*

[31.12] $heap$_{719,1;730,8}$ == $heap$_{funcstart_719,1}$.**replace**(p1 → ((-2 *

div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1,
177).rem))).**_replace**(p2 → **asType**<**short int**>((172 * div(**heapIs**
$\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).rem) −
(**asType**<**int**>(**asType**<**short int**>(div(**heapIs** $\$heap_{funcstart\_719,1}$,
$\$heap_{funcstart\_719,1}$.p2, 176).quot)) * **asType**<**int**>($\$heap_{719,1;729,8}$.b2))))

→ *[simplify]*

[31.14] $\$heap_{719,1;730,8}$ == $\$heap_{funcstart\_719,1}$.**_replace**(p1 → ((-2 *
div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1,
177).rem))).**_replace**(p2 → **asType**<**short int**>((172 * div(**heapIs**
$\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).rem) − (div(**heapIs**
$\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).quot *
asType<**int**>($\$heap_{719,1;729,8}$.b2))))

→ *[from term 26.19, $\$heap_{719,1;729,8}$ is equal to*
*$\$heap_{funcstart\_719,1}$.**_replace**(p1 → (-2 * div(**heapIs** $\$heap_{funcstart\_719,1}$,*
*$\$heap_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_719,1}$,*
$\$heap_{funcstart\_719,1}$.p1, 177).rem))]

[31.15] $\$heap_{719,1;730,8}$ == $\$heap_{funcstart\_719,1}$.**_replace**(p1 → ((-2 *
div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1,
177).rem))).**_replace**(p2 → **asType**<**short int**>((172 * div(**heapIs**
$\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).rem) − (div(**heapIs**
$\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).quot *
asType<**int**>($\$heap_{funcstart\_719,1}$.**_replace**(p1 → ((-2 * div(**heapIs**
$\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs**
$\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).rem))).b2))))

→ *[const member of object with modified fields]*

[31.16] $\$heap_{719,1;730,8}$ == $\$heap_{funcstart\_719,1}$.**_replace**(p1 → ((-2 *
div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1,
177).rem))).**_replace**(p2 → **asType**<**short int**>((172 * div(**heapIs**
$\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).rem) − (div(**heapIs**
$\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).quot *
asType<**int**>($\$heap_{funcstart\_719,1}$.b2))))

→ *[const static or extern object]*

[31.17] $\$heap_{719,1;730,8}$ == $\$heap_{funcstart\_719,1}$.**_replace**(p1 → ((-2 *
div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1,
177).rem))).**_replace**(p2 → **asType**<**short int**>((172 * div(**heapIs**
$\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).rem) − (div(**heapIs**
$\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).quot *

asType<int>($heap$_{init}$.b2))))

→ *[expand definition of constant 'b2' at prang.c (22,20)]*

[31.18] $heap$_{719,1;730,8}$ == $heap$_{funcstart_719,1}$.__replace__(p1 → ((-2 *
div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1, 177).quot) + (171 *
div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1,
177).rem))).__replace__(p2 → **asType<short int>**((172 * div(**heapIs**
$heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p2, 176).rem) − (div(**heapIs**
$heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p2, 176).quot *
asType<int>(**asType<short int>**((**int**)35)))))

→ *[simplify]*

[31.24] $heap$_{719,1;730,8}$ == $heap$_{funcstart_719,1}$.__replace__(p1 → ((-2 *
div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1, 177).quot) + (171 *
div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1,
177).rem))).__replace__(p2 → ((-35 * div(**heapIs** $heap$_{funcstart_719,1}$,
$heap$_{funcstart_719,1}$.p2, 176).quot) + (172 * div(**heapIs** $heap$_{funcstart_719,1}$,
$heap$_{funcstart_719,1}$.p2, 176).rem)))

[Take goal term]

[1.0] **minof(int)** ≤ $heap$_{719,1;730,8}$.b3

→ *[simplify]*

[1.1] -32768 ≤ $heap$_{719,1;730,8}$.b3

→ *[from term 31.24, $heap$_{719,1;730,8}$ is equal to*
*$heap$_{funcstart_719,1}$.__replace__(p1 → ((-2 * div(**heapIs** $heap$_{funcstart_719,1}$,*
*$heap$_{funcstart_719,1}$.p1, 177).quot) + (171 * div(**heapIs** $heap$_{funcstart_719,1}$,*
*$heap$_{funcstart_719,1}$.p1, 177).rem))).__replace__(p2 → (-35 * div(**heapIs***
*$heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p2, 176).quot) + (172 * div(**heapIs***
$heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p2, 176).rem))]

[1.2] -32768 ≤ $heap$_{funcstart_719,1}$.__replace__(p1 → ((-2 * div(**heapIs**
$heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1, 177).quot) + (171 * div(**heapIs**
$heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1, 177).rem))).__replace__(p2 → ((-35
* div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p2, 176).quot) + (172 *
div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p2, 176).rem))).b3

→ *[const member of object with modified fields]*

[1.4] -32768 ≤ $heap$_{funcstart_719,1}$.b3

→ *[const static or extern object]*

[1.5] -32768 ≤ $heap$_{init}$.b3

→ *[expand definition of constant 'b3' at prang.c (27,20)]*

[1.6] -32768 ≤ **asType<short int>**((**int**)63)

→ *[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 (49,35)

Condition defined at:

To prove: $\$\text{heap}_{719,1;730,8}.\text{b3} \leq$ **maxof(int)**

Given:

$\$\text{heap}_{init}.\text{LIMIT} ==$ (**int**)80

$\$\text{heap}_{init}.\text{M1} ==$ **asType<short int>**((**int**)30269)

$\$\text{heap}_{init}.\text{r1} ==$ **asType<short int>**((**int**)171)

$\$\text{heap}_{init}.\text{a1} ==$ **asType<short int>**((**int**)177)

$\$\text{heap}_{init}.\text{b1} ==$ **asType<short int>**((**int**)2)

$\$\text{heap}_{init}.\text{M2} ==$ **asType<short int>**((**int**)30307)

$\$\text{heap}_{init}.\text{r2} ==$ **asType<short int>**((**int**)172)

$\$\text{heap}_{init}.\text{a2} ==$ **asType<short int>**((**int**)176)

$\$\text{heap}_{init}.\text{b2} ==$ **asType<short int>**((**int**)35)

$\$\text{heap}_{init}.\text{M3} ==$ **asType<short int>**((**int**)30323)

$\$\text{heap}_{init}.\text{r3} ==$ **asType<short int>**((**int**)170)

$\$\text{heap}_{init}.\text{a3} ==$ **asType<short int>**((**int**)178)

$\$\text{heap}_{init}.\text{b3} ==$ **asType<short int>**((**int**)63)

$\$\text{heap}_{init}.\text{p1} ==$ **asType<short int>**((**int**)1)

$\$\text{heap}_{init}.\text{p2} ==$ **asType<short int>**((**int**)2)

$\$\text{heap}_{init}.\text{p3} ==$ **asType<short int>**((**int**)3)

div1 == div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$,
asType<int>($\$\text{heap}_{funcstart\_719,1}.\text{p1}$),
asType<int>($\$\text{heap}_{funcstart\_719,1}.\text{a1}$))

(**asType<integer>**(**asType<int>**($\$\text{heap}_{funcstart\_719,1}.\text{p1}$)) /
asType<integer>(**asType<int>**($\$\text{heap}_{funcstart\_719,1}.\text{a1}$))) ==
asType<integer>(div1.quot)

(**asType<integer>**(**asType<int>**($\$\text{heap}_{funcstart\_719,1}.\text{p1}$)) %
asType<integer>(**asType<int>**($\$\text{heap}_{funcstart\_719,1}.\text{a1}$))) ==
asType<integer>(div1.rem)

div2 == div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$,
asType<int>($\$\text{heap}_{funcstart\_719,1}.\text{p2}$),

asType\<int\>($\text{heap}_{funcstart\_719,1}$.a2))

(**asType\<integer\>**(**asType\<int\>**($\text{heap}_{funcstart\_719,1}$.p2)) /
asType\<integer\>(**asType\<int\>**($\text{heap}_{funcstart\_719,1}$.a2))) ==
asType\<integer\>(div2.quot)

(**asType\<integer\>**(**asType\<int\>**($\text{heap}_{funcstart\_719,1}$.p2)) %
asType\<integer\>(**asType\<int\>**($\text{heap}_{funcstart\_719,1}$.a2))) ==
asType\<integer\>(div2.rem)

div3 == div(**heapIs** $\text{heap}_{funcstart\_719,1}$,
asType\<int\>($\text{heap}_{funcstart\_719,1}$.p3),
asType\<int\>($\text{heap}_{funcstart\_719,1}$.a3))

(**asType\<integer\>**(**asType\<int\>**($\text{heap}_{funcstart\_719,1}$.p3)) /
asType\<integer\>(**asType\<int\>**($\text{heap}_{funcstart\_719,1}$.a3))) ==
asType\<integer\>(div3.quot)

(**asType\<integer\>**(**asType\<int\>**($\text{heap}_{funcstart\_719,1}$.p3)) %
asType\<integer\>(**asType\<int\>**($\text{heap}_{funcstart\_719,1}$.a3))) ==
asType\<integer\>(div3.rem)

$\text{heap}_{719,1;729,8}$ == $\text{heap}_{funcstart\_719,1}$.**replace**(p1 → **asType\<short
int\>**((**asType\<int\>**(**asType\<short int\>**(div1.rem)) *
asType\<int\>($\text{heap}_{funcstart\_719,1}$.r1)) − (**asType\<int\>**(**asType\<short
int\>**(div1.quot)) * **asType\<int\>**($\text{heap}_{funcstart\_719,1}$.b1)))))

$\text{heap}_{719,1;730,8}$ == $\text{heap}_{719,1;729,8}$.**replace**(p2 → **asType\<short
int\>**((**asType\<int\>**(**asType\<short int\>**(div2.rem)) *
asType\<int\>($\text{heap}_{719,1;729,8}$.r2)) − (**asType\<int\>**(**asType\<short
int\>**(div2.quot)) * **asType\<int\>**($\text{heap}_{719,1;729,8}$.b2)))))

Proof:

[Take given term]

[5.0] div1 == div(**heapIs** $\text{heap}_{funcstart\_719,1}$,
asType\<int\>($\text{heap}_{funcstart\_719,1}$.p1),
asType\<int\>($\text{heap}_{funcstart\_719,1}$.a1))

→ *[simplify]*

[5.1] div1 == div(**heapIs** $\text{heap}_{funcstart\_719,1}$, $\text{heap}_{funcstart\_719,1}$.p1,
asType\<int\>($\text{heap}_{funcstart\_719,1}$.a1))

→ *[const static or extern object]*

[5.2] div1 == div(**heapIs** $\text{heap}_{funcstart\_719,1}$, $\text{heap}_{funcstart\_719,1}$.p1,
asType\<int\>(heap_{init}.a1))

→ *[expand definition of constant 'a1' at prang.c (16,20)]*

[5.3] div1 == div(**heapIs** $\text{heap}_{funcstart\_719,1}$, $\text{heap}_{funcstart\_719,1}$.p1,
asType\<int\>(**asType\<short int\>**((**int**)177)))

$\rightarrow$ *[simplify]*

[5.6] div1 == div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}$.p1, 177)

[Take given term]

[12.0] div2 == div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$,
asType\<int\>($\$\text{heap}_{funcstart\_719,1}$.p2),
asType\<int\>($\$\text{heap}_{funcstart\_719,1}$.a2))

$\rightarrow$ *[simplify]*

[12.1] div2 == div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}$.p2,
asType\<int\>($\$\text{heap}_{funcstart\_719,1}$.a2))

$\rightarrow$ *[const static or extern object]*

[12.2] div2 == div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}$.p2,
asType\<int\>($\$\text{heap}_{init}$.a2))

$\rightarrow$ *[expand definition of constant 'a2' at prang.c (21,20)]*

[12.3] div2 == div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}$.p2,
asType\<int\>(**asType\<short int\>**((**int**)176)))

$\rightarrow$ *[simplify]*

[12.6] div2 == div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}$.p2, 176)

[Take given term]

[26.0] $\$\text{heap}_{719,1;729,8}$ == $\$\text{heap}_{funcstart\_719,1}$.**replace**(p1 $\rightarrow$ **asType\<short
int\>**((**asType\<int\>**(**asType\<short int\>**(div1.rem)) *
asType\<int\>($\$\text{heap}_{funcstart\_719,1}$.r1)) $-$ (**asType\<int\>**(**asType\<short
int\>**(div1.quot)) * **asType\<int\>**($\$\text{heap}_{funcstart\_719,1}$.b1))))

$\rightarrow$ *[from term 5.6, div1 is equal to div(**heapIs** $\$heap_{funcstart\_719,1}$,
$\$heap_{funcstart\_719,1}$.p1, 177)]*

[26.1] $\$\text{heap}_{719,1;729,8}$ == $\$\text{heap}_{funcstart\_719,1}$.**replace**(p1 $\rightarrow$ **asType\<short
int\>**((**asType\<int\>**(**asType\<short int\>**(div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$,
$\$\text{heap}_{funcstart\_719,1}$.p1, 177).rem)) * **asType\<int\>**($\$\text{heap}_{funcstart\_719,1}$.r1)) $-$
(**asType\<int\>**(**asType\<short int\>**(div1.quot)) *
asType\<int\>($\$\text{heap}_{funcstart\_719,1}$.b1))))

$\rightarrow$ *[simplify]*

[26.3] $\$\text{heap}_{719,1;729,8}$ == $\$\text{heap}_{funcstart\_719,1}$.**replace**(p1 $\rightarrow$ **asType\<short
int\>**((div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}$.p1, 177).rem *
asType\<int\>($\$\text{heap}_{funcstart\_719,1}$.r1)) $-$ (**asType\<int\>**(**asType\<short
int\>**(div1.quot)) * **asType\<int\>**($\$\text{heap}_{funcstart\_719,1}$.b1))))

$\rightarrow$ *[const static or extern object]*

[26.4] $\$\text{heap}_{719,1;729,8}$ == $\$\text{heap}_{funcstart\_719,1}$.**replace**(p1 $\rightarrow$ **asType\<short
int\>**((div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}$.p1, 177).rem *
asType\<int\>($\$\text{heap}_{init}$.r1)) $-$ (**asType\<int\>**(**asType\<short

int>(div1.quot)) * **asType**<**int**>($\text{heap}_{funcstart\_719,1}$.b1))))

→ *[expand definition of constant 'r1' at prang.c (15,20)]*

[26.5] $\text{heap}_{719,1;729,8}$ == $\text{heap}_{funcstart\_719,1}$._**replace**(p1 → **asType**<**short int**>((div(**heapIs** $\text{heap}_{funcstart\_719,1}$, $\text{heap}_{funcstart\_719,1}$.p1, 177).rem * **asType**<**int**>(**asType**<**short int**>((**int**)171))) − (**asType**<**int**>(**asType**<**short int**>(div1.quot)) * **asType**<**int**>($\text{heap}_{funcstart\_719,1}$.b1))))

→ *[simplify]*

[26.8] $\text{heap}_{719,1;729,8}$ == $\text{heap}_{funcstart\_719,1}$._**replace**(p1 → **asType**<**short int**>((div(**heapIs** $\text{heap}_{funcstart\_719,1}$, $\text{heap}_{funcstart\_719,1}$.p1, 177).rem * 171) − (**asType**<**int**>(**asType**<**short int**>(div1.quot)) * **asType**<**int**>($\text{heap}_{funcstart\_719,1}$.b1))))

→ *[from term 5.6, div1 is equal to div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p1, 177)]*

[26.9] $\text{heap}_{719,1;729,8}$ == $\text{heap}_{funcstart\_719,1}$._**replace**(p1 → **asType**<**short int**>((171 * div(**heapIs** $\text{heap}_{funcstart\_719,1}$, $\text{heap}_{funcstart\_719,1}$.p1, 177).rem) − (**asType**<**int**>(**asType**<**short int**>(div(**heapIs** $\text{heap}_{funcstart\_719,1}$, $\text{heap}_{funcstart\_719,1}$.p1, 177).quot)) * **asType**<**int**>($\text{heap}_{funcstart\_719,1}$.b1))))

→ *[simplify]*

[26.11] $\text{heap}_{719,1;729,8}$ == $\text{heap}_{funcstart\_719,1}$._**replace**(p1 → **asType**<**short int**>((171 * div(**heapIs** $\text{heap}_{funcstart\_719,1}$, $\text{heap}_{funcstart\_719,1}$.p1, 177).rem) − (div(**heapIs** $\text{heap}_{funcstart\_719,1}$, $\text{heap}_{funcstart\_719,1}$.p1, 177).quot * **asType**<**int**>($\text{heap}_{funcstart\_719,1}$.b1))))

→ *[const static or extern object]*

[26.12] $\text{heap}_{719,1;729,8}$ == $\text{heap}_{funcstart\_719,1}$._**replace**(p1 → **asType**<**short int**>((171 * div(**heapIs** $\text{heap}_{funcstart\_719,1}$, $\text{heap}_{funcstart\_719,1}$.p1, 177).rem) − (div(**heapIs** $\text{heap}_{funcstart\_719,1}$, $\text{heap}_{funcstart\_719,1}$.p1, 177).quot * **asType**<**int**>(heap_{init}.b1))))

→ *[expand definition of constant 'b1' at prang.c (17,20)]*

[26.13] $\text{heap}_{719,1;729,8}$ == $\text{heap}_{funcstart\_719,1}$._**replace**(p1 → **asType**<**short int**>((171 * div(**heapIs** $\text{heap}_{funcstart\_719,1}$, $\text{heap}_{funcstart\_719,1}$.p1, 177).rem) − (div(**heapIs** $\text{heap}_{funcstart\_719,1}$, $\text{heap}_{funcstart\_719,1}$.p1, 177).quot * **asType**<**int**>(**asType**<**short int**>((**int**)2)))))

→ *[simplify]*

[26.19] $\text{heap}_{719,1;729,8}$ == $\text{heap}_{funcstart\_719,1}$._**replace**(p1 → ((-2 * div(**heapIs** $\text{heap}_{funcstart\_719,1}$, $\text{heap}_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs** $\text{heap}_{funcstart\_719,1}$, $\text{heap}_{funcstart\_719,1}$.p1, 177).rem)))

[Take given term]

[31.0] $\$heap_{719,1;730,8}$ == $\$heap_{719,1;729,8}.\_$**replace**(p2 → **asType**$<$**short int**$>$((**asType**$<$**int**$>$(**asType**$<$**short int**$>$(div2.rem)) * **asType**$<$**int**$>$($\$heap_{719,1;729,8}.$r2)) − (**asType**$<$**int**$>$(**asType**$<$**short int**$>$(div2.quot)) * **asType**$<$**int**$>$($\$heap_{719,1;729,8}.$b2))))

→ *[from term 26.19, $\$heap_{719,1;729,8}$ is equal to $\$heap_{funcstart\_719,1}.\_$**replace***(p1 → (-2 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}.$p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}.$p1, 177).rem))]*

[31.1] $\$heap_{719,1;730,8}$ == $\$heap_{funcstart\_719,1}.\_$**replace**(p1 → ((-2 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}.$p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}.$p1, 177).rem)))._**replace**(p2 → **asType**$<$**short int**$>$((**asType**$<$**int**$>$(**asType**$<$**short int**$>$(div2.rem)) * **asType**$<$**int**$>$($\$heap_{719,1;729,8}.$r2)) − (**asType**$<$**int**$>$(**asType**$<$**short int**$>$(div2.quot)) * **asType**$<$**int**$>$($\$heap_{719,1;729,8}.$b2))))

→ *[from term 12.6, div2 is equal to div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}.$p2, 176)]*

[31.2] $\$heap_{719,1;730,8}$ == $\$heap_{funcstart\_719,1}.\_$**replace**(p1 → ((-2 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}.$p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}.$p1, 177).rem)))._**replace**(p2 → **asType**$<$**short int**$>$((**asType**$<$**int**$>$(**asType**$<$**short int**$>$(div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}.$p2, 176).rem)) * **asType**$<$**int**$>$($\$heap_{719,1;729,8}.$r2)) − (**asType**$<$**int**$>$(**asType**$<$**short int**$>$(div2.quot)) * **asType**$<$**int**$>$($\$heap_{719,1;729,8}.$b2))))

→ *[simplify]*

[31.4] $\$heap_{719,1;730,8}$ == $\$heap_{funcstart\_719,1}.\_$**replace**(p1 → ((-2 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}.$p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}.$p1, 177).rem)))._**replace**(p2 → **asType**$<$**short int**$>$((div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}.$p2, 176).rem * **asType**$<$**int**$>$($\$heap_{719,1;729,8}.$r2)) − (**asType**$<$**int**$>$(**asType**$<$**short int**$>$(div2.quot)) * **asType**$<$**int**$>$($\$heap_{719,1;729,8}.$b2))))

→ *[from term 26.19, $\$heap_{719,1;729,8}$ is equal to $\$heap_{funcstart\_719,1}.\_$**replace***(p1 → (-2 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}.$p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}.$p1, 177).rem))]*

[31.5] $\$heap_{719,1;730,8}$ == $\$heap_{funcstart\_719,1}.\_$**replace**(p1 → ((-2 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}.$p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}.$p1, 177).rem)))._**replace**(p2 → **asType**$<$**short int**$>$((div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}.$p2, 176).rem *

asType\<int\>($\text{heap}_{funcstart\_719,1}$.**replace**(p1 → ((-2 * div(**heapIs** $\text{heap}_{funcstart\_719,1}$, $\text{heap}_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs** $\text{heap}_{funcstart\_719,1}$, $\text{heap}_{funcstart\_719,1}$.p1, 177).rem))).r2)) −
(**asType\<int\>**(**asType\<short int\>**(div2.quot)) *
asType\<int\>($\text{heap}_{719,1;729,8}$.b2)))))

→ *[const member of object with modified fields]*

[31.6] $\text{heap}_{719,1;730,8}$ == $\text{heap}_{funcstart\_719,1}$.**replace**(p1 → ((-2 *
div(**heapIs** $\text{heap}_{funcstart\_719,1}$, $\text{heap}_{funcstart\_719,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\text{heap}_{funcstart\_719,1}$, $\text{heap}_{funcstart\_719,1}$.p1,
177).rem))).**replace**(p2 → **asType\<short int\>**((div(**heapIs**
$\text{heap}_{funcstart\_719,1}$, $\text{heap}_{funcstart\_719,1}$.p2, 176).rem *
asType\<int\>($\text{heap}_{funcstart\_719,1}$.r2)) − (**asType\<int\>**(**asType\<short
int\>**(div2.quot)) * **asType\<int\>**($\text{heap}_{719,1;729,8}$.b2)))))

→ *[const static or extern object]*

[31.7] $\text{heap}_{719,1;730,8}$ == $\text{heap}_{funcstart\_719,1}$.**replace**(p1 → ((-2 *
div(**heapIs** $\text{heap}_{funcstart\_719,1}$, $\text{heap}_{funcstart\_719,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\text{heap}_{funcstart\_719,1}$, $\text{heap}_{funcstart\_719,1}$.p1,
177).rem))).**replace**(p2 → **asType\<short int\>**((div(**heapIs**
$\text{heap}_{funcstart\_719,1}$, $\text{heap}_{funcstart\_719,1}$.p2, 176).rem *
asType\<int\>(heap_{init}.r2)) − (**asType\<int\>**(**asType\<short
int\>**(div2.quot)) * **asType\<int\>**($\text{heap}_{719,1;729,8}$.b2)))))

→ *[expand definition of constant 'r2' at prang.c (20,20)]*

[31.8] $\text{heap}_{719,1;730,8}$ == $\text{heap}_{funcstart\_719,1}$.**replace**(p1 → ((-2 *
div(**heapIs** $\text{heap}_{funcstart\_719,1}$, $\text{heap}_{funcstart\_719,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\text{heap}_{funcstart\_719,1}$, $\text{heap}_{funcstart\_719,1}$.p1,
177).rem))).**replace**(p2 → **asType\<short int\>**((div(**heapIs**
$\text{heap}_{funcstart\_719,1}$, $\text{heap}_{funcstart\_719,1}$.p2, 176).rem *
asType\<int\>(**asType\<short int\>**((**int**)172))) −
(**asType\<int\>**(**asType\<short int\>**(div2.quot)) *
asType\<int\>($\text{heap}_{719,1;729,8}$.b2)))))

→ *[simplify]*

[31.11] $\text{heap}_{719,1;730,8}$ == $\text{heap}_{funcstart\_719,1}$.**replace**(p1 → ((-2 *
div(**heapIs** $\text{heap}_{funcstart\_719,1}$, $\text{heap}_{funcstart\_719,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\text{heap}_{funcstart\_719,1}$, $\text{heap}_{funcstart\_719,1}$.p1,
177).rem))).**replace**(p2 → **asType\<short int\>**((div(**heapIs**
$\text{heap}_{funcstart\_719,1}$, $\text{heap}_{funcstart\_719,1}$.p2, 176).rem * 172) −
(**asType\<int\>**(**asType\<short int\>**(div2.quot)) *
asType\<int\>($\text{heap}_{719,1;729,8}$.b2)))))

→ *[from term 12.6, div2 is equal to div(**heapIs** $heap_{funcstart\_719,1}$,
$heap_{funcstart\_719,1}$.p2, 176)]*

[31.12] $\text{heap}_{719,1;730,8}$ == $\text{heap}_{funcstart\_719,1}$.**replace**(p1 → ((-2 *

div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}.\text{p1}$, 177).quot) + (171 * div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}.\text{p1}$, 177).rem))).**_replace**(p2 → **asType<short int>**((172 * div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}.\text{p2}$, 176).rem) − (**asType<int>**(**asType<short int>**(div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}.\text{p2}$, 176).quot)) * **asType<int>**($\$\text{heap}_{719,1;729,8}.\text{b2}$)))))

→ *[simplify]*

[31.14] $\$\text{heap}_{719,1;730,8}$ == $\$\text{heap}_{funcstart\_719,1}.$**_replace**(p1 → ((-2 * div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}.\text{p1}$, 177).quot) + (171 * div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}.\text{p1}$, 177).rem))).**_replace**(p2 → **asType<short int>**((172 * div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}.\text{p2}$, 176).rem) − (div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}.\text{p2}$, 176).quot * **asType<int>**($\$\text{heap}_{719,1;729,8}.\text{b2}$)))))

→ *[from term 26.19, $\$\text{heap}_{719,1;729,8}$ is equal to $\$\text{heap}_{funcstart\_719,1}.$**_replace**(p1 → (-2 * div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}.\text{p1}$, 177).quot) + (171 * div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}.\text{p1}$, 177).rem))]*

[31.15] $\$\text{heap}_{719,1;730,8}$ == $\$\text{heap}_{funcstart\_719,1}.$**_replace**(p1 → ((-2 * div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}.\text{p1}$, 177).quot) + (171 * div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}.\text{p1}$, 177).rem))).**_replace**(p2 → **asType<short int>**((172 * div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}.\text{p2}$, 176).rem) − (div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}.\text{p2}$, 176).quot * **asType<int>**($\$\text{heap}_{funcstart\_719,1}.$**_replace**(p1 → ((-2 * div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}.\text{p1}$, 177).quot) + (171 * div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}.\text{p1}$, 177).rem))).\text{b2}$)))))

→ *[const member of object with modified fields]*

[31.16] $\$\text{heap}_{719,1;730,8}$ == $\$\text{heap}_{funcstart\_719,1}.$**_replace**(p1 → ((-2 * div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}.\text{p1}$, 177).quot) + (171 * div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}.\text{p1}$, 177).rem))).**_replace**(p2 → **asType<short int>**((172 * div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}.\text{p2}$, 176).rem) − (div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}.\text{p2}$, 176).quot * **asType<int>**($\$\text{heap}_{funcstart\_719,1}.\text{b2}$)))))

→ *[const static or extern object]*

[31.17] $\$\text{heap}_{719,1;730,8}$ == $\$\text{heap}_{funcstart\_719,1}.$**_replace**(p1 → ((-2 * div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}.\text{p1}$, 177).quot) + (171 * div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}.\text{p1}$, 177).rem))).**_replace**(p2 → **asType<short int>**((172 * div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}.\text{p2}$, 176).rem) − (div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}.\text{p2}$, 176).quot *

asType<int>($heap$_{init}$.b2))))

→ *[expand definition of constant 'b2' at prang.c (22,20)]*

[31.18] $heap$_{719,1;730,8}$ == $heap$_{funcstart_719,1}$._**replace**(p1 → ((-2 * div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1, 177).quot) + (171 * div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1, 177).rem)))._**replace**(p2 → **asType<short int>**((172 * div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p2, 176).rem) − (div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p2, 176).quot * **asType<int>**(**asType<short int>**((**int**)35)))))

→ *[simplify]*

[31.24] $heap$_{719,1;730,8}$ == $heap$_{funcstart_719,1}$._**replace**(p1 → ((-2 * div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1, 177).quot) + (171 * div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1, 177).rem)))._**replace**(p2 → ((-35 * div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p2, 176).quot) + (172 * div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p2, 176).rem)))

[Take goal term]

[1.0] $heap$_{719,1;730,8}$.b3 ≤ **maxof(int)**

→ *[from term 31.24, $heap$_{719,1;730,8}$ is equal to $heap$_{funcstart_719,1}$._**replace**(p1 → ((-2 * div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1, 177).quot) + (171 * div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1, 177).rem)))._**replace**(p2 → (-35 * div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p2, 176).quot) + (172 * div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p2, 176).rem))]*

[1.1] $heap$_{funcstart_719,1}$._**replace**(p1 → ((-2 * div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1, 177).quot) + (171 * div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1, 177).rem)))._**replace**(p2 → ((-35 * div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p2, 176).quot) + (172 * div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p2, 176).rem))).b3 ≤ **maxof(int)**

→ *[const member of object with modified fields]*

[1.3] $heap$_{funcstart_719,1}$.b3 ≤ **maxof(int)**

→ *[const static or extern object]*

[1.4] $heap$_{init}$.b3 ≤ **maxof(int)**

→ *[expand definition of constant 'b3' at prang.c (27,20)]*

[1.5] **asType<short int>**((**int**)63) ≤ **maxof(int)**

→ *[simplify]*

[1.9] **true**

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

Condition generated at: C:\Escher\Customers\prang\prang.c (49,38)

Condition defined at:

To prove: minof(int) $\leq$ (**asType$<$int$>$**(**asType$<$short int$>$**(div3.quot)) * **asType$<$int$>$**($\$\text{heap}_{719,1;730,8}$.b3))

Given:

$\$\text{heap}_{init}$.LIMIT == (**int**)80

$\$\text{heap}_{init}$.M1 == **asType$<$short int$>$**((**int**)30269)

$\$\text{heap}_{init}$.r1 == **asType$<$short int$>$**((**int**)171)

$\$\text{heap}_{init}$.a1 == **asType$<$short int$>$**((**int**)177)

$\$\text{heap}_{init}$.b1 == **asType$<$short int$>$**((**int**)2)

$\$\text{heap}_{init}$.M2 == **asType$<$short int$>$**((**int**)30307)

$\$\text{heap}_{init}$.r2 == **asType$<$short int$>$**((**int**)172)

$\$\text{heap}_{init}$.a2 == **asType$<$short int$>$**((**int**)176)

$\$\text{heap}_{init}$.b2 == **asType$<$short int$>$**((**int**)35)

$\$\text{heap}_{init}$.M3 == **asType$<$short int$>$**((**int**)30323)

$\$\text{heap}_{init}$.r3 == **asType$<$short int$>$**((**int**)170)

$\$\text{heap}_{init}$.a3 == **asType$<$short int$>$**((**int**)178)

$\$\text{heap}_{init}$.b3 == **asType$<$short int$>$**((**int**)63)

$\$\text{heap}_{init}$.p1 == **asType$<$short int$>$**((**int**)1)

$\$\text{heap}_{init}$.p2 == **asType$<$short int$>$**((**int**)2)

$\$\text{heap}_{init}$.p3 == **asType$<$short int$>$**((**int**)3)

div1 == div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$,
asType$<$int$>$($\$\text{heap}_{funcstart\_719,1}$.p1),
asType$<$int$>$($\$\text{heap}_{funcstart\_719,1}$.a1))

(**asType$<$integer$>$**(**asType$<$int$>$**($\$\text{heap}_{funcstart\_719,1}$.p1)) /
asType$<$integer$>$(**asType$<$int$>$**($\$\text{heap}_{funcstart\_719,1}$.a1))) ==
asType$<$integer$>$(div1.quot)

(**asType$<$integer$>$**(**asType$<$int$>$**($\$\text{heap}_{funcstart\_719,1}$.p1)) %
asType$<$integer$>$(**asType$<$int$>$**($\$\text{heap}_{funcstart\_719,1}$.a1))) ==
asType$<$integer$>$(div1.rem)

div2 == div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$,
asType$<$int$>$($\$\text{heap}_{funcstart\_719,1}$.p2),
asType$<$int$>$($\$\text{heap}_{funcstart\_719,1}$.a2))

$(\textbf{asType}<\textbf{integer}>(\textbf{asType}<\textbf{int}>(\$\text{heap}_{funcstart\_719,1}.\text{p2})) /$
$\textbf{asType}<\textbf{integer}>(\textbf{asType}<\textbf{int}>(\$\text{heap}_{funcstart\_719,1}.\text{a2}))) ==$
$\textbf{asType}<\textbf{integer}>(\text{div2.quot})$

$(\textbf{asType}<\textbf{integer}>(\textbf{asType}<\textbf{int}>(\$\text{heap}_{funcstart\_719,1}.\text{p2})) \%$
$\textbf{asType}<\textbf{integer}>(\textbf{asType}<\textbf{int}>(\$\text{heap}_{funcstart\_719,1}.\text{a2}))) ==$
$\textbf{asType}<\textbf{integer}>(\text{div2.rem})$

$\text{div3} == \text{div}(\textbf{heapIs}\ \$\text{heap}_{funcstart\_719,1},$
$\textbf{asType}<\textbf{int}>(\$\text{heap}_{funcstart\_719,1}.\text{p3}),$
$\textbf{asType}<\textbf{int}>(\$\text{heap}_{funcstart\_719,1}.\text{a3}))$

$(\textbf{asType}<\textbf{integer}>(\textbf{asType}<\textbf{int}>(\$\text{heap}_{funcstart\_719,1}.\text{p3})) /$
$\textbf{asType}<\textbf{integer}>(\textbf{asType}<\textbf{int}>(\$\text{heap}_{funcstart\_719,1}.\text{a3}))) ==$
$\textbf{asType}<\textbf{integer}>(\text{div3.quot})$

$(\textbf{asType}<\textbf{integer}>(\textbf{asType}<\textbf{int}>(\$\text{heap}_{funcstart\_719,1}.\text{p3})) \%$
$\textbf{asType}<\textbf{integer}>(\textbf{asType}<\textbf{int}>(\$\text{heap}_{funcstart\_719,1}.\text{a3}))) ==$
$\textbf{asType}<\textbf{integer}>(\text{div3.rem})$

$\$\text{heap}_{719,1;729,8} == \$\text{heap}_{funcstart\_719,1}.\textbf{replace}(\text{p1} \to \textbf{asType}<\textbf{short}$
$\textbf{int}>((\textbf{asType}<\textbf{int}>(\textbf{asType}<\textbf{short int}>(\text{div1.rem})) *$
$\textbf{asType}<\textbf{int}>(\$\text{heap}_{funcstart\_719,1}.\text{r1})) - (\textbf{asType}<\textbf{int}>(\textbf{asType}<\textbf{short}$
$\textbf{int}>(\text{div1.quot})) * \textbf{asType}<\textbf{int}>(\$\text{heap}_{funcstart\_719,1}.\text{b1}))))$

$\$\text{heap}_{719,1;730,8} == \$\text{heap}_{719,1;729,8}.\textbf{replace}(\text{p2} \to \textbf{asType}<\textbf{short}$
$\textbf{int}>((\textbf{asType}<\textbf{int}>(\textbf{asType}<\textbf{short int}>(\text{div2.rem})) *$
$\textbf{asType}<\textbf{int}>(\$\text{heap}_{719,1;729,8}.\text{r2})) - (\textbf{asType}<\textbf{int}>(\textbf{asType}<\textbf{short}$
$\textbf{int}>(\text{div2.quot})) * \textbf{asType}<\textbf{int}>(\$\text{heap}_{719,1;729,8}.\text{b2}))))$

Proof:

[Take given term]

[5.0] $\text{div1} == \text{div}(\textbf{heapIs}\ \$\text{heap}_{funcstart\_719,1},$
$\textbf{asType}<\textbf{int}>(\$\text{heap}_{funcstart\_719,1}.\text{p1}),$
$\textbf{asType}<\textbf{int}>(\$\text{heap}_{funcstart\_719,1}.\text{a1}))$

$\to$ *[simplify]*

[5.1] $\text{div1} == \text{div}(\textbf{heapIs}\ \$\text{heap}_{funcstart\_719,1}, \$\text{heap}_{funcstart\_719,1}.\text{p1},$
$\textbf{asType}<\textbf{int}>(\$\text{heap}_{funcstart\_719,1}.\text{a1}))$

$\to$ *[const static or extern object]*

[5.2] $\text{div1} == \text{div}(\textbf{heapIs}\ \$\text{heap}_{funcstart\_719,1}, \$\text{heap}_{funcstart\_719,1}.\text{p1},$
$\textbf{asType}<\textbf{int}>(\$\text{heap}_{init}.\text{a1}))$

$\to$ *[expand definition of constant 'a1' at prang.c (16,20)]*

[5.3] $\text{div1} == \text{div}(\textbf{heapIs}\ \$\text{heap}_{funcstart\_719,1}, \$\text{heap}_{funcstart\_719,1}.\text{p1},$
$\textbf{asType}<\textbf{int}>(\textbf{asType}<\textbf{short int}>((\textbf{int})177)))$

$\to$ *[simplify]*

[5.6] div1 == div(**heapIs** \$heap$_{funcstart\_719,1}$, \$heap$_{funcstart\_719,1}$.p1, 177)

[Take given term]

[12.0] div2 == div(**heapIs** \$heap$_{funcstart\_719,1}$,
asType\<int\>(\$heap$_{funcstart\_719,1}$.p2),
asType\<int\>(\$heap$_{funcstart\_719,1}$.a2))

$\rightarrow$ *[simplify]*

[12.1] div2 == div(**heapIs** \$heap$_{funcstart\_719,1}$, \$heap$_{funcstart\_719,1}$.p2,
asType\<int\>(\$heap$_{funcstart\_719,1}$.a2))

$\rightarrow$ *[const static or extern object]*

[12.2] div2 == div(**heapIs** \$heap$_{funcstart\_719,1}$, \$heap$_{funcstart\_719,1}$.p2,
asType\<int\>(\$heap$_{init}$.a2))

$\rightarrow$ *[expand definition of constant 'a2' at prang.c (21,20)]*

[12.3] div2 == div(**heapIs** \$heap$_{funcstart\_719,1}$, \$heap$_{funcstart\_719,1}$.p2,
asType\<int\>(**asType\<short int\>**((**int**)176)))

$\rightarrow$ *[simplify]*

[12.6] div2 == div(**heapIs** \$heap$_{funcstart\_719,1}$, \$heap$_{funcstart\_719,1}$.p2, 176)

[Take given term]

[19.0] div3 == div(**heapIs** \$heap$_{funcstart\_719,1}$,
asType\<int\>(\$heap$_{funcstart\_719,1}$.p3),
asType\<int\>(\$heap$_{funcstart\_719,1}$.a3))

$\rightarrow$ *[simplify]*

[19.1] div3 == div(**heapIs** \$heap$_{funcstart\_719,1}$, \$heap$_{funcstart\_719,1}$.p3,
asType\<int\>(\$heap$_{funcstart\_719,1}$.a3))

$\rightarrow$ *[const static or extern object]*

[19.2] div3 == div(**heapIs** \$heap$_{funcstart\_719,1}$, \$heap$_{funcstart\_719,1}$.p3,
asType\<int\>(\$heap$_{init}$.a3))

$\rightarrow$ *[expand definition of constant 'a3' at prang.c (26,20)]*

[19.3] div3 == div(**heapIs** \$heap$_{funcstart\_719,1}$, \$heap$_{funcstart\_719,1}$.p3,
asType\<int\>(**asType\<short int\>**((**int**)178)))

$\rightarrow$ *[simplify]*

[19.6] div3 == div(**heapIs** \$heap$_{funcstart\_719,1}$, \$heap$_{funcstart\_719,1}$.p3, 178)

[Assume known post-assertion, class invariant or type constraint for term 19.6]

[22.0] **minof(short int)** $\leq$ \$heap$_{funcstart\_719,1}$.p3

$\rightarrow$ *[simplify]*

[22.3] -32769 < \$heap$_{funcstart\_719,1}$.p3

[Assume known post-assertion, class invariant or type constraint for term 19.6]

[24.0] (**asType**<**integer**>($\text{heap}_{funcstart\_719,1}$.p3) /
asType<**integer**>(178)) == **asType**<**integer**>(div(**heapIs**
$\text{heap}_{funcstart\_719,1}$, $\text{heap}_{funcstart\_719,1}$.p3, 178).quot)

$\rightarrow$ *[simplify]*

[24.2] ($\text{heap}_{funcstart\_719,1}$.p3 / 178) == **asType**<**integer**>(div(**heapIs**
$\text{heap}_{funcstart\_719,1}$, $\text{heap}_{funcstart\_719,1}$.p3, 178).quot)

$\rightarrow$ *[expand definition of operator './' in class 'int' at built in declaration]*

[24.3] ([**asType**<**integer**>($\text{heap}_{funcstart\_719,1}$.p3) < 0]:
$-(-$**asType**<**integer**>($\text{heap}_{funcstart\_719,1}$.p3) / 178), []:
asType<**integer**>($\text{heap}_{funcstart\_719,1}$.p3) / 178) ==
asType<**integer**>(div(**heapIs** $\text{heap}_{funcstart\_719,1}$, $\text{heap}_{funcstart\_719,1}$.p3,
178).quot)

$\rightarrow$ *[explicitly assert falsehood of skipped guards in subsequent guards]*

[24.4] ([**asType**<**integer**>($\text{heap}_{funcstart\_719,1}$.p3) < 0]:
$-(-$**asType**<**integer**>($\text{heap}_{funcstart\_719,1}$.p3) / 178),
[!(**asType**<**integer**>($\text{heap}_{funcstart\_719,1}$.p3) < 0)]:
asType<**integer**>($\text{heap}_{funcstart\_719,1}$.p3) / 178) ==
asType<**integer**>(div(**heapIs** $\text{heap}_{funcstart\_719,1}$, $\text{heap}_{funcstart\_719,1}$.p3,
178).quot)

$\rightarrow$ *[simplify]*

[24.17] 0 == $(-([0 < -$\text{heap}_{funcstart_719,1}$.p3]: $-(-$\text{heap}_{funcstart_719,1}$.p3 /
178), [-1 < $\text{heap}_{funcstart\_719,1}$.p3]: $\text{heap}_{funcstart\_719,1}$.p3 / 178) +
div(**heapIs** $\text{heap}_{funcstart\_719,1}$, $\text{heap}_{funcstart\_719,1}$.p3, 178).quot)

$\rightarrow$ *[move guard outside expression]*

[24.18] 0 == $(([0 < -$\text{heap}_{funcstart_719,1}$.p3]: $-(-(-$\text{heap}_{funcstart_719,1}$.p3 /
178)), [-1 < $\text{heap}_{funcstart\_719,1}$.p3]: $-($\text{heap}_{funcstart_719,1}$.p3 / 178)) +
div(**heapIs** $\text{heap}_{funcstart\_719,1}$, $\text{heap}_{funcstart\_719,1}$.p3, 178).quot)

$\rightarrow$ *[simplify]*

[24.19] 0 == $(([0 < -$\text{heap}_{funcstart_719,1}$.p3]: $-$\text{heap}_{funcstart_719,1}$.p3 / 178,
[-1 < $\text{heap}_{funcstart\_719,1}$.p3]: $-($\text{heap}_{funcstart_719,1}$.p3 / 178)) + div(**heapIs**
$\text{heap}_{funcstart\_719,1}$, $\text{heap}_{funcstart\_719,1}$.p3, 178).quot)

$\rightarrow$ *[move guard outside expression]*

[24.21] ([0 < $-$\text{heap}_{funcstart_719,1}$.p3]: 0 == $((-$\text{heap}_{funcstart_719,1}$.p3 / 178)
+ div(**heapIs** $\text{heap}_{funcstart\_719,1}$, $\text{heap}_{funcstart\_719,1}$.p3, 178).quot), [-1 <
$\text{heap}_{funcstart\_719,1}$.p3]: 0 == $(-($\text{heap}_{funcstart_719,1}$.p3 / 178) + div(**heapIs**
$\text{heap}_{funcstart\_719,1}$, $\text{heap}_{funcstart\_719,1}$.p3, 178).quot))

[Take given term]

[26.0] $\$heap_{719,1;729,8}$ == $\$heap_{funcstart\_719,1}$.__**replace**(p1 → **asType<short int>**((**asType<int>**(**asType<short int>**(div1.rem)) * **asType<int>**($\$heap_{funcstart\_719,1}$.r1)) − (**asType<int>**(**asType<short int>**(div1.quot)) * **asType<int>**($\$heap_{funcstart\_719,1}$.b1))))

→ *[from term 5.6, div1 is equal to div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177)]*

[26.1] $\$heap_{719,1;729,8}$ == $\$heap_{funcstart\_719,1}$.__**replace**(p1 → **asType<short int>**((**asType<int>**(**asType<short int>**(div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).rem)) * **asType<int>**($\$heap_{funcstart\_719,1}$.r1)) − (**asType<int>**(**asType<short int>**(div1.quot)) * **asType<int>**($\$heap_{funcstart\_719,1}$.b1))))

→ *[simplify]*

[26.3] $\$heap_{719,1;729,8}$ == $\$heap_{funcstart\_719,1}$.__**replace**(p1 → **asType<short int>**((div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).rem * **asType<int>**($\$heap_{funcstart\_719,1}$.r1)) − (**asType<int>**(**asType<short int>**(div1.quot)) * **asType<int>**($\$heap_{funcstart\_719,1}$.b1))))

→ *[const static or extern object]*

[26.4] $\$heap_{719,1;729,8}$ == $\$heap_{funcstart\_719,1}$.__**replace**(p1 → **asType<short int>**((div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).rem * **asType<int>**($\$heap_{init}$.r1)) − (**asType<int>**(**asType<short int>**(div1.quot)) * **asType<int>**($\$heap_{funcstart\_719,1}$.b1))))

→ *[expand definition of constant 'r1' at prang.c (15,20)]*

[26.5] $\$heap_{719,1;729,8}$ == $\$heap_{funcstart\_719,1}$.__**replace**(p1 → **asType<short int>**((div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).rem * **asType<int>**(**asType<short int>**((**int**)171))) − (**asType<int>**(**asType<short int>**(div1.quot)) * **asType<int>**($\$heap_{funcstart\_719,1}$.b1))))

→ *[simplify]*

[26.8] $\$heap_{719,1;729,8}$ == $\$heap_{funcstart\_719,1}$.__**replace**(p1 → **asType<short int>**((div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).rem * 171) − (**asType<int>**(**asType<short int>**(div1.quot)) * **asType<int>**($\$heap_{funcstart\_719,1}$.b1))))

→ *[from term 5.6, div1 is equal to div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177)]*

[26.9] $\$heap_{719,1;729,8}$ == $\$heap_{funcstart\_719,1}$.__**replace**(p1 → **asType<short int>**((171 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).rem) − (**asType<int>**(**asType<short int>**(div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot)) * **asType<int>**($\$heap_{funcstart\_719,1}$.b1))))

→ *[simplify]*

[26.11] $\$\text{heap}_{719,1;729,8}$ == $\$\text{heap}_{funcstart\_719,1}$._**replace**(p1 → **asType**<**short int**>((171 * div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}$.p1, 177).rem) − (div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}$.p1, 177).quot * **asType**<**int**>($\$\text{heap}_{funcstart\_719,1}$.b1))))

→ *[const static or extern object]*

[26.12] $\$\text{heap}_{719,1;729,8}$ == $\$\text{heap}_{funcstart\_719,1}$._**replace**(p1 → **asType**<**short int**>((171 * div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}$.p1, 177).rem) − (div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}$.p1, 177).quot * **asType**<**int**>($\$\text{heap}_{init}$.b1))))

→ *[expand definition of constant 'b1' at prang.c (17,20)]*

[26.13] $\$\text{heap}_{719,1;729,8}$ == $\$\text{heap}_{funcstart\_719,1}$._**replace**(p1 → **asType**<**short int**>((171 * div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}$.p1, 177).rem) − (div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}$.p1, 177).quot * **asType**<**int**>(**asType**<**short int**>((**int**)2)))))

→ *[simplify]*

[26.19] $\$\text{heap}_{719,1;729,8}$ == $\$\text{heap}_{funcstart\_719,1}$._**replace**(p1 → ((-2 * div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}$.p1, 177).rem)))

[Take given term]

[31.0] $\$\text{heap}_{719,1;730,8}$ == $\$\text{heap}_{719,1;729,8}$._**replace**(p2 → **asType**<**short int**>((**asType**<**int**>(**asType**<**short int**>(div2.rem)) * **asType**<**int**>($\$\text{heap}_{719,1;729,8}$.r2)) − (**asType**<**int**>(**asType**<**short int**>(div2.quot)) * **asType**<**int**>($\$\text{heap}_{719,1;729,8}$.b2))))

→ *[from term 26.19, $heap_{719,1;729,8}$ is equal to $heap_{funcstart\_719,1}$._**replace**(p1 → (-2 * div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p1, 177).rem))]*

[31.1] $\$\text{heap}_{719,1;730,8}$ == $\$\text{heap}_{funcstart\_719,1}$._**replace**(p1 → ((-2 * div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}$.p1, 177).rem)))._**replace**(p2 → **asType**<**short int**>((**asType**<**int**>(**asType**<**short int**>(div2.rem)) * **asType**<**int**>($\$\text{heap}_{719,1;729,8}$.r2)) − (**asType**<**int**>(**asType**<**short int**>(div2.quot)) * **asType**<**int**>($\$\text{heap}_{719,1;729,8}$.b2))))

→ *[from term 12.6, div2 is equal to div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p2, 176)]*

[31.2] $\$\text{heap}_{719,1;730,8}$ == $\$\text{heap}_{funcstart\_719,1}$._**replace**(p1 → ((-2 * div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}$.p1, 177).rem)))._**replace**(p2 → **asType**<**short int**>((**asType**<**int**>(**asType**<**short int**>(div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$,

$\text{\$heap}_{funcstart\_719,1}.\text{p2}, 176).\text{rem})) * \textbf{asType}{<}\textbf{int}{>}(\text{\$heap}_{719,1;729,8}.\text{r2})) -$
$(\textbf{asType}{<}\textbf{int}{>}(\textbf{asType}{<}\textbf{short int}{>}(\text{div2.quot})) *$
$\textbf{asType}{<}\textbf{int}{>}(\text{\$heap}_{719,1;729,8}.\text{b2}))))$

$\rightarrow$ *[simplify]*

[31.4] $\text{\$heap}_{719,1;730,8} == \text{\$heap}_{funcstart\_719,1}.\underline{\textbf{replace}}(\text{p1} \rightarrow ((\text{-2} *$
$\text{div}(\textbf{heapIs} \text{ \$heap}_{funcstart\_719,1}, \text{\$heap}_{funcstart\_719,1}.\text{p1}, 177).\text{quot}) + (171 *$
$\text{div}(\textbf{heapIs} \text{ \$heap}_{funcstart\_719,1}, \text{\$heap}_{funcstart\_719,1}.\text{p1},$
$177).\text{rem}))).\underline{\textbf{replace}}(\text{p2} \rightarrow \textbf{asType}{<}\textbf{short int}{>}((\text{div}(\textbf{heapIs}$
$\text{\$heap}_{funcstart\_719,1}, \text{\$heap}_{funcstart\_719,1}.\text{p2}, 176).\text{rem} *$
$\textbf{asType}{<}\textbf{int}{>}(\text{\$heap}_{719,1;729,8}.\text{r2})) - (\textbf{asType}{<}\textbf{int}{>}(\textbf{asType}{<}\textbf{short}$
$\textbf{int}{>}(\text{div2.quot})) * \textbf{asType}{<}\textbf{int}{>}(\text{\$heap}_{719,1;729,8}.\text{b2}))))$

$\rightarrow$ *[from term 26.19, $\text{\$heap}_{719,1;729,8}$ is equal to*
*$\text{\$heap}_{funcstart\_719,1}.\underline{\textbf{replace}}(p1 \rightarrow (\text{-2} * div(\textbf{heapIs} \text{ \$heap}_{funcstart\_719,1},$*
*$\text{\$heap}_{funcstart\_719,1}.p1, 177).quot) + (171 * div(\textbf{heapIs} \text{ \$heap}_{funcstart\_719,1},$*
$\text{\$heap}_{funcstart_719,1}.p1, 177).rem))]

[31.5] $\text{\$heap}_{719,1;730,8} == \text{\$heap}_{funcstart\_719,1}.\underline{\textbf{replace}}(\text{p1} \rightarrow ((\text{-2} *$
$\text{div}(\textbf{heapIs} \text{ \$heap}_{funcstart\_719,1}, \text{\$heap}_{funcstart\_719,1}.\text{p1}, 177).\text{quot}) + (171 *$
$\text{div}(\textbf{heapIs} \text{ \$heap}_{funcstart\_719,1}, \text{\$heap}_{funcstart\_719,1}.\text{p1},$
$177).\text{rem}))).\underline{\textbf{replace}}(\text{p2} \rightarrow \textbf{asType}{<}\textbf{short int}{>}((\text{div}(\textbf{heapIs}$
$\text{\$heap}_{funcstart\_719,1}, \text{\$heap}_{funcstart\_719,1}.\text{p2}, 176).\text{rem} *$
$\textbf{asType}{<}\textbf{int}{>}(\text{\$heap}_{funcstart\_719,1}.\underline{\textbf{replace}}(\text{p1} \rightarrow ((\text{-2} * \text{div}(\textbf{heapIs}$
$\text{\$heap}_{funcstart\_719,1}, \text{\$heap}_{funcstart\_719,1}.\text{p1}, 177).\text{quot}) + (171 * \text{div}(\textbf{heapIs}$
$\text{\$heap}_{funcstart\_719,1}, \text{\$heap}_{funcstart\_719,1}.\text{p1}, 177).\text{rem}))).\text{r2})) -$
$(\textbf{asType}{<}\textbf{int}{>}(\textbf{asType}{<}\textbf{short int}{>}(\text{div2.quot})) *$
$\textbf{asType}{<}\textbf{int}{>}(\text{\$heap}_{719,1;729,8}.\text{b2}))))$

$\rightarrow$ *[const member of object with modified fields]*

[31.6] $\text{\$heap}_{719,1;730,8} == \text{\$heap}_{funcstart\_719,1}.\underline{\textbf{replace}}(\text{p1} \rightarrow ((\text{-2} *$
$\text{div}(\textbf{heapIs} \text{ \$heap}_{funcstart\_719,1}, \text{\$heap}_{funcstart\_719,1}.\text{p1}, 177).\text{quot}) + (171 *$
$\text{div}(\textbf{heapIs} \text{ \$heap}_{funcstart\_719,1}, \text{\$heap}_{funcstart\_719,1}.\text{p1},$
$177).\text{rem}))).\underline{\textbf{replace}}(\text{p2} \rightarrow \textbf{asType}{<}\textbf{short int}{>}((\text{div}(\textbf{heapIs}$
$\text{\$heap}_{funcstart\_719,1}, \text{\$heap}_{funcstart\_719,1}.\text{p2}, 176).\text{rem} *$
$\textbf{asType}{<}\textbf{int}{>}(\text{\$heap}_{funcstart\_719,1}.\text{r2})) - (\textbf{asType}{<}\textbf{int}{>}(\textbf{asType}{<}\textbf{short}$
$\textbf{int}{>}(\text{div2.quot})) * \textbf{asType}{<}\textbf{int}{>}(\text{\$heap}_{719,1;729,8}.\text{b2}))))$

$\rightarrow$ *[const static or extern object]*

[31.7] $\text{\$heap}_{719,1;730,8} == \text{\$heap}_{funcstart\_719,1}.\underline{\textbf{replace}}(\text{p1} \rightarrow ((\text{-2} *$
$\text{div}(\textbf{heapIs} \text{ \$heap}_{funcstart\_719,1}, \text{\$heap}_{funcstart\_719,1}.\text{p1}, 177).\text{quot}) + (171 *$
$\text{div}(\textbf{heapIs} \text{ \$heap}_{funcstart\_719,1}, \text{\$heap}_{funcstart\_719,1}.\text{p1},$
$177).\text{rem}))).\underline{\textbf{replace}}(\text{p2} \rightarrow \textbf{asType}{<}\textbf{short int}{>}((\text{div}(\textbf{heapIs}$
$\text{\$heap}_{funcstart\_719,1}, \text{\$heap}_{funcstart\_719,1}.\text{p2}, 176).\text{rem} *$
$\textbf{asType}{<}\textbf{int}{>}(\text{\$heap}_{init}.\text{r2})) - (\textbf{asType}{<}\textbf{int}{>}(\textbf{asType}{<}\textbf{short}$
$\textbf{int}{>}(\text{div2.quot})) * \textbf{asType}{<}\textbf{int}{>}(\text{\$heap}_{719,1;729,8}.\text{b2}))))$

$\rightarrow$ *[expand definition of constant 'r2' at prang.c (20,20)]*

[31.8] $\text{\$heap}_{719,1;730,8} == \text{\$heap}_{funcstart\_719,1}.\textbf{replace}(\text{p1} \to ((\text{-2 } *$
$\text{div}(\textbf{heapIs } \text{\$heap}_{funcstart\_719,1}, \text{\$heap}_{funcstart\_719,1}.\text{p1}, 177).\text{quot}) + (171 *$
$\text{div}(\textbf{heapIs } \text{\$heap}_{funcstart\_719,1}, \text{\$heap}_{funcstart\_719,1}.\text{p1},$
$177).\text{rem}))).\textbf{\_replace}(\text{p2} \to \textbf{asType<short int>}((\text{div}(\textbf{heapIs}$
$\text{\$heap}_{funcstart\_719,1}, \text{\$heap}_{funcstart\_719,1}.\text{p2}, 176).\text{rem} *$
$\textbf{asType<int>}(\textbf{asType<short int>}((\textbf{int})172))) -$
$(\textbf{asType<int>}(\textbf{asType<short int>}(\text{div2.quot})) *$
$\textbf{asType<int>}(\text{\$heap}_{719,1;729,8}.\text{b2})))))$

$\to$ *[simplify]*

[31.11] $\text{\$heap}_{719,1;730,8} == \text{\$heap}_{funcstart\_719,1}.\textbf{replace}(\text{p1} \to ((\text{-2 } *$
$\text{div}(\textbf{heapIs } \text{\$heap}_{funcstart\_719,1}, \text{\$heap}_{funcstart\_719,1}.\text{p1}, 177).\text{quot}) + (171 *$
$\text{div}(\textbf{heapIs } \text{\$heap}_{funcstart\_719,1}, \text{\$heap}_{funcstart\_719,1}.\text{p1},$
$177).\text{rem}))).\textbf{\_replace}(\text{p2} \to \textbf{asType<short int>}((\text{div}(\textbf{heapIs}$
$\text{\$heap}_{funcstart\_719,1}, \text{\$heap}_{funcstart\_719,1}.\text{p2}, 176).\text{rem} * 172) -$
$(\textbf{asType<int>}(\textbf{asType<short int>}(\text{div2.quot})) *$
$\textbf{asType<int>}(\text{\$heap}_{719,1;729,8}.\text{b2})))))$

$\to$ *[from term 12.6, div2 is equal to div(**heapIs** $heap_{funcstart\_719,1}$,*
$heap_{funcstart_719,1}.p2, 176)]

[31.12] $\text{\$heap}_{719,1;730,8} == \text{\$heap}_{funcstart\_719,1}.\textbf{replace}(\text{p1} \to ((\text{-2 } *$
$\text{div}(\textbf{heapIs } \text{\$heap}_{funcstart\_719,1}, \text{\$heap}_{funcstart\_719,1}.\text{p1}, 177).\text{quot}) + (171 *$
$\text{div}(\textbf{heapIs } \text{\$heap}_{funcstart\_719,1}, \text{\$heap}_{funcstart\_719,1}.\text{p1},$
$177).\text{rem}))).\textbf{\_replace}(\text{p2} \to \textbf{asType<short int>}((172 * \text{div}(\textbf{heapIs}$
$\text{\$heap}_{funcstart\_719,1}, \text{\$heap}_{funcstart\_719,1}.\text{p2}, 176).\text{rem}) -$
$(\textbf{asType<int>}(\textbf{asType<short int>}(\text{div}(\textbf{heapIs } \text{\$heap}_{funcstart\_719,1},$
$\text{\$heap}_{funcstart\_719,1}.\text{p2}, 176).\text{quot})) * \textbf{asType<int>}(\text{\$heap}_{719,1;729,8}.\text{b2})))))$

$\to$ *[simplify]*

[31.14] $\text{\$heap}_{719,1;730,8} == \text{\$heap}_{funcstart\_719,1}.\textbf{replace}(\text{p1} \to ((\text{-2 } *$
$\text{div}(\textbf{heapIs } \text{\$heap}_{funcstart\_719,1}, \text{\$heap}_{funcstart\_719,1}.\text{p1}, 177).\text{quot}) + (171 *$
$\text{div}(\textbf{heapIs } \text{\$heap}_{funcstart\_719,1}, \text{\$heap}_{funcstart\_719,1}.\text{p1},$
$177).\text{rem}))).\textbf{\_replace}(\text{p2} \to \textbf{asType<short int>}((172 * \text{div}(\textbf{heapIs}$
$\text{\$heap}_{funcstart\_719,1}, \text{\$heap}_{funcstart\_719,1}.\text{p2}, 176).\text{rem}) - (\text{div}(\textbf{heapIs}$
$\text{\$heap}_{funcstart\_719,1}, \text{\$heap}_{funcstart\_719,1}.\text{p2}, 176).\text{quot} *$
$\textbf{asType<int>}(\text{\$heap}_{719,1;729,8}.\text{b2})))))$

$\to$ *[from term 26.19, $heap_{719,1;729,8}$ is equal to*
*$heap_{funcstart_719,1}.**replace**(p1 \to (-2 * div(**heapIs** $heap_{funcstart\_719,1}$,*
*$heap_{funcstart_719,1}.p1, 177).quot) + (171 * div(**heapIs** $heap_{funcstart\_719,1}$,*
$heap_{funcstart_719,1}.p1, 177).rem))]

[31.15] $\text{\$heap}_{719,1;730,8} == \text{\$heap}_{funcstart\_719,1}.\textbf{replace}(\text{p1} \to ((\text{-2 } *$
$\text{div}(\textbf{heapIs } \text{\$heap}_{funcstart\_719,1}, \text{\$heap}_{funcstart\_719,1}.\text{p1}, 177).\text{quot}) + (171 *$
$\text{div}(\textbf{heapIs } \text{\$heap}_{funcstart\_719,1}, \text{\$heap}_{funcstart\_719,1}.\text{p1},$
$177).\text{rem}))).\textbf{\_replace}(\text{p2} \to \textbf{asType<short int>}((172 * \text{div}(\textbf{heapIs}$
$\text{\$heap}_{funcstart\_719,1}, \text{\$heap}_{funcstart\_719,1}.\text{p2}, 176).\text{rem}) - (\text{div}(\textbf{heapIs}$

$\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p2, 176).quot *
asType\<int\>($\text{\$heap}_{funcstart\_719,1}$._**replace**(p1 → ((-2 * div(**heapIs**
$\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs**
$\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p1, 177).rem))).b2))))

→ *[const member of object with modified fields]*

[31.16] $\text{\$heap}_{719,1;730,8}$ == $\text{\$heap}_{funcstart\_719,1}$._**replace**(p1 → ((-2 *
div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p1,
177).rem)))._**replace**(p2 → **asType\<short int\>**((172 * div(**heapIs**
$\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p2, 176).rem) − (div(**heapIs**
$\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p2, 176).quot *
asType\<int\>($\text{\$heap}_{funcstart\_719,1}$.b2))))

→ *[const static or extern object]*

[31.17] $\text{\$heap}_{719,1;730,8}$ == $\text{\$heap}_{funcstart\_719,1}$._**replace**(p1 → ((-2 *
div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p1,
177).rem)))._**replace**(p2 → **asType\<short int\>**((172 * div(**heapIs**
$\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p2, 176).rem) − (div(**heapIs**
$\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p2, 176).quot *
asType\<int\>($\text{\$heap}_{init}$.b2))))

→ *[expand definition of constant 'b2' at prang.c (22,20)]*

[31.18] $\text{\$heap}_{719,1;730,8}$ == $\text{\$heap}_{funcstart\_719,1}$._**replace**(p1 → ((-2 *
div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p1,
177).rem)))._**replace**(p2 → **asType\<short int\>**((172 * div(**heapIs**
$\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p2, 176).rem) − (div(**heapIs**
$\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p2, 176).quot *
asType\<int\>(**asType\<short int\>**((**int**)35)))))

→ *[simplify]*

[31.24] $\text{\$heap}_{719,1;730,8}$ == $\text{\$heap}_{funcstart\_719,1}$._**replace**(p1 → ((-2 *
div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p1,
177).rem)))._**replace**(p2 → ((-35 * div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$,
$\text{\$heap}_{funcstart\_719,1}$.p2, 176).quot) + (172 * div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$,
$\text{\$heap}_{funcstart\_719,1}$.p2, 176).rem)))

[Take goal term]

[1.0] **minof(int)** ≤ (**asType\<int\>**(**asType\<short int\>**(div3.quot)) *
asType\<int\>($\text{\$heap}_{719,1;730,8}$.b3))

→ *[simplify]*

[1.1] -32768 ≤ (**asType\<int\>**(**asType\<short int\>**(div3.quot)) *
asType\<int\>($\text{\$heap}_{719,1;730,8}$.b3))

→ [from term 19.6, div3 is equal to div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p3, 178)]

[1.2] -32768 ≤ (**asType\<int\>**(**asType\<short int\>**(div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p3, 178).quot)) * **asType\<int\>**($\$heap_{719,1;730,8}$.b3))

→ [simplify]

[1.4] -32768 ≤ (div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p3, 178).quot * **asType\<int\>**($\$heap_{719,1;730,8}$.b3))

→ [from term 31.24, $\$heap_{719,1;730,8}$ is equal to $\$heap_{funcstart\_719,1}$._**replace**(p1 → ((-2 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).rem)))._**replace**(p2 → (-35 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).quot) + (172 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).rem))]

[1.5] -32768 ≤ (div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p3, 178).quot * **asType\<int\>**($\$heap_{funcstart\_719,1}$._**replace**(p1 → ((-2 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).rem)))._**replace**(p2 → ((-35 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).quot) + (172 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).rem))).b3))

→ [const member of object with modified fields]

[1.7] -32768 ≤ (div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p3, 178).quot * **asType\<int\>**($\$heap_{funcstart\_719,1}$.b3))

→ [const static or extern object]

[1.8] -32768 ≤ (div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p3, 178).quot * **asType\<int\>**($\$heap_{init}$.b3))

→ [expand definition of constant 'b3' at prang.c (27,20)]

[1.9] -32768 ≤ (div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p3, 178).quot * **asType\<int\>**(**asType\<short int\>**((int)63)))

→ [simplify]

[1.14] -32769 < (63 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p3, 178).quot)

→ [literal comparison of product]

[1.15] ([63 < 0]: (-32769 / -63) < −div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p3, 178).quot, [0 < 63]: (-32769 / 63) < div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p3, 178).quot, [0 == 63]: -32769 < 0)

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

[1.16] ([63 < 0]: (-32769 / -63) < $-$div(**heapIs** $\$heap_{funcstart\_719,1}$,
$\$heap_{funcstart\_719,1}$.p3, 178).quot, [(0 < 63) $\wedge$!(63 < 0)]: (-32769 / 63) <
div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p3, 178).quot, [(0 == 63)
$\wedge$!(0 < 63) $\wedge$!(63 < 0)]: -32769 < 0)

$\rightarrow$ *[simplify]*

[1.24] -521 < div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p3,
178).quot

$\rightarrow$ *[negate goal and search for contradiction]*

[1.25] !(-521 < div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p3,
178).quot)

$\rightarrow$ *[simplify]*

[1.27] 520 < $-$div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p3,
178).quot

[Branch on disjunction or conditional in term 24.21]

[51.0] (0 == (($-\$heap_{funcstart\_719,1}$.p3 / 178) + div(**heapIs**
$\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p3, 178).quot)) $\vee$ (0 ==
($-(\$heap_{funcstart\_719,1}$.p3 / 178) + div(**heapIs** $\$heap_{funcstart\_719,1}$,
$\$heap_{funcstart\_719,1}$.p3, 178).quot)) $\vee$ (-1 < $\$heap_{funcstart\_719,1}$.p3)

[Create new term from terms 1.27, 51.0 using rule: transitivity 16]

[56.0] ((0 + 520) < ($-\$heap_{funcstart\_719,1}$.p3 / 178)) $\vee$ (0 ==
($-(\$heap_{funcstart\_719,1}$.p3 / 178) + div(**heapIs** $\$heap_{funcstart\_719,1}$,
$\$heap_{funcstart\_719,1}$.p3, 178).quot)) $\vee$ (-1 < $\$heap_{funcstart\_719,1}$.p3)

$\rightarrow$ *[simplify]*

[56.8] (92737 < $-\$heap_{funcstart\_719,1}$.p3) $\vee$ ...

$\rightarrow$ *[from term 22.3, literala < $-\$heap_{funcstart\_719,1}$.p3 is false whenever -2 <
(-32769 + literala)]*

Proof of rule precondition:

[56.8.0] -2 < (-32769 + 92737)

$\rightarrow$ *[simplify]*

[56.8.2] **true**

[56.9] **false** $\vee$ ...

[Remove 'false' term 56.9 and fetch new term from containing clause]

[57.0] 0 == ($-(\$heap_{funcstart\_719,1}$.p3 / 178) + div(**heapIs**
$\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p3, 178).quot)

[Remove 'false' term 56.9 and fetch new term from containing clause]

[58.0] -1 < $\$heap_{funcstart\_719,1}$.p3

[Copy term 1.27]

*[61.0] 520 < −div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}.\mathrm{p3}$, 178).quot*

*→ [from term 57.0, div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}.p3$, 178).quot is equal to $\$heap_{funcstart\_719,1}.p3$ / 178]*

[61.1] 520 < −($\$heap_{funcstart\_719,1}.\mathrm{p3}$ / 178)

→ [simplify]

[61.7] 92560 < −$\$heap_{funcstart\_719,1}.\mathrm{p3}$

→ [from term 58.0, literala < −$\$heap_{funcstart\_719,1}.p3$ is false whenever -2 < (-1 + literala)]

> **Proof of rule precondition:**
>
> *[61.7.0] -2 < (-1 + 92560)*
>
> *→ [simplify]*
>
> *[61.7.2]* **true**

[61.8] **false**

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

Condition generated at: C:\Escher\Customers\prang\prang.c (49,38)

Condition defined at:

To prove: (**asType**<**int**>(**asType**<**short int**>(div3.quot)) * **asType**<**int**>($\$heap_{719,1;730,8}.\mathrm{b3}$)) ≤ **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)

$\$heap_{init}$.b1 == **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)

$\$heap_{init}$.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\>**$((\textbf{int})178)$

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

$\$heap_{init}.p1 == $ **asType\<short int\>**$((\textbf{int})1)$

$\$heap_{init}.p2 == $ **asType\<short int\>**$((\textbf{int})2)$

$\$heap_{init}.p3 == $ **asType\<short int\>**$((\textbf{int})3)$

$\text{div1} == \text{div}($**heapIs** $\$heap_{funcstart\_719,1},$
asType\<int\>$(\$heap_{funcstart\_719,1}.p1),$
asType\<int\>$(\$heap_{funcstart\_719,1}.a1))$

(asType\<integer\>(asType\<int\>$(\$heap_{funcstart\_719,1}.p1))$ /
asType\<integer\>(asType\<int\>$(\$heap_{funcstart\_719,1}.a1))) ==$
asType\<integer\>(div1.quot)

(asType\<integer\>(asType\<int\>$(\$heap_{funcstart\_719,1}.p1))$ %
asType\<integer\>(asType\<int\>$(\$heap_{funcstart\_719,1}.a1))) ==$
asType\<integer\>(div1.rem)

$\text{div2} == \text{div}($**heapIs** $\$heap_{funcstart\_719,1},$
asType\<int\>$(\$heap_{funcstart\_719,1}.p2),$
asType\<int\>$(\$heap_{funcstart\_719,1}.a2))$

(asType\<integer\>(asType\<int\>$(\$heap_{funcstart\_719,1}.p2))$ /
asType\<integer\>(asType\<int\>$(\$heap_{funcstart\_719,1}.a2))) ==$
asType\<integer\>(div2.quot)

(asType\<integer\>(asType\<int\>$(\$heap_{funcstart\_719,1}.p2))$ %
asType\<integer\>(asType\<int\>$(\$heap_{funcstart\_719,1}.a2))) ==$
asType\<integer\>(div2.rem)

$\text{div3} == \text{div}($**heapIs** $\$heap_{funcstart\_719,1},$
asType\<int\>$(\$heap_{funcstart\_719,1}.p3),$
asType\<int\>$(\$heap_{funcstart\_719,1}.a3))$

(asType\<integer\>(asType\<int\>$(\$heap_{funcstart\_719,1}.p3))$ /
asType\<integer\>(asType\<int\>$(\$heap_{funcstart\_719,1}.a3))) ==$
asType\<integer\>(div3.quot)

(asType\<integer\>(asType\<int\>$(\$heap_{funcstart\_719,1}.p3))$ %
asType\<integer\>(asType\<int\>$(\$heap_{funcstart\_719,1}.a3))) ==$
asType\<integer\>(div3.rem)

$\$heap_{719,1;729,8} == \$heap_{funcstart\_719,1}.$**replace**$(p1 \rightarrow$ **asType\<short
int\>**$((\textbf{asType\<int\>(asType\<short}$
int\>$(\text{div1.rem}))$ *
asType\<int\>$(\$heap_{funcstart\_719,1}.r1)) - ($**asType\<int\>(asType\<short**
int\>$(\text{div1.quot}))$ * **asType\<int\>**$(\$heap_{funcstart\_719,1}.b1))))$

$\$heap_{719,1;730,8} == \$heap_{719,1;729,8}.$**replace**$(p2 \rightarrow$ **asType\<short
int\>**$((\textbf{asType\<int\>(asType\<short}$
int\>$(\text{div2.rem}))$ *
asType\<int\>$(\$heap_{719,1;729,8}.r2)) - ($**asType\<int\>(asType\<short**

int>(div2.quot)) * **asType**<**int**>($heap$_{719,1;729,8}$.b2))))

Proof:

[Take given term]

[5.0] div1 == div(**heapIs** $heap$_{funcstart_719,1}$,
asType<**int**>($heap$_{funcstart_719,1}$.p1),
asType<**int**>($heap$_{funcstart_719,1}$.a1))

$\rightarrow$ *[simplify]*

[5.1] div1 == div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1,
asType<**int**>($heap$_{funcstart_719,1}$.a1))

$\rightarrow$ *[const static or extern object]*

[5.2] div1 == div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1,
asType<**int**>($heap$_{init}$.a1))

$\rightarrow$ *[expand definition of constant 'a1' at prang.c (16,20)]*

[5.3] div1 == div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1,
asType<**int**>(**asType**<**short int**>((**int**)177)))

$\rightarrow$ *[simplify]*

[5.6] div1 == div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1, 177)

[Take given term]

[12.0] div2 == div(**heapIs** $heap$_{funcstart_719,1}$,
asType<**int**>($heap$_{funcstart_719,1}$.p2),
asType<**int**>($heap$_{funcstart_719,1}$.a2))

$\rightarrow$ *[simplify]*

[12.1] div2 == div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p2,
asType<**int**>($heap$_{funcstart_719,1}$.a2))

$\rightarrow$ *[const static or extern object]*

[12.2] div2 == div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p2,
asType<**int**>($heap$_{init}$.a2))

$\rightarrow$ *[expand definition of constant 'a2' at prang.c (21,20)]*

[12.3] div2 == div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p2,
asType<**int**>(**asType**<**short int**>((**int**)176)))

$\rightarrow$ *[simplify]*

[12.6] div2 == div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p2, 176)

[Take given term]

[19.0] div3 == div(**heapIs** $heap$_{funcstart_719,1}$,
asType<**int**>($heap$_{funcstart_719,1}$.p3),
asType<**int**>($heap$_{funcstart_719,1}$.a3))

$\rightarrow$ *[simplify]*

[19.1] div3 == div(**heapIs** \$heap$_{funcstart\_719,1}$, \$heap$_{funcstart\_719,1}$.p3, **asType<int>**(\$heap$_{funcstart\_719,1}$.a3))

$\rightarrow$ *[const static or extern object]*

[19.2] div3 == div(**heapIs** \$heap$_{funcstart\_719,1}$, \$heap$_{funcstart\_719,1}$.p3, **asType<int>**(\$heap$_{init}$.a3))

$\rightarrow$ *[expand definition of constant 'a3' at prang.c (26,20)]*

[19.3] div3 == div(**heapIs** \$heap$_{funcstart\_719,1}$, \$heap$_{funcstart\_719,1}$.p3, **asType<int>**(**asType<short int>**(**(int)**178)))

$\rightarrow$ *[simplify]*

[19.6] div3 == div(**heapIs** \$heap$_{funcstart\_719,1}$, \$heap$_{funcstart\_719,1}$.p3, 178)

[Assume known post-assertion, class invariant or type constraint for term 19.6]

[23.0] \$heap$_{funcstart\_719,1}$.p3 $\leq$ **maxof**(**short int**)

$\rightarrow$ *[simplify]*

[23.9] -32768 < $-$\$heap$_{funcstart\_719,1}$.p3

[Assume known post-assertion, class invariant or type constraint for term 19.6]

[24.0] (**asType<integer>**(\$heap$_{funcstart\_719,1}$.p3) / **asType<integer>**(178)) == **asType<integer>**(div(**heapIs** \$heap$_{funcstart\_719,1}$, \$heap$_{funcstart\_719,1}$.p3, 178).quot)

$\rightarrow$ *[simplify]*

[24.2] (\$heap$_{funcstart\_719,1}$.p3 / 178) == **asType<integer>**(div(**heapIs** \$heap$_{funcstart\_719,1}$, \$heap$_{funcstart\_719,1}$.p3, 178).quot)

$\rightarrow$ *[expand definition of operator './' in class 'int' at built in declaration]*

[24.3] ([**asType<integer>**(\$heap$_{funcstart\_719,1}$.p3) < 0]: $-($$-$**asType<integer>**(\$heap$_{funcstart_719,1}$.p3) / 178), []: **asType<integer>**(\$heap$_{funcstart_719,1}$.p3) / 178) == **asType<integer>**(div(**heapIs** \$heap$_{funcstart_719,1}$, \$heap$_{funcstart_719,1}$.p3, 178).quot)

$\rightarrow$ *[explicitly assert falsehood of skipped guards in subsequent guards]*

[24.4] ([**asType<integer>**(\$heap$_{funcstart\_719,1}$.p3) < 0]: $-($$-$**asType<integer>**(\$heap$_{funcstart_719,1}$.p3) / 178), [!(**asType<integer>**(\$heap$_{funcstart_719,1}$.p3) < 0)]: **asType<integer>**(\$heap$_{funcstart_719,1}$.p3) / 178) == **asType<integer>**(div(**heapIs** \$heap$_{funcstart_719,1}$, \$heap$_{funcstart_719,1}$.p3, 178).quot)

$\rightarrow$ *[simplify]*

[24.17] 0 == ($-$([0 < $-$\$heap$_{funcstart\_719,1}$.p3]: $-($$-$\$heap$_{funcstart_719,1}$.p3 /

178), [-1 < $\$heap_{funcstart\_719,1}$.p3]: $\$heap_{funcstart\_719,1}$.p3 / 178) + div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p3, 178).quot)

$\rightarrow$ *[move guard outside expression]*

[24.18] 0 == (([0 < $-\$heap_{funcstart\_719,1}$.p3]: $-(-(-\$heap_{funcstart\_719,1}$.p3 / 178)), [-1 < $\$heap_{funcstart\_719,1}$.p3]: $-(\$heap_{funcstart\_719,1}$.p3 / 178)) + div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p3, 178).quot)

$\rightarrow$ *[simplify]*

[24.19] 0 == (([0 < $-\$heap_{funcstart\_719,1}$.p3]: $-\$heap_{funcstart\_719,1}$.p3 / 178, [-1 < $\$heap_{funcstart\_719,1}$.p3]: $-(\$heap_{funcstart\_719,1}$.p3 / 178)) + div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p3, 178).quot)

$\rightarrow$ *[move guard outside expression]*

[24.21] ([0 < $-\$heap_{funcstart\_719,1}$.p3]: 0 == (($-\$heap_{funcstart\_719,1}$.p3 / 178) + div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p3, 178).quot), [-1 < $\$heap_{funcstart\_719,1}$.p3]: 0 == ($-(\$heap_{funcstart\_719,1}$.p3 / 178) + div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p3, 178).quot))

[Take given term]

[26.0] $\$heap_{719,1;729,8}$ == $\$heap_{funcstart\_719,1}$.**replace**(p1 $\rightarrow$ **asType<short int>**((**asType<int>**(**asType<short int>**(div1.rem)) * **asType<int>**($\$heap_{funcstart\_719,1}$.r1)) $-$ (**asType<int>**(**asType<short int>**(div1.quot)) * **asType<int>**($\$heap_{funcstart\_719,1}$.b1)))))

$\rightarrow$ *[from term 5.6, div1 is equal to div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177)]*

[26.1] $\$heap_{719,1;729,8}$ == $\$heap_{funcstart\_719,1}$.**replace**(p1 $\rightarrow$ **asType<short int>**((**asType<int>**(**asType<short int>**(div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).rem)) * **asType<int>**($\$heap_{funcstart\_719,1}$.r1)) $-$ (**asType<int>**(**asType<short int>**(div1.quot)) * **asType<int>**($\$heap_{funcstart\_719,1}$.b1)))))

$\rightarrow$ *[simplify]*

[26.3] $\$heap_{719,1;729,8}$ == $\$heap_{funcstart\_719,1}$.**replace**(p1 $\rightarrow$ **asType<short int>**((div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).rem * **asType<int>**($\$heap_{funcstart\_719,1}$.r1)) $-$ (**asType<int>**(**asType<short int>**(div1.quot)) * **asType<int>**($\$heap_{funcstart\_719,1}$.b1)))))

$\rightarrow$ *[const static or extern object]*

[26.4] $\$heap_{719,1;729,8}$ == $\$heap_{funcstart\_719,1}$.**replace**(p1 $\rightarrow$ **asType<short int>**((div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).rem * **asType<int>**($\$heap_{init}$.r1)) $-$ (**asType<int>**(**asType<short int>**(div1.quot)) * **asType<int>**($\$heap_{funcstart\_719,1}$.b1)))))

$\rightarrow$ *[expand definition of constant 'r1' at prang.c (15,20)]*

[26.5] $\$heap_{719,1;729,8}$ == $\$heap_{funcstart\_719,1}$.**replace**(p1 $\rightarrow$ **asType<short**

int>((div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).rem *
asType<**int**>(**asType**<**short int**>((**int**)171))) −
(**asType**<**int**>(**asType**<**short int**>(div1.quot)) *
asType<**int**>($\$heap_{funcstart\_719,1}$.b1))))

→ *[simplify]*

[26.8] $\$heap_{719,1;729,8}$ == $\$heap_{funcstart\_719,1}$.**replace**(p1 → **asType**<**short
int**>((div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).rem * 171)
− (**asType**<**int**>(**asType**<**short int**>(div1.quot)) *
asType<**int**>($\$heap_{funcstart\_719,1}$.b1))))

→ *[from term 5.6, div1 is equal to div(**heapIs** $\$heap_{funcstart\_719,1}$,
$\$heap_{funcstart\_719,1}$.p1, 177)]*

[26.9] $\$heap_{719,1;729,8}$ == $\$heap_{funcstart\_719,1}$.**replace**(p1 → **asType**<**short
int**>((171 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).rem)
− (**asType**<**int**>(**asType**<**short int**>(div(**heapIs** $\$heap_{funcstart\_719,1}$,
$\$heap_{funcstart\_719,1}$.p1, 177).quot)) *
asType<**int**>($\$heap_{funcstart\_719,1}$.b1))))

→ *[simplify]*

[26.11] $\$heap_{719,1;729,8}$ == $\$heap_{funcstart\_719,1}$.**replace**(p1 → **asType**<**short
int**>((171 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).rem)
− (div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot *
asType<**int**>($\$heap_{funcstart\_719,1}$.b1))))

→ *[const static or extern object]*

[26.12] $\$heap_{719,1;729,8}$ == $\$heap_{funcstart\_719,1}$.**replace**(p1 → **asType**<**short
int**>((171 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).rem)
− (div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot *
asType<**int**>($\$heap_{init}$.b1))))

→ *[expand definition of constant 'b1' at prang.c (17,20)]*

[26.13] $\$heap_{719,1;729,8}$ == $\$heap_{funcstart\_719,1}$.**replace**(p1 → **asType**<**short
int**>((171 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).rem)
− (div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot *
asType<**int**>(**asType**<**short int**>((**int**)2)))))

→ *[simplify]*

[26.19] $\$heap_{719,1;729,8}$ == $\$heap_{funcstart\_719,1}$.**replace**(p1 → ((-2 *
div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).rem)))

[Take given term]

[31.0] $\$heap_{719,1;730,8}$ == $\$heap_{719,1;729,8}$.**replace**(p2 → **asType**<**short
int**>((**asType**<**int**>(**asType**<**short int**>(div2.rem)) *
asType<**int**>($\$heap_{719,1;729,8}$.r2)) − (**asType**<**int**>(**asType**<**short
int**>(div2.quot)) * **asType**<**int**>($\$heap_{719,1;729,8}$.b2))))

$\rightarrow$ *[from term 26.19, $\$heap_{719,1;729,8}$ is equal to*
*$\$heap_{funcstart\_719,1}.$__replace__$(p1 \rightarrow (-2 * div($__heapIs__ $\$heap_{funcstart\_719,1}$,*
*$\$heap_{funcstart\_719,1}.p1, 177).quot) + (171 * div($__heapIs__ $\$heap_{funcstart\_719,1}$,*
$\$heap_{funcstart_719,1}.p1, 177).rem))]

[31.1] $\$heap_{719,1;730,8}$ == $\$heap_{funcstart\_719,1}.$__replace__$(p1 \rightarrow ((-2 *$
div(__heapIs__ $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}.p1, 177).quot) + (171 *$
div(__heapIs__ $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}.p1$,
177).rem))).__replace__$(p2 \rightarrow$ __asType<short__
__int>((asType<int>(asType<short int>__(div2.rem)) *
__asType<int>__($\$heap_{719,1;729,8}.r2)) - ($__asType<int>(asType<short__
__int>__(div2.quot)) * __asType<int>__($\$heap_{719,1;729,8}.b2))))

$\rightarrow$ *[from term 12.6, div2 is equal to div($__heapIs__ $\$heap_{funcstart\_719,1}$,*
$\$heap_{funcstart_719,1}.p2, 176)]

[31.2] $\$heap_{719,1;730,8}$ == $\$heap_{funcstart\_719,1}.$__replace__$(p1 \rightarrow ((-2 *$
div(__heapIs__ $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}.p1, 177).quot) + (171 *$
div(__heapIs__ $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}.p1$,
177).rem))).__replace__$(p2 \rightarrow$ __asType<short__
__int>((asType<int>(asType<short int>__(div(__heapIs__ $\$heap_{funcstart\_719,1}$,
$\$heap_{funcstart\_719,1}.p2, 176).rem)) *$ __asType<int>__($\$heap_{719,1;729,8}.r2)) -$
(__asType<int>(asType<short int>__(div2.quot)) *
__asType<int>__($\$heap_{719,1;729,8}.b2))))

$\rightarrow$ *[simplify]*

[31.4] $\$heap_{719,1;730,8}$ == $\$heap_{funcstart\_719,1}.$__replace__$(p1 \rightarrow ((-2 *$
div(__heapIs__ $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}.p1, 177).quot) + (171 *$
div(__heapIs__ $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}.p1$,
177).rem))).__replace__$(p2 \rightarrow$ __asType<short int>((__div(__heapIs__
$\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}.p2, 176).rem *$
__asType<int>__($\$heap_{719,1;729,8}.r2)) - ($__asType<int>(asType<short__
__int>__(div2.quot)) * __asType<int>__($\$heap_{719,1;729,8}.b2))))

$\rightarrow$ *[from term 26.19, $\$heap_{719,1;729,8}$ is equal to*
*$\$heap_{funcstart\_719,1}.$__replace__$(p1 \rightarrow (-2 * div($__heapIs__ $\$heap_{funcstart\_719,1}$,*
*$\$heap_{funcstart\_719,1}.p1, 177).quot) + (171 * div($__heapIs__ $\$heap_{funcstart\_719,1}$,*
$\$heap_{funcstart_719,1}.p1, 177).rem))]

[31.5] $\$heap_{719,1;730,8}$ == $\$heap_{funcstart\_719,1}.$__replace__$(p1 \rightarrow ((-2 *$
div(__heapIs__ $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}.p1, 177).quot) + (171 *$
div(__heapIs__ $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}.p1$,
177).rem))).__replace__$(p2 \rightarrow$ __asType<short int>((__div(__heapIs__
$\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}.p2, 176).rem *$
__asType<int>__($\$heap_{funcstart\_719,1}.$__replace__$(p1 \rightarrow ((-2 * div($__heapIs__
$\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}.p1, 177).quot) + (171 * div($__heapIs__
$\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}.p1, 177).rem))).r2)) -$
(__asType<int>(asType<short int>__(div2.quot)) *
__asType<int>__($\$heap_{719,1;729,8}.b2))))

$\rightarrow$ *[const member of object with modified fields]*

[31.6] $\text{\$heap}_{719,1;730,8}$ == $\text{\$heap}_{funcstart\_719,1}$.**replace**(p1 $\rightarrow$ ((-2 * div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p1, 177).rem))).**replace**(p2 $\rightarrow$ **asType**<**short int**>((div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p2, 176).rem * **asType**<**int**>($\text{\$heap}_{funcstart\_719,1}$.r2)) $-$ (**asType**<**int**>(**asType**<**short int**>(div2.quot)) * **asType**<**int**>($\text{\$heap}_{719,1;729,8}$.b2)))))

$\rightarrow$ *[const static or extern object]*

[31.7] $\text{\$heap}_{719,1;730,8}$ == $\text{\$heap}_{funcstart\_719,1}$.**replace**(p1 $\rightarrow$ ((-2 * div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p1, 177).rem))).**replace**(p2 $\rightarrow$ **asType**<**short int**>((div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p2, 176).rem * **asType**<**int**>($\text{\$heap}_{init}$.r2)) $-$ (**asType**<**int**>(**asType**<**short int**>(div2.quot)) * **asType**<**int**>($\text{\$heap}_{719,1;729,8}$.b2)))))

$\rightarrow$ *[expand definition of constant 'r2' at prang.c (20,20)]*

[31.8] $\text{\$heap}_{719,1;730,8}$ == $\text{\$heap}_{funcstart\_719,1}$.**replace**(p1 $\rightarrow$ ((-2 * div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p1, 177).rem))).**replace**(p2 $\rightarrow$ **asType**<**short int**>((div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p2, 176).rem * **asType**<**int**>(**asType**<**short int**>((**int**)172))) $-$ (**asType**<**int**>(**asType**<**short int**>(div2.quot)) * **asType**<**int**>($\text{\$heap}_{719,1;729,8}$.b2)))))

$\rightarrow$ *[simplify]*

[31.11] $\text{\$heap}_{719,1;730,8}$ == $\text{\$heap}_{funcstart\_719,1}$.**replace**(p1 $\rightarrow$ ((-2 * div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p1, 177).rem))).**replace**(p2 $\rightarrow$ **asType**<**short int**>((div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p2, 176).rem * 172) $-$ (**asType**<**int**>(**asType**<**short int**>(div2.quot)) * **asType**<**int**>($\text{\$heap}_{719,1;729,8}$.b2)))))

$\rightarrow$ *[from term 12.6, div2 is equal to div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p2, 176)]*

[31.12] $\text{\$heap}_{719,1;730,8}$ == $\text{\$heap}_{funcstart\_719,1}$.**replace**(p1 $\rightarrow$ ((-2 * div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p1, 177).rem))).**replace**(p2 $\rightarrow$ **asType**<**short int**>((172 * div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p2, 176).rem) $-$ (**asType**<**int**>(**asType**<**short int**>(div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p2, 176).quot)) * **asType**<**int**>($\text{\$heap}_{719,1;729,8}$.b2)))))

→ *[simplify]*

[31.14] $\$heap_{719,1;730,8}$ == $\$heap_{funcstart\_719,1}$.**replace**(p1 → ((-2 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).rem))).**replace**(p2 → **asType<short int>**((172 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).rem) − (div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).quot * **asType<int>**($\$heap_{719,1;729,8}$.b2))))

→ *[from term 26.19, $\$heap_{719,1;729,8}$ is equal to $\$heap_{funcstart\_719,1}$.**replace**(p1 → (-2 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).rem))]*

[31.15] $\$heap_{719,1;730,8}$ == $\$heap_{funcstart\_719,1}$.**replace**(p1 → ((-2 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).rem))).**replace**(p2 → **asType<short int>**((172 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).rem) − (div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).quot * **asType<int>**($\$heap_{funcstart\_719,1}$.**replace**(p1 → ((-2 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).rem))).b2))))

→ *[const member of object with modified fields]*

[31.16] $\$heap_{719,1;730,8}$ == $\$heap_{funcstart\_719,1}$.**replace**(p1 → ((-2 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).rem))).**replace**(p2 → **asType<short int>**((172 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).rem) − (div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).quot * **asType<int>**($\$heap_{funcstart\_719,1}$.b2))))

→ *[const static or extern object]*

[31.17] $\$heap_{719,1;730,8}$ == $\$heap_{funcstart\_719,1}$.**replace**(p1 → ((-2 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).rem))).**replace**(p2 → **asType<short int>**((172 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).rem) − (div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).quot * **asType<int>**($\$heap_{init}$.b2))))

→ *[expand definition of constant 'b2' at prang.c (22,20)]*

[31.18] $\$heap_{719,1;730,8}$ == $\$heap_{funcstart\_719,1}$.**replace**(p1 → ((-2 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).rem))).**replace**(p2 → **asType<short int>**((172 * div(**heapIs**

$\text{heap}_{funcstart\_719,1}$, $\text{heap}_{funcstart\_719,1}$.p2, 176).rem) − (div(**heapIs**
$\text{heap}_{funcstart\_719,1}$, $\text{heap}_{funcstart\_719,1}$.p2, 176).quot *
asType<int>(**asType<short int>**((int)35)))))

$\rightarrow$ *[simplify]*

[31.24] $\text{heap}_{719,1;730,8}$ == $\text{heap}_{funcstart\_719,1}$.**replace**(p1 → ((-2 *
div(**heapIs** $\text{heap}_{funcstart\_719,1}$, $\text{heap}_{funcstart\_719,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\text{heap}_{funcstart\_719,1}$, $\text{heap}_{funcstart\_719,1}$.p1,
177).rem))).**replace**(p2 → ((-35 * div(**heapIs** $\text{heap}_{funcstart\_719,1}$,
$\text{heap}_{funcstart\_719,1}$.p2, 176).quot) + (172 * div(**heapIs** $\text{heap}_{funcstart\_719,1}$,
$\text{heap}_{funcstart\_719,1}$.p2, 176).rem)))

[Take goal term]

[1.0] (**asType<int>**(**asType<short int>**(div3.quot)) *
asType<int>($\text{heap}_{719,1;730,8}$.b3)) $\leq$ **maxof(int)**

$\rightarrow$ *[from term 19.6, div3 is equal to div(**heapIs** $\text{heap}_{funcstart\_719,1}$,*
$\text{heap}_{funcstart\_719,1}$.p3, 178)]

[1.1] (**asType<int>**(**asType<short int>**(div(**heapIs** $\text{heap}_{funcstart\_719,1}$,
$\text{heap}_{funcstart\_719,1}$.p3, 178).quot)) * **asType<int>**($\text{heap}_{719,1;730,8}$.b3)) $\leq$
maxof(int)

$\rightarrow$ *[simplify]*

[1.3] (div(**heapIs** $\text{heap}_{funcstart\_719,1}$, $\text{heap}_{funcstart\_719,1}$.p3, 178).quot *
asType<int>($\text{heap}_{719,1;730,8}$.b3)) $\leq$ **maxof(int)**

$\rightarrow$ *[from term 31.24, $\text{heap}_{719,1;730,8}$ is equal to*
*$\text{heap}_{funcstart\_719,1}$.**replace**(p1 → ((-2 * div(**heapIs** $\text{heap}_{funcstart\_719,1}$,*
*$\text{heap}_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs** $\text{heap}_{funcstart\_719,1}$,*
*$\text{heap}_{funcstart\_719,1}$.p1, 177).rem))).**replace**(p2 → (-35 * div(**heapIs***
*$\text{heap}_{funcstart\_719,1}$, $\text{heap}_{funcstart\_719,1}$.p2, 176).quot) + (172 * div(**heapIs***
$\text{heap}_{funcstart\_719,1}$, $\text{heap}_{funcstart\_719,1}$.p2, 176).rem))]

[1.4] (div(**heapIs** $\text{heap}_{funcstart\_719,1}$, $\text{heap}_{funcstart\_719,1}$.p3, 178).quot *
asType<int>($\text{heap}_{funcstart\_719,1}$.**replace**(p1 → ((-2 * div(**heapIs**
$\text{heap}_{funcstart\_719,1}$, $\text{heap}_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs**
$\text{heap}_{funcstart\_719,1}$, $\text{heap}_{funcstart\_719,1}$.p1, 177).rem))).**replace**(p2 → ((-35
* div(**heapIs** $\text{heap}_{funcstart\_719,1}$, $\text{heap}_{funcstart\_719,1}$.p2, 176).quot) + (172 *
div(**heapIs** $\text{heap}_{funcstart\_719,1}$, $\text{heap}_{funcstart\_719,1}$.p2, 176).rem))).b3)) $\leq$
maxof(int)

$\rightarrow$ *[const member of object with modified fields]*

[1.6] (div(**heapIs** $\text{heap}_{funcstart\_719,1}$, $\text{heap}_{funcstart\_719,1}$.p3, 178).quot *
asType<int>($\text{heap}_{funcstart\_719,1}$.b3)) $\leq$ **maxof(int)**

$\rightarrow$ *[const static or extern object]*

[1.7] (div(**heapIs** $\text{heap}_{funcstart\_719,1}$, $\text{heap}_{funcstart\_719,1}$.p3, 178).quot *
asType<int>(heap_{init}.b3)) $\leq$ **maxof(int)**

→ *[expand definition of constant 'b3' at prang.c (27,20)]*

[1.8] (div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p3, 178).quot *
asType<int>(asType<short int>((int)63))) ≤ **maxof(int)**

→ *[simplify]*

[1.21] -32768 < (-63 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p3, 178).quot)

→ *[literal comparison of product]*

[1.22] ([-63 < 0]: (-32768 / 63) < −div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p3, 178).quot, [0 < -63]: (-32768 / -63) < div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p3, 178).quot, [-63 == 0]: -32768 < 0)

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

[1.23] ([-63 < 0]: (-32768 / 63) < −div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p3, 178).quot, [(0 < -63) ∧ !(-63 < 0)]: (-32768 / -63) < div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p3, 178).quot, [(-63 == 0) ∧ !(-63 < 0) ∧ !(0 < -63)]: -32768 < 0)

→ *[simplify]*

[1.27] -521 < −div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p3, 178).quot

→ *[negate goal and search for contradiction]*

[1.28] !(-521 < −div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p3, 178).quot)

→ *[simplify]*

[1.31] 520 < div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p3, 178).quot

[Branch on disjunction or conditional in term 24.21]

[51.0] (0 == ((−$\$heap_{funcstart\_719,1}$.p3 / 178) + div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p3, 178).quot)) ∨ (0 == (−($\$heap_{funcstart\_719,1}$.p3 / 178) + div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p3, 178).quot)) ∨ (-1 < $\$heap_{funcstart\_719,1}$.p3)

[Branch on disjunction or conditional in term 24.21]

[52.0] (0 < −$\$heap_{funcstart\_719,1}$.p3) ∨ (0 == (−($\$heap_{funcstart\_719,1}$.p3 / 178) + div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p3, 178).quot)) ∨ (-1 < $\$heap_{funcstart\_719,1}$.p3)

[Create new term from terms 1.31, 51.0 using rule: transitivity 15]

[56.0] ((0 + 520) < −(−$\$heap_{funcstart\_719,1}$.p3 / 178)) ∨ (0 == (−($\$heap_{funcstart\_719,1}$.p3 / 178) + div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p3, 178).quot)) ∨ (-1 < $\$heap_{funcstart\_719,1}$.p3)

→ *[simplify]*

[56.8] $(92560 < \$heap_{funcstart\_719,1}.p3) \lor ...$

$\rightarrow$ *[from term 52.0, literala $< \$heap_{funcstart\_719,1}.p3$ is false whenever -2 $<$ (0 + literala)]*

Proof of rule precondition:

[56.8.0] -2 $<$ (0 + 92560)

$\rightarrow$ *[simplify]*

[56.8.2] **true**

[56.9] **false** $\lor ...$

[Remove 'false' term 56.9 and fetch new term from containing clause]

[57.0] 0 == $(-(\$heap_{funcstart\_719,1}.p3 \mathbin{/} 178) + \mathrm{div}(\textbf{heapIs}$ $\$heap_{funcstart\_719,1}, \$heap_{funcstart\_719,1}.p3, 178).\mathrm{quot})$

[Copy term 1.31]

[61.0] 520 $<$ div(**heapIs** $\$heap_{funcstart\_719,1}, \$heap_{funcstart\_719,1}.p3, 178).\mathrm{quot}$

$\rightarrow$ *[from term 57.0, div(**heapIs** $\$heap_{funcstart\_719,1}, \$heap_{funcstart\_719,1}.p3, 178).quot$ is equal to $\$heap_{funcstart\_719,1}.p3 \mathbin{/} 178$]*

[61.1] 520 $<$ ($\$heap_{funcstart\_719,1}.p3 \mathbin{/} 178$)

$\rightarrow$ *[simplify]*

[61.8] 92737 $< \$heap_{funcstart\_719,1}.p3$

$\rightarrow$ *[from term 23.9, literala $< \$heap_{funcstart\_719,1}.p3$ is false whenever -2 $<$ (-32768 + literala)]*

Proof of rule precondition:

[61.8.0] -2 $<$ (-32768 + 92737)

$\rightarrow$ *[simplify]*

[61.8.2] **true**

[61.9] **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 (49,33)

Condition defined at:

To prove: minof(short int) $\leq$ ((**asType**$<$**int**$>$(**asType**$<$**short int**$>$(div3.rem)) * **asType**$<$**int**$>$($\$heap_{719,1;730,8}.r3$)) $-$ (**asType**$<$**int**$>$(**asType**$<$**short int**$>$(div3.quot)) * **asType**$<$**int**$>$($\$heap_{719,1;730,8}.b3$)))

Given:

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

$\$heap_{init}.\text{M1} == \textbf{asType}\textbf{<short int>}((\textbf{int})30269)$

$\$heap_{init}.\text{r1} == \textbf{asType}\textbf{<short int>}((\textbf{int})171)$

$\$heap_{init}.\text{a1} == \textbf{asType}\textbf{<short int>}((\textbf{int})177)$

$\$heap_{init}.\text{b1} == \textbf{asType}\textbf{<short int>}((\textbf{int})2)$

$\$heap_{init}.\text{M2} == \textbf{asType}\textbf{<short int>}((\textbf{int})30307)$

$\$heap_{init}.\text{r2} == \textbf{asType}\textbf{<short int>}((\textbf{int})172)$

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

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

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

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

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

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

$\$heap_{init}.\text{p1} == \textbf{asType}\textbf{<short int>}((\textbf{int})1)$

$\$heap_{init}.\text{p2} == \textbf{asType}\textbf{<short int>}((\textbf{int})2)$

$\$heap_{init}.\text{p3} == \textbf{asType}\textbf{<short int>}((\textbf{int})3)$

$\text{div1} == \text{div}(\textbf{heapIs } \$heap_{funcstart\_719,1},$
$\textbf{asType}\textbf{<int>}(\$heap_{funcstart\_719,1}.\text{p1}),$
$\textbf{asType}\textbf{<int>}(\$heap_{funcstart\_719,1}.\text{a1}))$

$(\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<int>}(\$heap_{funcstart\_719,1}.\text{p1}))$ /
$\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<int>}(\$heap_{funcstart\_719,1}.\text{a1}))) ==$
$\textbf{asType}\textbf{<integer>}(\text{div1.quot})$

$(\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<int>}(\$heap_{funcstart\_719,1}.\text{p1}))$ %
$\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<int>}(\$heap_{funcstart\_719,1}.\text{a1}))) ==$
$\textbf{asType}\textbf{<integer>}(\text{div1.rem})$

$\text{div2} == \text{div}(\textbf{heapIs } \$heap_{funcstart\_719,1},$
$\textbf{asType}\textbf{<int>}(\$heap_{funcstart\_719,1}.\text{p2}),$
$\textbf{asType}\textbf{<int>}(\$heap_{funcstart\_719,1}.\text{a2}))$

$(\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<int>}(\$heap_{funcstart\_719,1}.\text{p2}))$ /
$\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<int>}(\$heap_{funcstart\_719,1}.\text{a2}))) ==$
$\textbf{asType}\textbf{<integer>}(\text{div2.quot})$

$(\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<int>}(\$heap_{funcstart\_719,1}.\text{p2}))$ %
$\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<int>}(\$heap_{funcstart\_719,1}.\text{a2}))) ==$
$\textbf{asType}\textbf{<integer>}(\text{div2.rem})$

$\text{div3} == \text{div}(\textbf{heapIs } \$heap_{funcstart\_719,1},$
$\textbf{asType}\textbf{<int>}(\$heap_{funcstart\_719,1}.\text{p3}),$

asType<**int**>($heap$_{funcstart_719,1}$.a3))

(**asType**<**integer**>(**asType**<**int**>($heap$_{funcstart_719,1}$.p3)) /
asType<**integer**>(**asType**<**int**>($heap$_{funcstart_719,1}$.a3))) ==
asType<**integer**>(div3.quot)

(**asType**<**integer**>(**asType**<**int**>($heap$_{funcstart_719,1}$.p3)) %
asType<**integer**>(**asType**<**int**>($heap$_{funcstart_719,1}$.a3))) ==
asType<**integer**>(div3.rem)

$heap$_{719,1;729,8}$ == $heap$_{funcstart_719,1}$.**replace**(p1 → **asType**<**short
int**>((**asType**<**int**>(**asType**<**short int**>(div1.rem)) *
asType<**int**>($heap$_{funcstart_719,1}$.r1)) − (**asType**<**int**>(**asType**<**short
int**>(div1.quot)) * **asType**<**int**>($heap$_{funcstart_719,1}$.b1))))

$heap$_{719,1;730,8}$ == $heap$_{719,1;729,8}$.**replace**(p2 → **asType**<**short
int**>((**asType**<**int**>(**asType**<**short int**>(div2.rem)) *
asType<**int**>($heap$_{719,1;729,8}$.r2)) − (**asType**<**int**>(**asType**<**short
int**>(div2.quot)) * **asType**<**int**>($heap$_{719,1;729,8}$.b2))))

Proof:

[Take given term]

[5.0] div1 == div(**heapIs** $heap$_{funcstart_719,1}$,
asType<**int**>($heap$_{funcstart_719,1}$.p1),
asType<**int**>($heap$_{funcstart_719,1}$.a1))

→ *[simplify]*

[5.1] div1 == div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1,
asType<**int**>($heap$_{funcstart_719,1}$.a1))

→ *[const static or extern object]*

[5.2] div1 == div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1,
asType<**int**>($heap$_{init}$.a1))

→ *[expand definition of constant 'a1' at prang.c (16,20)]*

[5.3] div1 == div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1,
asType<**int**>(**asType**<**short int**>((**int**)177)))

→ *[simplify]*

[5.6] div1 == div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1, 177)

[Take given term]

[12.0] div2 == div(**heapIs** $heap$_{funcstart_719,1}$,
asType<**int**>($heap$_{funcstart_719,1}$.p2),
asType<**int**>($heap$_{funcstart_719,1}$.a2))

→ *[simplify]*

[12.1] div2 == div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p2,
asType<**int**>($heap$_{funcstart_719,1}$.a2))

$\rightarrow$ *[const static or extern object]*

[12.2] div2 == div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, **asType**$<$**int**$>$($\$heap_{init}$.a2))

$\rightarrow$ *[expand definition of constant 'a2' at prang.c (21,20)]*

[12.3] div2 == div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, **asType**$<$**int**$>$(**asType**$<$**short int**$>$((**int**)176)))

$\rightarrow$ *[simplify]*

[12.6] div2 == div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176)

[Take given term]

[19.0] div3 == div(**heapIs** $\$heap_{funcstart\_719,1}$, **asType**$<$**int**$>$($\$heap_{funcstart\_719,1}$.p3), **asType**$<$**int**$>$($\$heap_{funcstart\_719,1}$.a3))

$\rightarrow$ *[simplify]*

[19.1] div3 == div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p3, **asType**$<$**int**$>$($\$heap_{funcstart\_719,1}$.a3))

$\rightarrow$ *[const static or extern object]*

[19.2] div3 == div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p3, **asType**$<$**int**$>$($\$heap_{init}$.a3))

$\rightarrow$ *[expand definition of constant 'a3' at prang.c (26,20)]*

[19.3] div3 == div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p3, **asType**$<$**int**$>$(**asType**$<$**short int**$>$((**int**)178)))

$\rightarrow$ *[simplify]*

[19.6] div3 == div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p3, 178)

[Assume known post-assertion, class invariant or type constraint for term 19.6]

[23.0] $\$heap_{funcstart\_719,1}$.p3 $\leq$ **maxof**(**short int**)

$\rightarrow$ *[simplify]*

[23.9] -32768 $<$ $-\$heap_{funcstart\_719,1}$.p3

[Assume known post-assertion, class invariant or type constraint for term 19.6]

[24.0] (**asType**$<$**integer**$>$($\$heap_{funcstart\_719,1}$.p3) $/$ **asType**$<$**integer**$>$(178)) == **asType**$<$**integer**$>$(div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p3, 178).quot)

$\rightarrow$ *[simplify]*

[24.2] ($\$heap_{funcstart\_719,1}$.p3 $/$ 178) == **asType**$<$**integer**$>$(div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p3, 178).quot)

$\rightarrow$ *[expand definition of operator './' in class 'int' at built in declaration]*

[24.3] (**[asType<integer>**($\text{heap}_{funcstart\_719,1}$.p3) < 0]:
$-(-$**asType<integer>**($\text{heap}_{funcstart\_719,1}$.p3) / 178), []:
asType<integer>($\text{heap}_{funcstart\_719,1}$.p3) / 178) ==
asType<integer>(div(**heapIs** $\text{heap}_{funcstart\_719,1}$, $\text{heap}_{funcstart\_719,1}$.p3,
178).quot)

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

[24.4] (**[asType<integer>**($\text{heap}_{funcstart\_719,1}$.p3) < 0]:
$-(-$**asType<integer>**($\text{heap}_{funcstart\_719,1}$.p3) / 178),
[!(**asType<integer>**($\text{heap}_{funcstart\_719,1}$.p3) < 0)]:
asType<integer>($\text{heap}_{funcstart\_719,1}$.p3) / 178) ==
asType<integer>(div(**heapIs** $\text{heap}_{funcstart\_719,1}$, $\text{heap}_{funcstart\_719,1}$.p3,
178).quot)

→ *[simplify]*

[24.17] 0 == ($-$([0 < $-\text{heap}_{funcstart\_719,1}$.p3]: $-(-\text{heap}_{funcstart\_719,1}$.p3 /
178), [-1 < $\text{heap}_{funcstart\_719,1}$.p3]: $\text{heap}_{funcstart\_719,1}$.p3 / 178) +
div(**heapIs** $\text{heap}_{funcstart\_719,1}$, $\text{heap}_{funcstart\_719,1}$.p3, 178).quot)

→ *[move guard outside expression]*

[24.18] 0 == (([0 < $-\text{heap}_{funcstart\_719,1}$.p3]: $-(-(-\text{heap}_{funcstart\_719,1}$.p3 /
178)), [-1 < $\text{heap}_{funcstart\_719,1}$.p3]: $-(\text{heap}_{funcstart\_719,1}$.p3 / 178)) +
div(**heapIs** $\text{heap}_{funcstart\_719,1}$, $\text{heap}_{funcstart\_719,1}$.p3, 178).quot)

→ *[simplify]*

[24.19] 0 == (([0 < $-\text{heap}_{funcstart\_719,1}$.p3]: $-\text{heap}_{funcstart\_719,1}$.p3 / 178,
[-1 < $\text{heap}_{funcstart\_719,1}$.p3]: $-(\text{heap}_{funcstart\_719,1}$.p3 / 178)) + div(**heapIs**
$\text{heap}_{funcstart\_719,1}$, $\text{heap}_{funcstart\_719,1}$.p3, 178).quot)

→ *[move guard outside expression]*

[24.21] ([0 < $-\text{heap}_{funcstart\_719,1}$.p3]: 0 == (($-\text{heap}_{funcstart\_719,1}$.p3 / 178)
+ div(**heapIs** $\text{heap}_{funcstart\_719,1}$, $\text{heap}_{funcstart\_719,1}$.p3, 178).quot), [-1 <
$\text{heap}_{funcstart\_719,1}$.p3]: 0 == ($-(\text{heap}_{funcstart\_719,1}$.p3 / 178) + div(**heapIs**
$\text{heap}_{funcstart\_719,1}$, $\text{heap}_{funcstart\_719,1}$.p3, 178).quot))

[Assume known post-assertion, class invariant or type constraint for term 19.6]

[25.0] (**asType<integer>**($\text{heap}_{funcstart\_719,1}$.p3) %
asType<integer>(178)) == **asType<integer>**(div(**heapIs**
$\text{heap}_{funcstart\_719,1}$, $\text{heap}_{funcstart\_719,1}$.p3, 178).rem)

→ *[simplify]*

[25.2] ($\text{heap}_{funcstart\_719,1}$.p3 % 178) == **asType<integer>**(div(**heapIs**
$\text{heap}_{funcstart\_719,1}$, $\text{heap}_{funcstart\_719,1}$.p3, 178).rem)

→ *[expand definition of operator '.%' in class 'int' at built in declaration]*

[25.3] (**[asType<integer>**($\text{heap}_{funcstart\_719,1}$.p3) < 0]:
$-(-$**asType<integer>**($\text{heap}_{funcstart\_719,1}$.p3) % 178), []:

asType<integer>($\text{\$heap}_{funcstart\_719,1}$.p3) % 178) ==
asType<integer>(div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p3, 178).rem)

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

[25.4] ([**asType<integer>**($\text{\$heap}_{funcstart\_719,1}$.p3) < 0]:
−(−**asType<integer>**($\text{\$heap}_{funcstart\_719,1}$.p3) % 178),
[!(**asType<integer>**($\text{\$heap}_{funcstart\_719,1}$.p3) < 0)]:
asType<integer>($\text{\$heap}_{funcstart\_719,1}$.p3) % 178) ==
asType<integer>(div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p3, 178).rem)

→ *[simplify]*

[25.14] ([0 < −$\text{\$heap}_{funcstart\_719,1}$.p3]: −(−$\text{\$heap}_{funcstart\_719,1}$.p3 % 178), [-1 < $\text{\$heap}_{funcstart\_719,1}$.p3]: **asType<integer>**($\text{\$heap}_{funcstart\_719,1}$.p3) % 178) == **asType<integer>**(div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p3, 178).rem)

→ *[remainder of negation]*

[25.15] ([0 < −$\text{\$heap}_{funcstart\_719,1}$.p3]: −([0 == ($\text{\$heap}_{funcstart\_719,1}$.p3 % 178)]: 0, []: 178 + −($\text{\$heap}_{funcstart\_719,1}$.p3 % 178)), [-1 < $\text{\$heap}_{funcstart\_719,1}$.p3]: **asType<integer>**($\text{\$heap}_{funcstart\_719,1}$.p3) % 178) == **asType<integer>**(div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p3, 178).rem)

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

[25.16] ([0 < −$\text{\$heap}_{funcstart\_719,1}$.p3]: −([0 == ($\text{\$heap}_{funcstart\_719,1}$.p3 % 178)]: 0, [!(0 == ($\text{\$heap}_{funcstart\_719,1}$.p3 % 178))]: 178 + −($\text{\$heap}_{funcstart\_719,1}$.p3 % 178)), [-1 < $\text{\$heap}_{funcstart\_719,1}$.p3]:
asType<integer>($\text{\$heap}_{funcstart\_719,1}$.p3) % 178) ==
asType<integer>(div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p3, 178).rem)

→ *[move guard outside expression]*

[25.17] ([0 < −$\text{\$heap}_{funcstart\_719,1}$.p3]: ([0 == ($\text{\$heap}_{funcstart\_719,1}$.p3 % 178)]: −0, [!(0 == ($\text{\$heap}_{funcstart\_719,1}$.p3 % 178))]: −(178 + −($\text{\$heap}_{funcstart\_719,1}$.p3 % 178))), [-1 < $\text{\$heap}_{funcstart\_719,1}$.p3]:
asType<integer>($\text{\$heap}_{funcstart\_719,1}$.p3) % 178) ==
asType<integer>(div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p3, 178).rem)

→ *[simplify]*

[25.24] 0 == (−([0 < −$\text{\$heap}_{funcstart\_719,1}$.p3]: ([0 == ($\text{\$heap}_{funcstart\_719,1}$.p3 % 178)]: 0, [!(0 == ($\text{\$heap}_{funcstart\_719,1}$.p3 % 178))]: -178 + ($\text{\$heap}_{funcstart\_719,1}$.p3 % 178)), [-1 < $\text{\$heap}_{funcstart\_719,1}$.p3]: $\text{\$heap}_{funcstart\_719,1}$.p3 % 178) + div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p3, 178).rem)

$\rightarrow$ *[move guard outside expression]*

[25.26] 0 == (([0 < $-$\$heap$_{funcstart\_719,1}$.p3]: ([0 == (\$heap$_{funcstart\_719,1}$.p3 % 178)]: $-$0, [!(0 == (\$heap$_{funcstart_719,1}$.p3 % 178)))]: $-$(-178 + (\$heap$_{funcstart\_719,1}$.p3 % 178))), [-1 < \$heap$_{funcstart\_719,1}$.p3]: $-$(\$heap$_{funcstart\_719,1}$.p3 % 178)) + div(**heapIs** \$heap$_{funcstart\_719,1}$, \$heap$_{funcstart\_719,1}$.p3, 178).rem)

$\rightarrow$ *[simplify]*

[25.29] 0 == (([0 < $-$\$heap$_{funcstart\_719,1}$.p3]: ([0 == (\$heap$_{funcstart\_719,1}$.p3 % 178)]: 0, [!(0 == (\$heap$_{funcstart\_719,1}$.p3 % 178)))]: 178 + $-$(\$heap$_{funcstart\_719,1}$.p3 % 178)), [-1 < \$heap$_{funcstart\_719,1}$.p3]: $-$(\$heap$_{funcstart\_719,1}$.p3 % 178)) + div(**heapIs** \$heap$_{funcstart\_719,1}$, \$heap$_{funcstart\_719,1}$.p3, 178).rem)

$\rightarrow$ *[move guard outside expression]*

[25.31] 0 == ([0 < $-$\$heap$_{funcstart\_719,1}$.p3]: ([0 == (\$heap$_{funcstart\_719,1}$.p3 % 178)]: 0 + div(**heapIs** \$heap$_{funcstart\_719,1}$, \$heap$_{funcstart\_719,1}$.p3, 178).rem, [!(0 == (\$heap$_{funcstart\_719,1}$.p3 % 178)))]: (178 + $-$(\$heap$_{funcstart\_719,1}$.p3 % 178)) + div(**heapIs** \$heap$_{funcstart\_719,1}$, \$heap$_{funcstart\_719,1}$.p3, 178).rem), [-1 < \$heap$_{funcstart\_719,1}$.p3]: $-$(\$heap$_{funcstart\_719,1}$.p3 % 178) + div(**heapIs** \$heap$_{funcstart\_719,1}$, \$heap$_{funcstart\_719,1}$.p3, 178).rem)

$\rightarrow$ *[simplify]*

[25.33] 0 == ([0 < $-$\$heap$_{funcstart\_719,1}$.p3]: ([0 == (\$heap$_{funcstart\_719,1}$.p3 % 178)]: div(**heapIs** \$heap$_{funcstart\_719,1}$, \$heap$_{funcstart\_719,1}$.p3, 178).rem, [!(0 == (\$heap$_{funcstart\_719,1}$.p3 % 178)))]: 178 + $-$(\$heap$_{funcstart\_719,1}$.p3 % 178) + div(**heapIs** \$heap$_{funcstart\_719,1}$, \$heap$_{funcstart\_719,1}$.p3, 178).rem), [-1 < \$heap$_{funcstart\_719,1}$.p3]: $-$(\$heap$_{funcstart\_719,1}$.p3 % 178) + div(**heapIs** \$heap$_{funcstart\_719,1}$, \$heap$_{funcstart\_719,1}$.p3, 178).rem)

$\rightarrow$ *[move guard outside expression]*

[25.35] ([0 < $-$\$heap$_{funcstart\_719,1}$.p3]: ([0 == (\$heap$_{funcstart\_719,1}$.p3 % 178)]: 0 == div(**heapIs** \$heap$_{funcstart\_719,1}$, \$heap$_{funcstart\_719,1}$.p3, 178).rem, [!(0 == (\$heap$_{funcstart\_719,1}$.p3 % 178)))]: 0 == (178 + $-$(\$heap$_{funcstart\_719,1}$.p3 % 178) + div(**heapIs** \$heap$_{funcstart\_719,1}$, \$heap$_{funcstart\_719,1}$.p3, 178).rem)), [-1 < \$heap$_{funcstart\_719,1}$.p3]: 0 == ($-$(\$heap$_{funcstart\_719,1}$.p3 % 178) + div(**heapIs** \$heap$_{funcstart\_719,1}$, \$heap$_{funcstart\_719,1}$.p3, 178).rem))

$\rightarrow$ *[simplify]*

[25.40] ([0 < $-$\$heap$_{funcstart\_719,1}$.p3]: ([0 == (\$heap$_{funcstart\_719,1}$.p3 % 178)]: 0 == div(**heapIs** \$heap$_{funcstart\_719,1}$, \$heap$_{funcstart\_719,1}$.p3, 178).rem, [!(0 == (\$heap$_{funcstart\_719,1}$.p3 % 178)))]: 178 == ((\$heap$_{funcstart\_719,1}$.p3 % 178) + $-$div(**heapIs** \$heap$_{funcstart\_719,1}$, \$heap$_{funcstart\_719,1}$.p3, 178).rem)), [-1 < \$heap$_{funcstart\_719,1}$.p3]: 0 == ($-$(\$heap$_{funcstart\_719,1}$.p3 % 178) + div(**heapIs** \$heap$_{funcstart\_719,1}$, \$heap$_{funcstart\_719,1}$.p3, 178).rem))

[Take given term]

[26.0] $\$heap_{719,1;729,8}$ == $\$heap_{funcstart\_719,1}$.__replace__(p1 → **asType<short int>**((**asType<int>**(**asType<short int>**(div1.rem)) * **asType<int>**($\$heap_{funcstart\_719,1}$.r1)) − (**asType<int>**(**asType<short int>**(div1.quot)) * **asType<int>**($\$heap_{funcstart\_719,1}$.b1)))))

→ *[from term 5.6, div1 is equal to div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177)]*

[26.1] $\$heap_{719,1;729,8}$ == $\$heap_{funcstart\_719,1}$.__replace__(p1 → **asType<short int>**((**asType<int>**(**asType<short int>**(div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).rem)) * **asType<int>**($\$heap_{funcstart\_719,1}$.r1)) − (**asType<int>**(**asType<short int>**(div1.quot)) * **asType<int>**($\$heap_{funcstart\_719,1}$.b1)))))

→ *[simplify]*

[26.3] $\$heap_{719,1;729,8}$ == $\$heap_{funcstart\_719,1}$.__replace__(p1 → **asType<short int>**((div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).rem * **asType<int>**($\$heap_{funcstart\_719,1}$.r1)) − (**asType<int>**(**asType<short int>**(div1.quot)) * **asType<int>**($\$heap_{funcstart\_719,1}$.b1)))))

→ *[const static or extern object]*

[26.4] $\$heap_{719,1;729,8}$ == $\$heap_{funcstart\_719,1}$.__replace__(p1 → **asType<short int>**((div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).rem * **asType<int>**($\$heap_{init}$.r1)) − (**asType<int>**(**asType<short int>**(div1.quot)) * **asType<int>**($\$heap_{funcstart\_719,1}$.b1)))))

→ *[expand definition of constant 'r1' at prang.c (15,20)]*

[26.5] $\$heap_{719,1;729,8}$ == $\$heap_{funcstart\_719,1}$.__replace__(p1 → **asType<short int>**((div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).rem * **asType<int>**(**asType<short int>**((**int**)171))) − (**asType<int>**(**asType<short int>**(div1.quot)) * **asType<int>**($\$heap_{funcstart\_719,1}$.b1)))))

→ *[simplify]*

[26.8] $\$heap_{719,1;729,8}$ == $\$heap_{funcstart\_719,1}$.__replace__(p1 → **asType<short int>**((div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).rem * 171) − (**asType<int>**(**asType<short int>**(div1.quot)) * **asType<int>**($\$heap_{funcstart\_719,1}$.b1)))))

→ *[from term 5.6, div1 is equal to div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177)]*

[26.9] $\$heap_{719,1;729,8}$ == $\$heap_{funcstart\_719,1}$.__replace__(p1 → **asType<short int>**((171 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).rem) − (**asType<int>**(**asType<short int>**(div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot)) * **asType<int>**($\$heap_{funcstart\_719,1}$.b1)))))

→ *[simplify]*

[26.11] $\text{\$heap}_{719,1;729,8}$ == $\text{\$heap}_{funcstart\_719,1}$._**replace**(p1 → **asType**<**short int**>((171 * div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p1, 177).rem) − (div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p1, 177).quot * **asType**<**int**>($\text{\$heap}_{funcstart\_719,1}$.b1))))

→ *[const static or extern object]*

[26.12] $\text{\$heap}_{719,1;729,8}$ == $\text{\$heap}_{funcstart\_719,1}$._**replace**(p1 → **asType**<**short int**>((171 * div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p1, 177).rem) − (div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p1, 177).quot * **asType**<**int**>($\text{\$heap}_{init}$.b1))))

→ *[expand definition of constant 'b1' at prang.c (17,20)]*

[26.13] $\text{\$heap}_{719,1;729,8}$ == $\text{\$heap}_{funcstart\_719,1}$._**replace**(p1 → **asType**<**short int**>((171 * div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p1, 177).rem) − (div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p1, 177).quot * **asType**<**int**>(**asType**<**short int**>((**int**)2)))))

→ *[simplify]*

[26.19] $\text{\$heap}_{719,1;729,8}$ == $\text{\$heap}_{funcstart\_719,1}$._**replace**(p1 → ((-2 * div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p1, 177).rem)))

[Take given term]

[31.0] $\text{\$heap}_{719,1;730,8}$ == $\text{\$heap}_{719,1;729,8}$._**replace**(p2 → **asType**<**short int**>((**asType**<**int**>(**asType**<**short int**>(div2.rem)) * **asType**<**int**>($\text{\$heap}_{719,1;729,8}$.r2)) − (**asType**<**int**>(**asType**<**short int**>(div2.quot)) * **asType**<**int**>($\text{\$heap}_{719,1;729,8}$.b2))))

→ *[from term 26.19, $heap_{719,1;729,8}$ is equal to $heap_{funcstart\_719,1}$._**replace***(p1 → (-2 * div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p1, 177).rem))]*

[31.1] $\text{\$heap}_{719,1;730,8}$ == $\text{\$heap}_{funcstart\_719,1}$._**replace**(p1 → ((-2 * div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p1, 177).rem)))._**replace**(p2 → **asType**<**short int**>((**asType**<**int**>(**asType**<**short int**>(div2.rem)) * **asType**<**int**>($\text{\$heap}_{719,1;729,8}$.r2)) − (**asType**<**int**>(**asType**<**short int**>(div2.quot)) * **asType**<**int**>($\text{\$heap}_{719,1;729,8}$.b2))))

→ *[from term 12.6, div2 is equal to div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p2, 176)]*

[31.2] $\text{\$heap}_{719,1;730,8}$ == $\text{\$heap}_{funcstart\_719,1}$._**replace**(p1 → ((-2 * div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p1, 177).rem)))._**replace**(p2 → **asType**<**short int**>((**asType**<**int**>(**asType**<**short int**>(div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$,

$heap_{funcstart\_719,1}$.p2, 176).rem)) * **asType\<int\>**($heap_{719,1;729,8}$.r2)) −
(**asType\<int\>**(**asType\<short int\>**(div2.quot)) *
asType\<int\>($heap_{719,1;729,8}$.b2))))

→ *[simplify]*

[31.4] $heap_{719,1;730,8}$ == $heap_{funcstart\_719,1}$._**replace**(p1 → ((-2 *
div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p1, 177).quot) + (171 *
div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p1,
177).rem)))._**replace**(p2 → **asType\<short int\>**((div(**heapIs**
$heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p2, 176).rem *
asType\<int\>($heap_{719,1;729,8}$.r2)) − (**asType\<int\>**(**asType\<short
int\>**(div2.quot)) * **asType\<int\>**($heap_{719,1;729,8}$.b2))))

→ *[from term 26.19, $heap_{719,1;729,8}$ is equal to*
*$heap_{funcstart\_719,1}$._**replace**(p1 → (-2 * div(**heapIs** $heap_{funcstart\_719,1}$,*
*$heap_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs** $heap_{funcstart\_719,1}$,*
$heap_{funcstart\_719,1}$.p1, 177).rem))]

[31.5] $heap_{719,1;730,8}$ == $heap_{funcstart\_719,1}$._**replace**(p1 → ((-2 *
div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p1, 177).quot) + (171 *
div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p1,
177).rem)))._**replace**(p2 → **asType\<short int\>**((div(**heapIs**
$heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p2, 176).rem *
asType\<int\>($heap_{funcstart\_719,1}$._**replace**(p1 → ((-2 * div(**heapIs**
$heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs**
$heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p1, 177).rem))).r2)) −
(**asType\<int\>**(**asType\<short int\>**(div2.quot)) *
asType\<int\>($heap_{719,1;729,8}$.b2))))

→ *[const member of object with modified fields]*

[31.6] $heap_{719,1;730,8}$ == $heap_{funcstart\_719,1}$._**replace**(p1 → ((-2 *
div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p1, 177).quot) + (171 *
div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p1,
177).rem)))._**replace**(p2 → **asType\<short int\>**((div(**heapIs**
$heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p2, 176).rem *
asType\<int\>($heap_{funcstart\_719,1}$.r2)) − (**asType\<int\>**(**asType\<short
int\>**(div2.quot)) * **asType\<int\>**($heap_{719,1;729,8}$.b2))))

→ *[const static or extern object]*

[31.7] $heap_{719,1;730,8}$ == $heap_{funcstart\_719,1}$._**replace**(p1 → ((-2 *
div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p1, 177).quot) + (171 *
div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p1,
177).rem)))._**replace**(p2 → **asType\<short int\>**((div(**heapIs**
$heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p2, 176).rem *
asType\<int\>($heap_{init}$.r2)) − (**asType\<int\>**(**asType\<short
int\>**(div2.quot)) * **asType\<int\>**($heap_{719,1;729,8}$.b2))))

→ *[expand definition of constant 'r2' at prang.c (20,20)]*

[31.8] $\text{\$heap}_{719,1;730,8}$ == $\text{\$heap}_{funcstart\_719,1}$._**replace**(p1 → ((-2 *
div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p1,
177).rem)))._**replace**(p2 → **asType**<**short int**>((div(**heapIs**
$\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p2, 176).rem *
asType<**int**>(**asType**<**short int**>((**int**)172))) −
(**asType**<**int**>(**asType**<**short int**>(div2.quot)) *
asType<**int**>($\text{\$heap}_{719,1;729,8}$.b2))))

→ *[simplify]*

[31.11] $\text{\$heap}_{719,1;730,8}$ == $\text{\$heap}_{funcstart\_719,1}$._**replace**(p1 → ((-2 *
div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p1,
177).rem)))._**replace**(p2 → **asType**<**short int**>((div(**heapIs**
$\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p2, 176).rem * 172) −
(**asType**<**int**>(**asType**<**short int**>(div2.quot)) *
asType<**int**>($\text{\$heap}_{719,1;729,8}$.b2))))

→ *[from term 12.6, div2 is equal to div(**heapIs** $heap_{funcstart\_719,1}$,
$heap_{funcstart\_719,1}$.p2, 176)]*

[31.12] $\text{\$heap}_{719,1;730,8}$ == $\text{\$heap}_{funcstart\_719,1}$._**replace**(p1 → ((-2 *
div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p1,
177).rem)))._**replace**(p2 → **asType**<**short int**>((172 * div(**heapIs**
$\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p2, 176).rem) −
(**asType**<**int**>(**asType**<**short int**>(div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$,
$\text{\$heap}_{funcstart\_719,1}$.p2, 176).quot)) * **asType**<**int**>($\text{\$heap}_{719,1;729,8}$.b2))))

→ *[simplify]*

[31.14] $\text{\$heap}_{719,1;730,8}$ == $\text{\$heap}_{funcstart\_719,1}$._**replace**(p1 → ((-2 *
div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p1,
177).rem)))._**replace**(p2 → **asType**<**short int**>((172 * div(**heapIs**
$\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p2, 176).rem) − (div(**heapIs**
$\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p2, 176).quot *
asType<**int**>($\text{\$heap}_{719,1;729,8}$.b2))))

→ *[from term 26.19, $heap_{719,1;729,8}$ is equal to
$heap_{funcstart\_719,1}$._**replace**(p1 → (-2 * div(**heapIs** $heap_{funcstart\_719,1}$,
$heap_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs** $heap_{funcstart\_719,1}$,
$heap_{funcstart\_719,1}$.p1, 177).rem))]*

[31.15] $\text{\$heap}_{719,1;730,8}$ == $\text{\$heap}_{funcstart\_719,1}$._**replace**(p1 → ((-2 *
div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p1,
177).rem)))._**replace**(p2 → **asType**<**short int**>((172 * div(**heapIs**
$\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p2, 176).rem) − (div(**heapIs**

$\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p2, 176).quot *
asType\<int\>($\text{\$heap}_{funcstart\_719,1}$._**replace**(p1 → ((-2 * div(**heapIs**
$\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs**
$\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p1, 177).rem))).b2))))

→ *[const member of object with modified fields]*

[31.16] $\text{\$heap}_{719,1;730,8}$ == $\text{\$heap}_{funcstart\_719,1}$._**replace**(p1 → ((-2 *
div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p1,
177).rem)))._**replace**(p2 → **asType\<short int\>**((172 * div(**heapIs**
$\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p2, 176).rem) − (div(**heapIs**
$\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p2, 176).quot *
asType\<int\>($\text{\$heap}_{funcstart\_719,1}$.b2))))

→ *[const static or extern object]*

[31.17] $\text{\$heap}_{719,1;730,8}$ == $\text{\$heap}_{funcstart\_719,1}$._**replace**(p1 → ((-2 *
div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p1,
177).rem)))._**replace**(p2 → **asType\<short int\>**((172 * div(**heapIs**
$\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p2, 176).rem) − (div(**heapIs**
$\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p2, 176).quot *
asType\<int\>($\text{\$heap}_{init}$.b2))))

→ *[expand definition of constant 'b2' at prang.c (22,20)]*

[31.18] $\text{\$heap}_{719,1;730,8}$ == $\text{\$heap}_{funcstart\_719,1}$._**replace**(p1 → ((-2 *
div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p1,
177).rem)))._**replace**(p2 → **asType\<short int\>**((172 * div(**heapIs**
$\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p2, 176).rem) − (div(**heapIs**
$\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p2, 176).quot *
asType\<int\>(**asType\<short int\>**((**int**)35)))))

→ *[simplify]*

[31.24] $\text{\$heap}_{719,1;730,8}$ == $\text{\$heap}_{funcstart\_719,1}$._**replace**(p1 → ((-2 *
div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p1,
177).rem)))._**replace**(p2 → ((-35 * div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$,
$\text{\$heap}_{funcstart\_719,1}$.p2, 176).quot) + (172 * div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$,
$\text{\$heap}_{funcstart\_719,1}$.p2, 176).rem)))

[Take goal term]

[1.0] **minof(short int)** ≤ ((**asType\<int\>**(**asType\<short int\>**(div3.rem)) *
asType\<int\>($\text{\$heap}_{719,1;730,8}$.r3)) − (**asType\<int\>**(**asType\<short
int\>**(div3.quot)) * **asType\<int\>**($\text{\$heap}_{719,1;730,8}$.b3)))

→ *[simplify]*

[1.1] -32768 ≤ ((**asType\<int\>**(**asType\<short int\>**(div3.rem)) *

asType<int>($heap$_{719,1;730,8}$.r3)) $-$ (**asType<int>**(**asType<short int>**(div3.quot)) * **asType<int>**($heap$_{719,1;730,8}$.b3)))

$\rightarrow$ *[from term 19.6, div3 is equal to div(**heapIs** $heap$_{funcstart_719,1}$,*
$heap$_{funcstart_719,1}$.p3, 178)]

[1.2] -32768 $\leq$ ((**asType<int>**(**asType<short int>**(div(**heapIs**
$heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p3, 178).rem)) *
asType<int>($heap$_{719,1;730,8}$.r3)) $-$ (**asType<int>**(**asType<short
int>**(div3.quot)) * **asType<int>**($heap$_{719,1;730,8}$.b3)))

$\rightarrow$ *[simplify]*

[1.4] -32768 $\leq$ ((div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p3,
178).rem * **asType<int>**($heap$_{719,1;730,8}$.r3)) $-$
(**asType<int>**(**asType<short int>**(div3.quot)) *
asType<int>($heap$_{719,1;730,8}$.b3)))

$\rightarrow$ *[from term 31.24, $heap$_{719,1;730,8}$ is equal to*
*$heap$_{funcstart_719,1}$._**replace**(p1 $\rightarrow$ ((-2 * div(**heapIs** $heap$_{funcstart_719,1}$,*
*$heap$_{funcstart_719,1}$.p1, 177).quot) + (171 * div(**heapIs** $heap$_{funcstart_719,1}$,*
*$heap$_{funcstart_719,1}$.p1, 177).rem)))._**replace**(p2 $\rightarrow$ (-35 * div(**heapIs***
*$heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p2, 176).quot) + (172 * div(**heapIs***
$heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p2, 176).rem))]

[1.5] -32768 $\leq$ ((div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p3,
178).rem * **asType<int>**($heap$_{funcstart_719,1}$._**replace**(p1 $\rightarrow$ ((-2 *
div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1, 177).quot) + (171 *
div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1,
177).rem)))._**replace**(p2 $\rightarrow$ ((-35 * div(**heapIs** $heap$_{funcstart_719,1}$,
$heap$_{funcstart_719,1}$.p2, 176).quot) + (172 * div(**heapIs** $heap$_{funcstart_719,1}$,
$heap$_{funcstart_719,1}$.p2, 176).rem))).r3)) $-$ (**asType<int>**(**asType<short
int>**(div3.quot)) * **asType<int>**($heap$_{719,1;730,8}$.b3)))

$\rightarrow$ *[const member of object with modified fields]*

[1.7] -32768 $\leq$ ((div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p3,
178).rem * **asType<int>**($heap$_{funcstart_719,1}$.r3)) $-$
(**asType<int>**(**asType<short int>**(div3.quot)) *
asType<int>($heap$_{719,1;730,8}$.b3)))

$\rightarrow$ *[const static or extern object]*

[1.8] -32768 $\leq$ ((div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p3,
178).rem * **asType<int>**($heap$_{init}$.r3)) $-$ (**asType<int>**(**asType<short
int>**(div3.quot)) * **asType<int>**($heap$_{719,1;730,8}$.b3)))

$\rightarrow$ *[expand definition of constant 'r3' at prang.c (25,20)]*

[1.9] -32768 $\leq$ ((div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p3,
178).rem * **asType<int>**(**asType<short int>**((**int**)170))) $-$
(**asType<int>**(**asType<short int>**(div3.quot)) *
asType<int>($heap$_{719,1;730,8}$.b3)))

$\rightarrow$ *[simplify]*

[1.12] -32768 $\leq$ ((div(**heapIs** \$heap$_{funcstart\_719,1}$, \$heap$_{funcstart\_719,1}$.p3, 178).rem * 170) $-$ (**asType<int>**(**asType<short int>**(div3.quot)) * **asType<int>**(\$heap$_{719,1;730,8}$.b3)))

$\rightarrow$ *[from term 19.6, div3 is equal to div(**heapIs** \$heap$_{funcstart\_719,1}$, \$heap$_{funcstart\_719,1}$.p3, 178)]*

[1.13] -32768 $\leq$ ((170 * div(**heapIs** \$heap$_{funcstart\_719,1}$, \$heap$_{funcstart\_719,1}$.p3, 178).rem) $-$ (**asType<int>**(**asType<short int>**(div(**heapIs** \$heap$_{funcstart\_719,1}$, \$heap$_{funcstart\_719,1}$.p3, 178).quot)) * **asType<int>**(\$heap$_{719,1;730,8}$.b3)))

$\rightarrow$ *[simplify]*

[1.15] -32768 $\leq$ ((170 * div(**heapIs** \$heap$_{funcstart\_719,1}$, \$heap$_{funcstart\_719,1}$.p3, 178).rem) $-$ (div(**heapIs** \$heap$_{funcstart\_719,1}$, \$heap$_{funcstart\_719,1}$.p3, 178).quot * **asType<int>**(\$heap$_{719,1;730,8}$.b3)))

$\rightarrow$ *[from term 31.24, \$heap$_{719,1;730,8}$ is equal to \$heap$_{funcstart\_719,1}$._**replace**(p1 $\rightarrow$ ((-2 * div(**heapIs** \$heap$_{funcstart\_719,1}$, \$heap$_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs** \$heap$_{funcstart\_719,1}$, \$heap$_{funcstart\_719,1}$.p1, 177).rem)))._**replace**(p2 $\rightarrow$ (-35 * div(**heapIs** \$heap$_{funcstart\_719,1}$, \$heap$_{funcstart\_719,1}$.p2, 176).quot) + (172 * div(**heapIs** \$heap$_{funcstart\_719,1}$, \$heap$_{funcstart\_719,1}$.p2, 176).rem))]*

[1.16] -32768 $\leq$ ((170 * div(**heapIs** \$heap$_{funcstart\_719,1}$, \$heap$_{funcstart\_719,1}$.p3, 178).rem) $-$ (div(**heapIs** \$heap$_{funcstart\_719,1}$, \$heap$_{funcstart\_719,1}$.p3, 178).quot * **asType<int>**(\$heap$_{funcstart\_719,1}$._**replace**(p1 $\rightarrow$ ((-2 * div(**heapIs** \$heap$_{funcstart\_719,1}$, \$heap$_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs** \$heap$_{funcstart\_719,1}$, \$heap$_{funcstart\_719,1}$.p1, 177).rem)))._**replace**(p2 $\rightarrow$ ((-35 * div(**heapIs** \$heap$_{funcstart\_719,1}$, \$heap$_{funcstart\_719,1}$.p2, 176).quot) + (172 * div(**heapIs** \$heap$_{funcstart\_719,1}$, \$heap$_{funcstart\_719,1}$.p2, 176).rem))).b3)))

$\rightarrow$ *[const member of object with modified fields]*

[1.18] -32768 $\leq$ ((170 * div(**heapIs** \$heap$_{funcstart\_719,1}$, \$heap$_{funcstart\_719,1}$.p3, 178).rem) $-$ (div(**heapIs** \$heap$_{funcstart\_719,1}$, \$heap$_{funcstart\_719,1}$.p3, 178).quot * **asType<int>**(\$heap$_{funcstart\_719,1}$.b3)))

$\rightarrow$ *[const static or extern object]*

[1.19] -32768 $\leq$ ((170 * div(**heapIs** \$heap$_{funcstart\_719,1}$, \$heap$_{funcstart\_719,1}$.p3, 178).rem) $-$ (div(**heapIs** \$heap$_{funcstart\_719,1}$, \$heap$_{funcstart\_719,1}$.p3, 178).quot * **asType<int>**(\$heap$_{init}$.b3)))

$\rightarrow$ *[expand definition of constant 'b3' at prang.c (27,20)]*

[1.20] -32768 $\leq$ ((170 * div(**heapIs** \$heap$_{funcstart\_719,1}$, \$heap$_{funcstart\_719,1}$.p3, 178).rem) $-$ (div(**heapIs** \$heap$_{funcstart\_719,1}$, \$heap$_{funcstart\_719,1}$.p3, 178).quot * **asType<int>**(**asType<short int>**((int)63))))

→ *[simplify]*

[1.27] -32769 < ((-63 * div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p3, 178).quot) + (170 * div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p3, 178).rem))

→ *[negate goal and search for contradiction]*

[1.28] !(-32769 < ((-63 * div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p3, 178).quot) + (170 * div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p3, 178).rem)))

→ *[simplify]*

[1.33] 32768 < ((63 * div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p3, 178).quot) + (-170 * div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p3, 178).rem))

[Branch on disjunction or conditional in term 24.21]

[54.0] (0 == ((−$\text{\$heap}_{funcstart\_719,1}$.p3 / 178) + div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p3, 178).quot)) ∨ (0 == (−($\text{\$heap}_{funcstart\_719,1}$.p3 / 178) + div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p3, 178).quot)) ∨ (-1 < $\text{\$heap}_{funcstart\_719,1}$.p3)

[Branch on disjunction or conditional in term 24.21]

[55.0] (0 < −$\text{\$heap}_{funcstart\_719,1}$.p3) ∨ (0 == (−($\text{\$heap}_{funcstart\_719,1}$.p3 / 178) + div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p3, 178).quot)) ∨ (-1 < $\text{\$heap}_{funcstart\_719,1}$.p3)

[Copy term 25.40]

[56.0] ([0 < −$\text{\$heap}_{funcstart\_719,1}$.p3]: ([0 == ($\text{\$heap}_{funcstart\_719,1}$.p3 % 178)]: 0 == div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p3, 178).rem, [!(0 == ($\text{\$heap}_{funcstart\_719,1}$.p3 % 178))]: 178 == (−div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p3, 178).rem + ($\text{\$heap}_{funcstart\_719,1}$.p3 % 178))), [-1 < $\text{\$heap}_{funcstart\_719,1}$.p3]: 0 == (−($\text{\$heap}_{funcstart\_719,1}$.p3 % 178) + div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p3, 178).rem)) ∨ (0 == (−($\text{\$heap}_{funcstart\_719,1}$.p3 / 178) + div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p3, 178).quot)) ∨ (-1 < $\text{\$heap}_{funcstart\_719,1}$.p3)

→ *[from term 55.0, literala < −$\text{\$heap}_{funcstart\_719,1}$.p3 is true whenever (-1 + literala) < 0]*

Proof of rule precondition:

[56.0.0] (-1 + 0) < 0

→ *[simplify]*

[56.0.2] **true**

[56.1] ([**true**]: ([0 == ($\text{\$heap}_{funcstart\_719,1}$.p3 % 178)]: 0 == div(**heapIs**

$\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p3, 178).rem, [!(0 ==
($\text{\$heap}_{funcstart\_719,1}$.p3 % 178))]: 178 == (−div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$,
$\text{\$heap}_{funcstart\_719,1}$.p3, 178).rem + ($\text{\$heap}_{funcstart\_719,1}$.p3 % 178))), [-1 <
$\text{\$heap}_{funcstart\_719,1}$.p3]: 0 == (−($\text{\$heap}_{funcstart\_719,1}$.p3 % 178) + div(**heapIs**
$\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p3, 178).rem)) ∨ ...

→ *[simplify]*

[56.3] ([0 == ($\text{\$heap}_{funcstart\_719,1}$.p3 % 178)]: 0 == div(**heapIs**
$\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p3, 178).rem, [!(0 ==
($\text{\$heap}_{funcstart\_719,1}$.p3 % 178))]: 178 == (−div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$,
$\text{\$heap}_{funcstart\_719,1}$.p3, 178).rem + ($\text{\$heap}_{funcstart\_719,1}$.p3 % 178))) ∨ ...

[Branch on disjunction or conditional in term 56.3]

[57.0] (0 == div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p3, 178).rem)
∨ (0 == (−($\text{\$heap}_{funcstart\_719,1}$.p3 / 178) + div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$,
$\text{\$heap}_{funcstart\_719,1}$.p3, 178).quot)) ∨ (-1 < $\text{\$heap}_{funcstart\_719,1}$.p3) ∨ (178 ==
(−div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p3, 178).rem +
($\text{\$heap}_{funcstart\_719,1}$.p3 % 178))) ∨ !(0 == ($\text{\$heap}_{funcstart\_719,1}$.p3 % 178))

[Copy term 1.33]

[59.0] (32768 < ((-170 * div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$,
$\text{\$heap}_{funcstart\_719,1}$.p3, 178).rem) + (63 * div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$,
$\text{\$heap}_{funcstart\_719,1}$.p3, 178).quot))) ∨ (0 == (−($\text{\$heap}_{funcstart\_719,1}$.p3 / 178)
+ div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p3, 178).quot)) ∨ (-1 <
$\text{\$heap}_{funcstart\_719,1}$.p3) ∨ (178 == (−div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$,
$\text{\$heap}_{funcstart\_719,1}$.p3, 178).rem + ($\text{\$heap}_{funcstart\_719,1}$.p3 % 178))) ∨ !(0 ==
($\text{\$heap}_{funcstart\_719,1}$.p3 % 178))

→ *[from term 57.0, div(heapIs $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p3,
178).rem is equal to 0]*

[59.1] (32768 < ((-170 * 0) + (63 * div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$,
$\text{\$heap}_{funcstart\_719,1}$.p3, 178).quot))) ∨ ...

→ *[simplify]*

[59.3] (32768 < (63 * div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p3,
178).quot)) ∨ ...

→ *[literal comparison of product]*

[59.4] ([63 < 0]: (32768 / -63) < −div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$,
$\text{\$heap}_{funcstart\_719,1}$.p3, 178).quot, [0 < 63]: (32768 / 63) < div(**heapIs**
$\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p3, 178).quot, [0 == 63]: 32768 < 0)
∨ ...

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

[59.5] ([63 < 0]: (32768 / -63) < −div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$,
$\text{\$heap}_{funcstart\_719,1}$.p3, 178).quot, [(0 < 63) ∧ !(63 < 0)]: (32768 / 63) <
div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p3, 178).quot, [(0 == 63)

$\land$!(0 < 63) $\land$!(63 < 0)]: 32768 < 0) $\lor$ ...

$\rightarrow$ *[simplify]*

[59.13] (520 < div(**heapIs** \$heap$_{funcstart\_719,1}$, \$heap$_{funcstart\_719,1}$.p3, 178).quot) $\lor$ ...

[Create new term from terms 59.13, 54.0 using rule: transitivity 15]

[61.0] ((0 + 520) < $-(-$\$heap$_{funcstart\_719,1}$.p3 / 178)) $\lor$ (0 == ($-($\$heap$_{funcstart\_719,1}$.p3 / 178) + div(**heapIs** \$heap$_{funcstart\_719,1}$, \$heap$_{funcstart\_719,1}$.p3, 178).quot)) $\lor$ (-1 < \$heap$_{funcstart\_719,1}$.p3) $\lor$ (178 == ($-$div(**heapIs** \$heap$_{funcstart\_719,1}$, \$heap$_{funcstart\_719,1}$.p3, 178).rem + (\$heap$_{funcstart\_719,1}$.p3 % 178))) $\lor$!(0 == (\$heap$_{funcstart\_719,1}$.p3 % 178))

$\rightarrow$ *[simplify]*

[61.8] (92560 < \$heap$_{funcstart\_719,1}$.p3) $\lor$ ...

$\rightarrow$ *[from term 55.0, literala < \$heap$_{funcstart\_719,1}$.p3 is false whenever -2 < (0 + literala)]*

> **Proof of rule precondition:**
>
> *[61.8.0]* -2 < (0 + 92560)
>
> $\rightarrow$ *[simplify]*
>
> *[61.8.2]* **true**

[61.9] **false** $\lor$ ...

[Remove 'false' term 61.9 and fetch new term from containing clause]

[62.0] (178 == ($-$div(**heapIs** \$heap$_{funcstart\_719,1}$, \$heap$_{funcstart\_719,1}$.p3, 178).rem + (\$heap$_{funcstart\_719,1}$.p3 % 178))) $\lor$ (0 == ($-($\$heap$_{funcstart\_719,1}$.p3 / 178) + div(**heapIs** \$heap$_{funcstart\_719,1}$, \$heap$_{funcstart\_719,1}$.p3, 178).quot)) $\lor$ (-1 < \$heap$_{funcstart\_719,1}$.p3)

[Remove 'false' term 61.9 and fetch new term from containing clause]

[63.0] !(0 == (\$heap$_{funcstart\_719,1}$.p3 % 178)) $\lor$ (0 == ($-($\$heap$_{funcstart\_719,1}$.p3 / 178) + div(**heapIs** \$heap$_{funcstart\_719,1}$, \$heap$_{funcstart\_719,1}$.p3, 178).quot)) $\lor$ (-1 < \$heap$_{funcstart\_719,1}$.p3)

[Copy term 1.33]

[64.0] (32768 < ((-170 * div(**heapIs** \$heap$_{funcstart\_719,1}$, \$heap$_{funcstart\_719,1}$.p3, 178).rem) + (63 * div(**heapIs** \$heap$_{funcstart\_719,1}$, \$heap$_{funcstart\_719,1}$.p3, 178).quot))) $\lor$ (0 == ($-($\$heap$_{funcstart\_719,1}$.p3 / 178) + div(**heapIs** \$heap$_{funcstart\_719,1}$, \$heap$_{funcstart\_719,1}$.p3, 178).quot)) $\lor$ (-1 < \$heap$_{funcstart\_719,1}$.p3)

$\rightarrow$ *[from term 62.0, div(**heapIs** \$heap$_{funcstart\_719,1}$, \$heap$_{funcstart\_719,1}$.p3, 178).rem is equal to -178 + (\$heap$_{funcstart\_719,1}$.p3 % 178)]*

[64.1] (32768 < ((-170 * (-178 + (\$heap$_{funcstart\_719,1}$.p3 % 178))) + (63 *

div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p3, 178).quot))) ∨ ...

→ *[simplify]*

[64.6] (2508 < ((-170 * ($\$heap_{funcstart\_719,1}$.p3 % 178)) + (63 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p3, 178).quot))) ∨ ...

[Create new term from term 63.0 using rule: try to prove equality by contradiction]

[68.0] ((0 < ($\$heap_{funcstart\_719,1}$.p3 % 178)) ∨ (($\$heap_{funcstart\_719,1}$.p3 % 178) < 0)) ∨ (0 == (−($\$heap_{funcstart\_719,1}$.p3 / 178) + div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p3, 178).quot)) ∨ (-1 < $\$heap_{funcstart\_719,1}$.p3)

→ *[simplify]*

[68.1] ((([-1 < 0]: ∃ **integer** n • (0 < ($\$heap_{funcstart\_719,1}$.p3 + (178 * n))) ∧ (($\$heap_{funcstart\_719,1}$.p3 + (178 * n)) < 178), []: **true**) ∨ (($\$heap_{funcstart\_719,1}$.p3 % 178) < 0)) ∨ ...

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

[68.2] ((([-1 < 0]: ∃ **integer** n • (0 < ($\$heap_{funcstart\_719,1}$.p3 + (178 * n))) ∧ (($\$heap_{funcstart\_719,1}$.p3 + (178 * n)) < 178), [!(-1 < 0)]: **true**) ∨ (($\$heap_{funcstart\_719,1}$.p3 % 178) < 0)) ∨ ...

→ *[simplify]*

[68.15] (∃ **integer** n • (-178 < (−$\$heap_{funcstart\_719,1}$.p3 + (-178 * n))) ∧ (0 < ((178 * n) + $\$heap_{funcstart\_719,1}$.p3)))) ∨ ...

→ *[introduce skolem term and eliminate 'exists']*

[68.16] ((-178 < (−$\$heap_{funcstart\_719,1}$.p3 + (-178 * $a_n))) ∧ (0 < ((178 * $a_n) + $\$heap_{funcstart\_719,1}$.p3)))) ∨ ...

→ *[separate conjunction and work on first sub-term]*

[68.17] (-178 < (−$\$heap_{funcstart\_719,1}$.p3 + (-178 * $a_n))) ∨ ...

[Work on sub-term 2 of conjunction in term 68.16]

[69.0] (0 < ((178 * $a_n) + $\$heap_{funcstart\_719,1}$.p3)) ∨ (0 == (−($\$heap_{funcstart\_719,1}$.p3 / 178) + div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p3, 178).quot)) ∨ (-1 < $\$heap_{funcstart\_719,1}$.p3)

[Create new term from terms 69.0, 55.0 using rule: transitivity 2]

[77.0] ((0 + 0 + 1) < (178 * $a_n)) ∨ (0 == (−($\$heap_{funcstart_719,1}$.p3 / 178) + div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p3, 178).quot)) ∨ (-1 < $\$heap_{funcstart\_719,1}$.p3)

→ *[simplify]*

[77.1] (1 < (178 * $a_n)) ∨ ...

→ *[literal comparison of product]*

[77.2] ([178 < 0]: (1 / -178) < −$a_n, [0 < 178]: (1 / 178) < $a_n, [0 == 178]: 1 < 0) ∨ ...

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

[77.3] ([178 < 0]: (1 / -178) < −$a_n, [(0 < 178) ∧ !(178 < 0)]: (1 / 178) < $a_n, [(0 == 178) ∧ !(0 < 178) ∧ !(178 < 0)]: 1 < 0) ∨ ...

→ *[simplify]*

[77.11] (0 < $a_n) ∨ ...

[Create new term from term 54.0 using rule: condition for equality of division]

[79.0] ((−$heap$_{funcstart_719,1}$.p3 < (178 * (0 + 1 + −div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p3, 178).quot))) ∧ ((178 * (0 + −div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p3, 178).quot)) < (1 + −$heap$_{funcstart\_719,1}$.p3))) ∨ (0 == (−($heap$_{funcstart_719,1}$.p3 / 178) + div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p3, 178).quot)) ∨ (-1 < $heap$_{funcstart_719,1}$.p3)

→ *[simplify]*

[79.18] ((-178 < ((-178 * div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p3, 178).quot) + $heap$_{funcstart_719,1}$.p3)) ∧ (-1 < (−$heap$_{funcstart\_719,1}$.p3 + (178 * div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p3, 178).quot)))) ∨ ...

→ *[separate conjunction and work on first sub-term]*

[79.19] (-178 < ((-178 * div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p3, 178).quot) + $heap$_{funcstart_719,1}$.p3)) ∨ ...

[Create new term from terms 79.19, 68.17 using rule: transitivity 1]

[81.0] ((-178 + -178 + 1) < ((-178 * div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p3, 178).quot) + (-178 * $a_n))) ∨ (0 == (−($heap$_{funcstart\_719,1}$.p3 / 178) + div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p3, 178).quot)) ∨ (-1 < $heap$_{funcstart_719,1}$.p3)

→ *[simplify]*

[81.1] (-355 < ((-178 * div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p3, 178).quot) + (-178 * $a_n))) ∨ ...

→ *[cancel common factor]*

Proof of rule precondition 1:

[81.1.0.0] !(-178 == 0)

→ *[simplify]*

[81.1.0.2] **true**

Proof of rule precondition 2:

[81.1.1.0] 1 < $gcf(-178, -178)

$\rightarrow$ *[simplify]*

[81.1.1.2] **true**

[81.2] ((-355 / \$gcf(-178, -178)) < (((-178 / \$gcf(-178, -178)) * div(**heapIs** \$heap$_{funcstart\_719,1}$, \$heap$_{funcstart\_719,1}$.p3, 178).quot) + ((-178 / \$gcf(-178, -178)) * \$a_n))) $\vee$ ...

$\rightarrow$ *[simplify]*

[81.10] (-2 < ($-$div(**heapIs** \$heap$_{funcstart\_719,1}$, \$heap$_{funcstart\_719,1}$.p3, 178).quot + $-$\$a_n)) $\vee$ ...

[Create new term from terms 77.11, 81.10 using rule: transitivity 3]

[83.0] ((-2 + 0 + 1) < $-$div(**heapIs** \$heap$_{funcstart\_719,1}$, \$heap$_{funcstart\_719,1}$.p3, 178).quot) $\vee$ (0 == ($-$(\$heap$_{funcstart\_719,1}$.p3 / 178) + div(**heapIs** \$heap$_{funcstart\_719,1}$, \$heap$_{funcstart\_719,1}$.p3, 178).quot)) $\vee$ (-1 < \$heap$_{funcstart\_719,1}$.p3)

$\rightarrow$ *[simplify]*

[83.1] (-1 < $-$div(**heapIs** \$heap$_{funcstart\_719,1}$, \$heap$_{funcstart\_719,1}$.p3, 178).quot) $\vee$ ...

[Create new term from terms 83.1, 64.6 using rule: transitivity 5]

[86.0] (2508 < ((-170 * (\$heap$_{funcstart\_719,1}$.p3 % 178)) + (63 * $-$(-1 + 1)))) $\vee$ (0 == ($-$(\$heap$_{funcstart\_719,1}$.p3 / 178) + div(**heapIs** \$heap$_{funcstart\_719,1}$, \$heap$_{funcstart\_719,1}$.p3, 178).quot)) $\vee$ (-1 < \$heap$_{funcstart\_719,1}$.p3)

$\rightarrow$ *[simplify]*

[86.4] (2508 < (-170 * (\$heap$_{funcstart\_719,1}$.p3 % 178))) $\vee$ ...

$\rightarrow$ *[literal comparison of product]*

[86.5] ([-170 < 0]: (2508 / 170) < $-$(\$heap$_{funcstart\_719,1}$.p3 % 178), [0 < -170]: (2508 / -170) < (\$heap$_{funcstart\_719,1}$.p3 % 178), [-170 == 0]: 2508 < 0) $\vee$ ...

$\rightarrow$ *[explicitly assert falsehood of skipped guards in subsequent guards]*

[86.6] ([-170 < 0]: (2508 / 170) < $-$(\$heap$_{funcstart\_719,1}$.p3 % 178), [(0 < -170) $\wedge$!(-170 < 0)]: (2508 / -170) < (\$heap$_{funcstart\_719,1}$.p3 % 178), [(-170 == 0) $\wedge$!(-170 < 0) $\wedge$!(0 < -170)]: 2508 < 0) $\vee$ ...

$\rightarrow$ *[simplify]*

[86.11] **false** $\vee$ ...

[Remove 'false' term 86.11 and fetch new term from containing clause]

[88.0] 0 == ($-$(\$heap$_{funcstart\_719,1}$.p3 / 178) + div(**heapIs** \$heap$_{funcstart\_719,1}$, \$heap$_{funcstart\_719,1}$.p3, 178).quot)

[Remove 'false' term 86.11 and fetch new term from containing clause]

[89.0] -1 < \$heap$_{funcstart\_719,1}$.p3

[Assume known post-assertion, class invariant or type constraint for term 19.6]

[25.40] ([0 < −$\$heap_{funcstart\_719,1}$.p3]: ([0 == ($\$heap_{funcstart\_719,1}$.p3 % 178)]: 0 == div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p3, 178).rem, [!(0 == ($\$heap_{funcstart\_719,1}$.p3 % 178))]: 178 == (($\$heap_{funcstart\_719,1}$.p3 % 178) + −div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p3, 178).rem)), [-1 < $\$heap_{funcstart\_719,1}$.p3]: 0 == (−($\$heap_{funcstart\_719,1}$.p3 % 178) + div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p3, 178).rem))

→ *[from term 89.0, literala < −$heap_{funcstart\_719,1}$.p3 is false whenever -2 < (-1 + literala)]*

Proof of rule precondition:

[25.40.0] -2 < (-1 + 0)

→ *[simplify]*

[25.40.2] **true**

[25.41] ([**false**]: ([0 == ($\$heap_{funcstart\_719,1}$.p3 % 178)]: 0 == div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p3, 178).rem, [!(0 == ($\$heap_{funcstart\_719,1}$.p3 % 178))]: 178 == (−div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p3, 178).rem + ($\$heap_{funcstart\_719,1}$.p3 % 178))), [-1 < $\$heap_{funcstart\_719,1}$.p3]: 0 == (−($\$heap_{funcstart\_719,1}$.p3 % 178) + div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p3, 178).rem))

→ *[from term 89.0, literala < $heap_{funcstart\_719,1}$.p3 is true whenever (-1 + literala) < -1]*

Proof of rule precondition:

[25.41.0] (-1 + -1) < -1

→ *[simplify]*

[25.41.2] **true**

[25.42] ([**false**]: ([0 == ($\$heap_{funcstart\_719,1}$.p3 % 178)]: 0 == div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p3, 178).rem, [!(0 == ($\$heap_{funcstart\_719,1}$.p3 % 178))]: 178 == (−div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p3, 178).rem + ($\$heap_{funcstart\_719,1}$.p3 % 178))), [**true**]: 0 == (−($\$heap_{funcstart\_719,1}$.p3 % 178) + div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p3, 178).rem))

→ *[simplify]*

[25.44] 0 == (−($\$heap_{funcstart\_719,1}$.p3 % 178) + div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p3, 178).rem)

[Copy term 1.33]

[90.0] 32768 < ((-170 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p3, 178).rem) + (63 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p3, 178).quot))

$\rightarrow$ [from term 25.44, div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}.p3$, 178).rem is equal to $\$heap_{funcstart\_719,1}.p3$ % 178]

[90.1] 32768 < ((-170 * ($\$heap_{funcstart\_719,1}.p3$ % 178)) + (63 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}.p3$, 178).quot))

[Create new term from term 88.0 using rule: condition for equality of division]

[95.0] (0 < (1 + (178 * (0 + −div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}.p3$, 178).quot)) + $\$heap_{funcstart\_719,1}.p3$)) ∧ ($\$heap_{funcstart\_719,1}.p3$ < (178 * (0 + 1 + div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}.p3$, 178).quot)))

$\rightarrow$ [simplify]

[95.12] (-1 < ((-178 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}.p3$, 178).quot) + $\$heap_{funcstart\_719,1}.p3$)) ∧ (-178 < (−$\$heap_{funcstart\_719,1}.p3$ + (178 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}.p3$, 178).quot)))

[Work on sub-term 2 of conjunction in term 95.12]

[96.0] -1 < ((-178 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}.p3$, 178).quot) + $\$heap_{funcstart\_719,1}.p3$)

[Create new term from terms 96.0, 23.9 using rule: transitivity 2]

[98.0] (-32768 + -1 + 1) < (-178 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}.p3$, 178).quot)

$\rightarrow$ [simplify]

[98.1] -32768 < (-178 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}.p3$, 178).quot)

$\rightarrow$ [literal comparison of product]

[98.2] ([-178 < 0]: (-32768 / 178) < −div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}.p3$, 178).quot, [0 < -178]: (-32768 / -178) < div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}.p3$, 178).quot, [-178 == 0]: -32768 < 0)

$\rightarrow$ [explicitly assert falsehood of skipped guards in subsequent guards]

[98.3] ([-178 < 0]: (-32768 / 178) < −div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}.p3$, 178).quot, [(0 < -178) ∧ !(-178 < 0)]: (-32768 / -178) < div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}.p3$, 178).quot, [(-178 == 0) ∧ !(-178 < 0) ∧ !(0 < -178)]: -32768 < 0)

$\rightarrow$ [simplify]

[98.7] -185 < −div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}.p3$, 178).quot

[Create new term from terms 98.7, 90.1 using rule: transitivity 5]

[100.0] 32768 < ((-170 * ($\$heap_{funcstart\_719,1}.p3$ % 178)) + (63 * −(-185 + 1)))

$\rightarrow$ *[simplify]*

[100.5] $21176 < (\text{-}170 * (\$heap_{funcstart\_719,1}.p3 \% 178))$

$\rightarrow$ *[literal comparison of product]*

[100.6] $([\text{-}170 < 0]: (21176 / 170) < -(\$heap_{funcstart\_719,1}.p3 \% 178), [0 < \text{-}170]: (21176 / \text{-}170) < (\$heap_{funcstart\_719,1}.p3 \% 178), [\text{-}170 == 0]: 21176 < 0)$

$\rightarrow$ *[explicitly assert falsehood of skipped guards in subsequent guards]*

[100.7] $([\text{-}170 < 0]: (21176 / 170) < -(\$heap_{funcstart\_719,1}.p3 \% 178), [(0 < \text{-}170) \wedge !(\text{-}170 < 0)]: (21176 / \text{-}170) < (\$heap_{funcstart\_719,1}.p3 \% 178), [(\text{-}170 == 0) \wedge !(\text{-}170 < 0) \wedge !(0 < \text{-}170)]: 21176 < 0)$

$\rightarrow$ *[simplify]*

[100.12] **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 (49,33)

Condition defined at:

To prove: $((\textbf{asType}<\textbf{int}>(\textbf{asType}<\textbf{short int}>(div3.rem)) * \textbf{asType}<\textbf{int}>(\$heap_{719,1;730,8}.r3)) - (\textbf{asType}<\textbf{int}>(\textbf{asType}<\textbf{short int}>(div3.quot)) * \textbf{asType}<\textbf{int}>(\$heap_{719,1;730,8}.b3))) \leq \textbf{maxof}(\textbf{short int})$

Given:

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

$\$heap_{init}.\text{M1} == \textbf{asType}<\textbf{short int}>((\textbf{int})30269)$

$\$heap_{init}.\text{r1} == \textbf{asType}<\textbf{short int}>((\textbf{int})171)$

$\$heap_{init}.\text{a1} == \textbf{asType}<\textbf{short int}>((\textbf{int})177)$

$\$heap_{init}.\text{b1} == \textbf{asType}<\textbf{short int}>((\textbf{int})2)$

$\$heap_{init}.\text{M2} == \textbf{asType}<\textbf{short int}>((\textbf{int})30307)$

$\$heap_{init}.\text{r2} == \textbf{asType}<\textbf{short int}>((\textbf{int})172)$

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

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

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

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

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

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

$\$heap_{init}.\text{p1} == \textbf{asType}<\textbf{short int}>((\textbf{int})1)$

$\text{\$heap}_{init}.p2 == \textbf{asType}\textbf{<short int>}((\textbf{int})2)$

$\text{\$heap}_{init}.p3 == \textbf{asType}\textbf{<short int>}((\textbf{int})3)$

$\text{div1} == \text{div}(\textbf{heapIs } \text{\$heap}_{funcstart\_719,1},$
$\textbf{asType}\textbf{<int>}(\text{\$heap}_{funcstart\_719,1}.p1),$
$\textbf{asType}\textbf{<int>}(\text{\$heap}_{funcstart\_719,1}.a1))$

$(\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<int>}(\text{\$heap}_{funcstart\_719,1}.p1))\ /$
$\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<int>}(\text{\$heap}_{funcstart\_719,1}.a1))) ==$
$\textbf{asType}\textbf{<integer>}(\text{div1.quot})$

$(\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<int>}(\text{\$heap}_{funcstart\_719,1}.p1))\ \%$
$\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<int>}(\text{\$heap}_{funcstart\_719,1}.a1))) ==$
$\textbf{asType}\textbf{<integer>}(\text{div1.rem})$

$\text{div2} == \text{div}(\textbf{heapIs } \text{\$heap}_{funcstart\_719,1},$
$\textbf{asType}\textbf{<int>}(\text{\$heap}_{funcstart\_719,1}.p2),$
$\textbf{asType}\textbf{<int>}(\text{\$heap}_{funcstart\_719,1}.a2))$

$(\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<int>}(\text{\$heap}_{funcstart\_719,1}.p2))\ /$
$\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<int>}(\text{\$heap}_{funcstart\_719,1}.a2))) ==$
$\textbf{asType}\textbf{<integer>}(\text{div2.quot})$

$(\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<int>}(\text{\$heap}_{funcstart\_719,1}.p2))\ \%$
$\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<int>}(\text{\$heap}_{funcstart\_719,1}.a2))) ==$
$\textbf{asType}\textbf{<integer>}(\text{div2.rem})$

$\text{div3} == \text{div}(\textbf{heapIs } \text{\$heap}_{funcstart\_719,1},$
$\textbf{asType}\textbf{<int>}(\text{\$heap}_{funcstart\_719,1}.p3),$
$\textbf{asType}\textbf{<int>}(\text{\$heap}_{funcstart\_719,1}.a3))$

$(\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<int>}(\text{\$heap}_{funcstart\_719,1}.p3))\ /$
$\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<int>}(\text{\$heap}_{funcstart\_719,1}.a3))) ==$
$\textbf{asType}\textbf{<integer>}(\text{div3.quot})$

$(\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<int>}(\text{\$heap}_{funcstart\_719,1}.p3))\ \%$
$\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<int>}(\text{\$heap}_{funcstart\_719,1}.a3))) ==$
$\textbf{asType}\textbf{<integer>}(\text{div3.rem})$

$\text{\$heap}_{719,1;729,8} == \text{\$heap}_{funcstart\_719,1}.\_\textbf{replace}(p1 \rightarrow \textbf{asType}\textbf{<short}$
$\textbf{int>}((\textbf{asType}\textbf{<int>}(\textbf{asType}\textbf{<short int>}(\text{div1.rem}))\ *$
$\textbf{asType}\textbf{<int>}(\text{\$heap}_{funcstart\_719,1}.r1)) - (\textbf{asType}\textbf{<int>}(\textbf{asType}\textbf{<short}$
$\textbf{int>}(\text{div1.quot})\ *\ \textbf{asType}\textbf{<int>}(\text{\$heap}_{funcstart\_719,1}.b1))))$

$\text{\$heap}_{719,1;730,8} == \text{\$heap}_{719,1;729,8}.\_\textbf{replace}(p2 \rightarrow \textbf{asType}\textbf{<short}$
$\textbf{int>}((\textbf{asType}\textbf{<int>}(\textbf{asType}\textbf{<short int>}(\text{div2.rem}))\ *$
$\textbf{asType}\textbf{<int>}(\text{\$heap}_{719,1;729,8}.r2)) - (\textbf{asType}\textbf{<int>}(\textbf{asType}\textbf{<short}$
$\textbf{int>}(\text{div2.quot})\ *\ \textbf{asType}\textbf{<int>}(\text{\$heap}_{719,1;729,8}.b2))))$

Proof:

[Take given term]

[5.0] div1 == div(**heapIs** $\$heap_{funcstart\_719,1}$,
asType\<int\>($\$heap_{funcstart\_719,1}$.p1),
asType\<int\>($\$heap_{funcstart\_719,1}$.a1))

$\rightarrow$ *[simplify]*

[5.1] div1 == div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1,
asType\<int\>($\$heap_{funcstart\_719,1}$.a1))

$\rightarrow$ *[const static or extern object]*

[5.2] div1 == div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1,
asType\<int\>($\$heap_{init}$.a1))

$\rightarrow$ *[expand definition of constant 'a1' at prang.c (16,20)]*

[5.3] div1 == div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1,
asType\<int\>(**asType\<short int\>**((**int**)177)))

$\rightarrow$ *[simplify]*

[5.6] div1 == div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177)

[Take given term]

[12.0] div2 == div(**heapIs** $\$heap_{funcstart\_719,1}$,
asType\<int\>($\$heap_{funcstart\_719,1}$.p2),
asType\<int\>($\$heap_{funcstart\_719,1}$.a2))

$\rightarrow$ *[simplify]*

[12.1] div2 == div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2,
asType\<int\>($\$heap_{funcstart\_719,1}$.a2))

$\rightarrow$ *[const static or extern object]*

[12.2] div2 == div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2,
asType\<int\>($\$heap_{init}$.a2))

$\rightarrow$ *[expand definition of constant 'a2' at prang.c (21,20)]*

[12.3] div2 == div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2,
asType\<int\>(**asType\<short int\>**((**int**)176)))

$\rightarrow$ *[simplify]*

[12.6] div2 == div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176)

[Take given term]

[19.0] div3 == div(**heapIs** $\$heap_{funcstart\_719,1}$,
asType\<int\>($\$heap_{funcstart\_719,1}$.p3),
asType\<int\>($\$heap_{funcstart\_719,1}$.a3))

$\rightarrow$ *[simplify]*

[19.1] div3 == div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p3,
asType\<int\>($\$heap_{funcstart\_719,1}$.a3))

$\rightarrow$ *[const static or extern object]*

[19.2] div3 == div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p3, **asType<int>**($\$heap_{init}$.a3))

$\rightarrow$ *[expand definition of constant 'a3' at prang.c (26,20)]*

[19.3] div3 == div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p3, **asType<int>**(**asType<short int>**((**int**)178)))

$\rightarrow$ *[simplify]*

[19.6] div3 == div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p3, 178)

[Assume known post-assertion, class invariant or type constraint for term 19.6]

[22.0] **minof**(**short int**) $\leq$ $\$heap_{funcstart\_719,1}$.p3

$\rightarrow$ *[simplify]*

[22.3] -32769 < $\$heap_{funcstart\_719,1}$.p3

[Assume known post-assertion, class invariant or type constraint for term 19.6]

[24.0] (**asType<integer>**($\$heap_{funcstart\_719,1}$.p3) / **asType<integer>**(178)) == **asType<integer>**(div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p3, 178).quot)

$\rightarrow$ *[simplify]*

[24.2] ($\$heap_{funcstart\_719,1}$.p3 / 178) == **asType<integer>**(div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p3, 178).quot)

$\rightarrow$ *[expand definition of operator './' in class 'int' at built in declaration]*

[24.3] ([**asType<integer>**($\$heap_{funcstart\_719,1}$.p3) < 0]: $-(-$**asType<integer>**($\$heap_{funcstart\_719,1}$.p3) / 178), []: **asType<integer>**($\$heap_{funcstart\_719,1}$.p3) / 178) == **asType<integer>**(div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p3, 178).quot)

$\rightarrow$ *[explicitly assert falsehood of skipped guards in subsequent guards]*

[24.4] ([**asType<integer>**($\$heap_{funcstart\_719,1}$.p3) < 0]: $-(-$**asType<integer>**($\$heap_{funcstart\_719,1}$.p3) / 178), [!(**asType<integer>**($\$heap_{funcstart\_719,1}$.p3) < 0)]: **asType<integer>**($\$heap_{funcstart\_719,1}$.p3) / 178) == **asType<integer>**(div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p3, 178).quot)

$\rightarrow$ *[simplify]*

[24.17] 0 == ($-$([0 < $-\$heap_{funcstart\_719,1}$.p3]: $-(-\$heap_{funcstart\_719,1}$.p3 / 178), [-1 < $\$heap_{funcstart\_719,1}$.p3]: $\$heap_{funcstart\_719,1}$.p3 / 178) + div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p3, 178).quot)

$\rightarrow$ *[move guard outside expression]*

[24.18] $0 == (([0 < -\$\text{heap}_{funcstart\_719,1}.\text{p3}]: -(-(-\$\text{heap}_{funcstart\_719,1}.\text{p3} /$
$178)), [\text{-}1 < \$\text{heap}_{funcstart\_719,1}.\text{p3}]: -(\$\text{heap}_{funcstart\_719,1}.\text{p3} / 178)) +$
$\text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_719,1}, \$\text{heap}_{funcstart\_719,1}.\text{p3}, 178).\text{quot})$

$\rightarrow$ *[simplify]*

[24.19] $0 == (([0 < -\$\text{heap}_{funcstart\_719,1}.\text{p3}]: -\$\text{heap}_{funcstart\_719,1}.\text{p3} / 178,$
$[\text{-}1 < \$\text{heap}_{funcstart\_719,1}.\text{p3}]: -(\$\text{heap}_{funcstart\_719,1}.\text{p3} / 178)) + \text{div}(\textbf{heapIs}$
$\$\text{heap}_{funcstart\_719,1}, \$\text{heap}_{funcstart\_719,1}.\text{p3}, 178).\text{quot})$

$\rightarrow$ *[move guard outside expression]*

[24.21] $([0 < -\$\text{heap}_{funcstart\_719,1}.\text{p3}]: 0 == ((-\$\text{heap}_{funcstart\_719,1}.\text{p3} / 178)$
$+ \text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_719,1}, \$\text{heap}_{funcstart\_719,1}.\text{p3}, 178).\text{quot}), [\text{-}1 <$
$\$\text{heap}_{funcstart\_719,1}.\text{p3}]: 0 == (-(\$\text{heap}_{funcstart\_719,1}.\text{p3} / 178) + \text{div}(\textbf{heapIs}$
$\$\text{heap}_{funcstart\_719,1}, \$\text{heap}_{funcstart\_719,1}.\text{p3}, 178).\text{quot}))$

[Assume known post-assertion, class invariant or type constraint for term 19.6]

[25.0] $(\textbf{asType}<\textbf{integer}>(\$\text{heap}_{funcstart\_719,1}.\text{p3}) \%$
$\textbf{asType}<\textbf{integer}>(178)) == \textbf{asType}<\textbf{integer}>(\text{div}(\textbf{heapIs}$
$\$\text{heap}_{funcstart\_719,1}, \$\text{heap}_{funcstart\_719,1}.\text{p3}, 178).\text{rem})$

$\rightarrow$ *[simplify]*

[25.2] $(\$\text{heap}_{funcstart\_719,1}.\text{p3} \% 178) == \textbf{asType}<\textbf{integer}>(\text{div}(\textbf{heapIs}$
$\$\text{heap}_{funcstart\_719,1}, \$\text{heap}_{funcstart\_719,1}.\text{p3}, 178).\text{rem})$

$\rightarrow$ *[expand definition of operator '.%' in class 'int' at built in declaration]*

[25.3] $([\textbf{asType}<\textbf{integer}>(\$\text{heap}_{funcstart\_719,1}.\text{p3}) < 0]:$
$-(-\textbf{asType}<\textbf{integer}>(\$\text{heap}_{funcstart\_719,1}.\text{p3}) \% 178), []:$
$\textbf{asType}<\textbf{integer}>(\$\text{heap}_{funcstart\_719,1}.\text{p3}) \% 178) ==$
$\textbf{asType}<\textbf{integer}>(\text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_719,1}, \$\text{heap}_{funcstart\_719,1}.\text{p3},$
$178).\text{rem})$

$\rightarrow$ *[explicitly assert falsehood of skipped guards in subsequent guards]*

[25.4] $([\textbf{asType}<\textbf{integer}>(\$\text{heap}_{funcstart\_719,1}.\text{p3}) < 0]:$
$-(-\textbf{asType}<\textbf{integer}>(\$\text{heap}_{funcstart\_719,1}.\text{p3}) \% 178),$
$[!(\textbf{asType}<\textbf{integer}>(\$\text{heap}_{funcstart\_719,1}.\text{p3}) < 0)]:$
$\textbf{asType}<\textbf{integer}>(\$\text{heap}_{funcstart\_719,1}.\text{p3}) \% 178) ==$
$\textbf{asType}<\textbf{integer}>(\text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_719,1}, \$\text{heap}_{funcstart\_719,1}.\text{p3},$
$178).\text{rem})$

$\rightarrow$ *[simplify]*

[25.14] $([0 < -\$\text{heap}_{funcstart\_719,1}.\text{p3}]: -(-\$\text{heap}_{funcstart\_719,1}.\text{p3} \% 178), [\text{-}1$
$< \$\text{heap}_{funcstart\_719,1}.\text{p3}]: \textbf{asType}<\textbf{integer}>(\$\text{heap}_{funcstart\_719,1}.\text{p3}) \% 178)$
$== \textbf{asType}<\textbf{integer}>(\text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_719,1},$
$\$\text{heap}_{funcstart\_719,1}.\text{p3}, 178).\text{rem})$

$\rightarrow$ *[remainder of negation]*

[25.15] $([0 < -\$\text{heap}_{funcstart\_719,1}.\text{p3}]: -([0 == (\$\text{heap}_{funcstart\_719,1}.\text{p3} \%$

178)]: 0, []: 178 + $-(\$\text{heap}_{funcstart\_719,1}.\text{p3} \% 178)$), [-1 < $\$\text{heap}_{funcstart\_719,1}.\text{p3}$]: **asType<integer>**($\$\text{heap}_{funcstart\_719,1}.\text{p3}$) % 178) == **asType<integer>**(div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}.\text{p3}$, 178).rem)

$\rightarrow$ *[explicitly assert falsehood of skipped guards in subsequent guards]*

[25.16] ([0 < $-\$\text{heap}_{funcstart\_719,1}.\text{p3}$]: $-$([0 == ($\$\text{heap}_{funcstart\_719,1}.\text{p3}$ % 178)]: 0, [!(0 == ($\$\text{heap}_{funcstart\_719,1}.\text{p3}$ % 178))]: 178 + $-(\$\text{heap}_{funcstart\_719,1}.\text{p3}$ % 178)), [-1 < $\$\text{heap}_{funcstart\_719,1}.\text{p3}$]: **asType<integer>**($\$\text{heap}_{funcstart\_719,1}.\text{p3}$) % 178) == **asType<integer>**(div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}.\text{p3}$, 178).rem)

$\rightarrow$ *[move guard outside expression]*

[25.17] ([0 < $-\$\text{heap}_{funcstart\_719,1}.\text{p3}$]: ([0 == ($\$\text{heap}_{funcstart\_719,1}.\text{p3}$ % 178)]: $-$0, [!(0 == ($\$\text{heap}_{funcstart_719,1}.\text{p3}$ % 178))]: $-$(178 + $-(\$\text{heap}_{funcstart\_719,1}.\text{p3}$ % 178))), [-1 < $\$\text{heap}_{funcstart\_719,1}.\text{p3}$]: **asType<integer>**($\$\text{heap}_{funcstart\_719,1}.\text{p3}$) % 178) == **asType<integer>**(div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}.\text{p3}$, 178).rem)

$\rightarrow$ *[simplify]*

[25.24] 0 == ($-$([0 < $-\$\text{heap}_{funcstart\_719,1}.\text{p3}$]: ([0 == ($\$\text{heap}_{funcstart\_719,1}.\text{p3}$ % 178)]: 0, [!(0 == ($\$\text{heap}_{funcstart\_719,1}.\text{p3}$ % 178))]: -178 + ($\$\text{heap}_{funcstart\_719,1}.\text{p3}$ % 178)), [-1 < $\$\text{heap}_{funcstart\_719,1}.\text{p3}$]: $\$\text{heap}_{funcstart\_719,1}.\text{p3}$ % 178) + div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}.\text{p3}$, 178).rem)

$\rightarrow$ *[move guard outside expression]*

[25.26] 0 == (([0 < $-\$\text{heap}_{funcstart\_719,1}.\text{p3}$]: ([0 == ($\$\text{heap}_{funcstart\_719,1}.\text{p3}$ % 178)]: $-$0, [!(0 == ($\$\text{heap}_{funcstart_719,1}.\text{p3}$ % 178))]: $-$(-178 + ($\$\text{heap}_{funcstart\_719,1}.\text{p3}$ % 178))), [-1 < $\$\text{heap}_{funcstart\_719,1}.\text{p3}$]: $-(\$\text{heap}_{funcstart\_719,1}.\text{p3}$ % 178)) + div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}.\text{p3}$, 178).rem)

$\rightarrow$ *[simplify]*

[25.29] 0 == (([0 < $-\$\text{heap}_{funcstart\_719,1}.\text{p3}$]: ([0 == ($\$\text{heap}_{funcstart\_719,1}.\text{p3}$ % 178)]: 0, [!(0 == ($\$\text{heap}_{funcstart\_719,1}.\text{p3}$ % 178))]: 178 + $-(\$\text{heap}_{funcstart\_719,1}.\text{p3}$ % 178)), [-1 < $\$\text{heap}_{funcstart\_719,1}.\text{p3}$]: $-(\$\text{heap}_{funcstart\_719,1}.\text{p3}$ % 178)) + div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}.\text{p3}$, 178).rem)

$\rightarrow$ *[move guard outside expression]*

[25.31] 0 == ([0 < $-\$\text{heap}_{funcstart\_719,1}.\text{p3}$]: ([0 == ($\$\text{heap}_{funcstart\_719,1}.\text{p3}$ % 178)]: 0 + div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}.\text{p3}$, 178).rem, [!(0 == ($\$\text{heap}_{funcstart\_719,1}.\text{p3}$ % 178))]: (178 + $-(\$\text{heap}_{funcstart\_719,1}.\text{p3}$ % 178)) + div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}.\text{p3}$, 178).rem), [-1

$< \$heap_{funcstart\_719,1}.p3]: -(\$heap_{funcstart\_719,1}.p3 \% 178) + \text{div}(\textbf{heapIs}$
$\$heap_{funcstart\_719,1}, \$heap_{funcstart\_719,1}.p3, 178).\text{rem})$

$\rightarrow$ *[simplify]*

[25.33] $0 == ([0 < -\$heap_{funcstart\_719,1}.p3]: ([0 == (\$heap_{funcstart\_719,1}.p3$
$\% 178)]: \text{div}(\textbf{heapIs } \$heap_{funcstart\_719,1}, \$heap_{funcstart\_719,1}.p3, 178).\text{rem},$
$[!(0 == (\$heap_{funcstart\_719,1}.p3 \% 178))]: 178 + -(\$heap_{funcstart\_719,1}.p3 \%$
$178) + \text{div}(\textbf{heapIs } \$heap_{funcstart\_719,1}, \$heap_{funcstart\_719,1}.p3, 178).\text{rem}), [\text{-1}$
$< \$heap_{funcstart\_719,1}.p3]: -(\$heap_{funcstart\_719,1}.p3 \% 178) + \text{div}(\textbf{heapIs}$
$\$heap_{funcstart\_719,1}, \$heap_{funcstart\_719,1}.p3, 178).\text{rem})$

$\rightarrow$ *[move guard outside expression]*

[25.35] $([0 < -\$heap_{funcstart\_719,1}.p3]: ([0 == (\$heap_{funcstart\_719,1}.p3 \% 178)]:$
$0 == \text{div}(\textbf{heapIs } \$heap_{funcstart\_719,1}, \$heap_{funcstart\_719,1}.p3, 178).\text{rem}, [!(0$
$== (\$heap_{funcstart\_719,1}.p3 \% 178))]: 0 == (178 + -(\$heap_{funcstart\_719,1}.p3$
$\% 178) + \text{div}(\textbf{heapIs } \$heap_{funcstart\_719,1}, \$heap_{funcstart\_719,1}.p3, 178).\text{rem})),$
$[\text{-1} < \$heap_{funcstart\_719,1}.p3]: 0 == (-(\$heap_{funcstart\_719,1}.p3 \% 178) +$
$\text{div}(\textbf{heapIs } \$heap_{funcstart\_719,1}, \$heap_{funcstart\_719,1}.p3, 178).\text{rem}))$

$\rightarrow$ *[simplify]*

[25.40] $([0 < -\$heap_{funcstart\_719,1}.p3]: ([0 == (\$heap_{funcstart\_719,1}.p3 \%$
$178)]: 0 == \text{div}(\textbf{heapIs } \$heap_{funcstart\_719,1}, \$heap_{funcstart\_719,1}.p3, 178).\text{rem},$
$[!(0 == (\$heap_{funcstart\_719,1}.p3 \% 178))]: 178 == ((\$heap_{funcstart\_719,1}.p3 \%$
$178) + -\text{div}(\textbf{heapIs } \$heap_{funcstart\_719,1}, \$heap_{funcstart\_719,1}.p3, 178).\text{rem})),$
$[\text{-1} < \$heap_{funcstart\_719,1}.p3]: 0 == (-(\$heap_{funcstart\_719,1}.p3 \% 178) +$
$\text{div}(\textbf{heapIs } \$heap_{funcstart\_719,1}, \$heap_{funcstart\_719,1}.p3, 178).\text{rem}))$

[Take given term]

[26.0] $\$heap_{719,1;729,8} == \$heap_{funcstart\_719,1}.\textbf{replace}(\text{p1} \rightarrow \textbf{asType<short}$
$\textbf{int>}((\textbf{asType<int>}(\textbf{asType<short int>}(\text{div1.rem})) *$
$\textbf{asType<int>}(\$heap_{funcstart\_719,1}.\text{r1})) - (\textbf{asType<int>}(\textbf{asType<short}$
$\textbf{int>}(\text{div1.quot})) * \textbf{asType<int>}(\$heap_{funcstart\_719,1}.\text{b1}))))$

$\rightarrow$ *[from term 5.6, div1 is equal to div(**heapIs** $\$heap_{funcstart\_719,1}$,*
$\$heap_{funcstart_719,1}.p1, 177)]

[26.1] $\$heap_{719,1;729,8} == \$heap_{funcstart\_719,1}.\textbf{replace}(\text{p1} \rightarrow \textbf{asType<short}$
$\textbf{int>}((\textbf{asType<int>}(\textbf{asType<short int>}(\text{div}(\textbf{heapIs } \$heap_{funcstart\_719,1},$
$\$heap_{funcstart\_719,1}.\text{p1}, 177).\text{rem})) * \textbf{asType<int>}(\$heap_{funcstart\_719,1}.\text{r1})) -$
$(\textbf{asType<int>}(\textbf{asType<short int>}(\text{div1.quot})) *$
$\textbf{asType<int>}(\$heap_{funcstart\_719,1}.\text{b1}))))$

$\rightarrow$ *[simplify]*

[26.3] $\$heap_{719,1;729,8} == \$heap_{funcstart\_719,1}.\textbf{replace}(\text{p1} \rightarrow \textbf{asType<short}$
$\textbf{int>}((\text{div}(\textbf{heapIs } \$heap_{funcstart\_719,1}, \$heap_{funcstart\_719,1}.\text{p1}, 177).\text{rem} *$
$\textbf{asType<int>}(\$heap_{funcstart\_719,1}.\text{r1})) - (\textbf{asType<int>}(\textbf{asType<short}$
$\textbf{int>}(\text{div1.quot})) * \textbf{asType<int>}(\$heap_{funcstart\_719,1}.\text{b1}))))$

$\rightarrow$ *[const static or extern object]*

[26.4] \$heap$_{719,1;729,8}$ == \$heap$_{funcstart\_719,1}$.**replace**(p1 $\rightarrow$ **asType**<**short int**>((div(**heapIs** \$heap$_{funcstart\_719,1}$, \$heap$_{funcstart\_719,1}$.p1, 177).rem * **asType**<**int**>(\$heap$_{init}$.r1)) $-$ (**asType**<**int**>(**asType**<**short int**>(div1.quot)) * **asType**<**int**>(\$heap$_{funcstart\_719,1}$.b1)))))

$\rightarrow$ *[expand definition of constant 'r1' at prang.c (15,20)]*

[26.5] \$heap$_{719,1;729,8}$ == \$heap$_{funcstart\_719,1}$.**replace**(p1 $\rightarrow$ **asType**<**short int**>((div(**heapIs** \$heap$_{funcstart\_719,1}$, \$heap$_{funcstart\_719,1}$.p1, 177).rem * **asType**<**int**>(**asType**<**short int**>((**int**)171))) $-$ (**asType**<**int**>(**asType**<**short int**>(div1.quot)) * **asType**<**int**>(\$heap$_{funcstart\_719,1}$.b1)))))

$\rightarrow$ *[simplify]*

[26.8] \$heap$_{719,1;729,8}$ == \$heap$_{funcstart\_719,1}$.**replace**(p1 $\rightarrow$ **asType**<**short int**>((div(**heapIs** \$heap$_{funcstart\_719,1}$, \$heap$_{funcstart\_719,1}$.p1, 177).rem * 171) $-$ (**asType**<**int**>(**asType**<**short int**>(div1.quot)) * **asType**<**int**>(\$heap$_{funcstart\_719,1}$.b1)))))

$\rightarrow$ *[from term 5.6, div1 is equal to div(**heapIs** \$heap$_{funcstart\_719,1}$, \$heap$_{funcstart\_719,1}$.p1, 177)]*

[26.9] \$heap$_{719,1;729,8}$ == \$heap$_{funcstart\_719,1}$.**replace**(p1 $\rightarrow$ **asType**<**short int**>((171 * div(**heapIs** \$heap$_{funcstart\_719,1}$, \$heap$_{funcstart\_719,1}$.p1, 177).rem) $-$ (**asType**<**int**>(**asType**<**short int**>(div(**heapIs** \$heap$_{funcstart\_719,1}$, \$heap$_{funcstart\_719,1}$.p1, 177).quot)) * **asType**<**int**>(\$heap$_{funcstart\_719,1}$.b1)))))

$\rightarrow$ *[simplify]*

[26.11] \$heap$_{719,1;729,8}$ == \$heap$_{funcstart\_719,1}$.**replace**(p1 $\rightarrow$ **asType**<**short int**>((171 * div(**heapIs** \$heap$_{funcstart\_719,1}$, \$heap$_{funcstart\_719,1}$.p1, 177).rem) $-$ (div(**heapIs** \$heap$_{funcstart\_719,1}$, \$heap$_{funcstart\_719,1}$.p1, 177).quot * **asType**<**int**>(\$heap$_{funcstart\_719,1}$.b1)))))

$\rightarrow$ *[const static or extern object]*

[26.12] \$heap$_{719,1;729,8}$ == \$heap$_{funcstart\_719,1}$.**replace**(p1 $\rightarrow$ **asType**<**short int**>((171 * div(**heapIs** \$heap$_{funcstart\_719,1}$, \$heap$_{funcstart\_719,1}$.p1, 177).rem) $-$ (div(**heapIs** \$heap$_{funcstart\_719,1}$, \$heap$_{funcstart\_719,1}$.p1, 177).quot * **asType**<**int**>(\$heap$_{init}$.b1)))))

$\rightarrow$ *[expand definition of constant 'b1' at prang.c (17,20)]*

[26.13] \$heap$_{719,1;729,8}$ == \$heap$_{funcstart\_719,1}$.**replace**(p1 $\rightarrow$ **asType**<**short int**>((171 * div(**heapIs** \$heap$_{funcstart\_719,1}$, \$heap$_{funcstart\_719,1}$.p1, 177).rem) $-$ (div(**heapIs** \$heap$_{funcstart\_719,1}$, \$heap$_{funcstart\_719,1}$.p1, 177).quot * **asType**<**int**>(**asType**<**short int**>((**int**)2)))))

$\rightarrow$ *[simplify]*

[26.19] $\$heap_{719,1;729,8}$ == $\$heap_{funcstart\_719,1}$._**replace**(p1 → ((-2 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).rem)))

[Take given term]

[31.0] $\$heap_{719,1;730,8}$ == $\$heap_{719,1;729,8}$._**replace**(p2 → **asType<short int>**((**asType<int>**(**asType<short int>**(div2.rem)) * **asType<int>**($\$heap_{719,1;729,8}$.r2)) − (**asType<int>**(**asType<short int>**(div2.quot)) * **asType<int>**($\$heap_{719,1;729,8}$.b2))))

→ *[from term 26.19, $heap_{719,1;729,8}$ is equal to $heap_{funcstart\_719,1}$._**replace**(p1 → (-2 * div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p1, 177).rem))]*

[31.1] $\$heap_{719,1;730,8}$ == $\$heap_{funcstart\_719,1}$._**replace**(p1 → ((-2 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).rem)))._**replace**(p2 → **asType<short int>**((**asType<int>**(**asType<short int>**(div2.rem)) * **asType<int>**($\$heap_{719,1;729,8}$.r2)) − (**asType<int>**(**asType<short int>**(div2.quot)) * **asType<int>**($\$heap_{719,1;729,8}$.b2))))

→ *[from term 12.6, div2 is equal to div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p2, 176)]*

[31.2] $\$heap_{719,1;730,8}$ == $\$heap_{funcstart\_719,1}$._**replace**(p1 → ((-2 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).rem)))._**replace**(p2 → **asType<short int>**((**asType<int>**(**asType<short int>**(div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).rem)) * **asType<int>**($\$heap_{719,1;729,8}$.r2)) − (**asType<int>**(**asType<short int>**(div2.quot)) * **asType<int>**($\$heap_{719,1;729,8}$.b2))))

→ *[simplify]*

[31.4] $\$heap_{719,1;730,8}$ == $\$heap_{funcstart\_719,1}$._**replace**(p1 → ((-2 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).rem)))._**replace**(p2 → **asType<short int>**((div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).rem * **asType<int>**($\$heap_{719,1;729,8}$.r2)) − (**asType<int>**(**asType<short int>**(div2.quot)) * **asType<int>**($\$heap_{719,1;729,8}$.b2))))

→ *[from term 26.19, $heap_{719,1;729,8}$ is equal to $heap_{funcstart\_719,1}$._**replace**(p1 → (-2 * div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p1, 177).rem))]*

[31.5] $\text{\$heap}_{719,1;730,8} == \text{\$heap}_{funcstart\_719,1}.\textbf{replace}(\text{p1} \rightarrow ((\text{-2} *$ div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}.\text{p1}$, 177).quot$) + (171 *$ div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}.\text{p1}$, 177).rem$))).\textbf{replace}(\text{p2} \rightarrow \textbf{asType}\text{<}\textbf{short int}\text{>}((\text{div}(\textbf{heapIs}$ $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}.\text{p2}$, 176).rem *$ **asType**<**int**>($\text{\$heap}_{funcstart\_719,1}.\textbf{replace}(\text{p1} \rightarrow ((\text{-2} *$ div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}.\text{p1}$, 177).quot$) + (171 *$ div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}.\text{p1}$, 177).rem$))).\text{r2}$)$) -$ (**asType**<**int**>(**asType**<**short int**>(div2.quot)) *$ **asType**<**int**>($\text{\$heap}_{719,1;729,8}.\text{b2}$))))

$\rightarrow$ *[const member of object with modified fields]*

[31.6] $\text{\$heap}_{719,1;730,8} == \text{\$heap}_{funcstart\_719,1}.\textbf{replace}(\text{p1} \rightarrow ((\text{-2} *$ div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}.\text{p1}$, 177).quot$) + (171 *$ div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}.\text{p1}$, 177).rem$))).\textbf{replace}(\text{p2} \rightarrow \textbf{asType}\text{<}\textbf{short int}\text{>}((\text{div}(\textbf{heapIs}$ $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}.\text{p2}$, 176).rem *$ **asType**<**int**>($\text{\$heap}_{funcstart\_719,1}.\text{r2}$)$) -$ (**asType**<**int**>(**asType**<**short int**>(div2.quot)) *$ **asType**<**int**>($\text{\$heap}_{719,1;729,8}.\text{b2}$))))

$\rightarrow$ *[const static or extern object]*

[31.7] $\text{\$heap}_{719,1;730,8} == \text{\$heap}_{funcstart\_719,1}.\textbf{replace}(\text{p1} \rightarrow ((\text{-2} *$ div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}.\text{p1}$, 177).quot$) + (171 *$ div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}.\text{p1}$, 177).rem$))).\textbf{replace}(\text{p2} \rightarrow \textbf{asType}\text{<}\textbf{short int}\text{>}((\text{div}(\textbf{heapIs}$ $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}.\text{p2}$, 176).rem *$ **asType**<**int**>($\text{\$heap}_{init}.\text{r2}$)$) -$ (**asType**<**int**>(**asType**<**short int**>(div2.quot)) *$ **asType**<**int**>($\text{\$heap}_{719,1;729,8}.\text{b2}$))))

$\rightarrow$ *[expand definition of constant 'r2' at prang.c (20,20)]*

[31.8] $\text{\$heap}_{719,1;730,8} == \text{\$heap}_{funcstart\_719,1}.\textbf{replace}(\text{p1} \rightarrow ((\text{-2} *$ div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}.\text{p1}$, 177).quot$) + (171 *$ div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}.\text{p1}$, 177).rem$))).\textbf{replace}(\text{p2} \rightarrow \textbf{asType}\text{<}\textbf{short int}\text{>}((\text{div}(\textbf{heapIs}$ $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}.\text{p2}$, 176).rem *$ **asType**<**int**>(**asType**<**short int**>((**int**)172))) -$ (**asType**<**int**>(**asType**<**short int**>(div2.quot)) *$ **asType**<**int**>($\text{\$heap}_{719,1;729,8}.\text{b2}$))))

$\rightarrow$ *[simplify]*

[31.11] $\text{\$heap}_{719,1;730,8} == \text{\$heap}_{funcstart\_719,1}.\textbf{replace}(\text{p1} \rightarrow ((\text{-2} *$ div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}.\text{p1}$, 177).quot$) + (171 *$ div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}.\text{p1}$, 177).rem$))).\textbf{replace}(\text{p2} \rightarrow \textbf{asType}\text{<}\textbf{short int}\text{>}((\text{div}(\textbf{heapIs}$ $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}.\text{p2}$, 176).rem * 172$) -$ (**asType**<**int**>(**asType**<**short int**>(div2.quot)) *$

asType<int>($heap_{719,1;729,8}$.b2))))

→ *[from term 12.6, div2 is equal to div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p2, 176)]*

[31.12] $heap_{719,1;730,8}$ == $heap_{funcstart\_719,1}$.**replace**(p1 → ((-2 * div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p1, 177).rem))).**replace**(p2 → **asType<short int>**((172 * div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p2, 176).rem) − (**asType<int>**(**asType<short int>**(div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p2, 176).quot)) * **asType<int>**($heap_{719,1;729,8}$.b2))))

→ *[simplify]*

[31.14] $heap_{719,1;730,8}$ == $heap_{funcstart\_719,1}$.**replace**(p1 → ((-2 * div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p1, 177).rem))).**replace**(p2 → **asType<short int>**((172 * div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p2, 176).rem) − (div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p2, 176).quot * **asType<int>**($heap_{719,1;729,8}$.b2))))

→ *[from term 26.19, $heap_{719,1;729,8}$ is equal to $heap_{funcstart\_719,1}$.**replace**(p1 → (-2 * div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p1, 177).rem))]*

[31.15] $heap_{719,1;730,8}$ == $heap_{funcstart\_719,1}$.**replace**(p1 → ((-2 * div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p1, 177).rem))).**replace**(p2 → **asType<short int>**((172 * div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p2, 176).rem) − (div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p2, 176).quot * **asType<int>**($heap_{funcstart\_719,1}$.**replace**(p1 → ((-2 * div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p1, 177).rem))).b2))))

→ *[const member of object with modified fields]*

[31.16] $heap_{719,1;730,8}$ == $heap_{funcstart\_719,1}$.**replace**(p1 → ((-2 * div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p1, 177).rem))).**replace**(p2 → **asType<short int>**((172 * div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p2, 176).rem) − (div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p2, 176).quot * **asType<int>**($heap_{funcstart\_719,1}$.b2))))

→ *[const static or extern object]*

[31.17] $heap_{719,1;730,8}$ == $heap_{funcstart\_719,1}$.**replace**(p1 → ((-2 *

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div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p1,
177).rem))). **_replace**(p2 → **asType**<**short int**>((172 * div(**heapIs**
$\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p2, 176).rem) − (div(**heapIs**
$\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p2, 176).quot *
asType<**int**>($\text{\$heap}_{init}$.b2))))

→ *[expand definition of constant 'b2' at prang.c (22,20)]*

[31.18] $\text{\$heap}_{719,1;730,8}$ == $\text{\$heap}_{funcstart\_719,1}$. **_replace**(p1 → ((-2 *
div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p1,
177).rem))). **_replace**(p2 → **asType**<**short int**>((172 * div(**heapIs**
$\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p2, 176).rem) − (div(**heapIs**
$\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p2, 176).quot *
asType<**int**>(**asType**<**short int**>((**int**)35)))))

→ *[simplify]*

[31.24] $\text{\$heap}_{719,1;730,8}$ == $\text{\$heap}_{funcstart\_719,1}$. **_replace**(p1 → ((-2 *
div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p1,
177).rem))). **_replace**(p2 → ((-35 * div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$,
$\text{\$heap}_{funcstart\_719,1}$.p2, 176).quot) + (172 * div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$,
$\text{\$heap}_{funcstart\_719,1}$.p2, 176).rem)))

[Take goal term]

[1.0] ((**asType**<**int**>(**asType**<**short int**>(div3.rem)) *
asType<**int**>($\text{\$heap}_{719,1;730,8}$.r3)) − (**asType**<**int**>(**asType**<**short
int**>(div3.quot)) * **asType**<**int**>($\text{\$heap}_{719,1;730,8}$.b3))) ≤ **maxof**(**short int**)

→ *[from term 19.6, div3 is equal to div(**heapIs** $heap_{funcstart\_719,1}$,
$heap_{funcstart\_719,1}$.p3, 178)]*

[1.1] ((**asType**<**int**>(**asType**<**short int**>(div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$,
$\text{\$heap}_{funcstart\_719,1}$.p3, 178).rem)) * **asType**<**int**>($\text{\$heap}_{719,1;730,8}$.r3)) −
(**asType**<**int**>(**asType**<**short int**>(div3.quot)) *
asType<**int**>($\text{\$heap}_{719,1;730,8}$.b3))) ≤ **maxof**(**short int**)

→ *[simplify]*

[1.3] ((div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p3, 178).rem *
asType<**int**>($\text{\$heap}_{719,1;730,8}$.r3)) − (**asType**<**int**>(**asType**<**short
int**>(div3.quot)) * **asType**<**int**>($\text{\$heap}_{719,1;730,8}$.b3))) ≤ **maxof**(**short int**)

→ *[from term 31.24, $heap_{719,1;730,8}$ is equal to
$heap_{funcstart\_719,1}$. **_replace**(p1 → ((-2 * div(**heapIs** $heap_{funcstart\_719,1}$,
$heap_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs** $heap_{funcstart\_719,1}$,
$heap_{funcstart\_719,1}$.p1, 177).rem))). **_replace**(p2 → (-35 * div(**heapIs**
$heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p2, 176).quot) + (172 * div(**heapIs**
$heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p2, 176).rem))]*

[1.4] ((div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p3, 178).rem *
asType\<int\>($\$heap_{funcstart\_719,1}$.**replace**(p1 → ((-2 * div(**heapIs**
$\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs**
$\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).rem))).**replace**(p2 → ((-35
* div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).quot) + (172 *
div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).rem))).r3)) −
(**asType\<int\>**(**asType\<short int\>**(div3.quot)) *
asType\<int\>($\$heap_{719,1;730,8}$.b3))) ≤ **maxof(short int)**

→ *[const member of object with modified fields]*

[1.6] ((div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p3, 178).rem *
asType\<int\>($\$heap_{funcstart\_719,1}$.r3)) − (**asType\<int\>**(**asType\<short
int\>**(div3.quot)) * **asType\<int\>**($\$heap_{719,1;730,8}$.b3))) ≤ **maxof(short int)**

→ *[const static or extern object]*

[1.7] ((div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p3, 178).rem *
asType\<int\>($\$heap_{init}$.r3)) − (**asType\<int\>**(**asType\<short
int\>**(div3.quot)) * **asType\<int\>**($\$heap_{719,1;730,8}$.b3))) ≤ **maxof(short int)**

→ *[expand definition of constant 'r3' at prang.c (25,20)]*

[1.8] ((div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p3, 178).rem *
asType\<int\>(**asType\<short int\>**((**int**)170))) −
(**asType\<int\>**(**asType\<short int\>**(div3.quot)) *
asType\<int\>($\$heap_{719,1;730,8}$.b3))) ≤ **maxof(short int)**

→ *[simplify]*

[1.11] ((div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p3, 178).rem *
170) − (**asType\<int\>**(**asType\<short int\>**(div3.quot)) *
asType\<int\>($\$heap_{719,1;730,8}$.b3))) ≤ **maxof(short int)**

→ *[from term 19.6, div3 is equal to div(**heapIs** $\$heap_{funcstart\_719,1}$,
$\$heap_{funcstart\_719,1}$.p3, 178)]*

[1.12] ((170 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p3,
178).rem) − (**asType\<int\>**(**asType\<short int\>**(div(**heapIs**
$\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p3, 178).quot)) *
asType\<int\>($\$heap_{719,1;730,8}$.b3))) ≤ **maxof(short int)**

→ *[simplify]*

[1.14] ((170 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p3,
178).rem) − (div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p3,
178).quot * **asType\<int\>**($\$heap_{719,1;730,8}$.b3))) ≤ **maxof(short int)**

→ *[from term 31.24, $\$heap_{719,1;730,8}$ is equal to
$\$heap_{funcstart\_719,1}$.**replace**(p1 → ((-2 * div(**heapIs** $\$heap_{funcstart\_719,1}$,
$\$heap_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_719,1}$,
$\$heap_{funcstart\_719,1}$.p1, 177).rem))).**replace**(p2 → (-35 * div(**heapIs**
$\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).quot) + (172 * div(**heapIs***

$heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.*p2, 176).rem))]*

[1.15] ((170 * div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p3, 178).rem) − (div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p3, 178).quot * **asType**<**int**>($heap_{funcstart\_719,1}$.**_replace**(p1 → ((-2 * div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p1, 177).rem))).**_replace**(p2 → ((-35 * div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p2, 176).quot) + (172 * div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p2, 176).rem))).b3))) ≤ **maxof**(**short int**)

→ *[const member of object with modified fields]*

[1.17] ((170 * div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p3, 178).rem) − (div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p3, 178).quot * **asType**<**int**>($heap_{funcstart\_719,1}$.b3))) ≤ **maxof**(**short int**)

→ *[const static or extern object]*

[1.18] ((170 * div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p3, 178).rem) − (div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p3, 178).quot * **asType**<**int**>($heap_{init}$.b3))) ≤ **maxof**(**short int**)

→ *[expand definition of constant 'b3' at prang.c (27,20)]*

[1.19] ((170 * div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p3, 178).rem) − (div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p3, 178).quot * **asType**<**int**>(**asType**<**short int**>((**int**)63)))) ≤ **maxof**(**short int**)

→ *[simplify]*

[1.38] -32768 < ((-170 * div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p3, 178).rem) + (63 * div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p3, 178).quot))

→ *[negate goal and search for contradiction]*

[1.39] !(-32768 < ((-170 * div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p3, 178).rem) + (63 * div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p3, 178).quot)))

→ *[simplify]*

[1.44] 32767 < ((170 * div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p3, 178).rem) + (-63 * div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p3, 178).quot))

[Branch on disjunction or conditional in term 24.21]

[54.0] (0 == ((−$heap_{funcstart\_719,1}$.p3 / 178) + div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p3, 178).quot)) ∨ (0 == (−($heap_{funcstart\_719,1}$.p3 / 178) + div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p3, 178).quot)) ∨ (-1 < $heap_{funcstart\_719,1}$.p3)

[Branch on disjunction or conditional in term 24.21]

[55.0] $(0 < -\$\text{heap}_{funcstart\_719,1}.\text{p3}) \lor (0 == (-(\$\text{heap}_{funcstart\_719,1}.\text{p3} / 178) + \text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_719,1}, \$\text{heap}_{funcstart\_719,1}.\text{p3}, 178).\text{quot})) \lor (-1 < \$\text{heap}_{funcstart\_719,1}.\text{p3})$

[Copy term 25.40]

[56.0] $([0 < -\$\text{heap}_{funcstart\_719,1}.\text{p3}]: ([0 == (\$\text{heap}_{funcstart\_719,1}.\text{p3} \% 178)]: 0 == \text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_719,1}, \$\text{heap}_{funcstart\_719,1}.\text{p3}, 178).\text{rem}, [!(0 == (\$\text{heap}_{funcstart\_719,1}.\text{p3} \% 178))]: 178 == (-\text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_719,1}, \$\text{heap}_{funcstart\_719,1}.\text{p3}, 178).\text{rem} + (\$\text{heap}_{funcstart\_719,1}.\text{p3} \% 178))), [-1 < \$\text{heap}_{funcstart\_719,1}.\text{p3}]: 0 == (-(\$\text{heap}_{funcstart\_719,1}.\text{p3} \% 178) + \text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_719,1}, \$\text{heap}_{funcstart\_719,1}.\text{p3}, 178).\text{rem})) \lor (0 == (-(\$\text{heap}_{funcstart\_719,1}.\text{p3} / 178) + \text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_719,1}, \$\text{heap}_{funcstart\_719,1}.\text{p3}, 178).\text{quot})) \lor (-1 < \$\text{heap}_{funcstart\_719,1}.\text{p3})$

$\rightarrow$ *[from term 55.0, literala $< -\$heap_{funcstart\_719,1}.p3$ is true whenever (-1 + literala) < 0]*

Proof of rule precondition:

[56.0.0] $(-1 + 0) < 0$

$\rightarrow$ *[simplify]*

[56.0.2] **true**

[56.1] $([\textbf{true}]: ([0 == (\$\text{heap}_{funcstart\_719,1}.\text{p3} \% 178)]: 0 == \text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_719,1}, \$\text{heap}_{funcstart\_719,1}.\text{p3}, 178).\text{rem}, [!(0 == (\$\text{heap}_{funcstart\_719,1}.\text{p3} \% 178))]: 178 == (-\text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_719,1}, \$\text{heap}_{funcstart\_719,1}.\text{p3}, 178).\text{rem} + (\$\text{heap}_{funcstart\_719,1}.\text{p3} \% 178))), [-1 < \$\text{heap}_{funcstart\_719,1}.\text{p3}]: 0 == (-(\$\text{heap}_{funcstart\_719,1}.\text{p3} \% 178) + \text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_719,1}, \$\text{heap}_{funcstart\_719,1}.\text{p3}, 178).\text{rem})) \lor ...$

$\rightarrow$ *[simplify]*

[56.3] $([0 == (\$\text{heap}_{funcstart\_719,1}.\text{p3} \% 178)]: 0 == \text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_719,1}, \$\text{heap}_{funcstart\_719,1}.\text{p3}, 178).\text{rem}, [!(0 == (\$\text{heap}_{funcstart\_719,1}.\text{p3} \% 178))]: 178 == (-\text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_719,1}, \$\text{heap}_{funcstart\_719,1}.\text{p3}, 178).\text{rem} + (\$\text{heap}_{funcstart\_719,1}.\text{p3} \% 178))) \lor ...$

[Branch on disjunction or conditional in term 56.3]

[57.0] $(0 == \text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_719,1}, \$\text{heap}_{funcstart\_719,1}.\text{p3}, 178).\text{rem}) \lor (0 == (-(\$\text{heap}_{funcstart\_719,1}.\text{p3} / 178) + \text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_719,1}, \$\text{heap}_{funcstart\_719,1}.\text{p3}, 178).\text{quot})) \lor (-1 < \$\text{heap}_{funcstart\_719,1}.\text{p3}) \lor (178 == (-\text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_719,1}, \$\text{heap}_{funcstart\_719,1}.\text{p3}, 178).\text{rem} + (\$\text{heap}_{funcstart\_719,1}.\text{p3} \% 178))) \lor !(0 == (\$\text{heap}_{funcstart\_719,1}.\text{p3} \% 178))$

[Copy term 1.44]

[59.0] $(32767 < ((-63 * \text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_719,1},$

$heap_{funcstart_719,1}.p3, 178).quot) + (170 * div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart_719,1}.p3, 178).rem))) $\lor$ (0 == (−($heap_{funcstart_719,1}.p3 / 178) + div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart_719,1}.p3, 178).quot)) $\lor$ (-1 < $heap_{funcstart_719,1}.p3) $\lor$ (178 == (−div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}.p3, 178).rem + ($heap_{funcstart_719,1}.p3 % 178))) $\lor$!(0 == ($heap_{funcstart_719,1}.p3 % 178))

→ *[from term 57.0, div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart_719,1}.p3, 178).rem is equal to 0]*

[59.1] (32767 < ((-63 * div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart_719,1}.p3, 178).quot) + (170 * 0))) $\lor$ ...

→ *[simplify]*

[59.3] (32767 < (-63 * div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart_719,1}.p3, 178).quot)) $\lor$ ...

→ *[literal comparison of product]*

[59.4] ([-63 < 0]: (32767 / 63) < −div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart_719,1}.p3, 178).quot, [0 < -63]: (32767 / -63) < div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart_719,1}.p3, 178).quot, [-63 == 0]: 32767 < 0) $\lor$ ...

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

[59.5] ([-63 < 0]: (32767 / 63) < −div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart_719,1}.p3, 178).quot, [(0 < -63) $\land$!(-63 < 0)]: (32767 / -63) < div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart_719,1}.p3, 178).quot, [(-63 == 0) $\land$!(-63 < 0) $\land$!(0 < -63)]: 32767 < 0) $\lor$ ...

→ *[simplify]*

[59.9] (520 < −div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart_719,1}.p3, 178).quot) $\lor$ ...

[Create new term from terms 59.9, 54.0 using rule: transitivity 16]

[60.0] ((0 + 520) < (−$heap_{funcstart_719,1}.p3 / 178)) $\lor$ (0 == (−($heap_{funcstart_719,1}.p3 / 178) + div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart_719,1}.p3, 178).quot)) $\lor$ (-1 < $heap_{funcstart_719,1}.p3) $\lor$ (178 == (−div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}.p3, 178).rem + ($heap_{funcstart_719,1}.p3 % 178))) $\lor$!(0 == ($heap_{funcstart_719,1}.p3 % 178))

→ *[simplify]*

[60.8] (92737 < −$heap_{funcstart_719,1}.p3) $\lor$ ...

→ *[from term 22.3, literala < −$heap_{funcstart_719,1}.p3 is false whenever -2 < (-32769 + literala)]*

Proof of rule precondition:

[60.8.0] -2 < (-32769 + 92737)

$\rightarrow$ *[simplify]*

[60.8.2] **true**

[60.9] **false** $\lor$ ...

[Remove 'false' term 60.9 and fetch new term from containing clause]

[61.0] $(178 == (-\text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_719,1}, \$\text{heap}_{funcstart\_719,1}.\text{p3},$ $178).\text{rem} + (\$\text{heap}_{funcstart\_719,1}.\text{p3} \% 178))) \lor (0 ==$ $(-(\$\text{heap}_{funcstart\_719,1}.\text{p3} / 178) + \text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_719,1},$ $\$\text{heap}_{funcstart\_719,1}.\text{p3}, 178).\text{quot})) \lor (\text{-1} < \$\text{heap}_{funcstart\_719,1}.\text{p3})$

[Remove 'false' term 60.9 and fetch new term from containing clause]

[62.0] $!(0 == (\$\text{heap}_{funcstart\_719,1}.\text{p3} \% 178)) \lor (0 ==$ $(-(\$\text{heap}_{funcstart\_719,1}.\text{p3} / 178) + \text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_719,1},$ $\$\text{heap}_{funcstart\_719,1}.\text{p3}, 178).\text{quot})) \lor (\text{-1} < \$\text{heap}_{funcstart\_719,1}.\text{p3})$

[Copy term 1.44]

[64.0] $(32767 < ((\text{-63} * \text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_719,1},$ $\$\text{heap}_{funcstart\_719,1}.\text{p3}, 178).\text{quot}) + (170 * \text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_719,1},$ $\$\text{heap}_{funcstart\_719,1}.\text{p3}, 178).\text{rem}))) \lor (0 == (-(\$\text{heap}_{funcstart\_719,1}.\text{p3} / 178)$ $+ \text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_719,1}, \$\text{heap}_{funcstart\_719,1}.\text{p3}, 178).\text{quot})) \lor (\text{-1} <$ $\$\text{heap}_{funcstart\_719,1}.\text{p3})$

$\rightarrow$ *[from term 61.0, div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p3, 178).rem is equal to -178 + ($\$heap_{funcstart\_719,1}$.p3 % 178)]*

[64.1] $(32767 < ((\text{-63} * \text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_719,1}, \$\text{heap}_{funcstart\_719,1}.\text{p3},$ $178).\text{quot}) + (170 * (\text{-178} + (\$\text{heap}_{funcstart\_719,1}.\text{p3} \% 178)))))) \lor ...$

$\rightarrow$ *[simplify]*

[64.6] $(63027 < ((\text{-63} * \text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_719,1}, \$\text{heap}_{funcstart\_719,1}.\text{p3},$ $178).\text{quot}) + (170 * (\$\text{heap}_{funcstart\_719,1}.\text{p3} \% 178)))) \lor ...$

[Create new term from term 62.0 using rule: try to prove equality by contradiction]

[68.0] $((0 < (\$\text{heap}_{funcstart\_719,1}.\text{p3} \% 178)) \lor ((\$\text{heap}_{funcstart\_719,1}.\text{p3} \% 178)$ $< 0)) \lor (0 == (-(\$\text{heap}_{funcstart\_719,1}.\text{p3} / 178) + \text{div}(\textbf{heapIs}$ $\$\text{heap}_{funcstart\_719,1}, \$\text{heap}_{funcstart\_719,1}.\text{p3}, 178).\text{quot})) \lor (\text{-1} <$ $\$\text{heap}_{funcstart\_719,1}.\text{p3})$

$\rightarrow$ *[simplify]*

[68.1] $(((\text{[-1} < 0]: \exists \textbf{ integer } n \bullet (0 < (\$\text{heap}_{funcstart\_719,1}.\text{p3} + (178 * n))) \land$ $((\$\text{heap}_{funcstart\_719,1}.\text{p3} + (178 * n)) < 178), []: \textbf{true}) \lor$ $((\$\text{heap}_{funcstart\_719,1}.\text{p3} \% 178) < 0)) \lor ...$

$\rightarrow$ *[explicitly assert falsehood of skipped guards in subsequent guards]*

[68.2] $(((\text{[-1} < 0]: \exists \textbf{ integer } n \bullet (0 < (\$\text{heap}_{funcstart\_719,1}.\text{p3} + (178 * n))) \land$ $((\$\text{heap}_{funcstart\_719,1}.\text{p3} + (178 * n)) < 178), [!(\text{-1} < 0)]: \textbf{true}) \lor$

(($heap$_{funcstart_719,1}$.p3 % 178) < 0)) ∨ ...

→ *[simplify]*

[68.15] (∃ **integer** n • (-178 < (−$heap$_{funcstart_719,1}$.p3 + (-178 * n))) ∧ (0 < ((178 * n) + $heap$_{funcstart_719,1}$.p3))) ∨ ...

→ *[introduce skolem term and eliminate 'exists']*

[68.16] ((-178 < (−$heap$_{funcstart_719,1}$.p3 + (-178 * $a_n))) ∧ (0 < ((178 * $a_n) + $heap$_{funcstart_719,1}$.p3))) ∨ ...

→ *[separate conjunction and work on first sub-term]*

[68.17] (-178 < (−$heap$_{funcstart_719,1}$.p3 + (-178 * $a_n))) ∨ ...

[Work on sub-term 2 of conjunction in term 68.16]

[69.0] (0 < ((178 * $a_n) + $heap$_{funcstart_719,1}$.p3)) ∨ (0 == (−($heap$_{funcstart\_719,1}$.p3 / 178) + div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p3, 178).quot)) ∨ (-1 < $heap$_{funcstart_719,1}$.p3)

[Create new term from term 54.0 using rule: condition for equality of division]

[79.0] ((−$heap$_{funcstart_719,1}$.p3 < (178 * (0 + 1 + −div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p3, 178).quot))) ∧ ((178 * (0 + −div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p3, 178).quot)) < (1 + −$heap$_{funcstart\_719,1}$.p3))) ∨ (0 == (−($heap$_{funcstart_719,1}$.p3 / 178) + div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p3, 178).quot)) ∨ (-1 < $heap$_{funcstart_719,1}$.p3)

→ *[simplify]*

[79.18] ((-178 < ((-178 * div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p3, 178).quot) + $heap$_{funcstart_719,1}$.p3)) ∧ (-1 < (−$heap$_{funcstart\_719,1}$.p3 + (178 * div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p3, 178).quot)))) ∨ ...

→ *[separate conjunction and work on first sub-term]*

[79.19] (-178 < ((-178 * div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p3, 178).quot) + $heap$_{funcstart_719,1}$.p3)) ∨ ...

[Work on sub-term 2 of conjunction in term 79.18]

[80.0] (-1 < (−$heap$_{funcstart_719,1}$.p3 + (178 * div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p3, 178).quot))) ∨ (0 == (−($heap$_{funcstart\_719,1}$.p3 / 178) + div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p3, 178).quot)) ∨ (-1 < $heap$_{funcstart_719,1}$.p3)

[Create new term from terms 79.19, 68.17 using rule: transitivity 1]

[81.0] ((-178 + -178 + 1) < ((-178 * div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p3, 178).quot) + (-178 * $a_n))) ∨ (0 == (−($heap$_{funcstart\_719,1}$.p3 / 178) + div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p3, 178).quot)) ∨ (-1 < $heap$_{funcstart_719,1}$.p3)

→ *[simplify]*

[81.1] (-355 < ((-178 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p3, 178).quot) + (-178 * $\$a\_n$))) ∨ ...

→ *[cancel common factor]*

Proof of rule precondition 1:

[81.1.0.0] !(-178 == 0)

→ *[simplify]*

[81.1.0.2] **true**

Proof of rule precondition 2:

[81.1.1.0] 1 < $\$gcf$(-178, -178)

→ *[simplify]*

[81.1.1.2] **true**

[81.2] ((-355 / $\$gcf$(-178, -178)) < (((-178 / $\$gcf$(-178, -178)) * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p3, 178).quot) + ((-178 / $\$gcf$(-178, -178)) * $\$a\_n$))) ∨ ...

→ *[simplify]*

[81.10] (-2 < (−div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p3, 178).quot + −$\$a\_n$)) ∨ ...

[Create new term from terms 80.0, 69.0 using rule: transitivity 1]

[83.0] ((-1 + 0 + 1) < ((178 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p3, 178).quot) + (178 * $\$a\_n$))) ∨ (0 == (−($\$heap_{funcstart\_719,1}$.p3 / 178) + div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p3, 178).quot)) ∨ (-1 < $\$heap_{funcstart\_719,1}$.p3)

→ *[simplify]*

[83.1] (0 < ((178 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p3, 178).quot) + (178 * $\$a\_n$))) ∨ ...

→ *[cancel common factor]*

Proof of rule precondition 1:

[83.1.0.0] !(0 == 178)

→ *[simplify]*

[83.1.0.2] **true**

Proof of rule precondition 2:

[83.1.1.0] 1 < $\$gcf$(178, 178)

→ *[simplify]*

[83.1.1.2] **true**

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[83.2] $((0 \text{ / } \$gcf(178, 178)) < (((178 \text{ / } \$gcf(178, 178)) * div(\textbf{heapIs}$ $\$heap_{funcstart\_719,1}, \$heap_{funcstart\_719,1}.p3, 178).quot) + ((178 \text{ / } \$gcf(178,$ $178)) * \$a\_n))) \vee ...$

$\rightarrow$ *[simplify]*

[83.10] $(0 < (div(\textbf{heapIs} \$heap_{funcstart\_719,1}, \$heap_{funcstart\_719,1}.p3,$ $178).quot + \$a\_n)) \vee ...$

$\rightarrow$ *[from term 81.10, 0 < (div(**heapIs** $\$heap_{funcstart\_719,1}$,* *$\$heap_{funcstart\_719,1}.p3, 178).quot + \$a\_n) is true if and only if -1 ==* *$(-div(\textbf{heapIs} \$heap_{funcstart_719,1}, \$heap_{funcstart_719,1}.p3, 178).quot +$* *$-\$a_n)]$*

[83.11] $(-1 == (-div(\textbf{heapIs} \$heap_{funcstart\_719,1}, \$heap_{funcstart\_719,1}.p3,$ $178).quot + -\$a\_n)) \vee ...$

$\rightarrow$ *[simplify]*

[83.15] $(1 == (div(\textbf{heapIs} \$heap_{funcstart\_719,1}, \$heap_{funcstart\_719,1}.p3,$ $178).quot + \$a\_n)) \vee ...$

[Create new term from terms 68.17, 22.3 using rule: transitivity 2]

[72.0] $((-32769 + -178 + 1) < (-178 * \$a\_n)) \vee (0 ==$ $(-(\$heap_{funcstart\_719,1}.p3 \text{ / } 178) + div(\textbf{heapIs} \$heap_{funcstart\_719,1},$ $\$heap_{funcstart\_719,1}.p3, 178).quot)) \vee (-1 < \$heap_{funcstart\_719,1}.p3)$

$\rightarrow$ *[simplify]*

[72.1] $(-32946 < (-178 * \$a\_n)) \vee ...$

$\rightarrow$ *[literal comparison of product]*

[72.2] $([-178 < 0]: (-32946 \text{ / } 178) < -\$a\_n, [0 < -178]: (-32946 \text{ / } -178) < \$a\_n,$ $[-178 == 0]: -32946 < 0) \vee ...$

$\rightarrow$ *[explicitly assert falsehood of skipped guards in subsequent guards]*

[72.3] $([-178 < 0]: (-32946 \text{ / } 178) < -\$a\_n, [(0 < -178) \wedge !(-178 < 0)]: (-32946$ $\text{ / } -178) < \$a\_n, [(-178 == 0) \wedge !(-178 < 0) \wedge !(0 < -178)]: -32946 < 0) \vee ...$

$\rightarrow$ *[simplify]*

[72.7] $(-186 < -\$a\_n) \vee ...$

$\rightarrow$ *[from term 83.15, $a_n is equal to 1 + -div(**heapIs** $\$heap_{funcstart\_719,1}$,* *$\$heap_{funcstart\_719,1}.p3, 178).quot]$*

[72.8] $(-186 < -(1 + -div(\textbf{heapIs} \$heap_{funcstart\_719,1}, \$heap_{funcstart\_719,1}.p3,$ $178).quot)) \vee ...$

$\rightarrow$ *[simplify]*

[72.13] $(-185 < div(\textbf{heapIs} \$heap_{funcstart\_719,1}, \$heap_{funcstart\_719,1}.p3,$ $178).quot) \vee ...$

[Create new term from terms 72.13, 64.6 using rule: transitivity 11]

[85.0] $((1 + 63027 + (\text{-}185 * 63)) < (170 * \$\text{heap}_{funcstart\_719,1}.p3 \% 178))) \vee$ $(0 == (-(\$\text{heap}_{funcstart\_719,1}.p3 / 178) + \text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_719,1},$ $\$\text{heap}_{funcstart\_719,1}.p3, 178).quot)) \vee (\text{-}1 < \$\text{heap}_{funcstart\_719,1}.p3)$

$\rightarrow$ *[simplify]*

[85.2] $(51373 < (170 * \$\text{heap}_{funcstart\_719,1}.p3 \% 178))) \vee ...$

$\rightarrow$ *[literal comparison of product]*

[85.3] $([170 < 0]: (51373 / \text{-}170) < -(\$\text{heap}_{funcstart\_719,1}.p3 \% 178), [0 < 170]:$ $(51373 / 170) < (\$\text{heap}_{funcstart\_719,1}.p3 \% 178), [0 == 170]: 51373 < 0) \vee ...$

$\rightarrow$ *[explicitly assert falsehood of skipped guards in subsequent guards]*

[85.4] $([170 < 0]: (51373 / \text{-}170) < -(\$\text{heap}_{funcstart\_719,1}.p3 \% 178), [(0 <$ $170) \wedge !(170 < 0)]: (51373 / 170) < (\$\text{heap}_{funcstart\_719,1}.p3 \% 178), [(0 ==$ $170) \wedge !(0 < 170) \wedge !(170 < 0)]: 51373 < 0) \vee ...$

$\rightarrow$ *[simplify]*

[85.13] **false** $\vee ...$

[Remove 'false' term 85.13 and fetch new term from containing clause]

[86.0] $0 == (-(\$\text{heap}_{funcstart\_719,1}.p3 / 178) + \text{div}(\textbf{heapIs}$ $\$\text{heap}_{funcstart\_719,1}, \$\text{heap}_{funcstart\_719,1}.p3, 178).quot)$

[Remove 'false' term 85.13 and fetch new term from containing clause]

[87.0] $\text{-}1 < \$\text{heap}_{funcstart\_719,1}.p3$

[Assume known post-assertion, class invariant or type constraint for term 19.6]

[25.40] $([0 < -\$\text{heap}_{funcstart\_719,1}.p3]: ([0 == (\$\text{heap}_{funcstart\_719,1}.p3 \%$ $178)]: 0 == \text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_719,1}, \$\text{heap}_{funcstart\_719,1}.p3, 178).rem,$ $[!(0 == (\$\text{heap}_{funcstart\_719,1}.p3 \% 178))]: 178 == ((\$\text{heap}_{funcstart\_719,1}.p3 \%$ $178) + -\text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_719,1}, \$\text{heap}_{funcstart\_719,1}.p3, 178).rem)),$ $[\text{-}1 < \$\text{heap}_{funcstart\_719,1}.p3]: 0 == (-(\$\text{heap}_{funcstart\_719,1}.p3 \% 178) +$ $\text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_719,1}, \$\text{heap}_{funcstart\_719,1}.p3, 178).rem))$

$\rightarrow$ *[from term 87.0, literala $< -\$\text{heap}_{funcstart\_719,1}.p3$ is false whenever -2 $<$* *($\text{-}1 + \text{literala}$)]*

Proof of rule precondition:

[25.40.0] $\text{-}2 < (\text{-}1 + 0)$

$\rightarrow$ *[simplify]*

[25.40.2] **true**

[25.41] $([\textbf{false}]: ([0 == (\$\text{heap}_{funcstart\_719,1}.p3 \% 178)]: 0 == \text{div}(\textbf{heapIs}$ $\$\text{heap}_{funcstart\_719,1}, \$\text{heap}_{funcstart\_719,1}.p3, 178).rem, [!(0 ==$ $(\$\text{heap}_{funcstart\_719,1}.p3 \% 178))]: 178 == (-\text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_719,1},$ $\$\text{heap}_{funcstart\_719,1}.p3, 178).rem + (\$\text{heap}_{funcstart\_719,1}.p3 \% 178))), [\text{-}1 <$ $\$\text{heap}_{funcstart\_719,1}.p3]: 0 == (-(\$\text{heap}_{funcstart\_719,1}.p3 \% 178) + \text{div}(\textbf{heapIs}$

$\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p3, 178).rem))

→ *[from term 87.0, literala < \$heap$_{funcstart\_719,1}$.p3 is true whenever (-1 + literala) < -1]*

Proof of rule precondition:

[25.41.0] (-1 + -1) < -1

→ *[simplify]*

[25.41.2] **true**

[25.42] ([**false**]: ([0 == (\$heap$_{funcstart\_719,1}$.p3 % 178)]: 0 == div(**heapIs** \$heap$_{funcstart\_719,1}$, \$heap$_{funcstart\_719,1}$.p3, 178).rem, [!(0 == (\$heap$_{funcstart\_719,1}$.p3 % 178))]: 178 == (−div(**heapIs** \$heap$_{funcstart\_719,1}$, \$heap$_{funcstart\_719,1}$.p3, 178).rem + (\$heap$_{funcstart\_719,1}$.p3 % 178))), [**true**]: 0 == (−(\$heap$_{funcstart\_719,1}$.p3 % 178) + div(**heapIs** \$heap$_{funcstart\_719,1}$, \$heap$_{funcstart\_719,1}$.p3, 178).rem))

→ *[simplify]*

[25.44] 0 == (−(\$heap$_{funcstart\_719,1}$.p3 % 178) + div(**heapIs** \$heap$_{funcstart\_719,1}$, \$heap$_{funcstart\_719,1}$.p3, 178).rem)

[Copy term 1.44]

[88.0] 32767 < ((-63 * div(**heapIs** \$heap$_{funcstart\_719,1}$, \$heap$_{funcstart\_719,1}$.p3, 178).quot) + (170 * div(**heapIs** \$heap$_{funcstart\_719,1}$, \$heap$_{funcstart\_719,1}$.p3, 178).rem))

→ *[from term 25.44, div(**heapIs** \$heap$_{funcstart\_719,1}$, \$heap$_{funcstart\_719,1}$.p3, 178).rem is equal to \$heap$_{funcstart\_719,1}$.p3 % 178]*

[88.1] 32767 < ((-63 * div(**heapIs** \$heap$_{funcstart\_719,1}$, \$heap$_{funcstart\_719,1}$.p3, 178).quot) + (170 * (\$heap$_{funcstart\_719,1}$.p3 % 178)))

[Create new term from term 86.0 using rule: condition for equality of division]

[93.0] (0 < (1 + (178 * (0 + −div(**heapIs** \$heap$_{funcstart\_719,1}$, \$heap$_{funcstart\_719,1}$.p3, 178).quot)) + \$heap$_{funcstart\_719,1}$.p3)) ∧ (\$heap$_{funcstart\_719,1}$.p3 < (178 * (0 + 1 + div(**heapIs** \$heap$_{funcstart\_719,1}$, \$heap$_{funcstart\_719,1}$.p3, 178).quot)))

→ *[simplify]*

[93.12] (-1 < ((-178 * div(**heapIs** \$heap$_{funcstart\_719,1}$, \$heap$_{funcstart\_719,1}$.p3, 178).quot) + \$heap$_{funcstart\_719,1}$.p3)) ∧ (-178 < (−\$heap$_{funcstart\_719,1}$.p3 + (178 * div(**heapIs** \$heap$_{funcstart\_719,1}$, \$heap$_{funcstart\_719,1}$.p3, 178).quot)))

→ *[separate conjunction and work on first sub-term]*

[93.13] -178 < (−\$heap$_{funcstart\_719,1}$.p3 + (178 * div(**heapIs** \$heap$_{funcstart\_719,1}$, \$heap$_{funcstart\_719,1}$.p3, 178).quot))

[Create new term from terms 93.13, 87.0 using rule: transitivity 2]

[95.0] (-178 + -1 + 1) < (178 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p3, 178).quot)

$\rightarrow$ *[simplify]*

[95.1] -178 < (178 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p3, 178).quot)

$\rightarrow$ *[literal comparison of product]*

[95.2] ([178 < 0]: (-178 / -178) < $-$div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p3, 178).quot, [0 < 178]: (-178 / 178) < div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p3, 178).quot, [0 == 178]: -178 < 0)

$\rightarrow$ *[explicitly assert falsehood of skipped guards in subsequent guards]*

[95.3] ([178 < 0]: (-178 / -178) < $-$div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p3, 178).quot, [(0 < 178) $\wedge$!(178 < 0)]: (-178 / 178) < div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p3, 178).quot, [(0 == 178) $\wedge$!(0 < 178) $\wedge$!(178 < 0)]: -178 < 0)

$\rightarrow$ *[simplify]*

[95.11] -1 < div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p3, 178).quot

[Create new term from terms 95.11, 88.1 using rule: transitivity 11]

[98.0] (1 + 32767 + (-1 * 63)) < (170 * ($\$heap_{funcstart\_719,1}$.p3 % 178))

$\rightarrow$ *[simplify]*

[98.2] 32705 < (170 * ($\$heap_{funcstart\_719,1}$.p3 % 178))

$\rightarrow$ *[literal comparison of product]*

[98.3] ([170 < 0]: (32705 / -170) < $-$($\$heap_{funcstart\_719,1}$.p3 % 178), [0 < 170]: (32705 / 170) < ($\$heap_{funcstart\_719,1}$.p3 % 178), [0 == 170]: 32705 < 0)

$\rightarrow$ *[explicitly assert falsehood of skipped guards in subsequent guards]*

[98.4] ([170 < 0]: (32705 / -170) < $-$($\$heap_{funcstart\_719,1}$.p3 % 178), [(0 < 170) $\wedge$!(170 < 0)]: (32705 / 170) < ($\$heap_{funcstart\_719,1}$.p3 % 178), [(0 == 170) $\wedge$!(0 < 170) $\wedge$!(170 < 0)]: 32705 < 0)

$\rightarrow$ *[simplify]*

[98.13] **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 (51,27)

Condition defined at:

To prove: minof(int) $\leq \$heap_{719,1;731,8}$.M1

Given:

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

$\$heap_{init}.\text{M1} == \textbf{asType}\textbf{<short int>}((\textbf{int})30269)$

$\$heap_{init}.\text{r1} == \textbf{asType}\textbf{<short int>}((\textbf{int})171)$

$\$heap_{init}.\text{a1} == \textbf{asType}\textbf{<short int>}((\textbf{int})177)$

$\$heap_{init}.\text{b1} == \textbf{asType}\textbf{<short int>}((\textbf{int})2)$

$\$heap_{init}.\text{M2} == \textbf{asType}\textbf{<short int>}((\textbf{int})30307)$

$\$heap_{init}.\text{r2} == \textbf{asType}\textbf{<short int>}((\textbf{int})172)$

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

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

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

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

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

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

$\$heap_{init}.\text{p1} == \textbf{asType}\textbf{<short int>}((\textbf{int})1)$

$\$heap_{init}.\text{p2} == \textbf{asType}\textbf{<short int>}((\textbf{int})2)$

$\$heap_{init}.\text{p3} == \textbf{asType}\textbf{<short int>}((\textbf{int})3)$

$\text{div1} == \text{div}(\textbf{heapIs } \$heap_{funcstart\_719,1},$
$\textbf{asType}\textbf{<int>}(\$heap_{funcstart\_719,1}.\text{p1}),$
$\textbf{asType}\textbf{<int>}(\$heap_{funcstart\_719,1}.\text{a1}))$

$(\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<int>}(\$heap_{funcstart\_719,1}.\text{p1})) \ /$
$\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<int>}(\$heap_{funcstart\_719,1}.\text{a1}))) ==$
$\textbf{asType}\textbf{<integer>}(\text{div1.quot})$

$(\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<int>}(\$heap_{funcstart\_719,1}.\text{p1})) \ \%$
$\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<int>}(\$heap_{funcstart\_719,1}.\text{a1}))) ==$
$\textbf{asType}\textbf{<integer>}(\text{div1.rem})$

$\text{div2} == \text{div}(\textbf{heapIs } \$heap_{funcstart\_719,1},$
$\textbf{asType}\textbf{<int>}(\$heap_{funcstart\_719,1}.\text{p2}),$
$\textbf{asType}\textbf{<int>}(\$heap_{funcstart\_719,1}.\text{a2}))$

$(\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<int>}(\$heap_{funcstart\_719,1}.\text{p2})) \ /$
$\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<int>}(\$heap_{funcstart\_719,1}.\text{a2}))) ==$
$\textbf{asType}\textbf{<integer>}(\text{div2.quot})$

$(\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<int>}(\$heap_{funcstart\_719,1}.\text{p2})) \ \%$
$\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<int>}(\$heap_{funcstart\_719,1}.\text{a2}))) ==$
$\textbf{asType}\textbf{<integer>}(\text{div2.rem})$

$\text{div3} == \text{div}(\textbf{heapIs } \$heap_{funcstart\_719,1},$
$\textbf{asType}\textbf{<int>}(\$heap_{funcstart\_719,1}.\text{p3}),$

asType<int>($heap$_{funcstart_719,1}$.a3))

(**asType<integer>**(**asType<int>**($heap$_{funcstart_719,1}$.p3)) /
asType<integer>(**asType<int>**($heap$_{funcstart_719,1}$.a3))) ==
asType<integer>(div3.quot)

(**asType<integer>**(**asType<int>**($heap$_{funcstart_719,1}$.p3)) %
asType<integer>(**asType<int>**($heap$_{funcstart_719,1}$.a3))) ==
asType<integer>(div3.rem)

$heap$_{719,1;729,8}$ == $heap$_{funcstart_719,1}$.**replace**(p1 → **asType<short
int>**((**asType<int>**(**asType<short int>**(div1.rem)) *
asType<int>($heap$_{funcstart_719,1}$.r1)) − (**asType<int>**(**asType<short
int>**(div1.quot)) * **asType<int>**($heap$_{funcstart_719,1}$.b1)))))

$heap$_{719,1;730,8}$ == $heap$_{719,1;729,8}$.**replace**(p2 → **asType<short
int>**((**asType<int>**(**asType<short int>**(div2.rem)) *
asType<int>($heap$_{719,1;729,8}$.r2)) − (**asType<int>**(**asType<short
int>**(div2.quot)) * **asType<int>**($heap$_{719,1;729,8}$.b2)))))

$heap$_{719,1;731,8}$ == $heap$_{719,1;730,8}$.**replace**(p3 → **asType<short
int>**((**asType<int>**(**asType<short int>**(div3.rem)) *
asType<int>($heap$_{719,1;730,8}$.r3)) − (**asType<int>**(**asType<short
int>**(div3.quot)) * **asType<int>**($heap$_{719,1;730,8}$.b3)))))

Proof:

[Take given term]

[5.0] div1 == div(**heapIs** $heap$_{funcstart_719,1}$,
asType<int>($heap$_{funcstart_719,1}$.p1),
asType<int>($heap$_{funcstart_719,1}$.a1))

→ *[simplify]*

[5.1] div1 == div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1,
asType<int>($heap$_{funcstart_719,1}$.a1))

→ *[const static or extern object]*

[5.2] div1 == div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1,
asType<int>($heap$_{init}$.a1))

→ *[expand definition of constant 'a1' at prang.c (16,20)]*

[5.3] div1 == div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1,
asType<int>(**asType<short int>**((**int**)177)))

→ *[simplify]*

[5.6] div1 == div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1, 177)

[Take given term]

[12.0] div2 == div(**heapIs** $heap$_{funcstart_719,1}$,
asType<int>($heap$_{funcstart_719,1}$.p2),

asType$<$**int**$>$($\$\text{heap}_{funcstart\_719,1}$.a2))

$\rightarrow$ *[simplify]*

[12.1] div2 == div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}$.p2, **asType**$<$**int**$>$($\$\text{heap}_{funcstart\_719,1}$.a2))

$\rightarrow$ *[const static or extern object]*

[12.2] div2 == div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}$.p2, **asType**$<$**int**$>$($\$\text{heap}_{init}$.a2))

$\rightarrow$ *[expand definition of constant 'a2' at prang.c (21,20)]*

[12.3] div2 == div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}$.p2, **asType**$<$**int**$>$(**asType**$<$**short int**$>$((**int**)176)))

$\rightarrow$ *[simplify]*

[12.6] div2 == div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}$.p2, 176)

[Take given term]

[19.0] div3 == div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$,
asType$<$**int**$>$($\$\text{heap}_{funcstart\_719,1}$.p3),
asType$<$**int**$>$($\$\text{heap}_{funcstart\_719,1}$.a3))

$\rightarrow$ *[simplify]*

[19.1] div3 == div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}$.p3, **asType**$<$**int**$>$($\$\text{heap}_{funcstart\_719,1}$.a3))

$\rightarrow$ *[const static or extern object]*

[19.2] div3 == div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}$.p3, **asType**$<$**int**$>$($\$\text{heap}_{init}$.a3))

$\rightarrow$ *[expand definition of constant 'a3' at prang.c (26,20)]*

[19.3] div3 == div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}$.p3, **asType**$<$**int**$>$(**asType**$<$**short int**$>$((**int**)178)))

$\rightarrow$ *[simplify]*

[19.6] div3 == div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}$.p3, 178)

[Take given term]

[26.0] $\$\text{heap}_{719,1;729,8}$ == $\$\text{heap}_{funcstart\_719,1}$._**replace**(p1 $\rightarrow$ **asType**$<$**short int**$>$((**asType**$<$**int**$>$(**asType**$<$**short int**$>$(div1.rem)) *
asType$<$**int**$>$($\$\text{heap}_{funcstart\_719,1}$.r1)) $-$ (**asType**$<$**int**$>$(**asType**$<$**short int**$>$(div1.quot)) * **asType**$<$**int**$>$($\$\text{heap}_{funcstart\_719,1}$.b1)))))

$\rightarrow$ *[from term 5.6, div1 is equal to div(**heapIs** $\$heap_{funcstart\_719,1}$,
$\$heap_{funcstart\_719,1}$.p1, 177)]*

[26.1] $\$\text{heap}_{719,1;729,8}$ == $\$\text{heap}_{funcstart\_719,1}$._**replace**(p1 $\rightarrow$ **asType**$<$**short int**$>$((**asType**$<$**int**$>$(**asType**$<$**short int**$>$(div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$,

$\$\text{heap}_{funcstart\_719,1}.\text{p1, 177).rem)) * }\textbf{asType}\textbf{<int>}(\$\text{heap}_{funcstart\_719,1}.\text{r1})) - (\textbf{asType}\textbf{<int>}(\textbf{asType}\textbf{<short int>}(\text{div1.quot}) *$
$\textbf{asType}\textbf{<int>}(\$\text{heap}_{funcstart\_719,1}.\text{b1}))))$

$\rightarrow$ [simplify]

[26.3] $\$\text{heap}_{719,1;729,8}$ == $\$\text{heap}_{funcstart\_719,1}.\textbf{\_replace}(\text{p1} \rightarrow \textbf{asType}\textbf{<short int>}((\text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_719,1}, \$\text{heap}_{funcstart\_719,1}.\text{p1, 177).rem * }\textbf{asType}\textbf{<int>}(\$\text{heap}_{funcstart\_719,1}.\text{r1})) - (\textbf{asType}\textbf{<int>}(\textbf{asType}\textbf{<short int>}(\text{div1.quot}) * \textbf{asType}\textbf{<int>}(\$\text{heap}_{funcstart\_719,1}.\text{b1}))))$

$\rightarrow$ [const static or extern object]

[26.4] $\$\text{heap}_{719,1;729,8}$ == $\$\text{heap}_{funcstart\_719,1}.\textbf{\_replace}(\text{p1} \rightarrow \textbf{asType}\textbf{<short int>}((\text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_719,1}, \$\text{heap}_{funcstart\_719,1}.\text{p1, 177).rem * }\textbf{asType}\textbf{<int>}(\$\text{heap}_{init}.\text{r1})) - (\textbf{asType}\textbf{<int>}(\textbf{asType}\textbf{<short int>}(\text{div1.quot}) * \textbf{asType}\textbf{<int>}(\$\text{heap}_{funcstart\_719,1}.\text{b1}))))$

$\rightarrow$ [expand definition of constant 'r1' at prang.c (15,20)]

[26.5] $\$\text{heap}_{719,1;729,8}$ == $\$\text{heap}_{funcstart\_719,1}.\textbf{\_replace}(\text{p1} \rightarrow \textbf{asType}\textbf{<short int>}((\text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_719,1}, \$\text{heap}_{funcstart\_719,1}.\text{p1, 177).rem * }\textbf{asType}\textbf{<int>}(\textbf{asType}\textbf{<short int>}((\textbf{int})171))) - (\textbf{asType}\textbf{<int>}(\textbf{asType}\textbf{<short int>}(\text{div1.quot}) * \textbf{asType}\textbf{<int>}(\$\text{heap}_{funcstart\_719,1}.\text{b1}))))$

$\rightarrow$ [simplify]

[26.8] $\$\text{heap}_{719,1;729,8}$ == $\$\text{heap}_{funcstart\_719,1}.\textbf{\_replace}(\text{p1} \rightarrow \textbf{asType}\textbf{<short int>}((\text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_719,1}, \$\text{heap}_{funcstart\_719,1}.\text{p1, 177).rem * 171)} - (\textbf{asType}\textbf{<int>}(\textbf{asType}\textbf{<short int>}(\text{div1.quot}) * \textbf{asType}\textbf{<int>}(\$\text{heap}_{funcstart\_719,1}.\text{b1}))))$

$\rightarrow$ [from term 5.6, div1 is equal to div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}.\text{p1, 177}]$

[26.9] $\$\text{heap}_{719,1;729,8}$ == $\$\text{heap}_{funcstart\_719,1}.\textbf{\_replace}(\text{p1} \rightarrow \textbf{asType}\textbf{<short int>}((171 * \text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_719,1}, \$\text{heap}_{funcstart\_719,1}.\text{p1, 177).rem)} - (\textbf{asType}\textbf{<int>}(\textbf{asType}\textbf{<short int>}(\text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_719,1}, \$\text{heap}_{funcstart\_719,1}.\text{p1, 177).quot})) * \textbf{asType}\textbf{<int>}(\$\text{heap}_{funcstart\_719,1}.\text{b1}))))$

$\rightarrow$ [simplify]

[26.11] $\$\text{heap}_{719,1;729,8}$ == $\$\text{heap}_{funcstart\_719,1}.\textbf{\_replace}(\text{p1} \rightarrow \textbf{asType}\textbf{<short int>}((171 * \text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_719,1}, \$\text{heap}_{funcstart\_719,1}.\text{p1, 177).rem)} - (\text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_719,1}, \$\text{heap}_{funcstart\_719,1}.\text{p1, 177).quot * }\textbf{asType}\textbf{<int>}(\$\text{heap}_{funcstart\_719,1}.\text{b1}))))$

$\rightarrow$ [const static or extern object]

[26.12] $\$\text{heap}_{719,1;729,8}$ == $\$\text{heap}_{funcstart\_719,1}.\textbf{\_replace}(\text{p1} \rightarrow \textbf{asType}\textbf{<short int>}((171 * \text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_719,1}, \$\text{heap}_{funcstart\_719,1}.\text{p1, 177).rem)} - (\text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_719,1}, \$\text{heap}_{funcstart\_719,1}.\text{p1, 177).quot *}$

asType\<int\>(heap_{init}.b1))))

→ *[expand definition of constant 'b1' at prang.c (17,20)]*

[26.13] $\text{heap}_{719,1;729,8}$ == $\text{heap}_{funcstart\_719,1}$._**replace**(p1 → **asType\<short int\>**((171 * div(**heapIs** $\text{heap}_{funcstart\_719,1}$, $\text{heap}_{funcstart\_719,1}$.p1, 177).rem) − (div(**heapIs** $\text{heap}_{funcstart\_719,1}$, $\text{heap}_{funcstart\_719,1}$.p1, 177).quot * **asType\<int\>(asType\<short int\>((int)2)**)))))

→ *[simplify]*

[26.19] $\text{heap}_{719,1;729,8}$ == $\text{heap}_{funcstart\_719,1}$._**replace**(p1 → ((-2 * div(**heapIs** $\text{heap}_{funcstart\_719,1}$, $\text{heap}_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs** $\text{heap}_{funcstart\_719,1}$, $\text{heap}_{funcstart\_719,1}$.p1, 177).rem)))

[Take given term]

[31.0] $\text{heap}_{719,1;730,8}$ == $\text{heap}_{719,1;729,8}$._**replace**(p2 → **asType\<short int\>**((**asType\<int\>(asType\<short int\>**(div2.rem)) * **asType\<int\>**($\text{heap}_{719,1;729,8}$.r2)) − (**asType\<int\>(asType\<short int\>**(div2.quot)) * **asType\<int\>**($\text{heap}_{719,1;729,8}$.b2)))))

→ *[from term 26.19, $heap_{719,1;729,8}$ is equal to $heap_{funcstart\_719,1}$._**replace**(p1 → (-2 * div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p1, 177).rem))]*

[31.1] $\text{heap}_{719,1;730,8}$ == $\text{heap}_{funcstart\_719,1}$._**replace**(p1 → ((-2 * div(**heapIs** $\text{heap}_{funcstart\_719,1}$, $\text{heap}_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs** $\text{heap}_{funcstart\_719,1}$, $\text{heap}_{funcstart\_719,1}$.p1, 177).rem)))._**replace**(p2 → **asType\<short int\>**((**asType\<int\>(asType\<short int\>**(div2.rem)) * **asType\<int\>**($\text{heap}_{719,1;729,8}$.r2)) − (**asType\<int\>(asType\<short int\>**(div2.quot)) * **asType\<int\>**($\text{heap}_{719,1;729,8}$.b2)))))

→ *[from term 12.6, div2 is equal to div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p2, 176)]*

[31.2] $\text{heap}_{719,1;730,8}$ == $\text{heap}_{funcstart\_719,1}$._**replace**(p1 → ((-2 * div(**heapIs** $\text{heap}_{funcstart\_719,1}$, $\text{heap}_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs** $\text{heap}_{funcstart\_719,1}$, $\text{heap}_{funcstart\_719,1}$.p1, 177).rem)))._**replace**(p2 → **asType\<short int\>**((**asType\<int\>(asType\<short int\>**(div(**heapIs** $\text{heap}_{funcstart\_719,1}$, $\text{heap}_{funcstart\_719,1}$.p2, 176).rem)) * **asType\<int\>**($\text{heap}_{719,1;729,8}$.r2)) − (**asType\<int\>(asType\<short int\>**(div2.quot)) * **asType\<int\>**($\text{heap}_{719,1;729,8}$.b2)))))

→ *[simplify]*

[31.4] $\text{heap}_{719,1;730,8}$ == $\text{heap}_{funcstart\_719,1}$._**replace**(p1 → ((-2 * div(**heapIs** $\text{heap}_{funcstart\_719,1}$, $\text{heap}_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs** $\text{heap}_{funcstart\_719,1}$, $\text{heap}_{funcstart\_719,1}$.p1, 177).rem)))._**replace**(p2 → **asType\<short int\>**((div(**heapIs**

$heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p2, 176).rem * **asType\<int\>**($heap_{719,1;729,8}$.r2)) − (**asType\<int\>**(**asType\<short int\>**(div2.quot)) * **asType\<int\>**($heap_{719,1;729,8}$.b2))))

→ *[from term 26.19, $heap_{719,1;729,8}$ is equal to $heap_{funcstart\_719,1}$.__replace(p1 → (-2 * div(__heapIs__ $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(__heapIs__ $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p1, 177).rem))]*

[31.5] $heap_{719,1;730,8}$ == $heap_{funcstart\_719,1}$.__replace__(p1 → ((-2 * div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p1, 177).rem))).__replace__(p2 → **asType\<short int\>**((div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p2, 176).rem * **asType\<int\>**($heap_{funcstart\_719,1}$.__replace__(p1 → ((-2 * div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p1, 177).rem))).r2)) − (**asType\<int\>**(**asType\<short int\>**(div2.quot)) * **asType\<int\>**($heap_{719,1;729,8}$.b2))))

→ *[const member of object with modified fields]*

[31.6] $heap_{719,1;730,8}$ == $heap_{funcstart\_719,1}$.__replace__(p1 → ((-2 * div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p1, 177).rem))).__replace__(p2 → **asType\<short int\>**((div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p2, 176).rem * **asType\<int\>**($heap_{funcstart\_719,1}$.r2)) − (**asType\<int\>**(**asType\<short int\>**(div2.quot)) * **asType\<int\>**($heap_{719,1;729,8}$.b2))))

→ *[const static or extern object]*

[31.7] $heap_{719,1;730,8}$ == $heap_{funcstart\_719,1}$.__replace__(p1 → ((-2 * div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p1, 177).rem))).__replace__(p2 → **asType\<short int\>**((div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p2, 176).rem * **asType\<int\>**($heap_{init}$.r2)) − (**asType\<int\>**(**asType\<short int\>**(div2.quot)) * **asType\<int\>**($heap_{719,1;729,8}$.b2))))

→ *[expand definition of constant 'r2' at prang.c (20,20)]*

[31.8] $heap_{719,1;730,8}$ == $heap_{funcstart\_719,1}$.__replace__(p1 → ((-2 * div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p1, 177).rem))).__replace__(p2 → **asType\<short int\>**((div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p2, 176).rem * **asType\<int\>**(**asType\<short int\>**((**int**)172))) − (**asType\<int\>**(**asType\<short int\>**(div2.quot)) * **asType\<int\>**($heap_{719,1;729,8}$.b2))))

→ *[simplify]*

[31.11] $\text{\$heap}_{719,1;730,8}$ == $\text{\$heap}_{funcstart\_719,1}$._**replace**(p1 → ((-2 * div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p1, 177).rem))). _**replace**(p2 → **asType<short int>**((div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p2, 176).rem * 172) − (**asType<int>**(**asType<short int>**(div2.quot)) * **asType<int>**($\text{\$heap}_{719,1;729,8}$.b2)))))

→ *[from term 12.6, div2 is equal to div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p2, 176)]*

[31.12] $\text{\$heap}_{719,1;730,8}$ == $\text{\$heap}_{funcstart\_719,1}$._**replace**(p1 → ((-2 * div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p1, 177).rem))). _**replace**(p2 → **asType<short int>**((172 * div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p2, 176).rem) − (**asType<int>**(**asType<short int>**(div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p2, 176).quot)) * **asType<int>**($\text{\$heap}_{719,1;729,8}$.b2)))))

→ *[simplify]*

[31.14] $\text{\$heap}_{719,1;730,8}$ == $\text{\$heap}_{funcstart\_719,1}$._**replace**(p1 → ((-2 * div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p1, 177).rem))). _**replace**(p2 → **asType<short int>**((172 * div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p2, 176).rem) − (div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p2, 176).quot * **asType<int>**($\text{\$heap}_{719,1;729,8}$.b2)))))

→ *[from term 26.19, $\text{\$heap}_{719,1;729,8}$ is equal to $\text{\$heap}_{funcstart\_719,1}$._**replace**(p1 → (-2 * div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p1, 177).rem))]*

[31.15] $\text{\$heap}_{719,1;730,8}$ == $\text{\$heap}_{funcstart\_719,1}$._**replace**(p1 → ((-2 * div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p1, 177).rem))). _**replace**(p2 → **asType<short int>**((172 * div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p2, 176).rem) − (div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p2, 176).quot * **asType<int>**($\text{\$heap}_{funcstart\_719,1}$._**replace**(p1 → ((-2 * div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p1, 177).rem))).b2)))))

→ *[const member of object with modified fields]*

[31.16] $\text{\$heap}_{719,1;730,8}$ == $\text{\$heap}_{funcstart\_719,1}$._**replace**(p1 → ((-2 * div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p1,

177).rem))).**replace**(p2 → **asType\<short int\>**((172 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).rem) − (div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).quot * **asType\<int\>**($\$heap_{funcstart\_719,1}$.b2)))))

→ [const static or extern object]

[31.17] $\$heap_{719,1;730,8}$ == $\$heap_{funcstart\_719,1}$.**replace**(p1 → ((-2 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).rem))).**replace**(p2 → **asType\<short int\>**((172 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).rem) − (div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).quot * **asType\<int\>**($\$heap_{init}$.b2)))))

→ [expand definition of constant 'b2' at prang.c (22,20)]

[31.18] $\$heap_{719,1;730,8}$ == $\$heap_{funcstart\_719,1}$.**replace**(p1 → ((-2 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).rem))).**replace**(p2 → **asType\<short int\>**((172 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).rem) − (div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).quot * **asType\<int\>**(**asType\<short int\>**((**int**)35)))))

→ [simplify]

[31.24] $\$heap_{719,1;730,8}$ == $\$heap_{funcstart\_719,1}$.**replace**(p1 → ((-2 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).rem))).**replace**(p2 → ((-35 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).quot) + (172 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).rem)))

[Take given term]

[36.0] $\$heap_{719,1;731,8}$ == $\$heap_{719,1;730,8}$.**replace**(p3 → **asType\<short int\>**((**asType\<int\>**(**asType\<short int\>**(div3.rem)) * **asType\<int\>**($\$heap_{719,1;730,8}$.r3)) − (**asType\<int\>**(**asType\<short int\>**(div3.quot)) * **asType\<int\>**($\$heap_{719,1;730,8}$.b3)))))

→ *[from term 31.24, $\$heap_{719,1;730,8}$ is equal to $\$heap_{funcstart\_719,1}$.**replace**(p1 → ((-2 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).rem))).**replace**(p2 → (-35 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).quot) + (172 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).rem))]*

[36.1] $\$heap_{719,1;731,8}$ == $\$heap_{funcstart\_719,1}$.**replace**(p1 → ((-2 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1,

177).rem))).**replace**(p2 → ((-35 * div(**heapIs** $\$heap_{funcstart\_719,1}$,
$\$heap_{funcstart\_719,1}$.p2, 176).quot) + (172 * div(**heapIs** $\$heap_{funcstart\_719,1}$,
$\$heap_{funcstart\_719,1}$.p2, 176).rem))).**replace**(p3 → **asType<short
int>**((**asType<int>**(**asType<short int>**(div3.rem)) *
asType<int>($\$heap_{719,1;730,8}$.r3)) − (**asType<int>**(**asType<short
int>**(div3.quot)) * **asType<int>**($\$heap_{719,1;730,8}$.b3)))))

→ *[from term 19.6, div3 is equal to div(**heapIs** $\$heap_{funcstart\_719,1}$,
$\$heap_{funcstart\_719,1}$.p3, 178)]*

[36.2] $\$heap_{719,1;731,8}$ == $\$heap_{funcstart\_719,1}$.**replace**(p1 → ((-2 *
div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1,
177).rem))).**replace**(p2 → ((-35 * div(**heapIs** $\$heap_{funcstart\_719,1}$,
$\$heap_{funcstart\_719,1}$.p2, 176).quot) + (172 * div(**heapIs** $\$heap_{funcstart\_719,1}$,
$\$heap_{funcstart\_719,1}$.p2, 176).rem))).**replace**(p3 → **asType<short
int>**((**asType<int>**(**asType<short int>**(div(**heapIs** $\$heap_{funcstart\_719,1}$,
$\$heap_{funcstart\_719,1}$.p3, 178).rem)) * **asType<int>**($\$heap_{719,1;730,8}$.r3)) −
(**asType<int>**(**asType<short int>**(div3.quot)) *
asType<int>($\$heap_{719,1;730,8}$.b3)))))

→ *[simplify]*

[36.4] $\$heap_{719,1;731,8}$ == $\$heap_{funcstart\_719,1}$.**replace**(p1 → ((-2 *
div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1,
177).rem))).**replace**(p2 → ((-35 * div(**heapIs** $\$heap_{funcstart\_719,1}$,
$\$heap_{funcstart\_719,1}$.p2, 176).quot) + (172 * div(**heapIs** $\$heap_{funcstart\_719,1}$,
$\$heap_{funcstart\_719,1}$.p2, 176).rem))).**replace**(p3 → **asType<short
int>**((div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p3, 178).rem *
asType<int>($\$heap_{719,1;730,8}$.r3)) − (**asType<int>**(**asType<short
int>**(div3.quot)) * **asType<int>**($\$heap_{719,1;730,8}$.b3)))))

→ *[from term 31.24, $\$heap_{719,1;730,8}$ is equal to
$\$heap_{funcstart\_719,1}$.**replace**(p1 → ((-2 * div(**heapIs** $\$heap_{funcstart\_719,1}$,
$\$heap_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_719,1}$,
$\$heap_{funcstart\_719,1}$.p1, 177).rem))).**replace**(p2 → (-35 * div(**heapIs**
$\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).quot) + (172 * div(**heapIs**
$\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).rem))]*

[36.5] $\$heap_{719,1;731,8}$ == $\$heap_{funcstart\_719,1}$.**replace**(p1 → ((-2 *
div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1,
177).rem))).**replace**(p2 → ((-35 * div(**heapIs** $\$heap_{funcstart\_719,1}$,
$\$heap_{funcstart\_719,1}$.p2, 176).quot) + (172 * div(**heapIs** $\$heap_{funcstart\_719,1}$,
$\$heap_{funcstart\_719,1}$.p2, 176).rem))).**replace**(p3 → **asType<short
int>**((div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p3, 178).rem *
asType<int>($\$heap_{funcstart\_719,1}$.**replace**(p1 → ((-2 * div(**heapIs**
$\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs**

$\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p1, 177).rem))).**_replace**(p2 → ((-35 * div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p2, 176).quot) + (172 * div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p2, 176).rem))).r3)) − (**asType\<int\>**(**asType\<short int\>**(div3.quot)) * **asType\<int\>**($\text{\$heap}_{719,1;730,8}$.b3)))))

→ *[const member of object with modified fields]*

[36.7] $\text{\$heap}_{719,1;731,8}$ == $\text{\$heap}_{funcstart\_719,1}$.**_replace**(p1 → ((-2 * div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p1, 177).rem))).**_replace**(p2 → ((-35 * div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p2, 176).quot) + (172 * div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p2, 176).rem))).**_replace**(p3 → **asType\<short int\>**((div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p3, 178).rem * **asType\<int\>**($\text{\$heap}_{funcstart\_719,1}$.r3)) − (**asType\<int\>**(**asType\<short int\>**(div3.quot)) * **asType\<int\>**($\text{\$heap}_{719,1;730,8}$.b3)))))

→ *[const static or extern object]*

[36.8] $\text{\$heap}_{719,1;731,8}$ == $\text{\$heap}_{funcstart\_719,1}$.**_replace**(p1 → ((-2 * div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p1, 177).rem))).**_replace**(p2 → ((-35 * div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p2, 176).quot) + (172 * div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p2, 176).rem))).**_replace**(p3 → **asType\<short int\>**((div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p3, 178).rem * **asType\<int\>**($\text{\$heap}_{init}$.r3)) − (**asType\<int\>**(**asType\<short int\>**(div3.quot)) * **asType\<int\>**($\text{\$heap}_{719,1;730,8}$.b3)))))

→ *[expand definition of constant 'r3' at prang.c (25,20)]*

[36.9] $\text{\$heap}_{719,1;731,8}$ == $\text{\$heap}_{funcstart\_719,1}$.**_replace**(p1 → ((-2 * div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p1, 177).rem))).**_replace**(p2 → ((-35 * div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p2, 176).quot) + (172 * div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p2, 176).rem))).**_replace**(p3 → **asType\<short int\>**((div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p3, 178).rem * **asType\<int\>**(**asType\<short int\>**((**int**)170))) − (**asType\<int\>**(**asType\<short int\>**(div3.quot)) * **asType\<int\>**($\text{\$heap}_{719,1;730,8}$.b3)))))

→ *[simplify]*

[36.12] $\text{\$heap}_{719,1;731,8}$ == $\text{\$heap}_{funcstart\_719,1}$.**_replace**(p1 → ((-2 * div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p1, 177).rem))).**_replace**(p2 → ((-35 * div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p2, 176).quot) + (172 * div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$,

$heap_{funcstart\_719,1}$.p2, 176).rem))).**_replace**(p3 → **asType<short int>**((div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p3, 178).rem * 170) − (**asType<int>**(**asType<short int>**(div3.quot)) * **asType<int>**($heap_{719,1;730,8}$.b3)))))

→ *[from term 19.6, div3 is equal to div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p3, 178)]*

[36.13] $heap_{719,1;731,8}$ == $heap_{funcstart\_719,1}$.**_replace**(p1 → ((-2 * div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p1, 177).rem))).**_replace**(p2 → ((-35 * div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p2, 176).quot) + (172 * div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p2, 176).rem))).**_replace**(p3 → **asType<short int>**((170 * div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p3, 178).rem) − (**asType<int>**(**asType<short int>**(div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p3, 178).quot)) * **asType<int>**($heap_{719,1;730,8}$.b3)))))

→ *[simplify]*

[36.15] $heap_{719,1;731,8}$ == $heap_{funcstart\_719,1}$.**_replace**(p1 → ((-2 * div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p1, 177).rem))).**_replace**(p2 → ((-35 * div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p2, 176).quot) + (172 * div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p2, 176).rem))).**_replace**(p3 → **asType<short int>**((170 * div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p3, 178).rem) − (div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p3, 178).quot * **asType<int>**($heap_{719,1;730,8}$.b3)))))

→ *[from term 31.24, $heap_{719,1;730,8}$ is equal to $heap_{funcstart\_719,1}$.**_replace**(p1 → ((-2 * div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p1, 177).rem))).**_replace**(p2 → (-35 * div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p2, 176).quot) + (172 * div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p2, 176).rem))]*

[36.16] $heap_{719,1;731,8}$ == $heap_{funcstart\_719,1}$.**_replace**(p1 → ((-2 * div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p1, 177).rem))).**_replace**(p2 → ((-35 * div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p2, 176).quot) + (172 * div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p2, 176).rem))).**_replace**(p3 → **asType<short int>**((170 * div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p3, 178).rem) − (div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p3, 178).quot * **asType<int>**($heap_{funcstart\_719,1}$.**_replace**(p1 → ((-2 * div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p1, 177).rem))).**_replace**(p2 → ((-35 * div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p2, 176).quot) + (172 *

div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).rem))).b3))))

→ *[const member of object with modified fields]*

[36.18] $\$heap_{719,1;731,8}$ == $\$heap_{funcstart\_719,1}$._**replace**(p1 → ((-2 *
div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1,
177).rem)))._**replace**(p2 → ((-35 * div(**heapIs** $\$heap_{funcstart\_719,1}$,
$\$heap_{funcstart\_719,1}$.p2, 176).quot) + (172 * div(**heapIs** $\$heap_{funcstart\_719,1}$,
$\$heap_{funcstart\_719,1}$.p2, 176).rem)))._**replace**(p3 → **asType**<**short int**>((170
* div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p3, 178).rem) −
(div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p3, 178).quot *
asType<**int**>($\$heap_{funcstart\_719,1}$.b3))))

→ *[const static or extern object]*

[36.19] $\$heap_{719,1;731,8}$ == $\$heap_{funcstart\_719,1}$._**replace**(p1 → ((-2 *
div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1,
177).rem)))._**replace**(p2 → ((-35 * div(**heapIs** $\$heap_{funcstart\_719,1}$,
$\$heap_{funcstart\_719,1}$.p2, 176).quot) + (172 * div(**heapIs** $\$heap_{funcstart\_719,1}$,
$\$heap_{funcstart\_719,1}$.p2, 176).rem)))._**replace**(p3 → **asType**<**short int**>((170
* div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p3, 178).rem) −
(div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p3, 178).quot *
asType<**int**>($\$heap_{init}$.b3))))

→ *[expand definition of constant 'b3' at prang.c (27,20)]*

[36.20] $\$heap_{719,1;731,8}$ == $\$heap_{funcstart\_719,1}$._**replace**(p1 → ((-2 *
div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1,
177).rem)))._**replace**(p2 → ((-35 * div(**heapIs** $\$heap_{funcstart\_719,1}$,
$\$heap_{funcstart\_719,1}$.p2, 176).quot) + (172 * div(**heapIs** $\$heap_{funcstart\_719,1}$,
$\$heap_{funcstart\_719,1}$.p2, 176).rem)))._**replace**(p3 → **asType**<**short int**>((170
* div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p3, 178).rem) −
(div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p3, 178).quot *
asType<**int**>(**asType**<**short int**>((**int**)63)))))

→ *[simplify]*

[36.26] $\$heap_{719,1;731,8}$ == $\$heap_{funcstart\_719,1}$._**replace**(p1 → ((-2 *
div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1,
177).rem)))._**replace**(p2 → ((-35 * div(**heapIs** $\$heap_{funcstart\_719,1}$,
$\$heap_{funcstart\_719,1}$.p2, 176).quot) + (172 * div(**heapIs** $\$heap_{funcstart\_719,1}$,
$\$heap_{funcstart\_719,1}$.p2, 176).rem)))._**replace**(p3 → ((-63 * div(**heapIs**
$\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p3, 178).quot) + (170 * div(**heapIs**
$\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p3, 178).rem)))

[Take goal term]

[1.0] **minof**(**int**) $\leq$ \$heap$_{719,1;731,8}$.M1

$\rightarrow$ *[simplify]*

[1.1] -32768 $\leq$ \$heap$_{719,1;731,8}$.M1

$\rightarrow$ *[from term 36.26, \$heap$_{719,1;731,8}$ is equal to \$heap$_{funcstart\_719,1}$.*_**replace**(p1 $\rightarrow$ ((-2 * div(**heapIs** \$heap$_{funcstart\_719,1}$, \$heap$_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs** \$heap$_{funcstart\_719,1}$, \$heap$_{funcstart\_719,1}$.p1, 177).rem))).*_**replace**(p2 $\rightarrow$ ((-35 * div(**heapIs** \$heap$_{funcstart\_719,1}$, \$heap$_{funcstart\_719,1}$.p2, 176).quot) + (172 * div(**heapIs** \$heap$_{funcstart\_719,1}$, \$heap$_{funcstart\_719,1}$.p2, 176).rem))).*_**replace**(p3 $\rightarrow$ (-63 * div(**heapIs** \$heap$_{funcstart\_719,1}$, \$heap$_{funcstart\_719,1}$.p3, 178).quot) + (170 * div(**heapIs** \$heap$_{funcstart\_719,1}$, \$heap$_{funcstart\_719,1}$.p3, 178).rem))]*

[1.2] -32768 $\leq$ \$heap$_{funcstart\_719,1}$.*_**replace**(p1 $\rightarrow$ ((-2 * div(**heapIs** \$heap$_{funcstart\_719,1}$, \$heap$_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs** \$heap$_{funcstart\_719,1}$, \$heap$_{funcstart\_719,1}$.p1, 177).rem))).*_**replace**(p2 $\rightarrow$ ((-35 * div(**heapIs** \$heap$_{funcstart\_719,1}$, \$heap$_{funcstart\_719,1}$.p2, 176).quot) + (172 * div(**heapIs** \$heap$_{funcstart\_719,1}$, \$heap$_{funcstart\_719,1}$.p2, 176).rem))).*_**replace**(p3 $\rightarrow$ ((-63 * div(**heapIs** \$heap$_{funcstart\_719,1}$, \$heap$_{funcstart\_719,1}$.p3, 178).quot) + (170 * div(**heapIs** \$heap$_{funcstart\_719,1}$, \$heap$_{funcstart\_719,1}$.p3, 178).rem))).M1

$\rightarrow$ *[const member of object with modified fields]*

[1.5] -32768 $\leq$ \$heap$_{funcstart\_719,1}$.M1

$\rightarrow$ *[const static or extern object]*

[1.6] -32768 $\leq$ \$heap$_{init}$.M1

$\rightarrow$ *[expand definition of constant 'M1' at prang.c (14,20)]*

[1.7] -32768 $\leq$ **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 (51,27)

Condition defined at:

To prove: \$heap$_{719,1;731,8}$.M1 $\leq$ **maxof**(**int**)

Given:

\$heap$_{init}$.LIMIT == (**int**)80

\$heap$_{init}$.M1 == **asType**<**short int**>((**int**)30269)

\$heap$_{init}$.r1 == **asType**<**short int**>((**int**)171)

$\text{\$heap}_{init}.\text{a1} == \textbf{asType}<\textbf{short int}>((\textbf{int})177)$

$\text{\$heap}_{init}.\text{b1} == \textbf{asType}<\textbf{short int}>((\textbf{int})2)$

$\text{\$heap}_{init}.\text{M2} == \textbf{asType}<\textbf{short int}>((\textbf{int})30307)$

$\text{\$heap}_{init}.\text{r2} == \textbf{asType}<\textbf{short int}>((\textbf{int})172)$

$\text{\$heap}_{init}.\text{a2} == \textbf{asType}<\textbf{short int}>((\textbf{int})176)$

$\text{\$heap}_{init}.\text{b2} == \textbf{asType}<\textbf{short int}>((\textbf{int})35)$

$\text{\$heap}_{init}.\text{M3} == \textbf{asType}<\textbf{short int}>((\textbf{int})30323)$

$\text{\$heap}_{init}.\text{r3} == \textbf{asType}<\textbf{short int}>((\textbf{int})170)$

$\text{\$heap}_{init}.\text{a3} == \textbf{asType}<\textbf{short int}>((\textbf{int})178)$

$\text{\$heap}_{init}.\text{b3} == \textbf{asType}<\textbf{short int}>((\textbf{int})63)$

$\text{\$heap}_{init}.\text{p1} == \textbf{asType}<\textbf{short int}>((\textbf{int})1)$

$\text{\$heap}_{init}.\text{p2} == \textbf{asType}<\textbf{short int}>((\textbf{int})2)$

$\text{\$heap}_{init}.\text{p3} == \textbf{asType}<\textbf{short int}>((\textbf{int})3)$

div1 == div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$,
asType<**int**>($\text{\$heap}_{funcstart\_719,1}$.p1),
asType<**int**>($\text{\$heap}_{funcstart\_719,1}$.a1))

(**asType**<**integer**>(**asType**<**int**>($\text{\$heap}_{funcstart\_719,1}$.p1)) /
asType<**integer**>(**asType**<**int**>($\text{\$heap}_{funcstart\_719,1}$.a1))) ==
asType<**integer**>(div1.quot)

(**asType**<**integer**>(**asType**<**int**>($\text{\$heap}_{funcstart\_719,1}$.p1)) %
asType<**integer**>(**asType**<**int**>($\text{\$heap}_{funcstart\_719,1}$.a1))) ==
asType<**integer**>(div1.rem)

div2 == div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$,
asType<**int**>($\text{\$heap}_{funcstart\_719,1}$.p2),
asType<**int**>($\text{\$heap}_{funcstart\_719,1}$.a2))

(**asType**<**integer**>(**asType**<**int**>($\text{\$heap}_{funcstart\_719,1}$.p2)) /
asType<**integer**>(**asType**<**int**>($\text{\$heap}_{funcstart\_719,1}$.a2))) ==
asType<**integer**>(div2.quot)

(**asType**<**integer**>(**asType**<**int**>($\text{\$heap}_{funcstart\_719,1}$.p2)) %
asType<**integer**>(**asType**<**int**>($\text{\$heap}_{funcstart\_719,1}$.a2))) ==
asType<**integer**>(div2.rem)

div3 == div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$,
asType<**int**>($\text{\$heap}_{funcstart\_719,1}$.p3),
asType<**int**>($\text{\$heap}_{funcstart\_719,1}$.a3))

(**asType**<**integer**>(**asType**<**int**>($\text{\$heap}_{funcstart\_719,1}$.p3)) /
asType<**integer**>(**asType**<**int**>($\text{\$heap}_{funcstart\_719,1}$.a3))) ==
asType<**integer**>(div3.quot)

(**asType<integer>**(**asType<int>**($heap$_{funcstart_719,1}$.p3)) %
asType<integer>(**asType<int>**($heap$_{funcstart_719,1}$.a3))) ==
asType<integer>(div3.rem)

$heap$_{719,1;729,8}$ == $heap$_{funcstart_719,1}$.**_replace**(p1 → **asType<short
int>**((**asType<int>**(**asType<short int>**(div1.rem)) *
asType<int>($heap$_{funcstart_719,1}$.r1)) − (**asType<int>**(**asType<short
int>**(div1.quot)) * **asType<int>**($heap$_{funcstart_719,1}$.b1))))

$heap$_{719,1;730,8}$ == $heap$_{719,1;729,8}$.**_replace**(p2 → **asType<short
int>**((**asType<int>**(**asType<short int>**(div2.rem)) *
asType<int>($heap$_{719,1;729,8}$.r2)) − (**asType<int>**(**asType<short
int>**(div2.quot)) * **asType<int>**($heap$_{719,1;729,8}$.b2))))

$heap$_{719,1;731,8}$ == $heap$_{719,1;730,8}$.**_replace**(p3 → **asType<short
int>**((**asType<int>**(**asType<short int>**(div3.rem)) *
asType<int>($heap$_{719,1;730,8}$.r3)) − (**asType<int>**(**asType<short
int>**(div3.quot)) * **asType<int>**($heap$_{719,1;730,8}$.b3))))

Proof:

[Take given term]

[5.0] div1 == div(**heapIs** $heap$_{funcstart_719,1}$,
asType<int>($heap$_{funcstart_719,1}$.p1),
asType<int>($heap$_{funcstart_719,1}$.a1))

→ *[simplify]*

[5.1] div1 == div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1,
asType<int>($heap$_{funcstart_719,1}$.a1))

→ *[const static or extern object]*

[5.2] div1 == div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1,
asType<int>($heap$_{init}$.a1))

→ *[expand definition of constant 'a1' at prang.c (16,20)]*

[5.3] div1 == div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1,
asType<int>(**asType<short int>**((**int**)177)))

→ *[simplify]*

[5.6] div1 == div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1, 177)

[Take given term]

[12.0] div2 == div(**heapIs** $heap$_{funcstart_719,1}$,
asType<int>($heap$_{funcstart_719,1}$.p2),
asType<int>($heap$_{funcstart_719,1}$.a2))

→ *[simplify]*

[12.1] div2 == div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p2,
asType<int>($heap$_{funcstart_719,1}$.a2))

$\rightarrow$ *[const static or extern object]*

[12.2] div2 == div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, **asType**<**int**>($\$heap_{init}$.a2))

$\rightarrow$ *[expand definition of constant 'a2' at prang.c (21,20)]*

[12.3] div2 == div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, **asType**<**int**>(**asType**<**short int**>((**int**)176)))

$\rightarrow$ *[simplify]*

[12.6] div2 == div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176)

[Take given term]

[19.0] div3 == div(**heapIs** $\$heap_{funcstart\_719,1}$, **asType**<**int**>($\$heap_{funcstart\_719,1}$.p3), **asType**<**int**>($\$heap_{funcstart\_719,1}$.a3))

$\rightarrow$ *[simplify]*

[19.1] div3 == div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p3, **asType**<**int**>($\$heap_{funcstart\_719,1}$.a3))

$\rightarrow$ *[const static or extern object]*

[19.2] div3 == div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p3, **asType**<**int**>($\$heap_{init}$.a3))

$\rightarrow$ *[expand definition of constant 'a3' at prang.c (26,20)]*

[19.3] div3 == div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p3, **asType**<**int**>(**asType**<**short int**>((**int**)178)))

$\rightarrow$ *[simplify]*

[19.6] div3 == div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p3, 178)

[Take given term]

[26.0] $\$heap_{719,1;729,8}$ == $\$heap_{funcstart\_719,1}$.**replace**(p1 $\rightarrow$ **asType**<**short int**>((**asType**<**int**>(**asType**<**short int**>(div1.rem)) * **asType**<**int**>($\$heap_{funcstart\_719,1}$.r1)) $-$ (**asType**<**int**>(**asType**<**short int**>(div1.quot)) * **asType**<**int**>($\$heap_{funcstart\_719,1}$.b1))))

$\rightarrow$ *[from term 5.6, div1 is equal to div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177)]*

[26.1] $\$heap_{719,1;729,8}$ == $\$heap_{funcstart\_719,1}$.**replace**(p1 $\rightarrow$ **asType**<**short int**>((**asType**<**int**>(**asType**<**short int**>(div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).rem)) * **asType**<**int**>($\$heap_{funcstart\_719,1}$.r1)) $-$ (**asType**<**int**>(**asType**<**short int**>(div1.quot)) * **asType**<**int**>($\$heap_{funcstart\_719,1}$.b1))))

$\rightarrow$ *[simplify]*

[26.3] $\$heap_{719,1;729,8}$ == $\$heap_{funcstart\_719,1}$.**replace**(p1 $\rightarrow$ **asType**<**short**

int>((div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).rem * **asType**<**int**>($\$heap_{funcstart\_719,1}$.r1)) − (**asType**<**int**>(**asType**<**short int**>(div1.quot)) * **asType**<**int**>($\$heap_{funcstart\_719,1}$.b1)))))

→ *[const static or extern object]*

[26.4] $\$heap_{719,1;729,8}$ == $\$heap_{funcstart\_719,1}$._**replace**(p1 → **asType**<**short int**>((div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).rem * **asType**<**int**>($\$heap_{init}$.r1)) − (**asType**<**int**>(**asType**<**short int**>(div1.quot)) * **asType**<**int**>($\$heap_{funcstart\_719,1}$.b1)))))

→ *[expand definition of constant 'r1' at prang.c (15,20)]*

[26.5] $\$heap_{719,1;729,8}$ == $\$heap_{funcstart\_719,1}$._**replace**(p1 → **asType**<**short int**>((div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).rem * **asType**<**int**>(**asType**<**short int**>((**int**)171))) − (**asType**<**int**>(**asType**<**short int**>(div1.quot)) * **asType**<**int**>($\$heap_{funcstart\_719,1}$.b1)))))

→ *[simplify]*

[26.8] $\$heap_{719,1;729,8}$ == $\$heap_{funcstart\_719,1}$._**replace**(p1 → **asType**<**short int**>((div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).rem * 171) − (**asType**<**int**>(**asType**<**short int**>(div1.quot)) * **asType**<**int**>($\$heap_{funcstart\_719,1}$.b1)))))

→ *[from term 5.6, div1 is equal to div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177)]*

[26.9] $\$heap_{719,1;729,8}$ == $\$heap_{funcstart\_719,1}$._**replace**(p1 → **asType**<**short int**>((171 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).rem) − (**asType**<**int**>(**asType**<**short int**>(div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot)) * **asType**<**int**>($\$heap_{funcstart\_719,1}$.b1)))))

→ *[simplify]*

[26.11] $\$heap_{719,1;729,8}$ == $\$heap_{funcstart\_719,1}$._**replace**(p1 → **asType**<**short int**>((171 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).rem) − (div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot * **asType**<**int**>($\$heap_{funcstart\_719,1}$.b1)))))

→ *[const static or extern object]*

[26.12] $\$heap_{719,1;729,8}$ == $\$heap_{funcstart\_719,1}$._**replace**(p1 → **asType**<**short int**>((171 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).rem) − (div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot * **asType**<**int**>($\$heap_{init}$.b1)))))

→ *[expand definition of constant 'b1' at prang.c (17,20)]*

[26.13] $\$heap_{719,1;729,8}$ == $\$heap_{funcstart\_719,1}$._**replace**(p1 → **asType**<**short int**>((171 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).rem) − (div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot *

asType<int>(asType<short int>((int)2)))))

$\rightarrow$ *[simplify]*

[26.19] $\text{\$heap}_{719,1;729,8}$ == $\text{\$heap}_{funcstart\_719,1}.\textbf{\_replace}(\text{p1} \rightarrow ((\text{-2} *$
div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}.\text{p1}$, 177).quot) + (171 *
div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}.\text{p1}$, 177).rem)))

[Take given term]

[31.0] $\text{\$heap}_{719,1;730,8}$ == $\text{\$heap}_{719,1;729,8}.\textbf{\_replace}(\text{p2} \rightarrow \textbf{asType<short}$
int>((asType<int>(asType<short int>(div2.rem)) *
asType<int>($\text{\$heap}_{719,1;729,8}.\text{r2}$)) $-$ (**asType<int>(asType<short**
int>(div2.quot)) * **asType<int>**($\text{\$heap}_{719,1;729,8}.\text{b2}$))))

$\rightarrow$ *[from term 26.19, $heap_{719,1;729,8}$ is equal to*
*$heap_{funcstart\_719,1}.\textbf{\_replace}(p1 \rightarrow (-2 * div(\textbf{heapIs } \$heap_{funcstart\_719,1},$*
*$\$heap_{funcstart\_719,1}.p1, 177).quot) + (171 * div(\textbf{heapIs } \$heap_{funcstart\_719,1},$*
$\$heap_{funcstart\_719,1}.p1, 177).rem))]$

[31.1] $\text{\$heap}_{719,1;730,8}$ == $\text{\$heap}_{funcstart\_719,1}.\textbf{\_replace}(\text{p1} \rightarrow ((\text{-2} *$
div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}.\text{p1}$, 177).quot) + (171 *
div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}.\text{p1}$,
177).rem))).**_replace**(p2 $\rightarrow$ **asType<short**
int>((asType<int>(asType<short int>(div2.rem)) *
asType<int>($\text{\$heap}_{719,1;729,8}.\text{r2}$)) $-$ (**asType<int>(asType<short**
int>(div2.quot)) * **asType<int>**($\text{\$heap}_{719,1;729,8}.\text{b2}$))))

$\rightarrow$ *[from term 12.6, div2 is equal to div(**heapIs** $heap_{funcstart\_719,1}$,*
$heap_{funcstart\_719,1}.p2, 176)]$

[31.2] $\text{\$heap}_{719,1;730,8}$ == $\text{\$heap}_{funcstart\_719,1}.\textbf{\_replace}(\text{p1} \rightarrow ((\text{-2} *$
div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}.\text{p1}$, 177).quot) + (171 *
div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}.\text{p1}$,
177).rem))).**_replace**(p2 $\rightarrow$ **asType<short**
int>((asType<int>(asType<short int>(div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$,
$\text{\$heap}_{funcstart\_719,1}.\text{p2}$, 176).rem)) * **asType<int>**($\text{\$heap}_{719,1;729,8}.\text{r2}$)) $-$
(**asType<int>(asType<short int>**(div2.quot)) *
asType<int>($\text{\$heap}_{719,1;729,8}.\text{b2}$))))

$\rightarrow$ *[simplify]*

[31.4] $\text{\$heap}_{719,1;730,8}$ == $\text{\$heap}_{funcstart\_719,1}.\textbf{\_replace}(\text{p1} \rightarrow ((\text{-2} *$
div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}.\text{p1}$, 177).quot) + (171 *
div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}.\text{p1}$,
177).rem))).**_replace**(p2 $\rightarrow$ **asType<short int>**((div(**heapIs**
$\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}.\text{p2}$, 176).rem *
asType<int>($\text{\$heap}_{719,1;729,8}.\text{r2}$)) $-$ (**asType<int>(asType<short**
int>(div2.quot)) * **asType<int>**($\text{\$heap}_{719,1;729,8}.\text{b2}$))))

$\rightarrow$ *[from term 26.19, $heap_{719,1;729,8}$ is equal to*
*$heap_{funcstart\_719,1}.\textbf{\_replace}(p1 \rightarrow (-2 * div(\textbf{heapIs } \$heap_{funcstart\_719,1},$*

*$heap_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p1, 177).rem))]*

[31.5] $heap_{719,1;730,8}$ == $heap_{funcstart\_719,1}$._**replace**(p1 → ((-2 * div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p1, 177).rem)))._**replace**(p2 → **asType<short int>**((div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p2, 176).rem * **asType<int>**($heap_{funcstart\_719,1}$._**replace**(p1 → ((-2 * div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p1, 177).rem))).r2)) − (**asType<int>**(**asType<short int>**(div2.quot)) * **asType<int>**($heap_{719,1;729,8}$.b2)))))

→ [const member of object with modified fields]

[31.6] $heap_{719,1;730,8}$ == $heap_{funcstart\_719,1}$._**replace**(p1 → ((-2 * div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p1, 177).rem)))._**replace**(p2 → **asType<short int>**((div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p2, 176).rem * **asType<int>**($heap_{funcstart\_719,1}$.r2)) − (**asType<int>**(**asType<short int>**(div2.quot)) * **asType<int>**($heap_{719,1;729,8}$.b2)))))

→ [const static or extern object]

[31.7] $heap_{719,1;730,8}$ == $heap_{funcstart\_719,1}$._**replace**(p1 → ((-2 * div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p1, 177).rem)))._**replace**(p2 → **asType<short int>**((div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p2, 176).rem * **asType<int>**($heap_{init}$.r2)) − (**asType<int>**(**asType<short int>**(div2.quot)) * **asType<int>**($heap_{719,1;729,8}$.b2)))))

→ [expand definition of constant 'r2' at prang.c (20,20)]

[31.8] $heap_{719,1;730,8}$ == $heap_{funcstart\_719,1}$._**replace**(p1 → ((-2 * div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p1, 177).rem)))._**replace**(p2 → **asType<short int>**((div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p2, 176).rem * **asType<int>**(**asType<short int>**((**int**)172))) − (**asType<int>**(**asType<short int>**(div2.quot)) * **asType<int>**($heap_{719,1;729,8}$.b2)))))

→ [simplify]

[31.11] $heap_{719,1;730,8}$ == $heap_{funcstart\_719,1}$._**replace**(p1 → ((-2 * div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p1, 177).rem)))._**replace**(p2 → **asType<short int>**((div(**heapIs**

$\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).rem * 172) $-$
(**asType**<**int**>(**asType**<**short int**>(div2.quot)) *
asType<**int**>($\$heap_{719,1;729,8}$.b2))))

$\rightarrow$ *[from term 12.6, div2 is equal to **heapIs** $\$heap_{funcstart\_719,1}$,*
$\$heap_{funcstart\_719,1}$.p2, 176)]

[31.12] $\$heap_{719,1;730,8}$ == $\$heap_{funcstart\_719,1}$.**replace**(p1 $\rightarrow$ ((-2 *
div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1,
177).rem))).**replace**(p2 $\rightarrow$ **asType**<**short int**>((172 * div(**heapIs**
$\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).rem) $-$
(**asType**<**int**>(**asType**<**short int**>(div(**heapIs** $\$heap_{funcstart\_719,1}$,
$\$heap_{funcstart\_719,1}$.p2, 176).quot)) * **asType**<**int**>($\$heap_{719,1;729,8}$.b2))))

$\rightarrow$ *[simplify]*

[31.14] $\$heap_{719,1;730,8}$ == $\$heap_{funcstart\_719,1}$.**replace**(p1 $\rightarrow$ ((-2 *
div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1,
177).rem))).**replace**(p2 $\rightarrow$ **asType**<**short int**>((172 * div(**heapIs**
$\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).rem) $-$ (div(**heapIs**
$\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).quot *
asType<**int**>($\$heap_{719,1;729,8}$.b2))))

$\rightarrow$ *[from term 26.19, $\$heap_{719,1;729,8}$ is equal to*
*$\$heap_{funcstart\_719,1}$.**replace**(p1 $\rightarrow$ (-2 * div(**heapIs** $\$heap_{funcstart\_719,1}$,*
*$\$heap_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_719,1}$,*
$\$heap_{funcstart\_719,1}$.p1, 177).rem))]

[31.15] $\$heap_{719,1;730,8}$ == $\$heap_{funcstart\_719,1}$.**replace**(p1 $\rightarrow$ ((-2 *
div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1,
177).rem))).**replace**(p2 $\rightarrow$ **asType**<**short int**>((172 * div(**heapIs**
$\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).rem) $-$ (div(**heapIs**
$\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).quot *
asType<**int**>($\$heap_{funcstart\_719,1}$.**replace**(p1 $\rightarrow$ ((-2 * div(**heapIs**
$\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs**
$\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).rem))).b2))))

$\rightarrow$ *[const member of object with modified fields]*

[31.16] $\$heap_{719,1;730,8}$ == $\$heap_{funcstart\_719,1}$.**replace**(p1 $\rightarrow$ ((-2 *
div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1,
177).rem))).**replace**(p2 $\rightarrow$ **asType**<**short int**>((172 * div(**heapIs**
$\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).rem) $-$ (div(**heapIs**
$\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).quot *
asType<**int**>($\$heap_{funcstart\_719,1}$.b2))))

$\rightarrow$ *[const static or extern object]*

[31.17] $heap_{719,1;730,8}$ == $heap_{funcstart\_719,1}$._**replace**(p1 → ((-2 *
div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p1, 177).quot) + (171 *
div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p1,
177).rem)))._**replace**(p2 → **asType**<**short int**>((172 * div(**heapIs**
$heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p2, 176).rem) − (div(**heapIs**
$heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p2, 176).quot *
asType<**int**>($heap_{init}$.b2))))

→ *[expand definition of constant 'b2' at prang.c (22,20)]*

[31.18] $heap_{719,1;730,8}$ == $heap_{funcstart\_719,1}$._**replace**(p1 → ((-2 *
div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p1, 177).quot) + (171 *
div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p1,
177).rem)))._**replace**(p2 → **asType**<**short int**>((172 * div(**heapIs**
$heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p2, 176).rem) − (div(**heapIs**
$heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p2, 176).quot *
asType<**int**>(**asType**<**short int**>((**int**)35)))))

→ *[simplify]*

[31.24] $heap_{719,1;730,8}$ == $heap_{funcstart\_719,1}$._**replace**(p1 → ((-2 *
div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p1, 177).quot) + (171 *
div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p1,
177).rem)))._**replace**(p2 → ((-35 * div(**heapIs** $heap_{funcstart\_719,1}$,
$heap_{funcstart\_719,1}$.p2, 176).quot) + (172 * div(**heapIs** $heap_{funcstart\_719,1}$,
$heap_{funcstart\_719,1}$.p2, 176).rem)))

[Take given term]

[36.0] $heap_{719,1;731,8}$ == $heap_{719,1;730,8}$._**replace**(p3 → **asType**<**short
int**>((**asType**<**int**>(**asType**<**short int**>(div3.rem)) *
asType<**int**>($heap_{719,1;730,8}$.r3)) − (**asType**<**int**>(**asType**<**short
int**>(div3.quot)) * **asType**<**int**>($heap_{719,1;730,8}$.b3))))

→ *[from term 31.24, $heap_{719,1;730,8}$ is equal to*
*$heap_{funcstart\_719,1}$._**replace**(p1 → ((-2 * div(**heapIs** $heap_{funcstart\_719,1}$,*
*$heap_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs** $heap_{funcstart\_719,1}$,*
*$heap_{funcstart\_719,1}$.p1, 177).rem)))._**replace**(p2 → (-35 * div(**heapIs***
*$heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p2, 176).quot) + (172 * div(**heapIs***
$heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p2, 176).rem))]

[36.1] $heap_{719,1;731,8}$ == $heap_{funcstart\_719,1}$._**replace**(p1 → ((-2 *
div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p1, 177).quot) + (171 *
div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p1,
177).rem)))._**replace**(p2 → ((-35 * div(**heapIs** $heap_{funcstart\_719,1}$,
$heap_{funcstart\_719,1}$.p2, 176).quot) + (172 * div(**heapIs** $heap_{funcstart\_719,1}$,
$heap_{funcstart\_719,1}$.p2, 176).rem)))._**replace**(p3 → **asType**<**short
int**>((**asType**<**int**>(**asType**<**short int**>(div3.rem)) *
asType<**int**>($heap_{719,1;730,8}$.r3)) − (**asType**<**int**>(**asType**<**short
int**>(div3.quot)) * **asType**<**int**>($heap_{719,1;730,8}$.b3))))

$\rightarrow$ *[from term 19.6, div3 is equal to div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}.p3$, 178)]*

[36.2] $\$heap_{719,1;731,8}$ == $\$heap_{funcstart\_719,1}$.**replace**(p1 $\rightarrow$ ((-2 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}.p1$, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}.p1$, 177).rem))).**replace**(p2 $\rightarrow$ ((-35 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}.p2$, 176).quot) + (172 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}.p2$, 176).rem))).**replace**(p3 $\rightarrow$ **asType$<$short int$>$**((**asType$<$int$>$**(**asType$<$short int$>$**(div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}.p3$, 178).rem)) * **asType$<int>$**($\$heap_{719,1;730,8}.r3$)) $-$ (**asType$<$int$>$**(**asType$<$short int$>$**(div3.quot)) * **asType$<$int$>$**($\$heap_{719,1;730,8}.b3$)))))

$\rightarrow$ *[simplify]*

[36.4] $\$heap_{719,1;731,8}$ == $\$heap_{funcstart\_719,1}$.**replace**(p1 $\rightarrow$ ((-2 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}.p1$, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}.p1$, 177).rem))).**replace**(p2 $\rightarrow$ ((-35 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}.p2$, 176).quot) + (172 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}.p2$, 176).rem))).**replace**(p3 $\rightarrow$ **asType$<$short int$>$**((div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}.p3$, 178).rem * **asType$<int>$**($\$heap_{719,1;730,8}.r3$)) $-$ (**asType$<$int$>$**(**asType$<$short int$>$**(div3.quot)) * **asType$<$int$>$**($\$heap_{719,1;730,8}.b3$)))))

$\rightarrow$ *[from term 31.24, $\$heap_{719,1;730,8}$ is equal to $\$heap_{funcstart\_719,1}$.**replace**(p1 $\rightarrow$ ((-2 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}.p1$, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}.p1$, 177).rem))).**replace**(p2 $\rightarrow$ (-35 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}.p2$, 176).quot) + (172 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}.p2$, 176).rem))]*

[36.5] $\$heap_{719,1;731,8}$ == $\$heap_{funcstart\_719,1}$.**replace**(p1 $\rightarrow$ ((-2 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}.p1$, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}.p1$, 177).rem))).**replace**(p2 $\rightarrow$ ((-35 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}.p2$, 176).quot) + (172 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}.p2$, 176).rem))).**replace**(p3 $\rightarrow$ **asType$<$short int$>$**((div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}.p3$, 178).rem * **asType$<int>$**($\$heap_{funcstart\_719,1}$.**replace**(p1 $\rightarrow$ ((-2 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}.p1$, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}.p1$, 177).rem))).**replace**(p2 $\rightarrow$ ((-35 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}.p2$, 176).quot) + (172 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}.p2$, 176).rem))).r3)) $-$ (**asType$<$int$>$**(**asType$<$short int$>$**(div3.quot)) * **asType$<$int$>$**($\$heap_{719,1;730,8}.b3$)))))

$\rightarrow$ *[const member of object with modified fields]*

[36.7] $\text{\$heap}_{719,1;731,8}$ == $\text{\$heap}_{funcstart\_719,1}$.**replace**(p1 → ((-2 *
div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p1,
177).rem))).**replace**(p2 → ((-35 * div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$,
$\text{\$heap}_{funcstart\_719,1}$.p2, 176).quot) + (172 * div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$,
$\text{\$heap}_{funcstart\_719,1}$.p2, 176).rem))).**replace**(p3 → **asType**<**short
int**>((div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p3, 178).rem *
asType<**int**>($\text{\$heap}_{funcstart\_719,1}$.r3)) − (**asType**<**int**>(**asType**<**short
int**>(div3.quot)) * **asType**<**int**>($\text{\$heap}_{719,1;730,8}$.b3)))))

→ *[const static or extern object]*

[36.8] $\text{\$heap}_{719,1;731,8}$ == $\text{\$heap}_{funcstart\_719,1}$.**replace**(p1 → ((-2 *
div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p1,
177).rem))).**replace**(p2 → ((-35 * div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$,
$\text{\$heap}_{funcstart\_719,1}$.p2, 176).quot) + (172 * div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$,
$\text{\$heap}_{funcstart\_719,1}$.p2, 176).rem))).**replace**(p3 → **asType**<**short
int**>((div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p3, 178).rem *
asType<**int**>($\text{\$heap}_{init}$.r3)) − (**asType**<**int**>(**asType**<**short
int**>(div3.quot)) * **asType**<**int**>($\text{\$heap}_{719,1;730,8}$.b3)))))

→ *[expand definition of constant 'r3' at prang.c (25,20)]*

[36.9] $\text{\$heap}_{719,1;731,8}$ == $\text{\$heap}_{funcstart\_719,1}$.**replace**(p1 → ((-2 *
div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p1,
177).rem))).**replace**(p2 → ((-35 * div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$,
$\text{\$heap}_{funcstart\_719,1}$.p2, 176).quot) + (172 * div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$,
$\text{\$heap}_{funcstart\_719,1}$.p2, 176).rem))).**replace**(p3 → **asType**<**short
int**>((div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p3, 178).rem *
asType<**int**>(**asType**<**short int**>((**int**)170))) −
(**asType**<**int**>(**asType**<**short int**>(div3.quot)) *
asType<**int**>($\text{\$heap}_{719,1;730,8}$.b3)))))

→ *[simplify]*

[36.12] $\text{\$heap}_{719,1;731,8}$ == $\text{\$heap}_{funcstart\_719,1}$.**replace**(p1 → ((-2 *
div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p1,
177).rem))).**replace**(p2 → ((-35 * div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$,
$\text{\$heap}_{funcstart\_719,1}$.p2, 176).quot) + (172 * div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$,
$\text{\$heap}_{funcstart\_719,1}$.p2, 176).rem))).**replace**(p3 → **asType**<**short
int**>((div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p3, 178).rem * 170)
− (**asType**<**int**>(**asType**<**short int**>(div3.quot)) *
asType<**int**>($\text{\$heap}_{719,1;730,8}$.b3)))))

→ *[from term 19.6, div3 is equal to div(**heapIs** $heap_{funcstart\_719,1}$,
$heap_{funcstart\_719,1}$.p3, 178)]*

[36.13] $\text{\$heap}_{719,1;731,8}$ == $\text{\$heap}_{funcstart\_719,1}$.**replace**(p1 → ((-2 *
div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p1,
177).rem))).**replace**(p2 → ((-35 * div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$,
$\text{\$heap}_{funcstart\_719,1}$.p2, 176).quot) + (172 * div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$,
$\text{\$heap}_{funcstart\_719,1}$.p2, 176).rem))).**replace**(p3 → **asType<short int>**((170
* div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p3, 178).rem) −
(**asType<int>**(**asType<short int>**(div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$,
$\text{\$heap}_{funcstart\_719,1}$.p3, 178).quot)) * **asType<int>**($\text{\$heap}_{719,1;730,8}$.b3))))

→ *[simplify]*

[36.15] $\text{\$heap}_{719,1;731,8}$ == $\text{\$heap}_{funcstart\_719,1}$.**replace**(p1 → ((-2 *
div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p1,
177).rem))).**replace**(p2 → ((-35 * div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$,
$\text{\$heap}_{funcstart\_719,1}$.p2, 176).quot) + (172 * div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$,
$\text{\$heap}_{funcstart\_719,1}$.p2, 176).rem))).**replace**(p3 → **asType<short int>**((170
* div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p3, 178).rem) −
(div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p3, 178).quot *
asType<int>($\text{\$heap}_{719,1;730,8}$.b3))))

→ *[from term 31.24, $\text{\$heap}_{719,1;730,8}$ is equal to*
*$\text{\$heap}_{funcstart\_719,1}$.**replace**(p1 → ((-2 * div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$,*
*$\text{\$heap}_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$,*
*$\text{\$heap}_{funcstart\_719,1}$.p1, 177).rem))).**replace**(p2 → (-35 * div(**heapIs***
*$\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p2, 176).quot) + (172 * div(**heapIs***
$\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p2, 176).rem))]

[36.16] $\text{\$heap}_{719,1;731,8}$ == $\text{\$heap}_{funcstart\_719,1}$.**replace**(p1 → ((-2 *
div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p1,
177).rem))).**replace**(p2 → ((-35 * div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$,
$\text{\$heap}_{funcstart\_719,1}$.p2, 176).quot) + (172 * div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$,
$\text{\$heap}_{funcstart\_719,1}$.p2, 176).rem))).**replace**(p3 → **asType<short int>**((170
* div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p3, 178).rem) −
(div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p3, 178).quot *
asType<int>($\text{\$heap}_{funcstart\_719,1}$.**replace**(p1 → ((-2 * div(**heapIs**
$\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs**
$\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p1, 177).rem))).**replace**(p2 → ((-35
* div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p2, 176).quot) + (172 *
div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p2, 176).rem))).b3))))

→ *[const member of object with modified fields]*

[36.18] $\text{\$heap}_{719,1;731,8}$ == $\text{\$heap}_{funcstart\_719,1}$.**replace**(p1 → ((-2 *
div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p1,
177).rem))).**replace**(p2 → ((-35 * div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$,

$\text{heap}_{funcstart\_719,1}.\text{p2}, 176).\text{quot}) + (172 * \text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_719,1},$ $\$\text{heap}_{funcstart\_719,1}.\text{p2}, 176).\text{rem}))).\_\textbf{replace}(\text{p3} \rightarrow \textbf{asType}<\textbf{short int}>((170$ $* \text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_719,1}, \$\text{heap}_{funcstart\_719,1}.\text{p3}, 178).\text{rem}) -$ $(\text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_719,1}, \$\text{heap}_{funcstart\_719,1}.\text{p3}, 178).\text{quot} *$ $\textbf{asType}<\textbf{int}>(\$\text{heap}_{funcstart\_719,1}.\text{b3}))))$

$\rightarrow$ *[const static or extern object]*

[36.19] $\$\text{heap}_{719,1;731,8} == \$\text{heap}_{funcstart\_719,1}.\_\textbf{replace}(\text{p1} \rightarrow ((-2 *$ $\text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_719,1}, \$\text{heap}_{funcstart\_719,1}.\text{p1}, 177).\text{quot}) + (171 *$ $\text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_719,1}, \$\text{heap}_{funcstart\_719,1}.\text{p1},$ $177).\text{rem}))).\_\textbf{replace}(\text{p2} \rightarrow ((-35 * \text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_719,1},$ $\$\text{heap}_{funcstart\_719,1}.\text{p2}, 176).\text{quot}) + (172 * \text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_719,1},$ $\$\text{heap}_{funcstart\_719,1}.\text{p2}, 176).\text{rem}))).\_\textbf{replace}(\text{p3} \rightarrow \textbf{asType}<\textbf{short int}>((170$ $* \text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_719,1}, \$\text{heap}_{funcstart\_719,1}.\text{p3}, 178).\text{rem}) -$ $(\text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_719,1}, \$\text{heap}_{funcstart\_719,1}.\text{p3}, 178).\text{quot} *$ $\textbf{asType}<\textbf{int}>(\$\text{heap}_{init}.\text{b3}))))$

$\rightarrow$ *[expand definition of constant 'b3' at prang.c (27,20)]*

[36.20] $\$\text{heap}_{719,1;731,8} == \$\text{heap}_{funcstart\_719,1}.\_\textbf{replace}(\text{p1} \rightarrow ((-2 *$ $\text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_719,1}, \$\text{heap}_{funcstart\_719,1}.\text{p1}, 177).\text{quot}) + (171 *$ $\text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_719,1}, \$\text{heap}_{funcstart\_719,1}.\text{p1},$ $177).\text{rem}))).\_\textbf{replace}(\text{p2} \rightarrow ((-35 * \text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_719,1},$ $\$\text{heap}_{funcstart\_719,1}.\text{p2}, 176).\text{quot}) + (172 * \text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_719,1},$ $\$\text{heap}_{funcstart\_719,1}.\text{p2}, 176).\text{rem}))).\_\textbf{replace}(\text{p3} \rightarrow \textbf{asType}<\textbf{short int}>((170$ $* \text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_719,1}, \$\text{heap}_{funcstart\_719,1}.\text{p3}, 178).\text{rem}) -$ $(\text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_719,1}, \$\text{heap}_{funcstart\_719,1}.\text{p3}, 178).\text{quot} *$ $\textbf{asType}<\textbf{int}>(\textbf{asType}<\textbf{short int}>((\textbf{int})63)))))$

$\rightarrow$ *[simplify]*

[36.26] $\$\text{heap}_{719,1;731,8} == \$\text{heap}_{funcstart\_719,1}.\_\textbf{replace}(\text{p1} \rightarrow ((-2 *$ $\text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_719,1}, \$\text{heap}_{funcstart\_719,1}.\text{p1}, 177).\text{quot}) + (171 *$ $\text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_719,1}, \$\text{heap}_{funcstart\_719,1}.\text{p1},$ $177).\text{rem}))).\_\textbf{replace}(\text{p2} \rightarrow ((-35 * \text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_719,1},$ $\$\text{heap}_{funcstart\_719,1}.\text{p2}, 176).\text{quot}) + (172 * \text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_719,1},$ $\$\text{heap}_{funcstart\_719,1}.\text{p2}, 176).\text{rem}))).\_\textbf{replace}(\text{p3} \rightarrow ((-63 * \text{div}(\textbf{heapIs}$ $\$\text{heap}_{funcstart\_719,1}, \$\text{heap}_{funcstart\_719,1}.\text{p3}, 178).\text{quot}) + (170 * \text{div}(\textbf{heapIs}$ $\$\text{heap}_{funcstart\_719,1}, \$\text{heap}_{funcstart\_719,1}.\text{p3}, 178).\text{rem})))$

[Take goal term]

[1.0] $\$\text{heap}_{719,1;731,8}.\text{M1} \leq \textbf{maxof}(\textbf{int})$

$\rightarrow$ *[from term 36.26, $heap_{719,1;731,8}$ is equal to*
*$heap_{funcstart\_719,1}.\_\textbf{replace}(p1 \rightarrow ((-2 * div(\textbf{heapIs } \$heap_{funcstart\_719,1},$*
*$\$heap_{funcstart\_719,1}.p1, 177).quot) + (171 * div(\textbf{heapIs } \$heap_{funcstart\_719,1},$*
*$\$heap_{funcstart\_719,1}.p1, 177).rem))).\_\textbf{replace}(p2 \rightarrow ((-35 * div(\textbf{heapIs}$*
*$\$heap_{funcstart\_719,1}, \$heap_{funcstart\_719,1}.p2, 176).quot) + (172 * div(\textbf{heapIs}$*
*$\$heap_{funcstart\_719,1}, \$heap_{funcstart\_719,1}.p2, 176).rem))).\_\textbf{replace}(p3 \rightarrow (-63 *$*

div(**heapIs** *$heap$*$_{funcstart\_719,1}$, *$heap$*$_{funcstart\_719,1}$*.p3, 178).quot) + (170 * div*(**heapIs** *$heap$*$_{funcstart\_719,1}$, *$heap$*$_{funcstart\_719,1}$*.p3, 178).rem))]*

[1.1] $heap$$_{funcstart\_719,1}$.**replace**(p1 → ((-2 * div(**heapIs** $heap$$_{funcstart_719,1}$, $heap$$_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs** $heap$$_{funcstart_719,1}$, $heap$$_{funcstart\_719,1}$.p1, 177).rem))).**replace**(p2 → ((-35 * div(**heapIs** $heap$$_{funcstart_719,1}$, $heap$$_{funcstart\_719,1}$.p2, 176).quot) + (172 * div(**heapIs** $heap$$_{funcstart_719,1}$, $heap$$_{funcstart\_719,1}$.p2, 176).rem))).**replace**(p3 → ((-63 * div(**heapIs** $heap$$_{funcstart_719,1}$, $heap$$_{funcstart\_719,1}$.p3, 178).quot) + (170 * div(**heapIs** $heap$$_{funcstart_719,1}$, $heap$$_{funcstart_719,1}$.p3, 178).rem))).M1 ≤ **maxof**(**int**)

→ *[const member of object with modified fields]*

[1.4] $heap$$_{funcstart_719,1}$.M1 ≤ **maxof**(**int**)

→ *[const static or extern object]*

[1.5] $heap$$_{init}$.M1 ≤ **maxof**(**int**)

→ *[expand definition of constant 'M1' at prang.c (14,20)]*

[1.6] **asType**<**short int**>((**int**)30269) ≤ **maxof**(**int**)

→ *[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 (51,17)

Condition defined at:

To prove: minof(**int**) ≤ $heap$$_{719,1;731,8}$.p1

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)

$heap$$_{init}$.M2 == **asType**<**short int**>((**int**)30307)

$heap$$_{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)

$\text{\$heap}_{init}.\text{r3} == \textbf{asType}\textbf{<short int>}((\textbf{int})170)$

$\text{\$heap}_{init}.\text{a3} == \textbf{asType}\textbf{<short int>}((\textbf{int})178)$

$\text{\$heap}_{init}.\text{b3} == \textbf{asType}\textbf{<short int>}((\textbf{int})63)$

$\text{\$heap}_{init}.\text{p1} == \textbf{asType}\textbf{<short int>}((\textbf{int})1)$

$\text{\$heap}_{init}.\text{p2} == \textbf{asType}\textbf{<short int>}((\textbf{int})2)$

$\text{\$heap}_{init}.\text{p3} == \textbf{asType}\textbf{<short int>}((\textbf{int})3)$

$\text{div1} == \text{div}(\textbf{heapIs } \text{\$heap}_{funcstart\_719,1},$
$\textbf{asType}\textbf{<int>}(\text{\$heap}_{funcstart\_719,1}.\text{p1}),$
$\textbf{asType}\textbf{<int>}(\text{\$heap}_{funcstart\_719,1}.\text{a1}))$

$(\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<int>}(\text{\$heap}_{funcstart\_719,1}.\text{p1})) \,/$
$\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<int>}(\text{\$heap}_{funcstart\_719,1}.\text{a1}))) ==$
$\textbf{asType}\textbf{<integer>}(\text{div1.quot})$

$(\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<int>}(\text{\$heap}_{funcstart\_719,1}.\text{p1})) \,\%$
$\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<int>}(\text{\$heap}_{funcstart\_719,1}.\text{a1}))) ==$
$\textbf{asType}\textbf{<integer>}(\text{div1.rem})$

$\text{div2} == \text{div}(\textbf{heapIs } \text{\$heap}_{funcstart\_719,1},$
$\textbf{asType}\textbf{<int>}(\text{\$heap}_{funcstart\_719,1}.\text{p2}),$
$\textbf{asType}\textbf{<int>}(\text{\$heap}_{funcstart\_719,1}.\text{a2}))$

$(\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<int>}(\text{\$heap}_{funcstart\_719,1}.\text{p2})) \,/$
$\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<int>}(\text{\$heap}_{funcstart\_719,1}.\text{a2}))) ==$
$\textbf{asType}\textbf{<integer>}(\text{div2.quot})$

$(\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<int>}(\text{\$heap}_{funcstart\_719,1}.\text{p2})) \,\%$
$\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<int>}(\text{\$heap}_{funcstart\_719,1}.\text{a2}))) ==$
$\textbf{asType}\textbf{<integer>}(\text{div2.rem})$

$\text{div3} == \text{div}(\textbf{heapIs } \text{\$heap}_{funcstart\_719,1},$
$\textbf{asType}\textbf{<int>}(\text{\$heap}_{funcstart\_719,1}.\text{p3}),$
$\textbf{asType}\textbf{<int>}(\text{\$heap}_{funcstart\_719,1}.\text{a3}))$

$(\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<int>}(\text{\$heap}_{funcstart\_719,1}.\text{p3})) \,/$
$\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<int>}(\text{\$heap}_{funcstart\_719,1}.\text{a3}))) ==$
$\textbf{asType}\textbf{<integer>}(\text{div3.quot})$

$(\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<int>}(\text{\$heap}_{funcstart\_719,1}.\text{p3})) \,\%$
$\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<int>}(\text{\$heap}_{funcstart\_719,1}.\text{a3}))) ==$
$\textbf{asType}\textbf{<integer>}(\text{div3.rem})$

$\text{\$heap}_{719,1;729,8} == \text{\$heap}_{funcstart\_719,1}.\textbf{\_replace}(\text{p1} \rightarrow \textbf{asType}\textbf{<short}$
$\textbf{int>}((\textbf{asType}\textbf{<int>}(\textbf{asType}\textbf{<short int>}(\text{div1.rem})) \,*$
$\textbf{asType}\textbf{<int>}(\text{\$heap}_{funcstart\_719,1}.\text{r1})) - (\textbf{asType}\textbf{<int>}(\textbf{asType}\textbf{<short}$
$\textbf{int>}(\text{div1.quot})) \,* \textbf{asType}\textbf{<int>}(\text{\$heap}_{funcstart\_719,1}.\text{b1}))))$

$\text{\$heap}_{719,1;730,8} == \text{\$heap}_{719,1;729,8}.\textbf{\_replace}(\text{p2} \rightarrow \textbf{asType}\textbf{<short}$
$\textbf{int>}((\textbf{asType}\textbf{<int>}(\textbf{asType}\textbf{<short int>}(\text{div2.rem})) \,*$

asType<int>($heap$_{719,1;729,8}$.r2)) − (**asType<int>**(**asType<short int>**(div2.quot)) * **asType<int>**($heap$_{719,1;729,8}$.b2)))))

$heap$_{719,1;731,8}$ == $heap$_{719,1;730,8}$._**replace**(p3 → **asType<short int>**((**asType<int>**(**asType<short int>**(div3.rem)) * **asType<int>**($heap$_{719,1;730,8}$.r3)) − (**asType<int>**(**asType<short int>**(div3.quot)) * **asType<int>**($heap$_{719,1;730,8}$.b3)))))

Proof:

[Take given term]

[5.0] div1 == div(**heapIs** $heap$_{funcstart_719,1}$,
asType<int>($heap$_{funcstart_719,1}$.p1),
asType<int>($heap$_{funcstart_719,1}$.a1))

→ *[simplify]*

[5.1] div1 == div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1,
asType<int>($heap$_{funcstart_719,1}$.a1))

→ *[const static or extern object]*

[5.2] div1 == div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1,
asType<int>($heap$_{init}$.a1))

→ *[expand definition of constant 'a1' at prang.c (16,20)]*

[5.3] div1 == div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1,
asType<int>(**asType<short int>**((**int**)177)))

→ *[simplify]*

[5.6] div1 == div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1, 177)

[Assume known post-assertion, class invariant or type constraint for term 5.6]

[9.0] $heap$_{funcstart_719,1}$.p1 ≤ **maxof**(**short int**)

→ *[simplify]*

[9.9] -32768 < −$heap$_{funcstart_719,1}$.p1

[Assume known post-assertion, class invariant or type constraint for term 5.6]

[10.0] (**asType<integer>**($heap$_{funcstart_719,1}$.p1) /
asType<integer>(177)) == **asType<integer>**(div(**heapIs**
$heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1, 177).quot)

→ *[simplify]*

[10.2] ($heap$_{funcstart_719,1}$.p1 / 177) == **asType<integer>**(div(**heapIs**
$heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1, 177).quot)

→ *[expand definition of operator './' in class 'int' at built in declaration]*

[10.3] ([**asType<integer>**($heap$_{funcstart_719,1}$.p1) < 0]:
−(−**asType<integer>**($heap$_{funcstart_719,1}$.p1) / 177), []:

asType<integer>($heap$_{funcstart_719,1}$.p1) / 177) ==
asType<integer>(div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1, 177).quot)

$\rightarrow$ *[explicitly assert falsehood of skipped guards in subsequent guards]*

[10.4] ([**asType<integer>**($heap$_{funcstart_719,1}$.p1) < 0]:
−(−**asType<integer>**($heap$_{funcstart_719,1}$.p1) / 177),
[!(**asType<integer>**($heap$_{funcstart_719,1}$.p1) < 0)]:
asType<integer>($heap$_{funcstart_719,1}$.p1) / 177) ==
asType<integer>(div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1, 177).quot)

$\rightarrow$ *[simplify]*

[10.17] 0 == (−([0 < −$heap$_{funcstart_719,1}$.p1]: −(−$heap$_{funcstart\_719,1}$.p1 / 177), [-1 < $heap$_{funcstart_719,1}$.p1]: $heap$_{funcstart_719,1}$.p1 / 177) + div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1, 177).quot)

$\rightarrow$ *[move guard outside expression]*

[10.18] 0 == (([0 < −$heap$_{funcstart_719,1}$.p1]: −(−(−$heap$_{funcstart\_719,1}$.p1 / 177)), [-1 < $heap$_{funcstart_719,1}$.p1]: −($heap$_{funcstart\_719,1}$.p1 / 177)) + div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1, 177).quot)

$\rightarrow$ *[simplify]*

[10.19] 0 == (([0 < −$heap$_{funcstart_719,1}$.p1]: −$heap$_{funcstart\_719,1}$.p1 / 177, [-1 < $heap$_{funcstart_719,1}$.p1]: −($heap$_{funcstart\_719,1}$.p1 / 177)) + div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1, 177).quot)

$\rightarrow$ *[move guard outside expression]*

[10.21] ([0 < −$heap$_{funcstart_719,1}$.p1]: 0 == ((−$heap$_{funcstart\_719,1}$.p1 / 177) + div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1, 177).quot), [-1 < $heap$_{funcstart_719,1}$.p1]: 0 == (−($heap$_{funcstart\_719,1}$.p1 / 177) + div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1, 177).quot))

[Assume known post-assertion, class invariant or type constraint for term 5.6]

[11.0] (**asType<integer>**($heap$_{funcstart_719,1}$.p1) %
asType<integer>(177)) == **asType<integer>**(div(**heapIs**
$heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1, 177).rem)

$\rightarrow$ *[simplify]*

[11.2] ($heap$_{funcstart_719,1}$.p1 % 177) == **asType<integer>**(div(**heapIs**
$heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1, 177).rem)

$\rightarrow$ *[expand definition of operator '.%' in class 'int' at built in declaration]*

[11.3] ([**asType<integer>**($heap$_{funcstart_719,1}$.p1) < 0]:
−(−**asType<integer>**($heap$_{funcstart_719,1}$.p1) % 177), []:
asType<integer>($heap$_{funcstart_719,1}$.p1) % 177) ==
asType<integer>(div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1,

177).rem)

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

[11.4] ([**asType**<**integer**>($heap$_{funcstart_719,1}$.p1) < 0]:
−(−**asType**<**integer**>($heap$_{funcstart_719,1}$.p1) % 177),
[!(**asType**<**integer**>($heap$_{funcstart_719,1}$.p1) < 0)]:
asType<**integer**>($heap$_{funcstart_719,1}$.p1) % 177) ==
asType<**integer**>(div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1,
177).rem)

→ *[simplify]*

[11.14] ([0 < −$heap$_{funcstart_719,1}$.p1]: −(−$heap$_{funcstart\_719,1}$.p1 % 177), [-1
< $heap$_{funcstart_719,1}$.p1]: **asType**<**integer**>($heap$_{funcstart\_719,1}$.p1) % 177)
== **asType**<**integer**>(div(**heapIs** $heap$_{funcstart_719,1}$,
$heap$_{funcstart_719,1}$.p1, 177).rem)

→ *[remainder of negation]*

[11.15] ([0 < −$heap$_{funcstart_719,1}$.p1]: −([0 == ($heap$_{funcstart\_719,1}$.p1 %
177)]: 0, []: 177 + −($heap$_{funcstart_719,1}$.p1 % 177)), [-1 <
$heap$_{funcstart_719,1}$.p1]: **asType**<**integer**>($heap$_{funcstart\_719,1}$.p1) % 177)
== **asType**<**integer**>(div(**heapIs** $heap$_{funcstart_719,1}$,
$heap$_{funcstart_719,1}$.p1, 177).rem)

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

[11.16] ([0 < −$heap$_{funcstart_719,1}$.p1]: −([0 == ($heap$_{funcstart\_719,1}$.p1 %
177)]: 0, [!(0 == ($heap$_{funcstart_719,1}$.p1 % 177))]: 177 +
−($heap$_{funcstart_719,1}$.p1 % 177)), [-1 < $heap$_{funcstart_719,1}$.p1]:
asType<**integer**>($heap$_{funcstart_719,1}$.p1) % 177) ==
asType<**integer**>(div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1,
177).rem)

→ *[move guard outside expression]*

[11.17] ([0 < −$heap$_{funcstart_719,1}$.p1]: ([0 == ($heap$_{funcstart\_719,1}$.p1 %
177)]: −0, [!(0 == ($heap$_{funcstart_719,1}$.p1 % 177))]: −(177 +
−($heap$_{funcstart_719,1}$.p1 % 177))), [-1 < $heap$_{funcstart_719,1}$.p1]:
asType<**integer**>($heap$_{funcstart_719,1}$.p1) % 177) ==
asType<**integer**>(div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1,
177).rem)

→ *[simplify]*

[11.24] 0 == (−([0 < −$heap$_{funcstart_719,1}$.p1]: ([0 ==
($heap$_{funcstart_719,1}$.p1 % 177)]: 0, [!(0 == ($heap$_{funcstart\_719,1}$.p1 % 177))]:
-177 + ($heap$_{funcstart_719,1}$.p1 % 177)), [-1 < $heap$_{funcstart_719,1}$.p1]:
$heap$_{funcstart_719,1}$.p1 % 177) + div(**heapIs** $heap$_{funcstart_719,1}$,
$heap$_{funcstart_719,1}$.p1, 177).rem)

→ *[move guard outside expression]*

[11.26] $0 == (([0 < -\$\text{heap}_{funcstart\_719,1}.\text{p1}]: ([0 == (\$\text{heap}_{funcstart\_719,1}.\text{p1}$ $\% ~177)]: -0, [!(0 == (\$\text{heap}_{funcstart\_719,1}.\text{p1} ~\% ~177))]: -(-177 +$ $(\$\text{heap}_{funcstart\_719,1}.\text{p1} ~\% ~177))), [-1 < \$\text{heap}_{funcstart\_719,1}.\text{p1}]:$ $-(\$\text{heap}_{funcstart\_719,1}.\text{p1} ~\% ~177)) + \text{div}(\textbf{heapIs} ~\$\text{heap}_{funcstart\_719,1},$ $\$\text{heap}_{funcstart\_719,1}.\text{p1}, 177).\text{rem})$

$\rightarrow$ *[simplify]*

[11.29] $0 == (([0 < -\$\text{heap}_{funcstart\_719,1}.\text{p1}]: ([0 == (\$\text{heap}_{funcstart\_719,1}.\text{p1}$ $\% ~177)]: 0, [!(0 == (\$\text{heap}_{funcstart\_719,1}.\text{p1} ~\% ~177))]: 177 +$ $-(\$\text{heap}_{funcstart\_719,1}.\text{p1} ~\% ~177)), [-1 < \$\text{heap}_{funcstart\_719,1}.\text{p1}]:$ $-(\$\text{heap}_{funcstart\_719,1}.\text{p1} ~\% ~177)) + \text{div}(\textbf{heapIs} ~\$\text{heap}_{funcstart\_719,1},$ $\$\text{heap}_{funcstart\_719,1}.\text{p1}, 177).\text{rem})$

$\rightarrow$ *[move guard outside expression]*

[11.31] $0 == ([0 < -\$\text{heap}_{funcstart\_719,1}.\text{p1}]: ([0 == (\$\text{heap}_{funcstart\_719,1}.\text{p1} ~\%$ $177)]: 0 + \text{div}(\textbf{heapIs} ~\$\text{heap}_{funcstart\_719,1}, \$\text{heap}_{funcstart\_719,1}.\text{p1}, 177).\text{rem},$ $[!(0 == (\$\text{heap}_{funcstart\_719,1}.\text{p1} ~\% ~177))]: (177 + -(\$\text{heap}_{funcstart\_719,1}.\text{p1} ~\%$ $177)) + \text{div}(\textbf{heapIs} ~\$\text{heap}_{funcstart\_719,1}, \$\text{heap}_{funcstart\_719,1}.\text{p1}, 177).\text{rem}), [-1$ $< \$\text{heap}_{funcstart\_719,1}.\text{p1}]: -(\$\text{heap}_{funcstart\_719,1}.\text{p1} ~\% ~177) + \text{div}(\textbf{heapIs}$ $\$\text{heap}_{funcstart\_719,1}, \$\text{heap}_{funcstart\_719,1}.\text{p1}, 177).\text{rem})$

$\rightarrow$ *[simplify]*

[11.33] $0 == ([0 < -\$\text{heap}_{funcstart\_719,1}.\text{p1}]: ([0 == (\$\text{heap}_{funcstart\_719,1}.\text{p1}$ $\% ~177)]: \text{div}(\textbf{heapIs} ~\$\text{heap}_{funcstart\_719,1}, \$\text{heap}_{funcstart\_719,1}.\text{p1}, 177).\text{rem},$ $[!(0 == (\$\text{heap}_{funcstart\_719,1}.\text{p1} ~\% ~177))]: 177 + -(\$\text{heap}_{funcstart\_719,1}.\text{p1} ~\%$ $177) + \text{div}(\textbf{heapIs} ~\$\text{heap}_{funcstart\_719,1}, \$\text{heap}_{funcstart\_719,1}.\text{p1}, 177).\text{rem}), [-1$ $< \$\text{heap}_{funcstart\_719,1}.\text{p1}]: -(\$\text{heap}_{funcstart\_719,1}.\text{p1} ~\% ~177) + \text{div}(\textbf{heapIs}$ $\$\text{heap}_{funcstart\_719,1}, \$\text{heap}_{funcstart\_719,1}.\text{p1}, 177).\text{rem})$

$\rightarrow$ *[move guard outside expression]*

[11.35] $([0 < -\$\text{heap}_{funcstart\_719,1}.\text{p1}]: ([0 == (\$\text{heap}_{funcstart\_719,1}.\text{p1} ~\% ~177)]:$ $0 == \text{div}(\textbf{heapIs} ~\$\text{heap}_{funcstart\_719,1}, \$\text{heap}_{funcstart\_719,1}.\text{p1}, 177).\text{rem}, [!(0$ $== (\$\text{heap}_{funcstart\_719,1}.\text{p1} ~\% ~177))]: 0 == (177 + -(\$\text{heap}_{funcstart\_719,1}.\text{p1}$ $\% ~177) + \text{div}(\textbf{heapIs} ~\$\text{heap}_{funcstart\_719,1}, \$\text{heap}_{funcstart\_719,1}.\text{p1}, 177).\text{rem})),$ $[-1 < \$\text{heap}_{funcstart\_719,1}.\text{p1}]: 0 == (-(\$\text{heap}_{funcstart\_719,1}.\text{p1} ~\% ~177) +$ $\text{div}(\textbf{heapIs} ~\$\text{heap}_{funcstart\_719,1}, \$\text{heap}_{funcstart\_719,1}.\text{p1}, 177).\text{rem}))$

$\rightarrow$ *[simplify]*

[11.40] $([0 < -\$\text{heap}_{funcstart\_719,1}.\text{p1}]: ([0 == (\$\text{heap}_{funcstart\_719,1}.\text{p1} ~\%$ $177)]: 0 == \text{div}(\textbf{heapIs} ~\$\text{heap}_{funcstart\_719,1}, \$\text{heap}_{funcstart\_719,1}.\text{p1}, 177).\text{rem},$ $[!(0 == (\$\text{heap}_{funcstart\_719,1}.\text{p1} ~\% ~177))]: 177 == ((\$\text{heap}_{funcstart\_719,1}.\text{p1} ~\%$ $177) + -\text{div}(\textbf{heapIs} ~\$\text{heap}_{funcstart\_719,1}, \$\text{heap}_{funcstart\_719,1}.\text{p1}, 177).\text{rem})),$ $[-1 < \$\text{heap}_{funcstart\_719,1}.\text{p1}]: 0 == (-(\$\text{heap}_{funcstart\_719,1}.\text{p1} ~\% ~177) +$ $\text{div}(\textbf{heapIs} ~\$\text{heap}_{funcstart\_719,1}, \$\text{heap}_{funcstart\_719,1}.\text{p1}, 177).\text{rem}))$

[Take given term]

[12.0] $\text{div2} == \text{div}(\textbf{heapIs} ~\$\text{heap}_{funcstart\_719,1},$

asType\<int\>($\text{heap}_{funcstart\_719,1}.\text{p2}$),
asType\<int\>($\text{heap}_{funcstart\_719,1}.\text{a2}$))

$\rightarrow$ *[simplify]*

[12.1] div2 == div(**heapIs** $\text{heap}_{funcstart\_719,1}$, $\text{heap}_{funcstart\_719,1}.\text{p2}$,
asType\<int\>($\text{heap}_{funcstart\_719,1}.\text{a2}$))

$\rightarrow$ *[const static or extern object]*

[12.2] div2 == div(**heapIs** $\text{heap}_{funcstart\_719,1}$, $\text{heap}_{funcstart\_719,1}.\text{p2}$,
asType\<int\>($\text{heap}_{init}.\text{a2}$))

$\rightarrow$ *[expand definition of constant 'a2' at prang.c (21,20)]*

[12.3] div2 == div(**heapIs** $\text{heap}_{funcstart\_719,1}$, $\text{heap}_{funcstart\_719,1}.\text{p2}$,
asType\<int\>(**asType\<short int\>**((**int**)176)))

$\rightarrow$ *[simplify]*

[12.6] div2 == div(**heapIs** $\text{heap}_{funcstart\_719,1}$, $\text{heap}_{funcstart\_719,1}.\text{p2}$, 176)

[Take given term]

[19.0] div3 == div(**heapIs** $\text{heap}_{funcstart\_719,1}$,
asType\<int\>($\text{heap}_{funcstart\_719,1}.\text{p3}$),
asType\<int\>($\text{heap}_{funcstart\_719,1}.\text{a3}$))

$\rightarrow$ *[simplify]*

[19.1] div3 == div(**heapIs** $\text{heap}_{funcstart\_719,1}$, $\text{heap}_{funcstart\_719,1}.\text{p3}$,
asType\<int\>($\text{heap}_{funcstart\_719,1}.\text{a3}$))

$\rightarrow$ *[const static or extern object]*

[19.2] div3 == div(**heapIs** $\text{heap}_{funcstart\_719,1}$, $\text{heap}_{funcstart\_719,1}.\text{p3}$,
asType\<int\>($\text{heap}_{init}.\text{a3}$))

$\rightarrow$ *[expand definition of constant 'a3' at prang.c (26,20)]*

[19.3] div3 == div(**heapIs** $\text{heap}_{funcstart\_719,1}$, $\text{heap}_{funcstart\_719,1}.\text{p3}$,
asType\<int\>(**asType\<short int\>**((**int**)178)))

$\rightarrow$ *[simplify]*

[19.6] div3 == div(**heapIs** $\text{heap}_{funcstart\_719,1}$, $\text{heap}_{funcstart\_719,1}.\text{p3}$, 178)

[Take given term]

[26.0] $\text{heap}_{719,1;729,8}$ == $\text{heap}_{funcstart\_719,1}.\_$**replace**(p1 $\rightarrow$ **asType\<short int\>**((**asType\<int\>**(**asType\<short int\>**(div1.rem)) *
asType\<int\>($\text{heap}_{funcstart\_719,1}.\text{r1}$)) $-$ (**asType\<int\>**(**asType\<short int\>**(div1.quot)) * **asType\<int\>**($\text{heap}_{funcstart\_719,1}.\text{b1}$))))

$\rightarrow$ *[from term 5.6, div1 is equal to div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}.p1$, 177)]*

[26.1] $\text{heap}_{719,1;729,8}$ == $\text{heap}_{funcstart\_719,1}.\_$**replace**(p1 $\rightarrow$ **asType\<short**

int>((**asType**<**int**>(**asType**<**short int**>(div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}$.p1, 177).rem)) * **asType**<**int**>($\$\text{heap}_{funcstart\_719,1}$.r1)) − (**asType**<**int**>(**asType**<**short int**>(div1.quot)) * **asType**<**int**>($\$\text{heap}_{funcstart\_719,1}$.b1))))

→ *[simplify]*

[26.3] $\$\text{heap}_{719,1;729,8}$ == $\$\text{heap}_{funcstart\_719,1}$.**replace**(p1 → **asType**<**short int**>((div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}$.p1, 177).rem * **asType**<**int**>($\$\text{heap}_{funcstart\_719,1}$.r1)) − (**asType**<**int**>(**asType**<**short int**>(div1.quot)) * **asType**<**int**>($\$\text{heap}_{funcstart\_719,1}$.b1))))

→ *[const static or extern object]*

[26.4] $\$\text{heap}_{719,1;729,8}$ == $\$\text{heap}_{funcstart\_719,1}$.**replace**(p1 → **asType**<**short int**>((div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}$.p1, 177).rem * **asType**<**int**>($\$\text{heap}_{init}$.r1)) − (**asType**<**int**>(**asType**<**short int**>(div1.quot)) * **asType**<**int**>($\$\text{heap}_{funcstart\_719,1}$.b1))))

→ *[expand definition of constant 'r1' at prang.c (15,20)]*

[26.5] $\$\text{heap}_{719,1;729,8}$ == $\$\text{heap}_{funcstart\_719,1}$.**replace**(p1 → **asType**<**short int**>((div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}$.p1, 177).rem * **asType**<**int**>(**asType**<**short int**>((**int**)171))) − (**asType**<**int**>(**asType**<**short int**>(div1.quot)) * **asType**<**int**>($\$\text{heap}_{funcstart\_719,1}$.b1))))

→ *[simplify]*

[26.8] $\$\text{heap}_{719,1;729,8}$ == $\$\text{heap}_{funcstart\_719,1}$.**replace**(p1 → **asType**<**short int**>((div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}$.p1, 177).rem * 171) − (**asType**<**int**>(**asType**<**short int**>(div1.quot)) * **asType**<**int**>($\$\text{heap}_{funcstart\_719,1}$.b1))))

→ *[from term 5.6, div1 is equal to div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177)]*

[26.9] $\$\text{heap}_{719,1;729,8}$ == $\$\text{heap}_{funcstart\_719,1}$.**replace**(p1 → **asType**<**short int**>((171 * div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}$.p1, 177).rem) − (**asType**<**int**>(**asType**<**short int**>(div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}$.p1, 177).quot)) * **asType**<**int**>($\$\text{heap}_{funcstart\_719,1}$.b1))))

→ *[simplify]*

[26.11] $\$\text{heap}_{719,1;729,8}$ == $\$\text{heap}_{funcstart\_719,1}$.**replace**(p1 → **asType**<**short int**>((171 * div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}$.p1, 177).rem) − (div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}$.p1, 177).quot * **asType**<**int**>($\$\text{heap}_{funcstart\_719,1}$.b1))))

→ *[const static or extern object]*

[26.12] $\$\text{heap}_{719,1;729,8}$ == $\$\text{heap}_{funcstart\_719,1}$.**replace**(p1 → **asType**<**short int**>((171 * div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}$.p1, 177).rem)

$-$ (div(**heapIs** \$heap$_{funcstart\_719,1}$, \$heap$_{funcstart\_719,1}$.p1, 177).quot * **asType<int>**(\$heap$_{init}$.b1))))

→ *[expand definition of constant 'b1' at prang.c (17,20)]*

[26.13] \$heap$_{719,1;729,8}$ == \$heap$_{funcstart\_719,1}$._**replace**(p1 → **asType<short int>**((171 * div(**heapIs** \$heap$_{funcstart\_719,1}$, \$heap$_{funcstart\_719,1}$.p1, 177).rem) $-$ (div(**heapIs** \$heap$_{funcstart\_719,1}$, \$heap$_{funcstart\_719,1}$.p1, 177).quot * **asType<int>**(**asType<short int>**((**int**)2)))))

→ *[simplify]*

[26.19] \$heap$_{719,1;729,8}$ == \$heap$_{funcstart\_719,1}$._**replace**(p1 → ((-2 * div(**heapIs** \$heap$_{funcstart\_719,1}$, \$heap$_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs** \$heap$_{funcstart\_719,1}$, \$heap$_{funcstart\_719,1}$.p1, 177).rem)))

[Take given term]

[31.0] \$heap$_{719,1;730,8}$ == \$heap$_{719,1;729,8}$._**replace**(p2 → **asType<short int>**((**asType<int>**(**asType<short int>**(div2.rem)) * **asType<int>**(\$heap$_{719,1;729,8}$.r2)) $-$ (**asType<int>**(**asType<short int>**(div2.quot)) * **asType<int>**(\$heap$_{719,1;729,8}$.b2))))

→ *[from term 26.19, \$heap$_{719,1;729,8}$ is equal to \$heap$_{funcstart\_719,1}$._**replace**(p1 → (-2 * div(**heapIs** \$heap$_{funcstart\_719,1}$, \$heap$_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs** \$heap$_{funcstart\_719,1}$, \$heap$_{funcstart\_719,1}$.p1, 177).rem))]*

[31.1] \$heap$_{719,1;730,8}$ == \$heap$_{funcstart\_719,1}$._**replace**(p1 → ((-2 * div(**heapIs** \$heap$_{funcstart\_719,1}$, \$heap$_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs** \$heap$_{funcstart\_719,1}$, \$heap$_{funcstart\_719,1}$.p1, 177).rem)))._**replace**(p2 → **asType<short int>**((**asType<int>**(**asType<short int>**(div2.rem)) * **asType<int>**(\$heap$_{719,1;729,8}$.r2)) $-$ (**asType<int>**(**asType<short int>**(div2.quot)) * **asType<int>**(\$heap$_{719,1;729,8}$.b2))))

→ *[from term 12.6, div2 is equal to div(**heapIs** \$heap$_{funcstart\_719,1}$, \$heap$_{funcstart\_719,1}$.p2, 176)]*

[31.2] \$heap$_{719,1;730,8}$ == \$heap$_{funcstart\_719,1}$._**replace**(p1 → ((-2 * div(**heapIs** \$heap$_{funcstart\_719,1}$, \$heap$_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs** \$heap$_{funcstart\_719,1}$, \$heap$_{funcstart\_719,1}$.p1, 177).rem)))._**replace**(p2 → **asType<short int>**((**asType<int>**(**asType<short int>**(div(**heapIs** \$heap$_{funcstart\_719,1}$, \$heap$_{funcstart\_719,1}$.p2, 176).rem)) * **asType<int>**(\$heap$_{719,1;729,8}$.r2)) $-$ (**asType<int>**(**asType<short int>**(div2.quot)) * **asType<int>**(\$heap$_{719,1;729,8}$.b2))))

→ *[simplify]*

[31.4] \$heap$_{719,1;730,8}$ == \$heap$_{funcstart\_719,1}$._**replace**(p1 → ((-2 * div(**heapIs** \$heap$_{funcstart\_719,1}$, \$heap$_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs** \$heap$_{funcstart\_719,1}$, \$heap$_{funcstart\_719,1}$.p1,

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177).rem))).**_replace**(p2 → **asType**<**short int**>((div(**heapIs**
$heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p2, 176).rem *
asType<**int**>($heap_{719,1;729,8}$.r2)) − (**asType**<**int**>(**asType**<**short**
int>(div2.quot)) * **asType**<**int**>($heap_{719,1;729,8}$.b2))))

→ *[from term 26.19, $heap_{719,1;729,8}$ is equal to*
*$heap_{funcstart\_719,1}$.**_replace**(p1 → (-2 * div(**heapIs** $heap_{funcstart\_719,1}$,*
*$heap_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs** $heap_{funcstart\_719,1}$,*
$heap_{funcstart\_719,1}$.p1, 177).rem))]

[31.5] $heap_{719,1;730,8}$ == $heap_{funcstart\_719,1}$.**_replace**(p1 → ((-2 *
div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p1, 177).quot) + (171 *
div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p1,
177).rem))).**_replace**(p2 → **asType**<**short int**>((div(**heapIs**
$heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p2, 176).rem *
asType<**int**>($heap_{funcstart\_719,1}$.**_replace**(p1 → ((-2 * div(**heapIs**
$heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs**
$heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p1, 177).rem))).r2)) −
(**asType**<**int**>(**asType**<**short int**>(div2.quot)) *
asType<**int**>($heap_{719,1;729,8}$.b2))))

→ *[const member of object with modified fields]*

[31.6] $heap_{719,1;730,8}$ == $heap_{funcstart\_719,1}$.**_replace**(p1 → ((-2 *
div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p1, 177).quot) + (171 *
div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p1,
177).rem))).**_replace**(p2 → **asType**<**short int**>((div(**heapIs**
$heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p2, 176).rem *
asType<**int**>($heap_{funcstart\_719,1}$.r2)) − (**asType**<**int**>(**asType**<**short**
int>(div2.quot)) * **asType**<**int**>($heap_{719,1;729,8}$.b2))))

→ *[const static or extern object]*

[31.7] $heap_{719,1;730,8}$ == $heap_{funcstart\_719,1}$.**_replace**(p1 → ((-2 *
div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p1, 177).quot) + (171 *
div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p1,
177).rem))).**_replace**(p2 → **asType**<**short int**>((div(**heapIs**
$heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p2, 176).rem *
asType<**int**>($heap_{init}$.r2)) − (**asType**<**int**>(**asType**<**short**
int>(div2.quot)) * **asType**<**int**>($heap_{719,1;729,8}$.b2))))

→ *[expand definition of constant 'r2' at prang.c (20,20)]*

[31.8] $heap_{719,1;730,8}$ == $heap_{funcstart\_719,1}$.**_replace**(p1 → ((-2 *
div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p1, 177).quot) + (171 *
div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p1,
177).rem))).**_replace**(p2 → **asType**<**short int**>((div(**heapIs**
$heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p2, 176).rem *
asType<**int**>(**asType**<**short int**>((**int**)172))) −
(**asType**<**int**>(**asType**<**short int**>(div2.quot)) *

asType$<$**int**$>$($\$\text{heap}_{719,1;729,8}$.b2))))

$\rightarrow$ *[simplify]*

[31.11] $\$\text{heap}_{719,1;730,8}$ == $\$\text{heap}_{funcstart\_719,1}$.**replace**(p1 $\rightarrow$ ((-2 * div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}$.p1, 177).rem))).**replace**(p2 $\rightarrow$ **asType**$<$**short int**$>$((div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}$.p2, 176).rem * 172) $-$ (**asType**$<$**int**$>$(**asType**$<$**short int**$>$(div2.quot)) * **asType**$<$**int**$>$($\$\text{heap}_{719,1;729,8}$.b2))))

$\rightarrow$ *[from term 12.6, div2 is equal to div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176)]*

[31.12] $\$\text{heap}_{719,1;730,8}$ == $\$\text{heap}_{funcstart\_719,1}$.**replace**(p1 $\rightarrow$ ((-2 * div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}$.p1, 177).rem))).**replace**(p2 $\rightarrow$ **asType**$<$**short int**$>$((172 * div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}$.p2, 176).rem) $-$ (**asType**$<$**int**$>$(**asType**$<$**short int**$>$(div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}$.p2, 176).quot)) * **asType**$<$**int**$>$($\$\text{heap}_{719,1;729,8}$.b2))))

$\rightarrow$ *[simplify]*

[31.14] $\$\text{heap}_{719,1;730,8}$ == $\$\text{heap}_{funcstart\_719,1}$.**replace**(p1 $\rightarrow$ ((-2 * div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}$.p1, 177).rem))).**replace**(p2 $\rightarrow$ **asType**$<$**short int**$>$((172 * div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}$.p2, 176).rem) $-$ (div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}$.p2, 176).quot * **asType**$<$**int**$>$($\$\text{heap}_{719,1;729,8}$.b2))))

$\rightarrow$ *[from term 26.19, $\$heap_{719,1;729,8}$ is equal to $\$heap_{funcstart\_719,1}$.**replace**(p1 $\rightarrow$ (-2 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).rem))]*

[31.15] $\$\text{heap}_{719,1;730,8}$ == $\$\text{heap}_{funcstart\_719,1}$.**replace**(p1 $\rightarrow$ ((-2 * div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}$.p1, 177).rem))).**replace**(p2 $\rightarrow$ **asType**$<$**short int**$>$((172 * div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}$.p2, 176).rem) $-$ (div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}$.p2, 176).quot * **asType**$<$**int**$>$($\$\text{heap}_{funcstart\_719,1}$.**replace**(p1 $\rightarrow$ ((-2 * div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}$.p1, 177).rem))).b2))))

$\rightarrow$ *[const member of object with modified fields]*

[31.16] $\$\text{heap}_{719,1;730,8}$ == $\$\text{heap}_{funcstart\_719,1}$.**replace**(p1 $\rightarrow$ ((-2 *

div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1,
177).rem))).**_replace**(p2 → **asType<short int>**((172 * div(**heapIs**
$\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).rem) − (div(**heapIs**
$\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).quot *
asType<int>($\$heap_{funcstart\_719,1}$.b2))))

→ *[const static or extern object]*

[31.17] $\$heap_{719,1;730,8}$ == $\$heap_{funcstart\_719,1}$.**_replace**(p1 → ((-2 *
div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1,
177).rem))).**_replace**(p2 → **asType<short int>**((172 * div(**heapIs**
$\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).rem) − (div(**heapIs**
$\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).quot *
asType<int>($\$heap_{init}$.b2))))

→ *[expand definition of constant 'b2' at prang.c (22,20)]*

[31.18] $\$heap_{719,1;730,8}$ == $\$heap_{funcstart\_719,1}$.**_replace**(p1 → ((-2 *
div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1,
177).rem))).**_replace**(p2 → **asType<short int>**((172 * div(**heapIs**
$\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).rem) − (div(**heapIs**
$\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).quot *
asType<int>(**asType<short int>**((**int**)35)))))

→ *[simplify]*

[31.24] $\$heap_{719,1;730,8}$ == $\$heap_{funcstart\_719,1}$.**_replace**(p1 → ((-2 *
div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1,
177).rem))).**_replace**(p2 → ((-35 * div(**heapIs** $\$heap_{funcstart\_719,1}$,
$\$heap_{funcstart\_719,1}$.p2, 176).quot) + (172 * div(**heapIs** $\$heap_{funcstart\_719,1}$,
$\$heap_{funcstart\_719,1}$.p2, 176).rem)))

[Take given term]

[36.0] $\$heap_{719,1;731,8}$ == $\$heap_{719,1;730,8}$.**_replace**(p3 → **asType<short
int>**((**asType<int>**(**asType<short int>**(div3.rem)) *
asType<int>($\$heap_{719,1;730,8}$.r3)) − (**asType<int>**(**asType<short
int>**(div3.quot)) * **asType<int>**($\$heap_{719,1;730,8}$.b3))))

→ *[from term 31.24, $\$heap_{719,1;730,8}$ is equal to
$\$heap_{funcstart\_719,1}$.**_replace**(p1 → ((-2 * div(**heapIs** $\$heap_{funcstart\_719,1}$,
$\$heap_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_719,1}$,
$\$heap_{funcstart\_719,1}$.p1, 177).rem))).**_replace**(p2 → (-35 * div(**heapIs**
$\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).quot) + (172 * div(**heapIs**
$\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).rem))]*

[36.1] $\$heap_{719,1;731,8}$ == $\$heap_{funcstart\_719,1}$.**_replace**(p1 → ((-2 *

div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}$.p1, 177).rem))).**_replace**(p2 → ((-35 * div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}$.p2, 176).quot) + (172 * div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}$.p2, 176).rem))).**_replace**(p3 → **asType\<short int\>**((**asType\<int\>**(**asType\<short int\>**(div3.rem)) * **asType\<int\>**($\$\text{heap}_{719,1;730,8}$.r3)) − (**asType\<int\>**(**asType\<short int\>**(div3.quot)) * **asType\<int\>**($\$\text{heap}_{719,1;730,8}$.b3)))))

→ *[from term 19.6, div3 is equal to div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p3, 178)]*

[36.2] $\$\text{heap}_{719,1;731,8}$ == $\$\text{heap}_{funcstart\_719,1}$.**_replace**(p1 → ((-2 * div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}$.p1, 177).rem))).**_replace**(p2 → ((-35 * div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}$.p2, 176).quot) + (172 * div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}$.p2, 176).rem))).**_replace**(p3 → **asType\<short int\>**((**asType\<int\>**(**asType\<short int\>**(div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}$.p3, 178).rem)) * **asType\<int\>**($\$\text{heap}_{719,1;730,8}$.r3)) − (**asType\<int\>**(**asType\<short int\>**(div3.quot)) * **asType\<int\>**($\$\text{heap}_{719,1;730,8}$.b3)))))

→ *[simplify]*

[36.4] $\$\text{heap}_{719,1;731,8}$ == $\$\text{heap}_{funcstart\_719,1}$.**_replace**(p1 → ((-2 * div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}$.p1, 177).rem))).**_replace**(p2 → ((-35 * div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}$.p2, 176).quot) + (172 * div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}$.p2, 176).rem))).**_replace**(p3 → **asType\<short int\>**((div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}$.p3, 178).rem * **asType\<int\>**($\$\text{heap}_{719,1;730,8}$.r3)) − (**asType\<int\>**(**asType\<short int\>**(div3.quot)) * **asType\<int\>**($\$\text{heap}_{719,1;730,8}$.b3)))))

→ *[from term 31.24, $\$heap_{719,1;730,8}$ is equal to $\$heap_{funcstart\_719,1}$.**_replace**(p1 → ((-2 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).rem))).**_replace**(p2 → (-35 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).quot) + (172 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).rem))]*

[36.5] $\$\text{heap}_{719,1;731,8}$ == $\$\text{heap}_{funcstart\_719,1}$.**_replace**(p1 → ((-2 * div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}$.p1, 177).rem))).**_replace**(p2 → ((-35 * div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}$.p2, 176).quot) + (172 * div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}$.p2, 176).rem))).**_replace**(p3 → **asType\<short int\>**((div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}$.p3, 178).rem *

asType\<int\>($heap_{funcstart\_719,1}$._**replace**(p1 → ((-2 * div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p1, 177).rem)))._**replace**(p2 → ((-35 * div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p2, 176).quot) + (172 * div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p2, 176).rem))).r3)) − (**asType\<int\>**(**asType\<short int\>**(div3.quot)) * **asType\<int\>**($heap_{719,1;730,8}$.b3)))))

→ *[const member of object with modified fields]*

[36.7] $heap_{719,1;731,8}$ == $heap_{funcstart\_719,1}$._**replace**(p1 → ((-2 * div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p1, 177).rem)))._**replace**(p2 → ((-35 * div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p2, 176).quot) + (172 * div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p2, 176).rem)))._**replace**(p3 → **asType\<short int\>**((div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p3, 178).rem * **asType\<int\>**($heap_{funcstart\_719,1}$.r3)) − (**asType\<int\>**(**asType\<short int\>**(div3.quot)) * **asType\<int\>**($heap_{719,1;730,8}$.b3)))))

→ *[const static or extern object]*

[36.8] $heap_{719,1;731,8}$ == $heap_{funcstart\_719,1}$._**replace**(p1 → ((-2 * div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p1, 177).rem)))._**replace**(p2 → ((-35 * div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p2, 176).quot) + (172 * div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p2, 176).rem)))._**replace**(p3 → **asType\<short int\>**((div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p3, 178).rem * **asType\<int\>**($heap_{init}$.r3)) − (**asType\<int\>**(**asType\<short int\>**(div3.quot)) * **asType\<int\>**($heap_{719,1;730,8}$.b3)))))

→ *[expand definition of constant 'r3' at prang.c (25,20)]*

[36.9] $heap_{719,1;731,8}$ == $heap_{funcstart\_719,1}$._**replace**(p1 → ((-2 * div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p1, 177).rem)))._**replace**(p2 → ((-35 * div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p2, 176).quot) + (172 * div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p2, 176).rem)))._**replace**(p3 → **asType\<short int\>**((div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p3, 178).rem * **asType\<int\>**(**asType\<short int\>**((int)170))) − (**asType\<int\>**(**asType\<short int\>**(div3.quot)) * **asType\<int\>**($heap_{719,1;730,8}$.b3)))))

→ *[simplify]*

[36.12] $heap_{719,1;731,8}$ == $heap_{funcstart\_719,1}$._**replace**(p1 → ((-2 * div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p1,

177).rem))).**replace**(p2 → ((-35 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).quot) + (172 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).rem))).**replace**(p3 → **asType<short int>**((div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p3, 178).rem * 170) − (**asType<int>**(**asType<short int>**(div3.quot)) * **asType<int>**($\$heap_{719,1;730,8}$.b3)))))

→ *[from term 19.6, div3 is equal to div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p3, 178)]*

[36.13] $\$heap_{719,1;731,8}$ == $\$heap_{funcstart\_719,1}$.**replace**(p1 → ((-2 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).rem))).**replace**(p2 → ((-35 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).quot) + (172 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).rem))).**replace**(p3 → **asType<short int>**((170 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p3, 178).rem) − (**asType<int>**(**asType<short int>**(div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p3, 178).quot)) * **asType<int>**($\$heap_{719,1;730,8}$.b3)))))

→ *[simplify]*

[36.15] $\$heap_{719,1;731,8}$ == $\$heap_{funcstart\_719,1}$.**replace**(p1 → ((-2 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).rem))).**replace**(p2 → ((-35 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).quot) + (172 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).rem))).**replace**(p3 → **asType<short int>**((170 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p3, 178).rem) − (div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p3, 178).quot * **asType<int>**($\$heap_{719,1;730,8}$.b3)))))

→ *[from term 31.24, $\$heap_{719,1;730,8}$ is equal to $\$heap_{funcstart\_719,1}$.**replace**(p1 → ((-2 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).rem))).**replace**(p2 → (-35 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).quot) + (172 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).rem))]*

[36.16] $\$heap_{719,1;731,8}$ == $\$heap_{funcstart\_719,1}$.**replace**(p1 → ((-2 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).rem))).**replace**(p2 → ((-35 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).quot) + (172 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).rem))).**replace**(p3 → **asType<short int>**((170 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p3, 178).rem) − (div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p3, 178).quot * **asType<int>**($\$heap_{funcstart\_719,1}$.**replace**(p1 → ((-2 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs**

$heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p1, 177).rem))).**_replace**(p2 → ((-35
* div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p2, 176).quot) + (172 *
div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p2, 176).rem))).b3))))

→ *[const member of object with modified fields]*

[36.18] $heap_{719,1;731,8}$ == $heap_{funcstart\_719,1}$.**_replace**(p1 → ((-2 *
div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p1, 177).quot) + (171 *
div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p1,
177).rem))).**_replace**(p2 → ((-35 * div(**heapIs** $heap_{funcstart\_719,1}$,
$heap_{funcstart\_719,1}$.p2, 176).quot) + (172 * div(**heapIs** $heap_{funcstart\_719,1}$,
$heap_{funcstart\_719,1}$.p2, 176).rem))).**_replace**(p3 → **asType**<**short int**>((170
* div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p3, 178).rem) −
(div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p3, 178).quot *
asType<**int**>($heap_{funcstart\_719,1}$.b3))))

→ *[const static or extern object]*

[36.19] $heap_{719,1;731,8}$ == $heap_{funcstart\_719,1}$.**_replace**(p1 → ((-2 *
div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p1, 177).quot) + (171 *
div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p1,
177).rem))).**_replace**(p2 → ((-35 * div(**heapIs** $heap_{funcstart\_719,1}$,
$heap_{funcstart\_719,1}$.p2, 176).quot) + (172 * div(**heapIs** $heap_{funcstart\_719,1}$,
$heap_{funcstart\_719,1}$.p2, 176).rem))).**_replace**(p3 → **asType**<**short int**>((170
* div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p3, 178).rem) −
(div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p3, 178).quot *
asType<**int**>($heap_{init}$.b3))))

→ *[expand definition of constant 'b3' at prang.c (27,20)]*

[36.20] $heap_{719,1;731,8}$ == $heap_{funcstart\_719,1}$.**_replace**(p1 → ((-2 *
div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p1, 177).quot) + (171 *
div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p1,
177).rem))).**_replace**(p2 → ((-35 * div(**heapIs** $heap_{funcstart\_719,1}$,
$heap_{funcstart\_719,1}$.p2, 176).quot) + (172 * div(**heapIs** $heap_{funcstart\_719,1}$,
$heap_{funcstart\_719,1}$.p2, 176).rem))).**_replace**(p3 → **asType**<**short int**>((170
* div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p3, 178).rem) −
(div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p3, 178).quot *
asType<**int**>(**asType**<**short int**>((**int**)63)))))

→ *[simplify]*

[36.26] $heap_{719,1;731,8}$ == $heap_{funcstart\_719,1}$.**_replace**(p1 → ((-2 *
div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p1, 177).quot) + (171 *
div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p1,
177).rem))).**_replace**(p2 → ((-35 * div(**heapIs** $heap_{funcstart\_719,1}$,
$heap_{funcstart\_719,1}$.p2, 176).quot) + (172 * div(**heapIs** $heap_{funcstart\_719,1}$,
$heap_{funcstart\_719,1}$.p2, 176).rem))).**_replace**(p3 → ((-63 * div(**heapIs**
$heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p3, 178).quot) + (170 * div(**heapIs**
$heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p3, 178).rem)))

[Take goal term]

[1.0] **minof**(**int**) ≤ $heap_{719,1;731,8}.p1$

→ *[simplify]*

[1.1] -32768 ≤ $heap_{719,1;731,8}.p1$

→ *[from term 36.26, $heap_{719,1;731,8}$ is equal to
$heap_{funcstart\_719,1}.$_**replace**(p1 → ((-2 * div(**heapIs** $heap_{funcstart\_719,1}$,
$heap_{funcstart\_719,1}.p1$, 177).quot) + (171 * div(**heapIs** $heap_{funcstart\_719,1}$,
$heap_{funcstart\_719,1}.p1$, 177).rem)))._**replace**(p2 → ((-35 * div(**heapIs**
$heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}.p2$, 176).quot) + (172 * div(**heapIs**
$heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}.p2$, 176).rem)))._**replace**(p3 → (-63 *
div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}.p3$, 178).quot) + (170 *
div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}.p3$, 178).rem))]*

[1.2] -32768 ≤ $heap_{funcstart\_719,1}.$_**replace**(p1 → ((-2 * div(**heapIs**
$heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}.p1$, 177).quot) + (171 * div(**heapIs**
$heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}.p1$, 177).rem)))._**replace**(p2 → ((-35
* div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}.p2$, 176).quot) + (172 *
div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}.p2$,
176).rem)))._**replace**(p3 → ((-63 * div(**heapIs** $heap_{funcstart\_719,1}$,
$heap_{funcstart\_719,1}.p3$, 178).quot) + (170 * div(**heapIs** $heap_{funcstart\_719,1}$,
$heap_{funcstart\_719,1}.p3$, 178).rem)))).p1

→ *[simplify]*

[1.7] -32769 < ((-2 * div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}.p1$,
177).quot) + (171 * div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}.p1$,
177).rem))

→ *[negate goal and search for contradiction]*

[1.8] !(-32769 < ((-2 * div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}.p1$,
177).quot) + (171 * div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}.p1$,
177).rem)))

→ *[simplify]*

[1.13] 32768 < ((2 * div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}.p1$,
177).quot) + (-171 * div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}.p1$,
177).rem))

[Branch on disjunction or conditional in term 10.21]

[41.0] (0 == ((−$heap_{funcstart\_719,1}.p1$ / 177) + div(**heapIs**
$heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}.p1$, 177).quot)) ∨ (0 ==
(−($heap_{funcstart\_719,1}.p1$ / 177) + div(**heapIs** $heap_{funcstart\_719,1}$,
$heap_{funcstart\_719,1}.p1$, 177).quot)) ∨ (-1 < $heap_{funcstart\_719,1}.p1$)

[Branch on disjunction or conditional in term 10.21]

[42.0] (0 < −$heap_{funcstart\_719,1}.p1$) ∨ (0 == (−($heap_{funcstart\_719,1}.p1$ /

177) + div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p1, 177).quot)) ∨ (-1 < $heap_{funcstart\_719,1}$.p1)

[Copy term 11.40]

[43.0] ([0 < −$heap_{funcstart\_719,1}$.p1]: ([0 == ($heap_{funcstart\_719,1}$.p1 % 177)]: 0 == div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p1, 177).rem, [!(0 == ($heap_{funcstart\_719,1}$.p1 % 177))]: 177 == (−div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p1, 177).rem + ($heap_{funcstart\_719,1}$.p1 % 177))), [-1 < $heap_{funcstart\_719,1}$.p1]: 0 == (−($heap_{funcstart\_719,1}$.p1 % 177) + div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p1, 177).rem)) ∨ (0 == (−($heap_{funcstart\_719,1}$.p1 / 177) + div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p1, 177).quot)) ∨ (-1 < $heap_{funcstart\_719,1}$.p1)

→ *[from term 42.0, literala < −$heap_{funcstart\_719,1}$.p1 is true whenever (-1 + literala) < 0]*

Proof of rule precondition:

[43.0.0] (-1 + 0) < 0

→ *[simplify]*

[43.0.2] **true**

[43.1] ([**true**]: ([0 == ($heap_{funcstart\_719,1}$.p1 % 177)]: 0 == div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p1, 177).rem, [!(0 == ($heap_{funcstart\_719,1}$.p1 % 177))]: 177 == (−div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p1, 177).rem + ($heap_{funcstart\_719,1}$.p1 % 177))), [-1 < $heap_{funcstart\_719,1}$.p1]: 0 == (−($heap_{funcstart\_719,1}$.p1 % 177) + div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p1, 177).rem)) ∨ ...

→ *[simplify]*

[43.3] ([0 == ($heap_{funcstart\_719,1}$.p1 % 177)]: 0 == div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p1, 177).rem, [!(0 == ($heap_{funcstart\_719,1}$.p1 % 177))]: 177 == (−div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p1, 177).rem + ($heap_{funcstart\_719,1}$.p1 % 177))) ∨ ...

[Branch on disjunction or conditional in term 43.3]

[44.0] (0 == div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p1, 177).rem) ∨ (0 == (−($heap_{funcstart\_719,1}$.p1 / 177) + div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p1, 177).quot)) ∨ (-1 < $heap_{funcstart\_719,1}$.p1) ∨ (177 == (−div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p1, 177).rem + ($heap_{funcstart\_719,1}$.p1 % 177))) ∨ !(0 == ($heap_{funcstart\_719,1}$.p1 % 177))

[Copy term 1.13]

[46.0] (32768 < ((-171 * div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p1, 177).rem) + (2 * div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p1, 177).quot))) ∨ (0 == (−($heap_{funcstart\_719,1}$.p1 / 177) + div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p1, 177).quot)) ∨ (-1 <

$heap_{funcstart\_719,1}$.p1) ∨ (177 == (−div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p1, 177).rem + ($heap_{funcstart\_719,1}$.p1 % 177))) ∨ !(0 == ($heap_{funcstart\_719,1}$.p1 % 177))

→ *[from term 44.0, div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p1, 177).rem is equal to 0]*

[46.1] (32768 < ((-171 * 0) + (2 * div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p1, 177).quot))) ∨ ...

→ *[simplify]*

[46.3] (32768 < (2 * div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p1, 177).quot)) ∨ ...

→ *[literal comparison of product]*

[46.4] ([2 < 0]: (32768 / -2) < −div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p1, 177).quot, [0 < 2]: (32768 / 2) < div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p1, 177).quot, [0 == 2]: 32768 < 0) ∨ ...

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

[46.5] ([2 < 0]: (32768 / -2) < −div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p1, 177).quot, [(0 < 2) ∧ !(2 < 0)]: (32768 / 2) < div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p1, 177).quot, [(0 == 2) ∧ !(0 < 2) ∧ !(2 < 0)]: 32768 < 0) ∨ ...

→ *[simplify]*

[46.13] (16384 < div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p1, 177).quot) ∨ ...

[Create new term from terms 46.13, 41.0 using rule: transitivity 15]

[68.0] ((0 + 16384) < −(−$heap_{funcstart\_719,1}$.p1 / 177)) ∨ (0 == (−($heap_{funcstart\_719,1}$.p1 / 177) + div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p1, 177).quot)) ∨ (-1 < $heap_{funcstart\_719,1}$.p1) ∨ (177 == (−div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p1, 177).rem + ($heap_{funcstart\_719,1}$.p1 % 177))) ∨ !(0 == ($heap_{funcstart\_719,1}$.p1 % 177))

→ *[simplify]*

[68.8] (2899968 < $heap_{funcstart\_719,1}$.p1) ∨ ...

→ *[from term 42.0, literala < $heap_{funcstart\_719,1}$.p1 is false whenever -2 < (0 + literala)]*

Proof of rule precondition:

[68.8.0] -2 < (0 + 2899968)

→ *[simplify]*

[68.8.2] **true**

[68.9] **false** $\lor$ ...

[Remove 'false' term 68.9 and fetch new term from containing clause]

[69.0] $(177 == (-\text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_719,1}, \$\text{heap}_{funcstart\_719,1}.\text{p1}, 177).\text{rem} + (\$\text{heap}_{funcstart\_719,1}.\text{p1} \% 177))) \lor (0 == (-(\$\text{heap}_{funcstart\_719,1}.\text{p1} / 177) + \text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_719,1}, \$\text{heap}_{funcstart\_719,1}.\text{p1}, 177).\text{quot})) \lor (\text{-1} < \$\text{heap}_{funcstart\_719,1}.\text{p1})$

[Copy term 1.13]

[72.0] $(32768 < ((\text{-171} * \text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_719,1}, \$\text{heap}_{funcstart\_719,1}.\text{p1}, 177).\text{rem}) + (2 * \text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_719,1}, \$\text{heap}_{funcstart\_719,1}.\text{p1}, 177).\text{quot}))) \lor (0 == (-(\$\text{heap}_{funcstart\_719,1}.\text{p1} / 177) + \text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_719,1}, \$\text{heap}_{funcstart\_719,1}.\text{p1}, 177).\text{quot})) \lor (\text{-1} < \$\text{heap}_{funcstart\_719,1}.\text{p1})$

$\rightarrow$ *[from term 69.0, div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).rem is equal to -177 + ($\$heap_{funcstart\_719,1}$.p1 % 177)]*

[72.1] $(32768 < ((\text{-171} * (\text{-177} + (\$\text{heap}_{funcstart\_719,1}.\text{p1} \% 177))) + (2 * \text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_719,1}, \$\text{heap}_{funcstart\_719,1}.\text{p1}, 177).\text{quot}))) \lor$ ...

$\rightarrow$ *[simplify]*

[72.6] $(2501 < ((\text{-171} * (\$\text{heap}_{funcstart\_719,1}.\text{p1} \% 177)) + (2 * \text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_719,1}, \$\text{heap}_{funcstart\_719,1}.\text{p1}, 177).\text{quot}))) \lor$ ...

[Create new term from term 41.0 using rule: condition for equality of division]

[80.0] $((-\$\text{heap}_{funcstart\_719,1}.\text{p1} < (177 * (0 + 1 + -\text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_719,1}, \$\text{heap}_{funcstart\_719,1}.\text{p1}, 177).\text{quot}))) \land ((177 * (0 + -\text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_719,1}, \$\text{heap}_{funcstart\_719,1}.\text{p1}, 177).\text{quot})) < (1 + -\$\text{heap}_{funcstart\_719,1}.\text{p1}))) \lor (0 == (-(\$\text{heap}_{funcstart\_719,1}.\text{p1} / 177) + \text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_719,1}, \$\text{heap}_{funcstart\_719,1}.\text{p1}, 177).\text{quot})) \lor (\text{-1} < \$\text{heap}_{funcstart\_719,1}.\text{p1})$

$\rightarrow$ *[simplify]*

[80.18] $((\text{-177} < ((\text{-177} * \text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_719,1}, \$\text{heap}_{funcstart\_719,1}.\text{p1}, 177).\text{quot}) + \$\text{heap}_{funcstart\_719,1}.\text{p1})) \land (\text{-1} < (-\$\text{heap}_{funcstart\_719,1}.\text{p1} + (177 * \text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_719,1}, \$\text{heap}_{funcstart\_719,1}.\text{p1}, 177).\text{quot})))) \lor$ ...

$\rightarrow$ *[separate conjunction and work on first sub-term]*

[80.19] $(\text{-177} < ((\text{-177} * \text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_719,1}, \$\text{heap}_{funcstart\_719,1}.\text{p1}, 177).\text{quot}) + \$\text{heap}_{funcstart\_719,1}.\text{p1})) \lor$ ...

[Create new term from terms 80.19, 42.0 using rule: transitivity 2]

[83.0] $((\text{-177} + 0 + 1) < (\text{-177} * \text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_719,1}, \$\text{heap}_{funcstart\_719,1}.\text{p1}, 177).\text{quot})) \lor (0 == (-(\$\text{heap}_{funcstart\_719,1}.\text{p1} / 177) + \text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_719,1}, \$\text{heap}_{funcstart\_719,1}.\text{p1}, 177).\text{quot})) \lor (\text{-1} < \$\text{heap}_{funcstart\_719,1}.\text{p1})$

$\rightarrow$ *[simplify]*

[83.1] (-176 < (-177 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot)) $\vee$ ...

$\rightarrow$ *[literal comparison of product]*

[83.2] ([-177 < 0]: (-176 / 177) < $-$div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot, [0 < -177]: (-176 / -177) < div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot, [-177 == 0]: -176 < 0) $\vee$ ...

$\rightarrow$ *[explicitly assert falsehood of skipped guards in subsequent guards]*

[83.3] ([-177 < 0]: (-176 / 177) < $-$div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot, [(0 < -177) $\wedge$!(-177 < 0)]: (-176 / -177) < div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot, [(-177 == 0) $\wedge$!(-177 < 0) $\wedge$!(0 < -177)]: -176 < 0) $\vee$ ...

$\rightarrow$ *[simplify]*

[83.7] (-1 < $-$div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot) $\vee$ ...

[Create new term from terms 83.7, 72.6 using rule: transitivity 5]

[92.0] (2501 < ((-171 * ($\$heap_{funcstart\_719,1}$.p1 % 177)) + (2 * $-$(-1 + 1)))) $\vee$ (0 == ($-$($\$heap_{funcstart\_719,1}$.p1 / 177) + div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot)) $\vee$ (-1 < $\$heap_{funcstart\_719,1}$.p1)

$\rightarrow$ *[simplify]*

[92.4] (2501 < (-171 * ($\$heap_{funcstart\_719,1}$.p1 % 177))) $\vee$ ...

$\rightarrow$ *[literal comparison of product]*

[92.5] ([-171 < 0]: (2501 / 171) < $-$($\$heap_{funcstart\_719,1}$.p1 % 177), [0 < -171]: (2501 / -171) < ($\$heap_{funcstart\_719,1}$.p1 % 177), [-171 == 0]: 2501 < 0) $\vee$ ...

$\rightarrow$ *[explicitly assert falsehood of skipped guards in subsequent guards]*

[92.6] ([-171 < 0]: (2501 / 171) < $-$($\$heap_{funcstart\_719,1}$.p1 % 177), [(0 < -171) $\wedge$!(-171 < 0)]: (2501 / -171) < ($\$heap_{funcstart\_719,1}$.p1 % 177), [(-171 == 0) $\wedge$!(-171 < 0) $\wedge$!(0 < -171)]: 2501 < 0) $\vee$ ...

$\rightarrow$ *[simplify]*

[92.11] **false** $\vee$ ...

[Remove 'false' term 92.11 and fetch new term from containing clause]

[94.0] 0 == ($-$($\$heap_{funcstart\_719,1}$.p1 / 177) + div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot)

[Remove 'false' term 92.11 and fetch new term from containing clause]

[95.0] -1 < $\$heap_{funcstart\_719,1}$.p1

[Assume known post-assertion, class invariant or type constraint for term 5.6]

[11.40] $([0 < -\$\text{heap}_{funcstart\_719,1}.\text{p1}]$: $([0 == (\$\text{heap}_{funcstart\_719,1}.\text{p1} \% 177)]$: $0 == \text{div}(\textbf{heapIs}\ \$\text{heap}_{funcstart\_719,1}, \$\text{heap}_{funcstart\_719,1}.\text{p1}, 177).\text{rem}$, $[!(0 == (\$\text{heap}_{funcstart\_719,1}.\text{p1} \% 177))]$: $177 == ((\$\text{heap}_{funcstart\_719,1}.\text{p1} \% 177) + -\text{div}(\textbf{heapIs}\ \$\text{heap}_{funcstart\_719,1}, \$\text{heap}_{funcstart\_719,1}.\text{p1}, 177).\text{rem}))$, $[-1 < \$\text{heap}_{funcstart\_719,1}.\text{p1}]$: $0 == (-(\$\text{heap}_{funcstart\_719,1}.\text{p1} \% 177) + \text{div}(\textbf{heapIs}\ \$\text{heap}_{funcstart\_719,1}, \$\text{heap}_{funcstart\_719,1}.\text{p1}, 177).\text{rem}))$

$\rightarrow$ *[from term 95.0, literala < −$heap$_{funcstart_719,1}$.p1 is false whenever -2 < (-1 + literala)]*

Proof of rule precondition:

[11.40.0] -2 < (-1 + 0)

$\rightarrow$ *[simplify]*

[11.40.2] **true**

[11.41] $([\textbf{false}]$: $([0 == (\$\text{heap}_{funcstart\_719,1}.\text{p1} \% 177)]$: $0 == \text{div}(\textbf{heapIs}\ \$\text{heap}_{funcstart\_719,1}, \$\text{heap}_{funcstart\_719,1}.\text{p1}, 177).\text{rem}$, $[!(0 == (\$\text{heap}_{funcstart\_719,1}.\text{p1} \% 177))]$: $177 == (-\text{div}(\textbf{heapIs}\ \$\text{heap}_{funcstart\_719,1}, \$\text{heap}_{funcstart\_719,1}.\text{p1}, 177).\text{rem} + (\$\text{heap}_{funcstart\_719,1}.\text{p1} \% 177)))$, $[-1 < \$\text{heap}_{funcstart\_719,1}.\text{p1}]$: $0 == (-(\$\text{heap}_{funcstart\_719,1}.\text{p1} \% 177) + \text{div}(\textbf{heapIs}\ \$\text{heap}_{funcstart\_719,1}, \$\text{heap}_{funcstart\_719,1}.\text{p1}, 177).\text{rem}))$

$\rightarrow$ *[from term 95.0, literala < $heap$_{funcstart_719,1}$.p1 is true whenever (-1 + literala) < -1]*

Proof of rule precondition:

[11.41.0] (-1 + -1) < -1

$\rightarrow$ *[simplify]*

[11.41.2] **true**

[11.42] $([\textbf{false}]$: $([0 == (\$\text{heap}_{funcstart\_719,1}.\text{p1} \% 177)]$: $0 == \text{div}(\textbf{heapIs}\ \$\text{heap}_{funcstart\_719,1}, \$\text{heap}_{funcstart\_719,1}.\text{p1}, 177).\text{rem}$, $[!(0 == (\$\text{heap}_{funcstart\_719,1}.\text{p1} \% 177))]$: $177 == (-\text{div}(\textbf{heapIs}\ \$\text{heap}_{funcstart\_719,1}, \$\text{heap}_{funcstart\_719,1}.\text{p1}, 177).\text{rem} + (\$\text{heap}_{funcstart\_719,1}.\text{p1} \% 177)))$, $[\textbf{true}]$: $0 == (-(\$\text{heap}_{funcstart\_719,1}.\text{p1} \% 177) + \text{div}(\textbf{heapIs}\ \$\text{heap}_{funcstart\_719,1}, \$\text{heap}_{funcstart\_719,1}.\text{p1}, 177).\text{rem}))$

$\rightarrow$ *[simplify]*

[11.44] $0 == (-(\$\text{heap}_{funcstart\_719,1}.\text{p1} \% 177) + \text{div}(\textbf{heapIs}\ \$\text{heap}_{funcstart\_719,1}, \$\text{heap}_{funcstart\_719,1}.\text{p1}, 177).\text{rem})$

[Copy term 1.13]

[98.0] $32768 < ((-171 * \text{div}(\textbf{heapIs}\ \$\text{heap}_{funcstart\_719,1}, \$\text{heap}_{funcstart\_719,1}.\text{p1}, 177).\text{rem}) + (2 * \text{div}(\textbf{heapIs}\ \$\text{heap}_{funcstart\_719,1}, \$\text{heap}_{funcstart\_719,1}.\text{p1}, 177).\text{quot}))$

$\rightarrow$ [from term 11.44, div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).rem is equal to $\$heap_{funcstart\_719,1}$.p1 % 177]

[98.1] 32768 < ((-171 * ($\$heap_{funcstart\_719,1}$.p1 % 177)) + (2 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot))

[Create new term from term 94.0 using rule: condition for equality of division]

[103.0] (0 < (1 + (177 * (0 + −div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot)) + $\$heap_{funcstart\_719,1}$.p1)) ∧ ($\$heap_{funcstart\_719,1}$.p1 < (177 * (0 + 1 + div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot)))

$\rightarrow$ [simplify]

[103.12] (-1 < ((-177 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot) + $\$heap_{funcstart\_719,1}$.p1)) ∧ (-177 < (−$\$heap_{funcstart\_719,1}$.p1 + (177 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot)))

[Work on sub-term 2 of conjunction in term 103.12]

[104.0] -1 < ((-177 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot) + $\$heap_{funcstart\_719,1}$.p1)

[Create new term from terms 104.0, 9.9 using rule: transitivity 2]

[106.0] (-32768 + -1 + 1) < (-177 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot)

$\rightarrow$ [simplify]

[106.1] -32768 < (-177 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot)

$\rightarrow$ [literal comparison of product]

[106.2] ([-177 < 0]: (-32768 / 177) < −div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot, [0 < -177]: (-32768 / -177) < div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot, [-177 == 0]: -32768 < 0)

$\rightarrow$ [explicitly assert falsehood of skipped guards in subsequent guards]

[106.3] ([-177 < 0]: (-32768 / 177) < −div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot, [(0 < -177) ∧ !(-177 < 0)]: (-32768 / -177) < div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot, [(-177 == 0) ∧ !(-177 < 0) ∧ !(0 < -177)]: -32768 < 0)

$\rightarrow$ [simplify]

[106.7] -186 < −div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot

[Create new term from terms 106.7, 98.1 using rule: transitivity 5]

[108.0] 32768 < ((-171 * ($\$heap_{funcstart\_719,1}$.p1 % 177)) + (2 * −(-186 + 1)))

$\rightarrow$ *[simplify]*

[108.5] $32398 < (-171 * (\$\text{heap}_{funcstart\_719,1}.\text{p1} \% 177))$

$\rightarrow$ *[literal comparison of product]*

[108.6] $([-171 < 0]: (32398 \mathbin{/} 171) < -(\$\text{heap}_{funcstart\_719,1}.\text{p1} \% 177), [0 < -171]: (32398 \mathbin{/} -171) < (\$\text{heap}_{funcstart\_719,1}.\text{p1} \% 177), [-171 == 0]: 32398 < 0)$

$\rightarrow$ *[explicitly assert falsehood of skipped guards in subsequent guards]*

[108.7] $([-171 < 0]: (32398 \mathbin{/} 171) < -(\$\text{heap}_{funcstart\_719,1}.\text{p1} \% 177), [(0 < -171) \wedge !(-171 < 0)]: (32398 \mathbin{/} -171) < (\$\text{heap}_{funcstart\_719,1}.\text{p1} \% 177), [(-171 == 0) \wedge !(-171 < 0) \wedge !(0 < -171)]: 32398 < 0)$

$\rightarrow$ *[simplify]*

[108.12] **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 (51,17)

Condition defined at:

To prove: $\$\text{heap}_{719,1;731,8}.\text{p1} \leq \mathbf{maxof(int)}$

Given:

$\$\text{heap}_{init}.\text{LIMIT} == (\mathbf{int})80$

$\$\text{heap}_{init}.\text{M1} == \mathbf{asType}{<}\mathbf{short\ int}{>}((\mathbf{int})30269)$

$\$\text{heap}_{init}.\text{r1} == \mathbf{asType}{<}\mathbf{short\ int}{>}((\mathbf{int})171)$

$\$\text{heap}_{init}.\text{a1} == \mathbf{asType}{<}\mathbf{short\ int}{>}((\mathbf{int})177)$

$\$\text{heap}_{init}.\text{b1} == \mathbf{asType}{<}\mathbf{short\ int}{>}((\mathbf{int})2)$

$\$\text{heap}_{init}.\text{M2} == \mathbf{asType}{<}\mathbf{short\ int}{>}((\mathbf{int})30307)$

$\$\text{heap}_{init}.\text{r2} == \mathbf{asType}{<}\mathbf{short\ int}{>}((\mathbf{int})172)$

$\$\text{heap}_{init}.\text{a2} == \mathbf{asType}{<}\mathbf{short\ int}{>}((\mathbf{int})176)$

$\$\text{heap}_{init}.\text{b2} == \mathbf{asType}{<}\mathbf{short\ int}{>}((\mathbf{int})35)$

$\$\text{heap}_{init}.\text{M3} == \mathbf{asType}{<}\mathbf{short\ int}{>}((\mathbf{int})30323)$

$\$\text{heap}_{init}.\text{r3} == \mathbf{asType}{<}\mathbf{short\ int}{>}((\mathbf{int})170)$

$\$\text{heap}_{init}.\text{a3} == \mathbf{asType}{<}\mathbf{short\ int}{>}((\mathbf{int})178)$

$\$\text{heap}_{init}.\text{b3} == \mathbf{asType}{<}\mathbf{short\ int}{>}((\mathbf{int})63)$

$\$\text{heap}_{init}.\text{p1} == \mathbf{asType}{<}\mathbf{short\ int}{>}((\mathbf{int})1)$

$\$\text{heap}_{init}.\text{p2} == \mathbf{asType}{<}\mathbf{short\ int}{>}((\mathbf{int})2)$

$\$\text{heap}_{init}.\text{p3} == \textbf{asType}\textbf{<short int>}((\textbf{int})3)$

$\text{div1} == \text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_719,1},$
$\textbf{asType}\textbf{<int>}(\$\text{heap}_{funcstart\_719,1}.\text{p1}),$
$\textbf{asType}\textbf{<int>}(\$\text{heap}_{funcstart\_719,1}.\text{a1}))$

$(\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<int>}(\$\text{heap}_{funcstart_719,1}.\text{p1})) \; / $
$\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<int>}(\$\text{heap}_{funcstart\_719,1}.\text{a1}))) ==$
$\textbf{asType}\textbf{<integer>}(\text{div1.quot})$

$(\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<int>}(\$\text{heap}_{funcstart_719,1}.\text{p1})) \; \% $
$\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<int>}(\$\text{heap}_{funcstart\_719,1}.\text{a1}))) ==$
$\textbf{asType}\textbf{<integer>}(\text{div1.rem})$

$\text{div2} == \text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_719,1},$
$\textbf{asType}\textbf{<int>}(\$\text{heap}_{funcstart\_719,1}.\text{p2}),$
$\textbf{asType}\textbf{<int>}(\$\text{heap}_{funcstart\_719,1}.\text{a2}))$

$(\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<int>}(\$\text{heap}_{funcstart_719,1}.\text{p2})) \; / $
$\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<int>}(\$\text{heap}_{funcstart\_719,1}.\text{a2}))) ==$
$\textbf{asType}\textbf{<integer>}(\text{div2.quot})$

$(\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<int>}(\$\text{heap}_{funcstart_719,1}.\text{p2})) \; \% $
$\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<int>}(\$\text{heap}_{funcstart\_719,1}.\text{a2}))) ==$
$\textbf{asType}\textbf{<integer>}(\text{div2.rem})$

$\text{div3} == \text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_719,1},$
$\textbf{asType}\textbf{<int>}(\$\text{heap}_{funcstart\_719,1}.\text{p3}),$
$\textbf{asType}\textbf{<int>}(\$\text{heap}_{funcstart\_719,1}.\text{a3}))$

$(\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<int>}(\$\text{heap}_{funcstart_719,1}.\text{p3})) \; / $
$\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<int>}(\$\text{heap}_{funcstart\_719,1}.\text{a3}))) ==$
$\textbf{asType}\textbf{<integer>}(\text{div3.quot})$

$(\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<int>}(\$\text{heap}_{funcstart_719,1}.\text{p3})) \; \% $
$\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<int>}(\$\text{heap}_{funcstart\_719,1}.\text{a3}))) ==$
$\textbf{asType}\textbf{<integer>}(\text{div3.rem})$

$\$\text{heap}_{719,1;729,8} == \$\text{heap}_{funcstart\_719,1}.\underline{\textbf{replace}}(\text{p1} \rightarrow \textbf{asType}\textbf{<short}$
$\textbf{int>}((\textbf{asType}\textbf{<int>}(\textbf{asType}\textbf{<short int>}(\text{div1.rem})) \; * $
$\textbf{asType}\textbf{<int>}(\$\text{heap}_{funcstart\_719,1}.\text{r1})) - (\textbf{asType}\textbf{<int>}(\textbf{asType}\textbf{<short}$
$\textbf{int>}(\text{div1.quot})) \; * \; \textbf{asType}\textbf{<int>}(\$\text{heap}_{funcstart\_719,1}.\text{b1}))))$

$\$\text{heap}_{719,1;730,8} == \$\text{heap}_{719,1;729,8}.\underline{\textbf{replace}}(\text{p2} \rightarrow \textbf{asType}\textbf{<short}$
$\textbf{int>}((\textbf{asType}\textbf{<int>}(\textbf{asType}\textbf{<short int>}(\text{div2.rem})) \; * $
$\textbf{asType}\textbf{<int>}(\$\text{heap}_{719,1;729,8}.\text{r2})) - (\textbf{asType}\textbf{<int>}(\textbf{asType}\textbf{<short}$
$\textbf{int>}(\text{div2.quot})) \; * \; \textbf{asType}\textbf{<int>}(\$\text{heap}_{719,1;729,8}.\text{b2}))))$

$\$\text{heap}_{719,1;731,8} == \$\text{heap}_{719,1;730,8}.\underline{\textbf{replace}}(\text{p3} \rightarrow \textbf{asType}\textbf{<short}$
$\textbf{int>}((\textbf{asType}\textbf{<int>}(\textbf{asType}\textbf{<short int>}(\text{div3.rem})) \; * $
$\textbf{asType}\textbf{<int>}(\$\text{heap}_{719,1;730,8}.\text{r3})) - (\textbf{asType}\textbf{<int>}(\textbf{asType}\textbf{<short}$
$\textbf{int>}(\text{div3.quot})) \; * \; \textbf{asType}\textbf{<int>}(\$\text{heap}_{719,1;730,8}.\text{b3}))))$

Proof:

[Take given term]

[5.0] div1 == div(**heapIs** $\$heap_{funcstart\_719,1}$,
asType<**int**>($\$heap_{funcstart\_719,1}$.p1),
asType<**int**>($\$heap_{funcstart\_719,1}$.a1))

$\rightarrow$ *[simplify]*

[5.1] div1 == div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1,
asType<**int**>($\$heap_{funcstart\_719,1}$.a1))

$\rightarrow$ *[const static or extern object]*

[5.2] div1 == div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1,
asType<**int**>($\$heap_{init}$.a1))

$\rightarrow$ *[expand definition of constant 'a1' at prang.c (16,20)]*

[5.3] div1 == div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1,
asType<**int**>(**asType**<**short int**>((**int**)177)))

$\rightarrow$ *[simplify]*

[5.6] div1 == div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177)

[Assume known post-assertion, class invariant or type constraint for term 5.6]

[8.0] **minof**(**short int**) $\leq$ $\$heap_{funcstart\_719,1}$.p1

$\rightarrow$ *[simplify]*

[8.3] -32769 < $\$heap_{funcstart\_719,1}$.p1

[Assume known post-assertion, class invariant or type constraint for term 5.6]

[10.0] (**asType**<**integer**>($\$heap_{funcstart\_719,1}$.p1) /
asType<**integer**>(177)) == **asType**<**integer**>(div(**heapIs**
$\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot)

$\rightarrow$ *[simplify]*

[10.2] ($\$heap_{funcstart\_719,1}$.p1 / 177) == **asType**<**integer**>(div(**heapIs**
$\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot)

$\rightarrow$ *[expand definition of operator './' in class 'int' at built in declaration]*

[10.3] ([**asType**<**integer**>($\$heap_{funcstart\_719,1}$.p1) < 0]:
$-(-$**asType**<**integer**>($\$heap_{funcstart\_719,1}$.p1) / 177), []:
asType<**integer**>($\$heap_{funcstart\_719,1}$.p1) / 177) ==
asType<**integer**>(div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1,
177).quot)

$\rightarrow$ *[explicitly assert falsehood of skipped guards in subsequent guards]*

[10.4] ([**asType**<**integer**>($\$heap_{funcstart\_719,1}$.p1) < 0]:
$-(-$**asType**<**integer**>($\$heap_{funcstart\_719,1}$.p1) / 177),

[!(**asType**<**integer**>($\text{heap}_{funcstart\_719,1}$.p1) < 0)]:
asType<**integer**>($\text{heap}_{funcstart\_719,1}$.p1) / 177) ==
asType<**integer**>(div(**heapIs** $\text{heap}_{funcstart\_719,1}$, $\text{heap}_{funcstart\_719,1}$.p1, 177).quot)

→ *[simplify]*

[10.17] 0 == (−([0 < −$\text{heap}_{funcstart\_719,1}$.p1]: −(−$\text{heap}_{funcstart\_719,1}$.p1 / 177), [-1 < $\text{heap}_{funcstart\_719,1}$.p1]: $\text{heap}_{funcstart\_719,1}$.p1 / 177) + div(**heapIs** $\text{heap}_{funcstart\_719,1}$, $\text{heap}_{funcstart\_719,1}$.p1, 177).quot)

→ *[move guard outside expression]*

[10.18] 0 == (((([0 < −$\text{heap}_{funcstart\_719,1}$.p1]: −(−(−$\text{heap}_{funcstart\_719,1}$.p1 / 177)), [-1 < $\text{heap}_{funcstart\_719,1}$.p1]: −($\text{heap}_{funcstart\_719,1}$.p1 / 177)) + div(**heapIs** $\text{heap}_{funcstart\_719,1}$, $\text{heap}_{funcstart\_719,1}$.p1, 177).quot)

→ *[simplify]*

[10.19] 0 == ((([0 < −$\text{heap}_{funcstart\_719,1}$.p1]: −$\text{heap}_{funcstart\_719,1}$.p1 / 177, [-1 < $\text{heap}_{funcstart\_719,1}$.p1]: −($\text{heap}_{funcstart\_719,1}$.p1 / 177)) + div(**heapIs** $\text{heap}_{funcstart\_719,1}$, $\text{heap}_{funcstart\_719,1}$.p1, 177).quot)

→ *[move guard outside expression]*

[10.21] ([0 < −$\text{heap}_{funcstart\_719,1}$.p1]: 0 == ((−$\text{heap}_{funcstart\_719,1}$.p1 / 177) + div(**heapIs** $\text{heap}_{funcstart\_719,1}$, $\text{heap}_{funcstart\_719,1}$.p1, 177).quot), [-1 < $\text{heap}_{funcstart\_719,1}$.p1]: 0 == (−($\text{heap}_{funcstart\_719,1}$.p1 / 177) + div(**heapIs** $\text{heap}_{funcstart\_719,1}$, $\text{heap}_{funcstart\_719,1}$.p1, 177).quot))

[Assume known post-assertion, class invariant or type constraint for term 5.6]

[11.0] (**asType**<**integer**>($\text{heap}_{funcstart\_719,1}$.p1) %
asType<**integer**>(177)) == **asType**<**integer**>(div(**heapIs**
$\text{heap}_{funcstart\_719,1}$, $\text{heap}_{funcstart\_719,1}$.p1, 177).rem)

→ *[simplify]*

[11.2] ($\text{heap}_{funcstart\_719,1}$.p1 % 177) == **asType**<**integer**>(div(**heapIs**
$\text{heap}_{funcstart\_719,1}$, $\text{heap}_{funcstart\_719,1}$.p1, 177).rem)

→ *[expand definition of operator '.%' in class 'int' at built in declaration]*

[11.3] ([**asType**<**integer**>($\text{heap}_{funcstart\_719,1}$.p1) < 0]:
−(−**asType**<**integer**>($\text{heap}_{funcstart\_719,1}$.p1) % 177), []:
asType<**integer**>($\text{heap}_{funcstart\_719,1}$.p1) % 177) ==
asType<**integer**>(div(**heapIs** $\text{heap}_{funcstart\_719,1}$, $\text{heap}_{funcstart\_719,1}$.p1, 177).rem)

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

[11.4] ([**asType**<**integer**>($\text{heap}_{funcstart\_719,1}$.p1) < 0]:
−(−**asType**<**integer**>($\text{heap}_{funcstart\_719,1}$.p1) % 177),
[!(**asType**<**integer**>($\text{heap}_{funcstart\_719,1}$.p1) < 0)]:
asType<**integer**>($\text{heap}_{funcstart\_719,1}$.p1) % 177) ==

asType<**integer**>(div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).rem)

$\rightarrow$ *[simplify]*

[11.14] ([0 < $-\$heap_{funcstart\_719,1}$.p1]: $-(-\$heap_{funcstart\_719,1}$.p1 % 177), [-1 < $\$heap_{funcstart\_719,1}$.p1]: **asType**<**integer**>($\$heap_{funcstart\_719,1}$.p1) % 177) == **asType**<**integer**>(div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).rem)

$\rightarrow$ *[remainder of negation]*

[11.15] ([0 < $-\$heap_{funcstart\_719,1}$.p1]: $-([0 == (\$heap_{funcstart\_719,1}$.p1 % 177)]: 0, []: 177 + $-(\$heap_{funcstart\_719,1}$.p1 % 177)), [-1 < $\$heap_{funcstart\_719,1}$.p1]: **asType**<**integer**>($\$heap_{funcstart\_719,1}$.p1) % 177) == **asType**<**integer**>(div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).rem)

$\rightarrow$ *[explicitly assert falsehood of skipped guards in subsequent guards]*

[11.16] ([0 < $-\$heap_{funcstart\_719,1}$.p1]: $-([0 == (\$heap_{funcstart\_719,1}$.p1 % 177)]: 0, [!(0 == ($\$heap_{funcstart\_719,1}$.p1 % 177))]: 177 + $-(\$heap_{funcstart\_719,1}$.p1 % 177)), [-1 < $\$heap_{funcstart\_719,1}$.p1]: **asType**<**integer**>($\$heap_{funcstart\_719,1}$.p1) % 177) == **asType**<**integer**>(div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).rem)

$\rightarrow$ *[move guard outside expression]*

[11.17] ([0 < $-\$heap_{funcstart\_719,1}$.p1]: ([0 == ($\$heap_{funcstart\_719,1}$.p1 % 177)]: -0, [!(0 == ($\$heap_{funcstart\_719,1}$.p1 % 177))]: $-(177 + -(\$heap_{funcstart\_719,1}$.p1 % 177))), [-1 < $\$heap_{funcstart\_719,1}$.p1]: **asType**<**integer**>($\$heap_{funcstart\_719,1}$.p1) % 177) == **asType**<**integer**>(div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).rem)

$\rightarrow$ *[simplify]*

[11.24] 0 == ($-([0 < -\$heap_{funcstart\_719,1}$.p1]: ([0 == ($\$heap_{funcstart\_719,1}$.p1 % 177)]: 0, [!(0 == ($\$heap_{funcstart\_719,1}$.p1 % 177))]: -177 + ($\$heap_{funcstart\_719,1}$.p1 % 177)), [-1 < $\$heap_{funcstart\_719,1}$.p1]: $\$heap_{funcstart\_719,1}$.p1 % 177) + div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).rem)

$\rightarrow$ *[move guard outside expression]*

[11.26] 0 == ((([0 < $-\$heap_{funcstart\_719,1}$.p1]: ([0 == ($\$heap_{funcstart\_719,1}$.p1 % 177)]: -0, [!(0 == ($\$heap_{funcstart\_719,1}$.p1 % 177))]: $-(-177 + (\$heap_{funcstart\_719,1}$.p1 % 177))), [-1 < $\$heap_{funcstart\_719,1}$.p1]: $-(\$heap_{funcstart\_719,1}$.p1 % 177)) + div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).rem)

$\rightarrow$ *[simplify]*

[11.29] $0 == (([0 < -\$heap_{funcstart\_719,1}.p1]: ([0 == (\$heap_{funcstart\_719,1}.p1$ % 177)]: 0, [!(0 == (\$heap_{funcstart_719,1}.p1$ % 177))]: 177 + $-(\$heap_{funcstart\_719,1}.p1$ % 177)), [-1 < \$heap_{funcstart_719,1}.p1$]: $-(\$heap_{funcstart\_719,1}.p1$ % 177)) + div(**heapIs** \$heap_{funcstart_719,1}$, \$heap_{funcstart\_719,1}.p1$, 177).rem)

$\rightarrow$ *[move guard outside expression]*

[11.31] $0 == ([0 < -\$heap_{funcstart\_719,1}.p1]: ([0 == (\$heap_{funcstart\_719,1}.p1$ % 177)]: 0 + div(**heapIs** \$heap_{funcstart_719,1}$, \$heap_{funcstart\_719,1}.p1$, 177).rem, [!(0 == (\$heap_{funcstart_719,1}.p1$ % 177))]: (177 + $-(\$heap_{funcstart\_719,1}.p1$ % 177)) + div(**heapIs** \$heap_{funcstart_719,1}$, \$heap_{funcstart\_719,1}.p1$, 177).rem), [-1 < \$heap_{funcstart_719,1}.p1$]: $-(\$heap_{funcstart\_719,1}.p1$ % 177) + div(**heapIs** \$heap_{funcstart_719,1}$, \$heap_{funcstart\_719,1}.p1$, 177).rem)

$\rightarrow$ *[simplify]*

[11.33] $0 == ([0 < -\$heap_{funcstart\_719,1}.p1]: ([0 == (\$heap_{funcstart\_719,1}.p1$ % 177)]: div(**heapIs** \$heap_{funcstart_719,1}$, \$heap_{funcstart\_719,1}.p1$, 177).rem, [!(0 == (\$heap_{funcstart_719,1}.p1$ % 177))]: 177 + $-(\$heap_{funcstart\_719,1}.p1$ % 177) + div(**heapIs** \$heap_{funcstart_719,1}$, \$heap_{funcstart\_719,1}.p1$, 177).rem), [-1 < \$heap_{funcstart_719,1}.p1$]: $-(\$heap_{funcstart\_719,1}.p1$ % 177) + div(**heapIs** \$heap_{funcstart_719,1}$, \$heap_{funcstart\_719,1}.p1$, 177).rem)

$\rightarrow$ *[move guard outside expression]*

[11.35] $([0 < -\$heap_{funcstart\_719,1}.p1]: ([0 == (\$heap_{funcstart\_719,1}.p1$ % 177)]: $0 == div($**heapIs** \$heap_{funcstart_719,1}$, \$heap_{funcstart\_719,1}.p1$, 177).rem, [!(0 == (\$heap_{funcstart_719,1}.p1$ % 177))]: $0 == (177 + -(\$heap_{funcstart\_719,1}.p1$ % 177) + div(**heapIs** \$heap_{funcstart_719,1}$, \$heap_{funcstart\_719,1}.p1$, 177).rem)), [-1 < \$heap_{funcstart_719,1}.p1$]: $0 == (-(\$heap_{funcstart\_719,1}.p1$ % 177) + div(**heapIs** \$heap_{funcstart_719,1}$, \$heap_{funcstart\_719,1}.p1$, 177).rem))

$\rightarrow$ *[simplify]*

[11.40] $([0 < -\$heap_{funcstart\_719,1}.p1]: ([0 == (\$heap_{funcstart\_719,1}.p1$ % 177)]: $0 == div($**heapIs** \$heap_{funcstart_719,1}$, \$heap_{funcstart\_719,1}.p1$, 177).rem, [!(0 == (\$heap_{funcstart_719,1}.p1$ % 177))]: $177 == ((\$heap_{funcstart\_719,1}.p1$ % 177) + $-div($**heapIs** \$heap_{funcstart_719,1}$, \$heap_{funcstart\_719,1}.p1$, 177).rem)), [-1 < \$heap_{funcstart_719,1}.p1$]: $0 == (-(\$heap_{funcstart\_719,1}.p1$ % 177) + div(**heapIs** \$heap_{funcstart_719,1}$, \$heap_{funcstart\_719,1}.p1$, 177).rem))

[Take given term]

[12.0] div2 == div(**heapIs** \$heap_{funcstart_719,1}$,
asType<int>(\$heap_{funcstart_719,1}.p2$),
asType<int>(\$heap_{funcstart_719,1}.a2$))

$\rightarrow$ *[simplify]*

[12.1] div2 == div(**heapIs** \$heap_{funcstart_719,1}$, \$heap_{funcstart\_719,1}.p2$,
asType<int>(\$heap_{funcstart_719,1}.a2$))

$\rightarrow$ [const static or extern object]

[12.2] div2 == div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2,
asType\<int\>($\$heap_{init}$.a2))

$\rightarrow$ [expand definition of constant 'a2' at prang.c (21,20)]

[12.3] div2 == div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2,
asType\<int\>(**asType\<short int\>**((**int**)176)))

$\rightarrow$ [simplify]

[12.6] div2 == div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176)

[Take given term]

[19.0] div3 == div(**heapIs** $\$heap_{funcstart\_719,1}$,
asType\<int\>($\$heap_{funcstart\_719,1}$.p3),
asType\<int\>($\$heap_{funcstart\_719,1}$.a3))

$\rightarrow$ [simplify]

[19.1] div3 == div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p3,
asType\<int\>($\$heap_{funcstart\_719,1}$.a3))

$\rightarrow$ [const static or extern object]

[19.2] div3 == div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p3,
asType\<int\>($\$heap_{init}$.a3))

$\rightarrow$ [expand definition of constant 'a3' at prang.c (26,20)]

[19.3] div3 == div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p3,
asType\<int\>(**asType\<short int\>**((**int**)178)))

$\rightarrow$ [simplify]

[19.6] div3 == div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p3, 178)

[Take given term]

[26.0] $\$heap_{719,1;729,8}$ == $\$heap_{funcstart\_719,1}$.**replace**(p1 $\rightarrow$ **asType\<short
int\>**((**asType\<int\>**(**asType\<short int\>**(div1.rem)) *
asType\<int\>($\$heap_{funcstart\_719,1}$.r1)) $-$ (**asType\<int\>**(**asType\<short
int\>**(div1.quot)) * **asType\<int\>**($\$heap_{funcstart\_719,1}$.b1))))

$\rightarrow$ [from term 5.6, div1 is equal to div(**heapIs** $\$heap_{funcstart\_719,1}$,
$\$heap_{funcstart\_719,1}$.p1, 177)]

[26.1] $\$heap_{719,1;729,8}$ == $\$heap_{funcstart\_719,1}$.**replace**(p1 $\rightarrow$ **asType\<short
int\>**((**asType\<int\>**(**asType\<short int\>**(div(**heapIs** $\$heap_{funcstart\_719,1}$,
$\$heap_{funcstart\_719,1}$.p1, 177).rem)) * **asType\<int\>**($\$heap_{funcstart\_719,1}$.r1)) $-$
(**asType\<int\>**(**asType\<short int\>**(div1.quot)) *
asType\<int\>($\$heap_{funcstart\_719,1}$.b1))))

$\rightarrow$ [simplify]

[26.3] $\$heap_{719,1;729,8}$ == $\$heap_{funcstart\_719,1}$.**replace**(p1 $\rightarrow$ **asType\<short

int>((div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).rem * **asType**<**int**>($\$heap_{funcstart\_719,1}$.r1)) − (**asType**<**int**>(**asType**<**short int**>(div1.quot)) * **asType**<**int**>($\$heap_{funcstart\_719,1}$.b1))))

→ *[const static or extern object]*

[26.4] $\$heap_{719,1;729,8}$ == $\$heap_{funcstart\_719,1}$.**replace**(p1 → **asType**<**short int**>((div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).rem * **asType**<**int**>($\$heap_{init}$.r1)) − (**asType**<**int**>(**asType**<**short int**>(div1.quot)) * **asType**<**int**>($\$heap_{funcstart\_719,1}$.b1))))

→ *[expand definition of constant 'r1' at prang.c (15,20)]*

[26.5] $\$heap_{719,1;729,8}$ == $\$heap_{funcstart\_719,1}$.**replace**(p1 → **asType**<**short int**>((div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).rem * **asType**<**int**>(**asType**<**short int**>((**int**)171))) − (**asType**<**int**>(**asType**<**short int**>(div1.quot)) * **asType**<**int**>($\$heap_{funcstart\_719,1}$.b1))))

→ *[simplify]*

[26.8] $\$heap_{719,1;729,8}$ == $\$heap_{funcstart\_719,1}$.**replace**(p1 → **asType**<**short int**>((div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).rem * 171) − (**asType**<**int**>(**asType**<**short int**>(div1.quot)) * **asType**<**int**>($\$heap_{funcstart\_719,1}$.b1))))

→ *[from term 5.6, div1 is equal to div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177]*

[26.9] $\$heap_{719,1;729,8}$ == $\$heap_{funcstart\_719,1}$.**replace**(p1 → **asType**<**short int**>((171 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).rem) − (**asType**<**int**>(**asType**<**short int**>(div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot)) * **asType**<**int**>($\$heap_{funcstart\_719,1}$.b1))))

→ *[simplify]*

[26.11] $\$heap_{719,1;729,8}$ == $\$heap_{funcstart\_719,1}$.**replace**(p1 → **asType**<**short int**>((171 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).rem) − (div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot * **asType**<**int**>($\$heap_{funcstart\_719,1}$.b1))))

→ *[const static or extern object]*

[26.12] $\$heap_{719,1;729,8}$ == $\$heap_{funcstart\_719,1}$.**replace**(p1 → **asType**<**short int**>((171 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).rem) − (div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot * **asType**<**int**>($\$heap_{init}$.b1))))

→ *[expand definition of constant 'b1' at prang.c (17,20)]*

[26.13] $\$heap_{719,1;729,8}$ == $\$heap_{funcstart\_719,1}$.**replace**(p1 → **asType**<**short int**>((171 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).rem) − (div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot *

asType<int>(asType<short int>((int)2)))))

→ *[simplify]*

[26.19] $\$heap_{719,1;729,8}$ == $\$heap_{funcstart\_719,1}$._**replace**$(p1 \to ((-2\ *$
div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).rem)))

[Take given term]

[31.0] $\$heap_{719,1;730,8}$ == $\$heap_{719,1;729,8}$._**replace**$(p2 \to$ **asType<short
int>**((**asType<int>**(**asType<short int>**(div2.rem)) *
asType<int>($\$heap_{719,1;729,8}$.r2)) − (**asType<int>**(**asType<short
int>**(div2.quot)) * **asType<int>**($\$heap_{719,1;729,8}$.b2))))

→ *[from term 26.19, $\$heap_{719,1;729,8}$ is equal to
$\$heap_{funcstart\_719,1}$._**replace**(p1 → (-2 * div(**heapIs** $\$heap_{funcstart\_719,1}$,
$\$heap_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_719,1}$,
$\$heap_{funcstart\_719,1}$.p1, 177).rem))]*

[31.1] $\$heap_{719,1;730,8}$ == $\$heap_{funcstart\_719,1}$._**replace**$(p1 \to ((-2\ *$
div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1,
177).rem)))._**replace**$(p2 \to$ **asType<short
int>**((**asType<int>**(**asType<short int>**(div2.rem)) *
asType<int>($\$heap_{719,1;729,8}$.r2)) − (**asType<int>**(**asType<short
int>**(div2.quot)) * **asType<int>**($\$heap_{719,1;729,8}$.b2))))

→ *[from term 12.6, div2 is equal to div(**heapIs** $\$heap_{funcstart\_719,1}$,
$\$heap_{funcstart\_719,1}$.p2, 176)]*

[31.2] $\$heap_{719,1;730,8}$ == $\$heap_{funcstart\_719,1}$._**replace**$(p1 \to ((-2\ *$
div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1,
177).rem)))._**replace**$(p2 \to$ **asType<short
int>**((**asType<int>**(**asType<short int>**(div(**heapIs** $\$heap_{funcstart\_719,1}$,
$\$heap_{funcstart\_719,1}$.p2, 176).rem)) * **asType<int>**($\$heap_{719,1;729,8}$.r2)) −
(**asType<int>**(**asType<short int>**(div2.quot)) *
asType<int>($\$heap_{719,1;729,8}$.b2))))

→ *[simplify]*

[31.4] $\$heap_{719,1;730,8}$ == $\$heap_{funcstart\_719,1}$._**replace**$(p1 \to ((-2\ *$
div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1,
177).rem)))._**replace**$(p2 \to$ **asType<short int>**((div(**heapIs**
$\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).rem *
asType<int>($\$heap_{719,1;729,8}$.r2)) − (**asType<int>**(**asType<short
int>**(div2.quot)) * **asType<int>**($\$heap_{719,1;729,8}$.b2))))

→ *[from term 26.19, $\$heap_{719,1;729,8}$ is equal to
$\$heap_{funcstart\_719,1}$._**replace**(p1 → (-2 * div(**heapIs** $\$heap_{funcstart\_719,1}$,*

*$heap_{funcstart_719,1}.p1, 177).quot) + (171 * div(heapIs $heap_{funcstart_719,1},*
$heap_{funcstart_719,1}.p1, 177).rem))]

[31.5] $heap$_{719,1;730,8}$ == $heap$_{funcstart_719,1}$._**replace**(p1 → ((-2 *
div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1, 177).quot) + (171 *
div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1,
177).rem)))._**replace**(p2 → **asType**<**short int**>((div(**heapIs**
$heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p2, 176).rem *
asType<**int**>($heap$_{funcstart_719,1}$._**replace**(p1 → ((-2 * div(**heapIs**
$heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1, 177).quot) + (171 * div(**heapIs**
$heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1, 177).rem))).r2)) −
(**asType**<**int**>(**asType**<**short int**>(div2.quot)) *
asType<**int**>($heap$_{719,1;729,8}$.b2)))))

→ *[const member of object with modified fields]*

[31.6] $heap$_{719,1;730,8}$ == $heap$_{funcstart_719,1}$._**replace**(p1 → ((-2 *
div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1, 177).quot) + (171 *
div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1,
177).rem)))._**replace**(p2 → **asType**<**short int**>((div(**heapIs**
$heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p2, 176).rem *
asType<**int**>($heap$_{funcstart_719,1}$.r2)) − (**asType**<**int**>(**asType**<**short
int**>(div2.quot)) * **asType**<**int**>($heap$_{719,1;729,8}$.b2)))))

→ *[const static or extern object]*

[31.7] $heap$_{719,1;730,8}$ == $heap$_{funcstart_719,1}$._**replace**(p1 → ((-2 *
div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1, 177).quot) + (171 *
div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1,
177).rem)))._**replace**(p2 → **asType**<**short int**>((div(**heapIs**
$heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p2, 176).rem *
asType<**int**>($heap$_{init}$.r2)) − (**asType**<**int**>(**asType**<**short
int**>(div2.quot)) * **asType**<**int**>($heap$_{719,1;729,8}$.b2)))))

→ *[expand definition of constant 'r2' at prang.c (20,20)]*

[31.8] $heap$_{719,1;730,8}$ == $heap$_{funcstart_719,1}$._**replace**(p1 → ((-2 *
div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1, 177).quot) + (171 *
div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1,
177).rem)))._**replace**(p2 → **asType**<**short int**>((div(**heapIs**
$heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p2, 176).rem *
asType<**int**>(**asType**<**short int**>((**int**)172))) −
(**asType**<**int**>(**asType**<**short int**>(div2.quot)) *
asType<**int**>($heap$_{719,1;729,8}$.b2)))))

→ *[simplify]*

[31.11] $heap$_{719,1;730,8}$ == $heap$_{funcstart_719,1}$._**replace**(p1 → ((-2 *
div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1, 177).quot) + (171 *
div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1,
177).rem)))._**replace**(p2 → **asType**<**short int**>((div(**heapIs**

$\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).rem * 172) −
(**asType**<**int**>(**asType**<**short int**>(div2.quot)) *
asType<**int**>($\$heap_{719,1;729,8}$.b2))))

→ *[from term 12.6, div2 is equal to* **heapIs** *$\$heap_{funcstart\_719,1}$,*
$\$heap_{funcstart\_719,1}$.p2, 176)]

[31.12] $\$heap_{719,1;730,8}$ == $\$heap_{funcstart\_719,1}$._**replace**(p1 → ((-2 *
div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1,
177).rem)))._**replace**(p2 → **asType**<**short int**>((172 * div(**heapIs**
$\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).rem) −
(**asType**<**int**>(**asType**<**short int**>(div(**heapIs** $\$heap_{funcstart\_719,1}$,
$\$heap_{funcstart\_719,1}$.p2, 176).quot)) * **asType**<**int**>($\$heap_{719,1;729,8}$.b2))))

→ *[simplify]*

[31.14] $\$heap_{719,1;730,8}$ == $\$heap_{funcstart\_719,1}$._**replace**(p1 → ((-2 *
div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1,
177).rem)))._**replace**(p2 → **asType**<**short int**>((172 * div(**heapIs**
$\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).rem) − (div(**heapIs**
$\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).quot *
asType<**int**>($\$heap_{719,1;729,8}$.b2))))

→ *[from term 26.19, $\$heap_{719,1;729,8}$ is equal to*
*$\$heap_{funcstart\_719,1}$._**replace**(p1 → (-2 * div(**heapIs** $\$heap_{funcstart\_719,1}$,*
*$\$heap_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_719,1}$,*
$\$heap_{funcstart\_719,1}$.p1, 177).rem))]

[31.15] $\$heap_{719,1;730,8}$ == $\$heap_{funcstart\_719,1}$._**replace**(p1 → ((-2 *
div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1,
177).rem)))._**replace**(p2 → **asType**<**short int**>((172 * div(**heapIs**
$\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).rem) − (div(**heapIs**
$\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).quot *
asType<**int**>($\$heap_{funcstart\_719,1}$._**replace**(p1 → ((-2 * div(**heapIs**
$\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs**
$\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).rem))).b2))))

→ *[const member of object with modified fields]*

[31.16] $\$heap_{719,1;730,8}$ == $\$heap_{funcstart\_719,1}$._**replace**(p1 → ((-2 *
div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1,
177).rem)))._**replace**(p2 → **asType**<**short int**>((172 * div(**heapIs**
$\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).rem) − (div(**heapIs**
$\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).quot *
asType<**int**>($\$heap_{funcstart\_719,1}$.b2))))

→ *[const static or extern object]*

[31.17] $\$heap_{719,1;730,8}$ == $\$heap_{funcstart\_719,1}$._**replace**(p1 → ((-2 *
div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1,
177).rem)))._**replace**(p2 → **asType\<short int\>**((172 * div(**heapIs**
$\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).rem) − (div(**heapIs**
$\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).quot *
asType\<int\>($\$heap_{init}$.b2))))

→ *[expand definition of constant 'b2' at prang.c (22,20)]*

[31.18] $\$heap_{719,1;730,8}$ == $\$heap_{funcstart\_719,1}$._**replace**(p1 → ((-2 *
div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1,
177).rem)))._**replace**(p2 → **asType\<short int\>**((172 * div(**heapIs**
$\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).rem) − (div(**heapIs**
$\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).quot *
asType\<int\>(**asType\<short int\>**((**int**)35)))))

→ *[simplify]*

[31.24] $\$heap_{719,1;730,8}$ == $\$heap_{funcstart\_719,1}$._**replace**(p1 → ((-2 *
div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1,
177).rem)))._**replace**(p2 → ((-35 * div(**heapIs** $\$heap_{funcstart\_719,1}$,
$\$heap_{funcstart\_719,1}$.p2, 176).quot) + (172 * div(**heapIs** $\$heap_{funcstart\_719,1}$,
$\$heap_{funcstart\_719,1}$.p2, 176).rem)))

[Take given term]

[36.0] $\$heap_{719,1;731,8}$ == $\$heap_{719,1;730,8}$._**replace**(p3 → **asType\<short
int\>**((**asType\<int\>**(**asType\<short int\>**(div3.rem)) *
asType\<int\>($\$heap_{719,1;730,8}$.r3)) − (**asType\<int\>**(**asType\<short
int\>**(div3.quot)) * **asType\<int\>**($\$heap_{719,1;730,8}$.b3))))

→ *[from term 31.24, $\$heap_{719,1;730,8}$ is equal to*
*$\$heap_{funcstart\_719,1}$._**replace**(p1 → ((-2 * div(**heapIs** $\$heap_{funcstart\_719,1}$,*
*$\$heap_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_719,1}$,*
*$\$heap_{funcstart\_719,1}$.p1, 177).rem)))._**replace**(p2 → (-35 * div(**heapIs***
*$\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).quot) + (172 * div(**heapIs***
$\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).rem))]

[36.1] $\$heap_{719,1;731,8}$ == $\$heap_{funcstart\_719,1}$._**replace**(p1 → ((-2 *
div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1,
177).rem)))._**replace**(p2 → ((-35 * div(**heapIs** $\$heap_{funcstart\_719,1}$,
$\$heap_{funcstart\_719,1}$.p2, 176).quot) + (172 * div(**heapIs** $\$heap_{funcstart\_719,1}$,
$\$heap_{funcstart\_719,1}$.p2, 176).rem)))._**replace**(p3 → **asType\<short
int\>**((**asType\<int\>**(**asType\<short int\>**(div3.rem)) *
asType\<int\>($\$heap_{719,1;730,8}$.r3)) − (**asType\<int\>**(**asType\<short
int\>**(div3.quot)) * **asType\<int\>**($\$heap_{719,1;730,8}$.b3))))

→ *[from term 19.6, div3 is equal to div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart_719,1}.p3, 178)]*

[36.2] $heap_{719,1;731,8}$ == $heap_{funcstart\_719,1}$.__replace__(p1 → ((-2 * div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart_719,1}.p1, 177).quot) + (171 * div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart_719,1}.p1, 177).rem))).__replace__(p2 → ((-35 * div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart_719,1}.p2, 176).quot) + (172 * div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart_719,1}.p2, 176).rem))).__replace__(p3 → **asType<short int>**((**asType<int>**(**asType<short int>**(div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}.p3, 178).rem)) * **asType<int>**($heap_{719,1;730,8}.r3)) − (**asType<int>**(**asType<short int>**(div3.quot)) * **asType<int>**($heap_{719,1;730,8}.b3)))))

→ *[simplify]*

[36.4] $heap_{719,1;731,8}$ == $heap_{funcstart\_719,1}$.__replace__(p1 → ((-2 * div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart_719,1}.p1, 177).quot) + (171 * div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart_719,1}.p1, 177).rem))).__replace__(p2 → ((-35 * div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart_719,1}.p2, 176).quot) + (172 * div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart_719,1}.p2, 176).rem))).__replace__(p3 → **asType<short int>**((div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}.p3, 178).rem * **asType<int>**($heap_{719,1;730,8}.r3)) − (**asType<int>**(**asType<short int>**(div3.quot)) * **asType<int>**($heap_{719,1;730,8}.b3)))))

→ *[from term 31.24, $heap_{719,1;730,8}$ is equal to $heap_{funcstart\_719,1}$.__replace__(p1 → ((-2 * div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart_719,1}.p1, 177).quot) + (171 * div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart_719,1}.p1, 177).rem))).__replace__(p2 → (-35 * div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart_719,1}.p2, 176).quot) + (172 * div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart_719,1}.p2, 176).rem))]*

[36.5] $heap_{719,1;731,8}$ == $heap_{funcstart\_719,1}$.__replace__(p1 → ((-2 * div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart_719,1}.p1, 177).quot) + (171 * div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart_719,1}.p1, 177).rem))).__replace__(p2 → ((-35 * div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart_719,1}.p2, 176).quot) + (172 * div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart_719,1}.p2, 176).rem))).__replace__(p3 → **asType<short int>**((div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}.p3, 178).rem * **asType<int>**($heap_{funcstart_719,1}$.__replace__(p1 → ((-2 * div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart_719,1}.p1, 177).quot) + (171 * div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart_719,1}.p1, 177).rem))).__replace__(p2 → ((-35 * div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart_719,1}.p2, 176).quot) + (172 * div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}.p2, 176).rem))).r3)) − (**asType<int>**(**asType<short int>**(div3.quot)) * **asType<int>**($heap_{719,1;730,8}.b3)))))

→ *[const member of object with modified fields]*

[36.7] $\$heap_{719,1;731,8}$ == $\$heap_{funcstart\_719,1}$.**replace**(p1 → ((-2 *
div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1,
177).rem))).**replace**(p2 → ((-35 * div(**heapIs** $\$heap_{funcstart\_719,1}$,
$\$heap_{funcstart\_719,1}$.p2, 176).quot) + (172 * div(**heapIs** $\$heap_{funcstart\_719,1}$,
$\$heap_{funcstart\_719,1}$.p2, 176).rem))).**replace**(p3 → **asType**<**short
int**>((div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p3, 178).rem *
asType<**int**>($\$heap_{funcstart\_719,1}$.r3)) − (**asType**<**int**>(**asType**<**short
int**>(div3.quot)) * **asType**<**int**>($\$heap_{719,1;730,8}$.b3)))))

→ *[const static or extern object]*

[36.8] $\$heap_{719,1;731,8}$ == $\$heap_{funcstart\_719,1}$.**replace**(p1 → ((-2 *
div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1,
177).rem))).**replace**(p2 → ((-35 * div(**heapIs** $\$heap_{funcstart\_719,1}$,
$\$heap_{funcstart\_719,1}$.p2, 176).quot) + (172 * div(**heapIs** $\$heap_{funcstart\_719,1}$,
$\$heap_{funcstart\_719,1}$.p2, 176).rem))).**replace**(p3 → **asType**<**short
int**>((div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p3, 178).rem *
asType<**int**>($\$heap_{init}$.r3)) − (**asType**<**int**>(**asType**<**short
int**>(div3.quot)) * **asType**<**int**>($\$heap_{719,1;730,8}$.b3)))))

→ *[expand definition of constant 'r3' at prang.c (25,20)]*

[36.9] $\$heap_{719,1;731,8}$ == $\$heap_{funcstart\_719,1}$.**replace**(p1 → ((-2 *
div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1,
177).rem))).**replace**(p2 → ((-35 * div(**heapIs** $\$heap_{funcstart\_719,1}$,
$\$heap_{funcstart\_719,1}$.p2, 176).quot) + (172 * div(**heapIs** $\$heap_{funcstart\_719,1}$,
$\$heap_{funcstart\_719,1}$.p2, 176).rem))).**replace**(p3 → **asType**<**short
int**>((div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p3, 178).rem *
asType<**int**>(**asType**<**short int**>((**int**)170))) −
(**asType**<**int**>(**asType**<**short int**>(div3.quot)) *
asType<**int**>($\$heap_{719,1;730,8}$.b3)))))

→ *[simplify]*

[36.12] $\$heap_{719,1;731,8}$ == $\$heap_{funcstart\_719,1}$.**replace**(p1 → ((-2 *
div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1,
177).rem))).**replace**(p2 → ((-35 * div(**heapIs** $\$heap_{funcstart\_719,1}$,
$\$heap_{funcstart\_719,1}$.p2, 176).quot) + (172 * div(**heapIs** $\$heap_{funcstart\_719,1}$,
$\$heap_{funcstart\_719,1}$.p2, 176).rem))).**replace**(p3 → **asType**<**short
int**>((div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p3, 178).rem * 170)
− (**asType**<**int**>(**asType**<**short int**>(div3.quot)) *
asType<**int**>($\$heap_{719,1;730,8}$.b3)))))

→ *[from term 19.6, div3 is equal to div(**heapIs** $heap_{funcstart\_719,1}$,
$heap_{funcstart\_719,1}$.p3, 178)]*

[36.13] $\text{\$heap}_{719,1;731,8}$ == $\text{\$heap}_{funcstart\_719,1}$.__replace__(p1 → ((-2 *
div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p1,
177).rem))).__replace__(p2 → ((-35 * div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$,
$\text{\$heap}_{funcstart\_719,1}$.p2, 176).quot) + (172 * div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$,
$\text{\$heap}_{funcstart\_719,1}$.p2, 176).rem))).__replace__(p3 → **asType<short int>**((170
* div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p3, 178).rem) −
(**asType<int>**(**asType<short int>**(div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$,
$\text{\$heap}_{funcstart\_719,1}$.p3, 178).quot)) * **asType<int>**($\text{\$heap}_{719,1;730,8}$.b3)))))

→ *[simplify]*

[36.15] $\text{\$heap}_{719,1;731,8}$ == $\text{\$heap}_{funcstart\_719,1}$.__replace__(p1 → ((-2 *
div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p1,
177).rem))).__replace__(p2 → ((-35 * div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$,
$\text{\$heap}_{funcstart\_719,1}$.p2, 176).quot) + (172 * div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$,
$\text{\$heap}_{funcstart\_719,1}$.p2, 176).rem))).__replace__(p3 → **asType<short int>**((170
* div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p3, 178).rem) −
(div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p3, 178).quot *
asType<int>($\text{\$heap}_{719,1;730,8}$.b3)))))

→ *[from term 31.24, $heap_{719,1;730,8}$ is equal to*
*$heap_{funcstart\_719,1}$.__replace__(p1 → ((-2 * div(**heapIs** $heap_{funcstart\_719,1}$,*
*$heap_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs** $heap_{funcstart\_719,1}$,*
*$heap_{funcstart\_719,1}$.p1, 177).rem))).__replace__(p2 → (-35 * div(**heapIs***
*$heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p2, 176).quot) + (172 * div(**heapIs***
$heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p2, 176).rem))]

[36.16] $\text{\$heap}_{719,1;731,8}$ == $\text{\$heap}_{funcstart\_719,1}$.__replace__(p1 → ((-2 *
div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p1,
177).rem))).__replace__(p2 → ((-35 * div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$,
$\text{\$heap}_{funcstart\_719,1}$.p2, 176).quot) + (172 * div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$,
$\text{\$heap}_{funcstart\_719,1}$.p2, 176).rem))).__replace__(p3 → **asType<short int>**((170
* div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p3, 178).rem) −
(div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p3, 178).quot *
asType<int>($\text{\$heap}_{funcstart\_719,1}$.__replace__(p1 → ((-2 * div(**heapIs**
$\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs**
$\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p1, 177).rem))).__replace__(p2 → ((-35
* div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p2, 176).quot) + (172 *
div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p2, 176).rem))).b3))))

→ *[const member of object with modified fields]*

[36.18] $\text{\$heap}_{719,1;731,8}$ == $\text{\$heap}_{funcstart\_719,1}$.__replace__(p1 → ((-2 *
div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p1,
177).rem))).__replace__(p2 → ((-35 * div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$,

$\text{\$heap}_{funcstart\_719,1}.\text{p2}, 176).\text{quot}) + (172 * \text{div}(\textbf{heapIs}\ \text{\$heap}_{funcstart\_719,1},$
$\text{\$heap}_{funcstart\_719,1}.\text{p2}, 176).\text{rem}))).\_\textbf{replace}(\text{p3} \rightarrow \textbf{asType}<\textbf{short int}>((170$
$* \text{div}(\textbf{heapIs}\ \text{\$heap}_{funcstart\_719,1}, \text{\$heap}_{funcstart\_719,1}.\text{p3}, 178).\text{rem}) -$
$(\text{div}(\textbf{heapIs}\ \text{\$heap}_{funcstart\_719,1}, \text{\$heap}_{funcstart\_719,1}.\text{p3}, 178).\text{quot} *$
$\textbf{asType}<\textbf{int}>(\text{\$heap}_{funcstart\_719,1}.\text{b3}))))$

$\rightarrow$ *[const static or extern object]*

[36.19] $\text{\$heap}_{719,1;731,8} == \text{\$heap}_{funcstart\_719,1}.\_\textbf{replace}(\text{p1} \rightarrow ((-2 *$
$\text{div}(\textbf{heapIs}\ \text{\$heap}_{funcstart\_719,1}, \text{\$heap}_{funcstart\_719,1}.\text{p1}, 177).\text{quot}) + (171 *$
$\text{div}(\textbf{heapIs}\ \text{\$heap}_{funcstart\_719,1}, \text{\$heap}_{funcstart\_719,1}.\text{p1},$
$177).\text{rem}))).\_\textbf{replace}(\text{p2} \rightarrow ((-35 * \text{div}(\textbf{heapIs}\ \text{\$heap}_{funcstart\_719,1},$
$\text{\$heap}_{funcstart\_719,1}.\text{p2}, 176).\text{quot}) + (172 * \text{div}(\textbf{heapIs}\ \text{\$heap}_{funcstart\_719,1},$
$\text{\$heap}_{funcstart\_719,1}.\text{p2}, 176).\text{rem}))).\_\textbf{replace}(\text{p3} \rightarrow \textbf{asType}<\textbf{short int}>((170$
$* \text{div}(\textbf{heapIs}\ \text{\$heap}_{funcstart\_719,1}, \text{\$heap}_{funcstart\_719,1}.\text{p3}, 178).\text{rem}) -$
$(\text{div}(\textbf{heapIs}\ \text{\$heap}_{funcstart\_719,1}, \text{\$heap}_{funcstart\_719,1}.\text{p3}, 178).\text{quot} *$
$\textbf{asType}<\textbf{int}>(\text{\$heap}_{init}.\text{b3}))))$

$\rightarrow$ *[expand definition of constant 'b3' at prang.c (27,20)]*

[36.20] $\text{\$heap}_{719,1;731,8} == \text{\$heap}_{funcstart\_719,1}.\_\textbf{replace}(\text{p1} \rightarrow ((-2 *$
$\text{div}(\textbf{heapIs}\ \text{\$heap}_{funcstart\_719,1}, \text{\$heap}_{funcstart\_719,1}.\text{p1}, 177).\text{quot}) + (171 *$
$\text{div}(\textbf{heapIs}\ \text{\$heap}_{funcstart\_719,1}, \text{\$heap}_{funcstart\_719,1}.\text{p1},$
$177).\text{rem}))).\_\textbf{replace}(\text{p2} \rightarrow ((-35 * \text{div}(\textbf{heapIs}\ \text{\$heap}_{funcstart\_719,1},$
$\text{\$heap}_{funcstart\_719,1}.\text{p2}, 176).\text{quot}) + (172 * \text{div}(\textbf{heapIs}\ \text{\$heap}_{funcstart\_719,1},$
$\text{\$heap}_{funcstart\_719,1}.\text{p2}, 176).\text{rem}))).\_\textbf{replace}(\text{p3} \rightarrow \textbf{asType}<\textbf{short int}>((170$
$* \text{div}(\textbf{heapIs}\ \text{\$heap}_{funcstart\_719,1}, \text{\$heap}_{funcstart\_719,1}.\text{p3}, 178).\text{rem}) -$
$(\text{div}(\textbf{heapIs}\ \text{\$heap}_{funcstart\_719,1}, \text{\$heap}_{funcstart\_719,1}.\text{p3}, 178).\text{quot} *$
$\textbf{asType}<\textbf{int}>(\textbf{asType}<\textbf{short int}>((\textbf{int})63))))))$

$\rightarrow$ *[simplify]*

[36.26] $\text{\$heap}_{719,1;731,8} == \text{\$heap}_{funcstart\_719,1}.\_\textbf{replace}(\text{p1} \rightarrow ((-2 *$
$\text{div}(\textbf{heapIs}\ \text{\$heap}_{funcstart\_719,1}, \text{\$heap}_{funcstart\_719,1}.\text{p1}, 177).\text{quot}) + (171 *$
$\text{div}(\textbf{heapIs}\ \text{\$heap}_{funcstart\_719,1}, \text{\$heap}_{funcstart\_719,1}.\text{p1},$
$177).\text{rem}))).\_\textbf{replace}(\text{p2} \rightarrow ((-35 * \text{div}(\textbf{heapIs}\ \text{\$heap}_{funcstart\_719,1},$
$\text{\$heap}_{funcstart\_719,1}.\text{p2}, 176).\text{quot}) + (172 * \text{div}(\textbf{heapIs}\ \text{\$heap}_{funcstart\_719,1},$
$\text{\$heap}_{funcstart\_719,1}.\text{p2}, 176).\text{rem}))).\_\textbf{replace}(\text{p3} \rightarrow ((-63 * \text{div}(\textbf{heapIs}$
$\text{\$heap}_{funcstart\_719,1}, \text{\$heap}_{funcstart\_719,1}.\text{p3}, 178).\text{quot}) + (170 * \text{div}(\textbf{heapIs}$
$\text{\$heap}_{funcstart\_719,1}, \text{\$heap}_{funcstart\_719,1}.\text{p3}, 178).\text{rem})))$

[Take goal term]

[1.0] $\text{\$heap}_{719,1;731,8}.\text{p1} \leq \textbf{maxof}(\textbf{int})$

$\rightarrow$ *[from term 36.26, $\text{\$heap}_{719,1;731,8}$ is equal to*
*$\text{\$heap}_{funcstart\_719,1}.\_\textbf{replace}(p1 \rightarrow ((-2 * div(\textbf{heapIs}\ \text{\$heap}_{funcstart\_719,1},$*
*$\text{\$heap}_{funcstart\_719,1}.p1, 177).quot) + (171 * div(\textbf{heapIs}\ \text{\$heap}_{funcstart\_719,1},$*
*$\text{\$heap}_{funcstart\_719,1}.p1, 177).rem))).\_\textbf{replace}(p2 \rightarrow ((-35 * div(\textbf{heapIs}$*
*$\text{\$heap}_{funcstart\_719,1}, \text{\$heap}_{funcstart\_719,1}.p2, 176).quot) + (172 * div(\textbf{heapIs}$*
*$\text{\$heap}_{funcstart\_719,1}, \text{\$heap}_{funcstart\_719,1}.p2, 176).rem))).\_\textbf{replace}(p3 \rightarrow (-63 *$*

*div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p3, 178).quot) + (170 **
*div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p3, 178).rem))]*

[1.1] $\$heap_{funcstart\_719,1}$.__replace__(p1 → ((-2 * div(**heapIs**
$\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs**
$\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).rem))).__replace__(p2 → ((-35
* div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).quot) + (172 *
div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2,
176).rem))).__replace__(p3 → ((-63 * div(**heapIs** $\$heap_{funcstart\_719,1}$,
$\$heap_{funcstart\_719,1}$.p3, 178).quot) + (170 * div(**heapIs** $\$heap_{funcstart\_719,1}$,
$\$heap_{funcstart\_719,1}$.p3, 178).rem))).p1 ≤ **maxof**(**int**)

→ *[simplify]*

[1.18] -32768 < ((-171 * div(**heapIs** $\$heap_{funcstart\_719,1}$,
$\$heap_{funcstart\_719,1}$.p1, 177).rem) + (2 * div(**heapIs** $\$heap_{funcstart\_719,1}$,
$\$heap_{funcstart\_719,1}$.p1, 177).quot))

→ *[negate goal and search for contradiction]*

[1.19] !(-32768 < ((-171 * div(**heapIs** $\$heap_{funcstart\_719,1}$,
$\$heap_{funcstart\_719,1}$.p1, 177).rem) + (2 * div(**heapIs** $\$heap_{funcstart\_719,1}$,
$\$heap_{funcstart\_719,1}$.p1, 177).quot)))

→ *[simplify]*

[1.24] 32767 < ((171 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1,
177).rem) + (-2 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1,
177).quot))

[Branch on disjunction or conditional in term 10.21]

[41.0] (0 == ((−$\$heap_{funcstart\_719,1}$.p1 / 177) + div(**heapIs**
$\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot)) ∨ (0 ==
(−($\$heap_{funcstart\_719,1}$.p1 / 177) + div(**heapIs** $\$heap_{funcstart\_719,1}$,
$\$heap_{funcstart\_719,1}$.p1, 177).quot)) ∨ (-1 < $\$heap_{funcstart\_719,1}$.p1)

[Branch on disjunction or conditional in term 10.21]

[42.0] (0 < −$\$heap_{funcstart\_719,1}$.p1) ∨ (0 == (−($\$heap_{funcstart\_719,1}$.p1 /
177) + div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot)) ∨
(-1 < $\$heap_{funcstart\_719,1}$.p1)

[Copy term 11.40]

[43.0] ([0 < −$\$heap_{funcstart\_719,1}$.p1]: ([0 == $\$heap_{funcstart\_719,1}$.p1 % 177)]:
0 == div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).rem, [!(0
== ($\$heap_{funcstart\_719,1}$.p1 % 177))]: 177 == (−div(**heapIs**
$\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).rem +
($\$heap_{funcstart\_719,1}$.p1 % 177))), [-1 < $\$heap_{funcstart\_719,1}$.p1]: 0 ==
(−($\$heap_{funcstart\_719,1}$.p1 % 177) + div(**heapIs** $\$heap_{funcstart\_719,1}$,
$\$heap_{funcstart\_719,1}$.p1, 177).rem)) ∨ (0 == (−($\$heap_{funcstart\_719,1}$.p1 / 177)
+ div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot)) ∨ (-1 <

$heap_{funcstart\_719,1}.p1)$

→ *[from term 42.0, literala $< -$heap_{funcstart_719,1}.p1$ is true whenever (-1 + literala) < 0]*

Proof of rule precondition:

[43.0.0] (-1 + 0) < 0

→ *[simplify]*

[43.0.2] **true**

[43.1] ([**true**]: ([0 == ($heap_{funcstart\_719,1}.p1$ % 177)]: 0 == div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}.p1$, 177).rem, [!(0 == ($heap_{funcstart\_719,1}.p1$ % 177))]: 177 == ($-$div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}.p1$, 177).rem + ($heap_{funcstart\_719,1}.p1$ % 177))), [-1 < $heap_{funcstart\_719,1}.p1$]: 0 == ($-$($heap_{funcstart\_719,1}.p1$ % 177) + div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}.p1$, 177).rem)) ∨ ...

→ *[simplify]*

[43.3] ([0 == ($heap_{funcstart\_719,1}.p1$ % 177)]: 0 == div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}.p1$, 177).rem, [!(0 == ($heap_{funcstart\_719,1}.p1$ % 177))]: 177 == ($-$div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}.p1$, 177).rem + ($heap_{funcstart\_719,1}.p1$ % 177))) ∨ ...

[Branch on disjunction or conditional in term 43.3]

[44.0] (0 == div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}.p1$, 177).rem) ∨ (0 == ($-$($heap_{funcstart\_719,1}.p1$ / 177) + div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}.p1$, 177).quot)) ∨ (-1 < $heap_{funcstart\_719,1}.p1$) ∨ (177 == ($-$div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}.p1$, 177).rem + ($heap_{funcstart\_719,1}.p1$ % 177))) ∨ !(0 == ($heap_{funcstart\_719,1}.p1$ % 177))

[Copy term 1.24]

[46.0] (32767 < ((-2 * div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}.p1$, 177).quot) + (171 * div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}.p1$, 177).rem))) ∨ (0 == ($-$($heap_{funcstart\_719,1}.p1$ / 177) + div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}.p1$, 177).quot)) ∨ (-1 < $heap_{funcstart\_719,1}.p1$) ∨ (177 == ($-$div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}.p1$, 177).rem + ($heap_{funcstart\_719,1}.p1$ % 177))) ∨ !(0 == ($heap_{funcstart\_719,1}.p1$ % 177))

→ *[from term 44.0, div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}.p1$, 177).rem is equal to 0]*

[46.1] (32767 < ((-2 * div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}.p1$, 177).quot) + (171 * 0))) ∨ ...

→ *[simplify]*

[46.3] (32767 < (-2 * div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}.p1$, 177).quot)) ∨ ...

$\rightarrow$ *[literal comparison of product]*

[46.4] ([-2 < 0]: (32767 / 2) < $-$div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}$.p1, 177).quot, [0 < -2]: (32767 / -2) < div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}$.p1, 177).quot, [-2 == 0]: 32767 < 0) $\vee$ ...

$\rightarrow$ *[explicitly assert falsehood of skipped guards in subsequent guards]*

[46.5] ([-2 < 0]: (32767 / 2) < $-$div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}$.p1, 177).quot, [(0 < -2) $\wedge$!(-2 < 0)]: (32767 / -2) < div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}$.p1, 177).quot, [(-2 == 0) $\wedge$!(-2 < 0) $\wedge$!(0 < -2)]: 32767 < 0) $\vee$ ...

$\rightarrow$ *[simplify]*

[46.9] (16383 < $-$div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}$.p1, 177).quot) $\vee$ ...

[Create new term from terms 46.9, 41.0 using rule: transitivity 16]

[68.0] ((0 + 16383) < ($-\$\text{heap}_{funcstart\_719,1}$.p1 / 177)) $\vee$ (0 == ($-(\$\text{heap}_{funcstart\_719,1}$.p1 / 177) + div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}$.p1, 177).quot)) $\vee$ (-1 < $\$\text{heap}_{funcstart\_719,1}$.p1) $\vee$ (177 == ($-$div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}$.p1, 177).rem + ($\$\text{heap}_{funcstart\_719,1}$.p1 % 177))) $\vee$!(0 == ($\$\text{heap}_{funcstart\_719,1}$.p1 % 177))

$\rightarrow$ *[simplify]*

[68.8] (2899967 < $-\$\text{heap}_{funcstart\_719,1}$.p1) $\vee$ ...

$\rightarrow$ *[from term 8.3, literala < $-\$heap_{funcstart\_719,1}$.p1 is false whenever -2 < (-32769 + literala)]*

Proof of rule precondition:

[68.8.0] -2 < (-32769 + 2899967)

$\rightarrow$ *[simplify]*

[68.8.2] **true**

[68.9] **false** $\vee$ ...

[Remove 'false' term 68.9 and fetch new term from containing clause]

[69.0] (177 == ($-$div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}$.p1, 177).rem + ($\$\text{heap}_{funcstart\_719,1}$.p1 % 177))) $\vee$ (0 == ($-(\$\text{heap}_{funcstart\_719,1}$.p1 / 177) + div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}$.p1, 177).quot)) $\vee$ (-1 < $\$\text{heap}_{funcstart\_719,1}$.p1)

[Remove 'false' term 68.9 and fetch new term from containing clause]

[70.0] !(0 == ($\$\text{heap}_{funcstart\_719,1}$.p1 % 177)) $\vee$ (0 == ($-(\$\text{heap}_{funcstart\_719,1}$.p1 / 177) + div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}$.p1, 177).quot)) $\vee$ (-1 < $\$\text{heap}_{funcstart\_719,1}$.p1)

[Copy term 1.24]

[72.0] $(32767 < ((-2 * \text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_719,1}, \$\text{heap}_{funcstart\_719,1}.\text{p1}, 177).\text{quot}) + (171 * \text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_719,1}, \$\text{heap}_{funcstart\_719,1}.\text{p1}, 177).\text{rem}))) \lor (0 == (-(\$\text{heap}_{funcstart\_719,1}.\text{p1} / 177) + \text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_719,1}, \$\text{heap}_{funcstart\_719,1}.\text{p1}, 177).\text{quot})) \lor (-1 < \$\text{heap}_{funcstart\_719,1}.\text{p1})$

$\rightarrow$ *[from term 69.0, div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1, 177).rem is equal to -177 + ($heap$_{funcstart\_719,1}$.p1 % 177)]*

[72.1] $(32767 < ((-2 * \text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_719,1}, \$\text{heap}_{funcstart\_719,1}.\text{p1}, 177).\text{quot}) + (171 * (-177 + (\$\text{heap}_{funcstart\_719,1}.\text{p1} \% 177))))) \lor ...$

$\rightarrow$ *[simplify]*

[72.6] $(63034 < ((-2 * \text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_719,1}, \$\text{heap}_{funcstart\_719,1}.\text{p1}, 177).\text{quot}) + (171 * (\$\text{heap}_{funcstart\_719,1}.\text{p1} \% 177)))) \lor ...$

[Create new term from term 70.0 using rule: try to prove equality by contradiction]

[76.0] $((0 < (\$\text{heap}_{funcstart\_719,1}.\text{p1} \% 177)) \lor ((\$\text{heap}_{funcstart\_719,1}.\text{p1} \% 177) < 0)) \lor (0 == (-(\$\text{heap}_{funcstart\_719,1}.\text{p1} / 177) + \text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_719,1}, \$\text{heap}_{funcstart\_719,1}.\text{p1}, 177).\text{quot})) \lor (-1 < \$\text{heap}_{funcstart\_719,1}.\text{p1})$

$\rightarrow$ *[simplify]*

[76.1] $(([-1 < 0]: \exists \textbf{ integer } \text{n} \bullet (0 < (\$\text{heap}_{funcstart\_719,1}.\text{p1} + (177 * \text{n}))) \land ((\$\text{heap}_{funcstart\_719,1}.\text{p1} + (177 * \text{n})) < 177), []: \textbf{true}) \lor ((\$\text{heap}_{funcstart\_719,1}.\text{p1} \% 177) < 0)) \lor ...$

$\rightarrow$ *[explicitly assert falsehood of skipped guards in subsequent guards]*

[76.2] $(([-1 < 0]: \exists \textbf{ integer } \text{n} \bullet (0 < (\$\text{heap}_{funcstart\_719,1}.\text{p1} + (177 * \text{n}))) \land ((\$\text{heap}_{funcstart\_719,1}.\text{p1} + (177 * \text{n})) < 177), [!(-1 < 0)]: \textbf{true}) \lor ((\$\text{heap}_{funcstart\_719,1}.\text{p1} \% 177) < 0)) \lor ...$

$\rightarrow$ *[simplify]*

[76.15] $(\exists \textbf{ integer } \text{n} \bullet (-177 < (-\$\text{heap}_{funcstart\_719,1}.\text{p1} + (-177 * \text{n}))) \land (0 < ((177 * \text{n}) + \$\text{heap}_{funcstart\_719,1}.\text{p1}))) \lor ...$

$\rightarrow$ *[introduce skolem term and eliminate 'exists']*

[76.16] $((-177 < (-\$\text{heap}_{funcstart\_719,1}.\text{p1} + (-177 * \$\text{a\_n}))) \land (0 < ((177 * \$\text{a\_n}) + \$\text{heap}_{funcstart\_719,1}.\text{p1}))) \lor ...$

$\rightarrow$ *[separate conjunction and work on first sub-term]*

[76.17] $(-177 < (-\$\text{heap}_{funcstart\_719,1}.\text{p1} + (-177 * \$\text{a\_n}))) \lor ...$

[Work on sub-term 2 of conjunction in term 76.16]

[77.0] $(0 < ((177 * \$\text{a\_n}) + \$\text{heap}_{funcstart\_719,1}.\text{p1})) \lor (0 == (-(\$\text{heap}_{funcstart\_719,1}.\text{p1} / 177) + \text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_719,1},$

$heap_{funcstart\_719,1}$.p1, 177).quot)) $\lor$ (-1 < $heap_{funcstart\_719,1}$.p1)

[Create new term from term 41.0 using rule: condition for equality of division]

[80.0] $((-$heap$_{funcstart\_719,1}$.p1 < (177 * (0 + 1 + $-$div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p1, 177).quot))) $\land$ ((177 * (0 + $-$div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p1, 177).quot)) < (1 + $-$heap$_{funcstart\_719,1}$.p1))) $\lor$ (0 == ($-($heap$_{funcstart\_719,1}$.p1 / 177) + div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p1, 177).quot)) $\lor$ (-1 < $heap_{funcstart\_719,1}$.p1)

$\rightarrow$ *[simplify]*

[80.18] ((-177 < ((-177 * div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p1, 177).quot) + $heap_{funcstart\_719,1}$.p1)) $\land$ (-1 < ($-$heap$_{funcstart\_719,1}$.p1 + (177 * div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p1, 177).quot)))) $\lor$ ...

$\rightarrow$ *[separate conjunction and work on first sub-term]*

[80.19] (-177 < ((-177 * div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p1, 177).quot) + $heap_{funcstart\_719,1}$.p1)) $\lor$ ...

[Work on sub-term 2 of conjunction in term 80.18]

[81.0] (-1 < ($-$heap$_{funcstart\_719,1}$.p1 + (177 * div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p1, 177).quot))) $\lor$ (0 == ($-($heap$_{funcstart\_719,1}$.p1 / 177) + div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p1, 177).quot)) $\lor$ (-1 < $heap_{funcstart\_719,1}$.p1)

[Create new term from terms 80.19, 76.17 using rule: transitivity 1]

[82.0] ((-177 + -177 + 1) < ((-177 * div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p1, 177).quot) + (-177 * $a_n))) $\lor$ (0 == ($-($heap$_{funcstart\_719,1}$.p1 / 177) + div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p1, 177).quot)) $\lor$ (-1 < $heap_{funcstart\_719,1}$.p1)

$\rightarrow$ *[simplify]*

[82.1] (-353 < ((-177 * div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p1, 177).quot) + (-177 * $a_n))) $\lor$ ...

$\rightarrow$ *[cancel common factor]*

Proof of rule precondition 1:

[82.1.0.0] !(-177 == 0)

$\rightarrow$ *[simplify]*

[82.1.0.2] **true**

Proof of rule precondition 2:

[82.1.1.0] 1 < $gcf(-177, -177)

$\rightarrow$ *[simplify]*

[82.1.1.2] **true**

[82.2] ((-353 / $gcf(-177, -177)) < (((-177 / $gcf(-177, -177)) * div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1, 177).quot) + ((-177 / $gcf(-177, -177)) * $a_n))) ∨ ...

→ *[simplify]*

[82.10] (-2 < (−div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1, 177).quot + −$a_n)) ∨ ...

[Create new term from terms 81.0, 77.0 using rule: transitivity 1]

[86.0] ((-1 + 0 + 1) < ((177 * div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1, 177).quot) + (177 * $a_n))) ∨ (0 == (−($heap$_{funcstart\_719,1}$.p1 / 177) + div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1, 177).quot)) ∨ (-1 < $heap$_{funcstart_719,1}$.p1)

→ *[simplify]*

[86.1] (0 < ((177 * div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1, 177).quot) + (177 * $a_n))) ∨ ...

→ *[cancel common factor]*

Proof of rule precondition 1:

[86.1.0.0] !(0 == 177)

→ *[simplify]*

[86.1.0.2] **true**

Proof of rule precondition 2:

[86.1.1.0] 1 < $gcf(177, 177)

→ *[simplify]*

[86.1.1.2] **true**

[86.2] ((0 / $gcf(177, 177)) < (((177 / $gcf(177, 177)) * div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1, 177).quot) + ((177 / $gcf(177, 177)) * $a_n))) ∨ ...

→ *[simplify]*

[86.10] (0 < (div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1, 177).quot + $a_n)) ∨ ...

→ *[from term 82.10, 0 < (div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1, 177).quot + $a_n) is true if and only if -1 == (−div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1, 177).quot + −$a_n)]*

[86.11] (-1 == (−div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1, 177).quot + −$a_n)) ∨ ...

$\rightarrow$ [simplify]

[86.15] (1 == (div(**heapIs** \$heap$_{funcstart\_719,1}$, \$heap$_{funcstart\_719,1}$.p1, 177).quot + \$a_n)) $\lor$ ...

[Create new term from terms 76.17, 8.3 using rule: transitivity 2]

[78.0] ((-32769 + -177 + 1) < (-177 * \$a_n)) $\lor$ (0 == ($-$(\$heap$_{funcstart\_719,1}$.p1 / 177) + div(**heapIs** \$heap$_{funcstart\_719,1}$, \$heap$_{funcstart\_719,1}$.p1, 177).quot)) $\lor$ (-1 < \$heap$_{funcstart\_719,1}$.p1)

$\rightarrow$ [simplify]

[78.1] (-32945 < (-177 * \$a_n)) $\lor$ ...

$\rightarrow$ [literal comparison of product]

[78.2] ([-177 < 0]: (-32945 / 177) < $-$\$a_n, [0 < -177]: (-32945 / -177) < \$a_n, [-177 == 0]: -32945 < 0) $\lor$ ...

$\rightarrow$ [explicitly assert falsehood of skipped guards in subsequent guards]

[78.3] ([-177 < 0]: (-32945 / 177) < $-$\$a_n, [(0 < -177) $\land$!(-177 < 0)]: (-32945 / -177) < \$a_n, [(-177 == 0) $\land$!(-177 < 0) $\land$!(0 < -177)]: -32945 < 0) $\lor$ ...

$\rightarrow$ [simplify]

[78.7] (-187 < $-$\$a_n) $\lor$ ...

$\rightarrow$ [from term 86.15, \$a_n is equal to 1 + $-$div(**heapIs** \$heap$_{funcstart\_719,1}$, \$heap$_{funcstart\_719,1}$.p1, 177).quot]

[78.8] (-187 < $-$(1 + $-$div(**heapIs** \$heap$_{funcstart\_719,1}$, \$heap$_{funcstart\_719,1}$.p1, 177).quot)) $\lor$ ...

$\rightarrow$ [simplify]

[78.13] (-186 < div(**heapIs** \$heap$_{funcstart\_719,1}$, \$heap$_{funcstart\_719,1}$.p1, 177).quot) $\lor$ ...

[Create new term from terms 78.13, 72.6 using rule: transitivity 11]

[90.0] ((1 + 63034 + (-186 * 2)) < (171 * (\$heap$_{funcstart\_719,1}$.p1 % 177))) $\lor$ (0 == ($-$(\$heap$_{funcstart\_719,1}$.p1 / 177) + div(**heapIs** \$heap$_{funcstart\_719,1}$, \$heap$_{funcstart\_719,1}$.p1, 177).quot)) $\lor$ (-1 < \$heap$_{funcstart\_719,1}$.p1)

$\rightarrow$ [simplify]

[90.2] (62663 < (171 * (\$heap$_{funcstart\_719,1}$.p1 % 177))) $\lor$ ...

$\rightarrow$ [literal comparison of product]

[90.3] ([171 < 0]: (62663 / -171) < $-$(\$heap$_{funcstart\_719,1}$.p1 % 177), [0 < 171]: (62663 / 171) < (\$heap$_{funcstart\_719,1}$.p1 % 177), [0 == 171]: 62663 < 0) $\lor$ ...

$\rightarrow$ [explicitly assert falsehood of skipped guards in subsequent guards]

[90.4] ([171 < 0]: (62663 / -171) < $-$(\$heap$_{funcstart\_719,1}$.p1 % 177), [(0 < 171) $\land$!(171 < 0)]: (62663 / 171) < (\$heap$_{funcstart\_719,1}$.p1 % 177), [(0 ==

171) ∧ !(0 < 171) ∧ !(171 < 0)]: 62663 < 0) ∨ ...

→ *[simplify]*

[90.13] **false** ∨ ...

[Remove 'false' term 90.13 and fetch new term from containing clause]

[91.0] 0 == (−($heap$_{funcstart_719,1}$.p1 / 177) + div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1, 177).quot)

[Remove 'false' term 90.13 and fetch new term from containing clause]

[92.0] -1 < $heap$_{funcstart_719,1}$.p1

[Assume known post-assertion, class invariant or type constraint for term 5.6]

[11.40] ([0 < −$heap$_{funcstart_719,1}$.p1]: ([0 == ($heap$_{funcstart\_719,1}$.p1 % 177)]: 0 == div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1, 177).rem, [!(0 == ($heap$_{funcstart\_719,1}$.p1 % 177))]: 177 == (($heap$_{funcstart_719,1}$.p1 % 177) + −div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1, 177).rem)), [-1 < $heap$_{funcstart_719,1}$.p1]: 0 == (−($heap$_{funcstart\_719,1}$.p1 % 177) + div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1, 177).rem))

→ *[from term 92.0, literala < −$heap$_{funcstart_719,1}$.p1 is false whenever -2 < (-1 + literala)]*

Proof of rule precondition:

[11.40.0] -2 < (-1 + 0)

→ *[simplify]*

[11.40.2] **true**

[11.41] ([**false**]: ([0 == ($heap$_{funcstart_719,1}$.p1 % 177)]: 0 == div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1, 177).rem, [!(0 == ($heap$_{funcstart\_719,1}$.p1 % 177))]: 177 == (−div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1, 177).rem + ($heap$_{funcstart\_719,1}$.p1 % 177))), [-1 < $heap$_{funcstart_719,1}$.p1]: 0 == (−($heap$_{funcstart\_719,1}$.p1 % 177) + div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1, 177).rem))

→ *[from term 92.0, literala < $heap$_{funcstart_719,1}$.p1 is true whenever (-1 + literala) < -1]*

Proof of rule precondition:

[11.41.0] (-1 + -1) < -1

→ *[simplify]*

[11.41.2] **true**

[11.42] ([**false**]: ([0 == ($heap$_{funcstart_719,1}$.p1 % 177)]: 0 == div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1, 177).rem, [!(0 == ($heap$_{funcstart\_719,1}$.p1 % 177))]: 177 == (−div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1, 177).rem + ($heap$_{funcstart\_719,1}$.p1 % 177))), [**true**]: 0

== ($-(\$heap_{funcstart_719,1}.p1 \% 177) + $ div(**heapIs** $\$heap_{funcstart\_719,1}$,
$\$heap_{funcstart\_719,1}.p1$, 177).rem))

$\rightarrow$ *[simplify]*

[11.44] $0 == (-(\$heap_{funcstart_719,1}.p1 \% 177) + $ div(**heapIs**
$\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}.p1$, 177).rem)

[Copy term 1.24]

[94.0] $32767 < ((-2 * $ div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}.p1$,
177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}.p1$,
177).rem))

$\rightarrow$ *[from term 11.44, div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}.p1$,
177).rem is equal to $\$heap_{funcstart\_719,1}.p1 \% 177$]*

[94.1] $32767 < ((-2 * $ div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}.p1$,
177).quot) + (171 * (\$heap_{funcstart_719,1}.p1 \% 177)))

[Create new term from term 91.0 using rule: condition for equality of division]

[102.0] $(0 < (1 + (177 * (0 + -$ div(**heapIs** $\$heap_{funcstart\_719,1}$,
$\$heap_{funcstart\_719,1}.p1$, 177).quot)) $+ \$heap_{funcstart\_719,1}.p1$)) $\wedge$
$(\$heap_{funcstart_719,1}.p1 < (177 * (0 + 1 + $ div(**heapIs** $\$heap_{funcstart\_719,1}$,
$\$heap_{funcstart\_719,1}.p1$, 177).quot)))

$\rightarrow$ *[simplify]*

[102.12] $(-1 < ((-177 * $ div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}.p1$,
177).quot) $+ \$heap_{funcstart\_719,1}.p1$)) $\wedge$ $(-177 < (-\$heap_{funcstart\_719,1}.p1 +$
$(177 * $ div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}.p1$, 177).quot)))

$\rightarrow$ *[separate conjunction and work on first sub-term]*

[102.13] $-177 < (-\$heap_{funcstart_719,1}.p1 + (177 * $ div(**heapIs**
$\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}.p1$, 177).quot))

[Create new term from terms 102.13, 92.0 using rule: transitivity 2]

[104.0] $(-177 + -1 + 1) < (177 * $ div(**heapIs** $\$heap_{funcstart\_719,1}$,
$\$heap_{funcstart\_719,1}.p1$, 177).quot)

$\rightarrow$ *[simplify]*

[104.1] $-177 < (177 * $ div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}.p1$,
177).quot)

$\rightarrow$ *[literal comparison of product]*

[104.2] $([177 < 0]$: $(-177 / -177) < -$div(**heapIs** $\$heap_{funcstart\_719,1}$,
$\$heap_{funcstart\_719,1}.p1$, 177).quot, $[0 < 177]$: $(-177 / 177) < $ div(**heapIs**
$\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}.p1$, 177).quot, $[0 == 177]$: $-177 < 0$)

$\rightarrow$ *[explicitly assert falsehood of skipped guards in subsequent guards]*

[104.3] $([177 < 0]$: $(-177 / -177) < -$div(**heapIs** $\$heap_{funcstart\_719,1}$,

$\text{heap}_{funcstart\_719,1}$.p1, 177).quot, $[(0 < 177) \land !(177 < 0)]$: (-177 / 177) < div(**heapIs** $\text{heap}_{funcstart\_719,1}$, $\text{heap}_{funcstart\_719,1}$.p1, 177).quot, $[(0 == 177) \land !(0 < 177) \land !(177 < 0)]$: -177 < 0)

$\rightarrow$ *[simplify]*

[104.11] -1 < div(**heapIs** $\text{heap}_{funcstart\_719,1}$, $\text{heap}_{funcstart\_719,1}$.p1, 177).quot

[Create new term from terms 104.11, 94.1 using rule: transitivity 11]

[107.0] (1 + 32767 + (-1 * 2)) < (171 * ($\text{heap}_{funcstart\_719,1}$.p1 % 177))

$\rightarrow$ *[simplify]*

[107.2] 32766 < (171 * ($\text{heap}_{funcstart\_719,1}$.p1 % 177))

$\rightarrow$ *[literal comparison of product]*

[107.3] ($[171 < 0]$: (32766 / -171) < $-$($\text{heap}_{funcstart\_719,1}$.p1 % 177), $[0 < 171]$: (32766 / 171) < ($\text{heap}_{funcstart\_719,1}$.p1 % 177), $[0 == 171]$: 32766 < 0)

$\rightarrow$ *[explicitly assert falsehood of skipped guards in subsequent guards]*

[107.4] ($[171 < 0]$: (32766 / -171) < $-$($\text{heap}_{funcstart\_719,1}$.p1 % 177), $[(0 < 171) \land !(171 < 0)]$: (32766 / 171) < ($\text{heap}_{funcstart\_719,1}$.p1 % 177), $[(0 == 171) \land !(0 < 171) \land !(171 < 0)]$: 32766 < 0)

$\rightarrow$ *[simplify]*

[107.13] **false**

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

Condition generated at: C:\Escher\Customers\prang\prang.c (51,11)

Condition defined at:

To prove: minof(int) $\leq$
static_cast<integer>(asType<int>($\text{heap}_{719,1;731,8}$.p1) < (int)0)

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)

heap_{init}.M2 == **asType<short int>**((**int**)30307)

heap_{init}.r2 == **asType<short int>**((**int**)172)

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

$\$\text{heap}_{init}.\text{b2} == \textbf{asType}\textbf{<short int>}((\textbf{int})35)$

$\$\text{heap}_{init}.\text{M3} == \textbf{asType}\textbf{<short int>}((\textbf{int})30323)$

$\$\text{heap}_{init}.\text{r3} == \textbf{asType}\textbf{<short int>}((\textbf{int})170)$

$\$\text{heap}_{init}.\text{a3} == \textbf{asType}\textbf{<short int>}((\textbf{int})178)$

$\$\text{heap}_{init}.\text{b3} == \textbf{asType}\textbf{<short int>}((\textbf{int})63)$

$\$\text{heap}_{init}.\text{p1} == \textbf{asType}\textbf{<short int>}((\textbf{int})1)$

$\$\text{heap}_{init}.\text{p2} == \textbf{asType}\textbf{<short int>}((\textbf{int})2)$

$\$\text{heap}_{init}.\text{p3} == \textbf{asType}\textbf{<short int>}((\textbf{int})3)$

div1 == div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$,
asType<int>($\$\text{heap}_{funcstart\_719,1}.\text{p1}$),
asType<int>($\$\text{heap}_{funcstart\_719,1}.\text{a1}$))

(**asType<integer>**(**asType<int>**($\$\text{heap}_{funcstart\_719,1}.\text{p1}$)) /
asType<integer>(**asType<int>**($\$\text{heap}_{funcstart\_719,1}.\text{a1}$))) ==
asType<integer>(div1.quot)

(**asType<integer>**(**asType<int>**($\$\text{heap}_{funcstart\_719,1}.\text{p1}$)) %
asType<integer>(**asType<int>**($\$\text{heap}_{funcstart\_719,1}.\text{a1}$))) ==
asType<integer>(div1.rem)

div2 == div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$,
asType<int>($\$\text{heap}_{funcstart\_719,1}.\text{p2}$),
asType<int>($\$\text{heap}_{funcstart\_719,1}.\text{a2}$))

(**asType<integer>**(**asType<int>**($\$\text{heap}_{funcstart\_719,1}.\text{p2}$)) /
asType<integer>(**asType<int>**($\$\text{heap}_{funcstart\_719,1}.\text{a2}$))) ==
asType<integer>(div2.quot)

(**asType<integer>**(**asType<int>**($\$\text{heap}_{funcstart\_719,1}.\text{p2}$)) %
asType<integer>(**asType<int>**($\$\text{heap}_{funcstart\_719,1}.\text{a2}$))) ==
asType<integer>(div2.rem)

div3 == div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$,
asType<int>($\$\text{heap}_{funcstart\_719,1}.\text{p3}$),
asType<int>($\$\text{heap}_{funcstart\_719,1}.\text{a3}$))

(**asType<integer>**(**asType<int>**($\$\text{heap}_{funcstart\_719,1}.\text{p3}$)) /
asType<integer>(**asType<int>**($\$\text{heap}_{funcstart\_719,1}.\text{a3}$))) ==
asType<integer>(div3.quot)

(**asType<integer>**(**asType<int>**($\$\text{heap}_{funcstart\_719,1}.\text{p3}$)) %
asType<integer>(**asType<int>**($\$\text{heap}_{funcstart\_719,1}.\text{a3}$))) ==
asType<integer>(div3.rem)

$\$\text{heap}_{719,1;729,8} == \$\text{heap}_{funcstart\_719,1}.$**replace**(p1 → **asType<short
int>**((**asType<int>**(**asType<short int>**(div1.rem)) *
asType<int>($\$\text{heap}_{funcstart\_719,1}.\text{r1}$)) − (**asType<int>**(**asType<short**

int>(div1.quot)) * **asType**<**int**>($heap$_{funcstart_719,1}$.b1))))

$heap$_{719,1;730,8}$ == $heap$_{719,1;729,8}$._**replace**(p2 → **asType**<**short int**>((**asType**<**int**>(**asType**<**short int**>(div2.rem)) * **asType**<**int**>($heap$_{719,1;729,8}$.r2)) − (**asType**<**int**>(**asType**<**short int**>(div2.quot)) * **asType**<**int**>($heap$_{719,1;729,8}$.b2))))

$heap$_{719,1;731,8}$ == $heap$_{719,1;730,8}$._**replace**(p3 → **asType**<**short int**>((**asType**<**int**>(**asType**<**short int**>(div3.rem)) * **asType**<**int**>($heap$_{719,1;730,8}$.r3)) − (**asType**<**int**>(**asType**<**short int**>(div3.quot)) * **asType**<**int**>($heap$_{719,1;730,8}$.b3))))

Proof:

[Take given term]

[5.0] div1 == div(**heapIs** $heap$_{funcstart_719,1}$,
asType<**int**>($heap$_{funcstart_719,1}$.p1),
asType<**int**>($heap$_{funcstart_719,1}$.a1))

→ *[simplify]*

[5.1] div1 == div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1,
asType<**int**>($heap$_{funcstart_719,1}$.a1))

→ *[const static or extern object]*

[5.2] div1 == div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1,
asType<**int**>($heap$_{init}$.a1))

→ *[expand definition of constant 'a1' at prang.c (16,20)]*

[5.3] div1 == div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1,
asType<**int**>(**asType**<**short int**>((**int**)177)))

→ *[simplify]*

[5.6] div1 == div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1, 177)

[Take given term]

[12.0] div2 == div(**heapIs** $heap$_{funcstart_719,1}$,
asType<**int**>($heap$_{funcstart_719,1}$.p2),
asType<**int**>($heap$_{funcstart_719,1}$.a2))

→ *[simplify]*

[12.1] div2 == div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p2,
asType<**int**>($heap$_{funcstart_719,1}$.a2))

→ *[const static or extern object]*

[12.2] div2 == div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p2,
asType<**int**>($heap$_{init}$.a2))

→ *[expand definition of constant 'a2' at prang.c (21,20)]*

[12.3] div2 == div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p2,

asType<int>(asType<short int>((int)176)))

→ *[simplify]*

[12.6] div2 == div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176)

[Take given term]

[19.0] div3 == div(**heapIs** $\$heap_{funcstart\_719,1}$,
asType<int>($\$heap_{funcstart\_719,1}$.p3),
asType<int>($\$heap_{funcstart\_719,1}$.a3))

→ *[simplify]*

[19.1] div3 == div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p3,
asType<int>($\$heap_{funcstart\_719,1}$.a3))

→ *[const static or extern object]*

[19.2] div3 == div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p3,
asType<int>($\$heap_{init}$.a3))

→ *[expand definition of constant 'a3' at prang.c (26,20)]*

[19.3] div3 == div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p3,
asType<int>(asType<short int>((int)178)))

→ *[simplify]*

[19.6] div3 == div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p3, 178)

[Take given term]

[26.0] $\$heap_{719,1;729,8}$ == $\$heap_{funcstart\_719,1}$.**replace**(p1 → **asType<short
int>**((**asType<int>(asType<short int>**(div1.rem)) *
asType<int>($\$heap_{funcstart\_719,1}$.r1)) − (**asType<int>(asType<short
int>**(div1.quot)) * **asType<int>**($\$heap_{funcstart\_719,1}$.b1)))))

→ *[from term 5.6, div1 is equal to div(**heapIs** $\$heap_{funcstart\_719,1}$,
$\$heap_{funcstart\_719,1}$.p1, 177)]*

[26.1] $\$heap_{719,1;729,8}$ == $\$heap_{funcstart\_719,1}$.**replace**(p1 → **asType<short
int>**((**asType<int>(asType<short int>**(div(**heapIs** $\$heap_{funcstart\_719,1}$,
$\$heap_{funcstart\_719,1}$.p1, 177).rem)) * **asType<int>**($\$heap_{funcstart\_719,1}$.r1)) −
(**asType<int>(asType<short int>**(div1.quot)) *
asType<int>($\$heap_{funcstart\_719,1}$.b1)))))

→ *[simplify]*

[26.3] $\$heap_{719,1;729,8}$ == $\$heap_{funcstart\_719,1}$.**replace**(p1 → **asType<short
int>**((div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).rem *
asType<int>($\$heap_{funcstart\_719,1}$.r1)) − (**asType<int>(asType<short
int>**(div1.quot)) * **asType<int>**($\$heap_{funcstart\_719,1}$.b1)))))

→ *[const static or extern object]*

[26.4] $\$heap_{719,1;729,8}$ == $\$heap_{funcstart\_719,1}$.**replace**(p1 → **asType<short

int>((div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}$.p1, 177).rem * **asType**<**int**>($\$\text{heap}_{init}$.r1)) − (**asType**<**int**>(**asType**<**short int**>(div1.quot)) * **asType**<**int**>($\$\text{heap}_{funcstart\_719,1}$.b1))))

→ *[expand definition of constant 'r1' at prang.c (15,20)]*

[26.5] $\$\text{heap}_{719,1;729,8}$ == $\$\text{heap}_{funcstart\_719,1}$.**replace**(p1 → **asType**<**short int**>((div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}$.p1, 177).rem * **asType**<**int**>(**asType**<**short int**>((int)171))) − (**asType**<**int**>(**asType**<**short int**>(div1.quot)) * **asType**<**int**>($\$\text{heap}_{funcstart\_719,1}$.b1))))

→ *[simplify]*

[26.8] $\$\text{heap}_{719,1;729,8}$ == $\$\text{heap}_{funcstart\_719,1}$.**replace**(p1 → **asType**<**short int**>((div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}$.p1, 177).rem * 171) − (**asType**<**int**>(**asType**<**short int**>(div1.quot)) * **asType**<**int**>($\$\text{heap}_{funcstart\_719,1}$.b1))))

→ *[from term 5.6, div1 is equal to div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}$.p1, 177)]*

[26.9] $\$\text{heap}_{719,1;729,8}$ == $\$\text{heap}_{funcstart\_719,1}$.**replace**(p1 → **asType**<**short int**>((171 * div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}$.p1, 177).rem) − (**asType**<**int**>(**asType**<**short int**>(div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}$.p1, 177).quot)) * **asType**<**int**>($\$\text{heap}_{funcstart\_719,1}$.b1))))

→ *[simplify]*

[26.11] $\$\text{heap}_{719,1;729,8}$ == $\$\text{heap}_{funcstart\_719,1}$.**replace**(p1 → **asType**<**short int**>((171 * div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}$.p1, 177).rem) − (div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}$.p1, 177).quot * **asType**<**int**>($\$\text{heap}_{funcstart\_719,1}$.b1))))

→ *[const static or extern object]*

[26.12] $\$\text{heap}_{719,1;729,8}$ == $\$\text{heap}_{funcstart\_719,1}$.**replace**(p1 → **asType**<**short int**>((171 * div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}$.p1, 177).rem) − (div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}$.p1, 177).quot * **asType**<**int**>($\$\text{heap}_{init}$.b1))))

→ *[expand definition of constant 'b1' at prang.c (17,20)]*

[26.13] $\$\text{heap}_{719,1;729,8}$ == $\$\text{heap}_{funcstart\_719,1}$.**replace**(p1 → **asType**<**short int**>((171 * div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}$.p1, 177).rem) − (div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}$.p1, 177).quot * **asType**<**int**>(**asType**<**short int**>((int)2)))))

→ *[simplify]*

[26.19] $\$\text{heap}_{719,1;729,8}$ == $\$\text{heap}_{funcstart\_719,1}$.**replace**(p1 → ((-2 * div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}$.p1, 177).rem)))

[Take given term]

[31.0] $\$heap_{719,1;730,8} == \$heap_{719,1;729,8}$._**replace**$(p2 \rightarrow$ **asType**$<$**short int**$>((\mathbf{asType}<\mathbf{int}>(\mathbf{asType}<\mathbf{short\ int}>(\text{div2.rem}))\ *$ **asType**$<$**int**$>(\$heap_{719,1;729,8}.r2)) - (\mathbf{asType}<\mathbf{int}>(\mathbf{asType}<\mathbf{short}$ **int**$>(\text{div2.quot}))\ *$ **asType**$<$**int**$>(\$heap_{719,1;729,8}.b2))))$

$\rightarrow$ *[from term 26.19, $\$heap_{719,1;729,8}$ is equal to $\$heap_{funcstart\_719,1}$._**replace**$(p1 \rightarrow (-2 * div($**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}.p1, 177).quot) + (171 * div($**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart_719,1}.p1, 177).rem))]*

[31.1] $\$heap_{719,1;730,8} == \$heap_{funcstart\_719,1}$._**replace**$(p1 \rightarrow ((-2\ *$ div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}.p1, 177).quot) + (171\ *$ div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}.p1$, $177).rem)))$._**replace**$(p2 \rightarrow$ **asType**$<$**short int**$>((\mathbf{asType}<\mathbf{int}>(\mathbf{asType}<\mathbf{short\ int}>(\text{div2.rem}))\ *$ **asType**$<$**int**$>(\$heap_{719,1;729,8}.r2)) - (\mathbf{asType}<\mathbf{int}>(\mathbf{asType}<\mathbf{short}$ **int**$>(\text{div2.quot}))\ *$ **asType**$<$**int**$>(\$heap_{719,1;729,8}.b2))))$

$\rightarrow$ *[from term 12.6, div2 is equal to div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart_719,1}.p2, 176)]*

[31.2] $\$heap_{719,1;730,8} == \$heap_{funcstart\_719,1}$._**replace**$(p1 \rightarrow ((-2\ *$ div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}.p1, 177).quot) + (171\ *$ div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}.p1$, $177).rem)))$._**replace**$(p2 \rightarrow$ **asType**$<$**short int**$>((\mathbf{asType}<\mathbf{int}>(\mathbf{asType}<\mathbf{short\ int}>($div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}.p2, 176).rem))\ *$ **asType**$<$**int**$>(\$heap_{719,1;729,8}.r2)) - (\mathbf{asType}<\mathbf{int}>(\mathbf{asType}<\mathbf{short\ int}>(\text{div2.quot}))\ *$ **asType**$<$**int**$>(\$heap_{719,1;729,8}.b2))))$

$\rightarrow$ *[simplify]*

[31.4] $\$heap_{719,1;730,8} == \$heap_{funcstart\_719,1}$._**replace**$(p1 \rightarrow ((-2\ *$ div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}.p1, 177).quot) + (171\ *$ div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}.p1$, $177).rem)))$._**replace**$(p2 \rightarrow$ **asType**$<$**short int**$>(($div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}.p2, 176).rem\ *$ **asType**$<$**int**$>(\$heap_{719,1;729,8}.r2)) - (\mathbf{asType}<\mathbf{int}>(\mathbf{asType}<\mathbf{short}$ **int**$>(\text{div2.quot}))\ *$ **asType**$<$**int**$>(\$heap_{719,1;729,8}.b2))))$

$\rightarrow$ *[from term 26.19, $\$heap_{719,1;729,8}$ is equal to $\$heap_{funcstart\_719,1}$._**replace**$(p1 \rightarrow (-2 * div($**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}.p1, 177).quot) + (171 * div($**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart_719,1}.p1, 177).rem))]*

[31.5] $\$heap_{719,1;730,8} == \$heap_{funcstart\_719,1}$._**replace**$(p1 \rightarrow ((-2\ *$ div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}.p1, 177).quot) + (171\ *$ div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}.p1$, $177).rem)))$._**replace**$(p2 \rightarrow$ **asType**$<$**short int**$>(($div(**heapIs**

$heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p2, 176).rem *
asType\<int\>($heap_{funcstart\_719,1}$.**_replace**(p1 → ((-2 * div(**heapIs**
$heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs**
$heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p1, 177).rem))).r2)) −
(**asType\<int\>**(**asType\<short int\>**(div2.quot)) *
asType\<int\>($heap_{719,1;729,8}$.b2)))))

→ *[const member of object with modified fields]*

[31.6] $heap_{719,1;730,8}$ == $heap_{funcstart\_719,1}$.**_replace**(p1 → ((-2 *
div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p1, 177).quot) + (171 *
div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p1,
177).rem))).**_replace**(p2 → **asType\<short int\>**((div(**heapIs**
$heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p2, 176).rem *
asType\<int\>($heap_{funcstart\_719,1}$.r2)) − (**asType\<int\>**(**asType\<short
int\>**(div2.quot)) * **asType\<int\>**($heap_{719,1;729,8}$.b2)))))

→ *[const static or extern object]*

[31.7] $heap_{719,1;730,8}$ == $heap_{funcstart\_719,1}$.**_replace**(p1 → ((-2 *
div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p1, 177).quot) + (171 *
div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p1,
177).rem))).**_replace**(p2 → **asType\<short int\>**((div(**heapIs**
$heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p2, 176).rem *
asType\<int\>($heap_{init}$.r2)) − (**asType\<int\>**(**asType\<short
int\>**(div2.quot)) * **asType\<int\>**($heap_{719,1;729,8}$.b2)))))

→ *[expand definition of constant 'r2' at prang.c (20,20)]*

[31.8] $heap_{719,1;730,8}$ == $heap_{funcstart\_719,1}$.**_replace**(p1 → ((-2 *
div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p1, 177).quot) + (171 *
div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p1,
177).rem))).**_replace**(p2 → **asType\<short int\>**((div(**heapIs**
$heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p2, 176).rem *
asType\<int\>(**asType\<short int\>**((**int**)172))) −
(**asType\<int\>**(**asType\<short int\>**(div2.quot)) *
asType\<int\>($heap_{719,1;729,8}$.b2)))))

→ *[simplify]*

[31.11] $heap_{719,1;730,8}$ == $heap_{funcstart\_719,1}$.**_replace**(p1 → ((-2 *
div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p1, 177).quot) + (171 *
div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p1,
177).rem))).**_replace**(p2 → **asType\<short int\>**((div(**heapIs**
$heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p2, 176).rem * 172) −
(**asType\<int\>**(**asType\<short int\>**(div2.quot)) *
asType\<int\>($heap_{719,1;729,8}$.b2)))))

→ *[from term 12.6, div2 is equal to div(**heapIs** $heap_{funcstart\_719,1}$,
$heap_{funcstart\_719,1}$.p2, 176)]*

[31.12] $\text{\$heap}_{719,1;730,8}$ == $\text{\$heap}_{funcstart\_719,1}$.**replace**(p1 → ((-2 * div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p1, 177).rem))).**replace**(p2 → **asType**<**short int**>((172 * div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p2, 176).rem) − (**asType**<**int**>(**asType**<**short int**>(div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p2, 176).quot)) * **asType**<**int**>($\text{\$heap}_{719,1;729,8}$.b2))))

→ *[simplify]*

[31.14] $\text{\$heap}_{719,1;730,8}$ == $\text{\$heap}_{funcstart\_719,1}$.**replace**(p1 → ((-2 * div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p1, 177).rem))).**replace**(p2 → **asType**<**short int**>((172 * div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p2, 176).rem) − (div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p2, 176).quot * **asType**<**int**>($\text{\$heap}_{719,1;729,8}$.b2))))

→ *[from term 26.19, $\text{\$heap}_{719,1;729,8}$ is equal to $\text{\$heap}_{funcstart\_719,1}$.**replace**(p1 → (-2 * div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p1, 177).rem))]*

[31.15] $\text{\$heap}_{719,1;730,8}$ == $\text{\$heap}_{funcstart\_719,1}$.**replace**(p1 → ((-2 * div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p1, 177).rem))).**replace**(p2 → **asType**<**short int**>((172 * div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p2, 176).rem) − (div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p2, 176).quot * **asType**<**int**>($\text{\$heap}_{funcstart\_719,1}$.**replace**(p1 → ((-2 * div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p1, 177).rem))).b2))))

→ *[const member of object with modified fields]*

[31.16] $\text{\$heap}_{719,1;730,8}$ == $\text{\$heap}_{funcstart\_719,1}$.**replace**(p1 → ((-2 * div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p1, 177).rem))).**replace**(p2 → **asType**<**short int**>((172 * div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p2, 176).rem) − (div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p2, 176).quot * **asType**<**int**>($\text{\$heap}_{funcstart\_719,1}$.b2))))

→ *[const static or extern object]*

[31.17] $\text{\$heap}_{719,1;730,8}$ == $\text{\$heap}_{funcstart\_719,1}$.**replace**(p1 → ((-2 * div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p1, 177).rem))).**replace**(p2 → **asType**<**short int**>((172 * div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p2, 176).rem) − (div(**heapIs**

$\text{heap}_{funcstart\_719,1}$, $\text{heap}_{funcstart\_719,1}$.p2, 176).quot *
asType<int>(heap_{init}.b2))))

→ *[expand definition of constant 'b2' at prang.c (22,20)]*

[31.18] $\text{heap}_{719,1;730,8}$ == $\text{heap}_{funcstart\_719,1}$.**replace**(p1 → ((-2 *
div(**heapIs** $\text{heap}_{funcstart\_719,1}$, $\text{heap}_{funcstart\_719,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\text{heap}_{funcstart\_719,1}$, $\text{heap}_{funcstart\_719,1}$.p1,
177).rem))).**replace**(p2 → **asType<short int>**((172 * div(**heapIs**
$\text{heap}_{funcstart\_719,1}$, $\text{heap}_{funcstart\_719,1}$.p2, 176).rem) − (div(**heapIs**
$\text{heap}_{funcstart\_719,1}$, $\text{heap}_{funcstart\_719,1}$.p2, 176).quot *
asType<int>(**asType<short int>**((**int**)35)))))

→ *[simplify]*

[31.24] $\text{heap}_{719,1;730,8}$ == $\text{heap}_{funcstart\_719,1}$.**replace**(p1 → ((-2 *
div(**heapIs** $\text{heap}_{funcstart\_719,1}$, $\text{heap}_{funcstart\_719,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\text{heap}_{funcstart\_719,1}$, $\text{heap}_{funcstart\_719,1}$.p1,
177).rem))).**replace**(p2 → ((-35 * div(**heapIs** $\text{heap}_{funcstart\_719,1}$,
$\text{heap}_{funcstart\_719,1}$.p2, 176).quot) + (172 * div(**heapIs** $\text{heap}_{funcstart\_719,1}$,
$\text{heap}_{funcstart\_719,1}$.p2, 176).rem)))

[Take given term]

[36.0] $\text{heap}_{719,1;731,8}$ == $\text{heap}_{719,1;730,8}$.**replace**(p3 → **asType<short
int>**((**asType<int>**(**asType<short int>**(div3.rem)) *
asType<int>($\text{heap}_{719,1;730,8}$.r3)) − (**asType<int>**(**asType<short
int>**(div3.quot)) * **asType<int>**($\text{heap}_{719,1;730,8}$.b3))))

→ *[from term 31.24, $heap_{719,1;730,8}$ is equal to*
*$heap_{funcstart\_719,1}$.__replace__(p1 → ((-2 * div(__heapIs__ $heap_{funcstart\_719,1}$,*
*$heap_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(__heapIs__ $heap_{funcstart\_719,1}$,*
*$heap_{funcstart\_719,1}$.p1, 177).rem))).__replace__(p2 → (-35 * div(__heapIs__*
*$heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p2, 176).quot) + (172 * div(__heapIs__*
$heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p2, 176).rem))]

[36.1] $\text{heap}_{719,1;731,8}$ == $\text{heap}_{funcstart\_719,1}$.**replace**(p1 → ((-2 *
div(**heapIs** $\text{heap}_{funcstart\_719,1}$, $\text{heap}_{funcstart\_719,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\text{heap}_{funcstart\_719,1}$, $\text{heap}_{funcstart\_719,1}$.p1,
177).rem))).**replace**(p2 → ((-35 * div(**heapIs** $\text{heap}_{funcstart\_719,1}$,
$\text{heap}_{funcstart\_719,1}$.p2, 176).quot) + (172 * div(**heapIs** $\text{heap}_{funcstart\_719,1}$,
$\text{heap}_{funcstart\_719,1}$.p2, 176).rem))).**replace**(p3 → **asType<short
int>**((**asType<int>**(**asType<short int>**(div3.rem)) *
asType<int>($\text{heap}_{719,1;730,8}$.r3)) − (**asType<int>**(**asType<short
int>**(div3.quot)) * **asType<int>**($\text{heap}_{719,1;730,8}$.b3))))

→ *[from term 19.6, div3 is equal to div(__heapIs__ $heap_{funcstart\_719,1}$,*
$heap_{funcstart\_719,1}$.p3, 178)]

[36.2] $\text{heap}_{719,1;731,8}$ == $\text{heap}_{funcstart\_719,1}$.**replace**(p1 → ((-2 *
div(**heapIs** $\text{heap}_{funcstart\_719,1}$, $\text{heap}_{funcstart\_719,1}$.p1, 177).quot) + (171 *

div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).rem))). **replace**(p2 → ((-35 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).quot) + (172 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).rem))). **replace**(p3 → **asType<short int>**((**asType<int>**(**asType<short int>**(div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p3, 178).rem)) * **asType<int>**($\$heap_{719,1;730,8}$.r3)) − (**asType<int>**(**asType<short int>**(div3.quot)) * **asType<int>**($\$heap_{719,1;730,8}$.b3)))))

→ *[simplify]*

[36.4] $\$heap_{719,1;731,8}$ == $\$heap_{funcstart\_719,1}$. **replace**(p1 → ((-2 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).rem))). **replace**(p2 → ((-35 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).quot) + (172 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).rem))). **replace**(p3 → **asType<short int>**((div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p3, 178).rem * **asType<int>**($\$heap_{719,1;730,8}$.r3)) − (**asType<int>**(**asType<short int>**(div3.quot)) * **asType<int>**($\$heap_{719,1;730,8}$.b3)))))

→ *[from term 31.24, $\$heap_{719,1;730,8}$ is equal to*
*$\$heap_{funcstart\_719,1}$. **replace**(p1 → ((-2 * div(**heapIs** $\$heap_{funcstart\_719,1}$,*
*$\$heap_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_719,1}$,*
*$\$heap_{funcstart\_719,1}$.p1, 177).rem))). **replace**(p2 → (-35 * div(**heapIs***
*$\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).quot) + (172 * div(**heapIs***
$\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).rem))]

[36.5] $\$heap_{719,1;731,8}$ == $\$heap_{funcstart\_719,1}$. **replace**(p1 → ((-2 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).rem))). **replace**(p2 → ((-35 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).quot) + (172 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).rem))). **replace**(p3 → **asType<short int>**((div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p3, 178).rem * **asType<int>**($\$heap_{funcstart\_719,1}$. **replace**(p1 → ((-2 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).rem))). **replace**(p2 → ((-35 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).quot) + (172 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).rem))).r3)) − (**asType<int>**(**asType<short int>**(div3.quot)) * **asType<int>**($\$heap_{719,1;730,8}$.b3)))))

→ *[const member of object with modified fields]*

[36.7] $\$heap_{719,1;731,8}$ == $\$heap_{funcstart\_719,1}$. **replace**(p1 → ((-2 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).rem))). **replace**(p2 → ((-35 * div(**heapIs** $\$heap_{funcstart\_719,1}$,

$heap_{funcstart\_719,1}$.p2, 176).quot) + (172 * div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p2, 176).rem))). **replace**(p3 → **asType**<**short int**>((div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p3, 178).rem * **asType**<**int**>($heap_{funcstart\_719,1}$.r3)) − (**asType**<**int**>(**asType**<**short int**>(div3.quot)) * **asType**<**int**>($heap_{719,1;730,8}$.b3)))))

→ *[const static or extern object]*

[36.8] $heap_{719,1;731,8}$ == $heap_{funcstart\_719,1}$. **replace**(p1 → ((-2 * div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p1, 177).rem))). **replace**(p2 → ((-35 * div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p2, 176).quot) + (172 * div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p2, 176).rem))). **replace**(p3 → **asType**<**short int**>((div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p3, 178).rem * **asType**<**int**>($heap_{init}$.r3)) − (**asType**<**int**>(**asType**<**short int**>(div3.quot)) * **asType**<**int**>($heap_{719,1;730,8}$.b3)))))

→ *[expand definition of constant 'r3' at prang.c (25,20)]*

[36.9] $heap_{719,1;731,8}$ == $heap_{funcstart\_719,1}$. **replace**(p1 → ((-2 * div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p1, 177).rem))). **replace**(p2 → ((-35 * div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p2, 176).quot) + (172 * div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p2, 176).rem))). **replace**(p3 → **asType**<**short int**>((div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p3, 178).rem * **asType**<**int**>(**asType**<**short int**>((**int**)170))) − (**asType**<**int**>(**asType**<**short int**>(div3.quot)) * **asType**<**int**>($heap_{719,1;730,8}$.b3)))))

→ *[simplify]*

[36.12] $heap_{719,1;731,8}$ == $heap_{funcstart\_719,1}$. **replace**(p1 → ((-2 * div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p1, 177).rem))). **replace**(p2 → ((-35 * div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p2, 176).quot) + (172 * div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p2, 176).rem))). **replace**(p3 → **asType**<**short int**>((div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p3, 178).rem * 170) − (**asType**<**int**>(**asType**<**short int**>(div3.quot)) * **asType**<**int**>($heap_{719,1;730,8}$.b3)))))

→ *[from term 19.6, div3 is equal to div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p3, 178)]*

[36.13] $heap_{719,1;731,8}$ == $heap_{funcstart\_719,1}$. **replace**(p1 → ((-2 * div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p1, 177).rem))). **replace**(p2 → ((-35 * div(**heapIs** $heap_{funcstart\_719,1}$,

$\$\text{heap}_{funcstart\_719,1}.\text{p2}, 176).\text{quot}) + (172 * \text{div}(\textbf{heapIs}\ \$\text{heap}_{funcstart\_719,1},$
$\$\text{heap}_{funcstart\_719,1}.\text{p2}, 176).\text{rem}))).\_\textbf{replace}(\text{p3} \rightarrow \textbf{asType}\textbf{<short int>}((170$
$* \text{div}(\textbf{heapIs}\ \$\text{heap}_{funcstart\_719,1}, \$\text{heap}_{funcstart\_719,1}.\text{p3}, 178).\text{rem}) -$
$(\textbf{asType}\textbf{<int>}(\textbf{asType}\textbf{<short int>}(\text{div}(\textbf{heapIs}\ \$\text{heap}_{funcstart\_719,1},$
$\$\text{heap}_{funcstart\_719,1}.\text{p3}, 178).\text{quot})) * \textbf{asType}\textbf{<int>}(\$\text{heap}_{719,1;730,8}.\text{b3}))))$

$\rightarrow$ *[simplify]*

[36.15] $\$\text{heap}_{719,1;731,8} == \$\text{heap}_{funcstart\_719,1}.\_\textbf{replace}(\text{p1} \rightarrow ((-2 *$
$\text{div}(\textbf{heapIs}\ \$\text{heap}_{funcstart\_719,1}, \$\text{heap}_{funcstart\_719,1}.\text{p1}, 177).\text{quot}) + (171 *$
$\text{div}(\textbf{heapIs}\ \$\text{heap}_{funcstart\_719,1}, \$\text{heap}_{funcstart\_719,1}.\text{p1},$
$177).\text{rem}))).\_\textbf{replace}(\text{p2} \rightarrow ((-35 * \text{div}(\textbf{heapIs}\ \$\text{heap}_{funcstart\_719,1},$
$\$\text{heap}_{funcstart\_719,1}.\text{p2}, 176).\text{quot}) + (172 * \text{div}(\textbf{heapIs}\ \$\text{heap}_{funcstart\_719,1},$
$\$\text{heap}_{funcstart\_719,1}.\text{p2}, 176).\text{rem}))).\_\textbf{replace}(\text{p3} \rightarrow \textbf{asType}\textbf{<short int>}((170$
$* \text{div}(\textbf{heapIs}\ \$\text{heap}_{funcstart\_719,1}, \$\text{heap}_{funcstart\_719,1}.\text{p3}, 178).\text{rem}) -$
$(\text{div}(\textbf{heapIs}\ \$\text{heap}_{funcstart\_719,1}, \$\text{heap}_{funcstart\_719,1}.\text{p3}, 178).\text{quot} *$
$\textbf{asType}\textbf{<int>}(\$\text{heap}_{719,1;730,8}.\text{b3}))))$

$\rightarrow$ *[from term 31.24, $\$\text{heap}_{719,1;730,8}$ is equal to*
$\$\text{heap}_{funcstart\_719,1}.\_\textbf{replace}(p1 \rightarrow ((-2 * \text{div}(\textbf{heapIs}\ \$\text{heap}_{funcstart\_719,1},$
$\$\text{heap}_{funcstart\_719,1}.p1, 177).quot) + (171 * \text{div}(\textbf{heapIs}\ \$\text{heap}_{funcstart\_719,1},$
$\$\text{heap}_{funcstart\_719,1}.p1, 177).rem))).\_\textbf{replace}(p2 \rightarrow (-35 * \text{div}(\textbf{heapIs}$
$\$\text{heap}_{funcstart\_719,1}, \$\text{heap}_{funcstart\_719,1}.p2, 176).quot) + (172 * \text{div}(\textbf{heapIs}$
$\$\text{heap}_{funcstart_719,1}, \$\text{heap}_{funcstart_719,1}.p2, 176).rem))]*

[36.16] $\$\text{heap}_{719,1;731,8} == \$\text{heap}_{funcstart\_719,1}.\_\textbf{replace}(\text{p1} \rightarrow ((-2 *$
$\text{div}(\textbf{heapIs}\ \$\text{heap}_{funcstart\_719,1}, \$\text{heap}_{funcstart\_719,1}.\text{p1}, 177).\text{quot}) + (171 *$
$\text{div}(\textbf{heapIs}\ \$\text{heap}_{funcstart\_719,1}, \$\text{heap}_{funcstart\_719,1}.\text{p1},$
$177).\text{rem}))).\_\textbf{replace}(\text{p2} \rightarrow ((-35 * \text{div}(\textbf{heapIs}\ \$\text{heap}_{funcstart\_719,1},$
$\$\text{heap}_{funcstart\_719,1}.\text{p2}, 176).\text{quot}) + (172 * \text{div}(\textbf{heapIs}\ \$\text{heap}_{funcstart\_719,1},$
$\$\text{heap}_{funcstart\_719,1}.\text{p2}, 176).\text{rem}))).\_\textbf{replace}(\text{p3} \rightarrow \textbf{asType}\textbf{<short int>}((170$
$* \text{div}(\textbf{heapIs}\ \$\text{heap}_{funcstart\_719,1}, \$\text{heap}_{funcstart\_719,1}.\text{p3}, 178).\text{rem}) -$
$(\text{div}(\textbf{heapIs}\ \$\text{heap}_{funcstart\_719,1}, \$\text{heap}_{funcstart\_719,1}.\text{p3}, 178).\text{quot} *$
$\textbf{asType}\textbf{<int>}(\$\text{heap}_{funcstart\_719,1}.\_\textbf{replace}(\text{p1} \rightarrow ((-2 * \text{div}(\textbf{heapIs}$
$\$\text{heap}_{funcstart\_719,1}, \$\text{heap}_{funcstart\_719,1}.\text{p1}, 177).\text{quot}) + (171 * \text{div}(\textbf{heapIs}$
$\$\text{heap}_{funcstart\_719,1}, \$\text{heap}_{funcstart\_719,1}.\text{p1}, 177).\text{rem}))).\_\textbf{replace}(\text{p2} \rightarrow ((-35$
$* \text{div}(\textbf{heapIs}\ \$\text{heap}_{funcstart\_719,1}, \$\text{heap}_{funcstart\_719,1}.\text{p2}, 176).\text{quot}) + (172 *$
$\text{div}(\textbf{heapIs}\ \$\text{heap}_{funcstart\_719,1}, \$\text{heap}_{funcstart\_719,1}.\text{p2}, 176).\text{rem}))).\text{b3}))))$

$\rightarrow$ *[const member of object with modified fields]*

[36.18] $\$\text{heap}_{719,1;731,8} == \$\text{heap}_{funcstart\_719,1}.\_\textbf{replace}(\text{p1} \rightarrow ((-2 *$
$\text{div}(\textbf{heapIs}\ \$\text{heap}_{funcstart\_719,1}, \$\text{heap}_{funcstart\_719,1}.\text{p1}, 177).\text{quot}) + (171 *$
$\text{div}(\textbf{heapIs}\ \$\text{heap}_{funcstart\_719,1}, \$\text{heap}_{funcstart\_719,1}.\text{p1},$
$177).\text{rem}))).\_\textbf{replace}(\text{p2} \rightarrow ((-35 * \text{div}(\textbf{heapIs}\ \$\text{heap}_{funcstart\_719,1},$
$\$\text{heap}_{funcstart\_719,1}.\text{p2}, 176).\text{quot}) + (172 * \text{div}(\textbf{heapIs}\ \$\text{heap}_{funcstart\_719,1},$
$\$\text{heap}_{funcstart\_719,1}.\text{p2}, 176).\text{rem}))).\_\textbf{replace}(\text{p3} \rightarrow \textbf{asType}\textbf{<short int>}((170$
$* \text{div}(\textbf{heapIs}\ \$\text{heap}_{funcstart\_719,1}, \$\text{heap}_{funcstart\_719,1}.\text{p3}, 178).\text{rem}) -$
$(\text{div}(\textbf{heapIs}\ \$\text{heap}_{funcstart\_719,1}, \$\text{heap}_{funcstart\_719,1}.\text{p3}, 178).\text{quot} *$

asType<int>($heap$_{funcstart_719,1}$.b3))))

→ *[const static or extern object]*

[36.19] $heap$_{719,1;731,8}$ == $heap$_{funcstart_719,1}$._**replace**(p1 → ((-2 *
div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1, 177).quot) + (171 *
div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1,
177).rem)))._**replace**(p2 → ((-35 * div(**heapIs** $heap$_{funcstart_719,1}$,
$heap$_{funcstart_719,1}$.p2, 176).quot) + (172 * div(**heapIs** $heap$_{funcstart_719,1}$,
$heap$_{funcstart_719,1}$.p2, 176).rem)))._**replace**(p3 → **asType<short int>**((170
* div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p3, 178).rem) −
(div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p3, 178).quot *
asType<int>($heap$_{init}$.b3))))

→ *[expand definition of constant 'b3' at prang.c (27,20)]*

[36.20] $heap$_{719,1;731,8}$ == $heap$_{funcstart_719,1}$._**replace**(p1 → ((-2 *
div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1, 177).quot) + (171 *
div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1,
177).rem)))._**replace**(p2 → ((-35 * div(**heapIs** $heap$_{funcstart_719,1}$,
$heap$_{funcstart_719,1}$.p2, 176).quot) + (172 * div(**heapIs** $heap$_{funcstart_719,1}$,
$heap$_{funcstart_719,1}$.p2, 176).rem)))._**replace**(p3 → **asType<short int>**((170
* div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p3, 178).rem) −
(div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p3, 178).quot *
asType<int>(**asType<short int>**((**int**)63)))))

→ *[simplify]*

[36.26] $heap$_{719,1;731,8}$ == $heap$_{funcstart_719,1}$._**replace**(p1 → ((-2 *
div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1, 177).quot) + (171 *
div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1,
177).rem)))._**replace**(p2 → ((-35 * div(**heapIs** $heap$_{funcstart_719,1}$,
$heap$_{funcstart_719,1}$.p2, 176).quot) + (172 * div(**heapIs** $heap$_{funcstart_719,1}$,
$heap$_{funcstart_719,1}$.p2, 176).rem)))._**replace**(p3 → ((-63 * div(**heapIs**
$heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p3, 178).quot) + (170 * div(**heapIs**
$heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p3, 178).rem)))

[Take goal term]

[1.0] **minof(int)** ≤ **static_cast<integer>**(**asType<int>**($heap$_{719,1;731,8}$.p1)
< (**int**)0)

→ *[simplify]*

[1.1] -32768 ≤ **static_cast<integer>**(**asType<int>**($heap$_{719,1;731,8}$.p1) <
(**int**)0)

→ *[from term 36.26, $heap$_{719,1;731,8}$ is equal to
$heap$_{funcstart_719,1}$._**replace**(p1 → ((-2 * div(**heapIs** $heap$_{funcstart_719,1}$,
$heap$_{funcstart_719,1}$.p1, 177).quot) + (171 * div(**heapIs** $heap$_{funcstart_719,1}$,
$heap$_{funcstart_719,1}$.p1, 177).rem)))._**replace**(p2 → ((-35 * div(**heapIs**
$heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p2, 176).quot) + (172 * div(**heapIs**

$\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).rem))). _**replace**(p3 → (-63 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p3, 178).quot) + (170 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p3, 178).rem))]

[1.2] -32768 ≤
static_cast<integer>(**asType<int>**($\$heap_{funcstart\_719,1}$._**replace**(p1 →
((-2 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot) +
(171 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1,
177).rem))). _**replace**(p2 → ((-35 * div(**heapIs** $\$heap_{funcstart\_719,1}$,
$\$heap_{funcstart\_719,1}$.p2, 176).quot) + (172 * div(**heapIs** $\$heap_{funcstart\_719,1}$,
$\$heap_{funcstart\_719,1}$.p2, 176).rem))). _**replace**(p3 → ((-63 * div(**heapIs**
$\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p3, 178).quot) + (170 * div(**heapIs**
$\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p3, 178).rem))).p1) < (**int**)0)

→ *[simplify]*

[1.14] -32768 ≤ ([0 < ((-171 * div(**heapIs** $\$heap_{funcstart\_719,1}$,
$\$heap_{funcstart\_719,1}$.p1, 177).rem) + (2 * div(**heapIs** $\$heap_{funcstart\_719,1}$,
$\$heap_{funcstart\_719,1}$.p1, 177).quot))]: 1, []: 0)

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

[1.15] -32768 ≤ ([0 < ((-171 * div(**heapIs** $\$heap_{funcstart\_719,1}$,
$\$heap_{funcstart\_719,1}$.p1, 177).rem) + (2 * div(**heapIs** $\$heap_{funcstart\_719,1}$,
$\$heap_{funcstart\_719,1}$.p1, 177).quot))]: 1, [!(0 < ((-171 * div(**heapIs**
$\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).rem) + (2 * div(**heapIs**
$\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot)))]: 0)

→ *[simplify]*

[1.22] -32769 < ([0 < ((-171 * div(**heapIs** $\$heap_{funcstart\_719,1}$,
$\$heap_{funcstart\_719,1}$.p1, 177).rem) + (2 * div(**heapIs** $\$heap_{funcstart\_719,1}$,
$\$heap_{funcstart\_719,1}$.p1, 177).quot))]: 1, [-1 < ((-2 * div(**heapIs**
$\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs**
$\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).rem))]: 0)

→ *[move guard outside expression]*

[1.23] ([0 < ((-171 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1,
177).rem) + (2 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1,
177).quot))]: -32769 < 1, [-1 < ((-2 * div(**heapIs** $\$heap_{funcstart\_719,1}$,
$\$heap_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_719,1}$,
$\$heap_{funcstart\_719,1}$.p1, 177).rem))]: -32769 < 0)

→ *[simplify]*

[1.25] ([0 < ((-171 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1,
177).rem) + (2 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1,
177).quot))]: **true**, [-1 < ((-2 * div(**heapIs** $\$heap_{funcstart\_719,1}$,
$\$heap_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_719,1}$,
$\$heap_{funcstart\_719,1}$.p1, 177).rem))]: **true**)

→ *[all guards have equal guarded terms]*

[1.26] **true**

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

Condition generated at: C:\Escher\Customers\prang\prang.c (51,11)

Condition defined at:

To prove: static_cast<integer>(asType<int>($heap$_{719,1;731,8}$.p1) < (int)0) ≤ 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)

$heap$_{init}$.b1 == **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)

$heap$_{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)

$heap$_{init}$.b3 == **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)

div1 == div(**heapIs** $heap$_{funcstart_719,1}$, **asType<int>**($heap$_{funcstart\_719,1}$.p1), **asType<int>**($heap$_{funcstart_719,1}$.a1))

(**asType<integer>**(**asType<int>**($heap$_{funcstart_719,1}$.p1)) / **asType<integer>**(**asType<int>**($heap$_{funcstart\_719,1}$.a1))) == **asType<integer>**(div1.quot)

(**asType<integer>**(**asType<int>**($heap$_{funcstart_719,1}$.p1)) % **asType<integer>**(**asType<int>**($heap$_{funcstart\_719,1}$.a1))) == **asType<integer>**(div1.rem)

div2 == div(**heapIs** $heap$_{funcstart_719,1}$,

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asType\<int\>($\text{\$heap}_{funcstart\_719,1}.\text{p2}$),
asType\<int\>($\text{\$heap}_{funcstart\_719,1}.\text{a2}$))

(**asType\<integer\>**(**asType\<int\>**($\text{\$heap}_{funcstart\_719,1}.\text{p2}$)) /
asType\<integer\>(**asType\<int\>**($\text{\$heap}_{funcstart\_719,1}.\text{a2}$))) ==
asType\<integer\>(div2.quot)

(**asType\<integer\>**(**asType\<int\>**($\text{\$heap}_{funcstart\_719,1}.\text{p2}$)) %
asType\<integer\>(**asType\<int\>**($\text{\$heap}_{funcstart\_719,1}.\text{a2}$))) ==
asType\<integer\>(div2.rem)

div3 == div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$,
asType\<int\>($\text{\$heap}_{funcstart\_719,1}.\text{p3}$),
asType\<int\>($\text{\$heap}_{funcstart\_719,1}.\text{a3}$))

(**asType\<integer\>**(**asType\<int\>**($\text{\$heap}_{funcstart\_719,1}.\text{p3}$)) /
asType\<integer\>(**asType\<int\>**($\text{\$heap}_{funcstart\_719,1}.\text{a3}$))) ==
asType\<integer\>(div3.quot)

(**asType\<integer\>**(**asType\<int\>**($\text{\$heap}_{funcstart\_719,1}.\text{p3}$)) %
asType\<integer\>(**asType\<int\>**($\text{\$heap}_{funcstart\_719,1}.\text{a3}$))) ==
asType\<integer\>(div3.rem)

$\text{\$heap}_{719,1;729,8}$ == $\text{\$heap}_{funcstart\_719,1}.$**replace**(p1 → **asType\<short
int\>**((**asType\<int\>**(**asType\<short int\>**(div1.rem)) *
asType\<int\>($\text{\$heap}_{funcstart\_719,1}.\text{r1}$)) − (**asType\<int\>**(**asType\<short
int\>**(div1.quot)) * **asType\<int\>**($\text{\$heap}_{funcstart\_719,1}.\text{b1}$)))))

$\text{\$heap}_{719,1;730,8}$ == $\text{\$heap}_{719,1;729,8}.$**replace**(p2 → **asType\<short
int\>**((**asType\<int\>**(**asType\<short int\>**(div2.rem)) *
asType\<int\>($\text{\$heap}_{719,1;729,8}.\text{r2}$)) − (**asType\<int\>**(**asType\<short
int\>**(div2.quot)) * **asType\<int\>**($\text{\$heap}_{719,1;729,8}.\text{b2}$)))))

$\text{\$heap}_{719,1;731,8}$ == $\text{\$heap}_{719,1;730,8}.$**replace**(p3 → **asType\<short
int\>**((**asType\<int\>**(**asType\<short int\>**(div3.rem)) *
asType\<int\>($\text{\$heap}_{719,1;730,8}.\text{r3}$)) − (**asType\<int\>**(**asType\<short
int\>**(div3.quot)) * **asType\<int\>**($\text{\$heap}_{719,1;730,8}.\text{b3}$)))))

Proof:

[Take given term]

[5.0] div1 == div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$,
asType\<int\>($\text{\$heap}_{funcstart\_719,1}.\text{p1}$),
asType\<int\>($\text{\$heap}_{funcstart\_719,1}.\text{a1}$))

→ *[simplify]*

[5.1] div1 == div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}.\text{p1}$,
asType\<int\>($\text{\$heap}_{funcstart\_719,1}.\text{a1}$))

→ *[const static or extern object]*

[5.2] div1 == div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}.\text{p1}$,

asType<**int**>($heap$_{init}$.a1))

$\rightarrow$ *[expand definition of constant 'a1' at prang.c (16,20)]*

[5.3] div1 == div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1,
asType<**int**>(**asType**<**short int**>((**int**)177)))

$\rightarrow$ *[simplify]*

[5.6] div1 == div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1, 177)

[Take given term]

[12.0] div2 == div(**heapIs** $heap$_{funcstart_719,1}$,
asType<**int**>($heap$_{funcstart_719,1}$.p2),
asType<**int**>($heap$_{funcstart_719,1}$.a2))

$\rightarrow$ *[simplify]*

[12.1] div2 == div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p2,
asType<**int**>($heap$_{funcstart_719,1}$.a2))

$\rightarrow$ *[const static or extern object]*

[12.2] div2 == div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p2,
asType<**int**>($heap$_{init}$.a2))

$\rightarrow$ *[expand definition of constant 'a2' at prang.c (21,20)]*

[12.3] div2 == div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p2,
asType<**int**>(**asType**<**short int**>((**int**)176)))

$\rightarrow$ *[simplify]*

[12.6] div2 == div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p2, 176)

[Take given term]

[19.0] div3 == div(**heapIs** $heap$_{funcstart_719,1}$,
asType<**int**>($heap$_{funcstart_719,1}$.p3),
asType<**int**>($heap$_{funcstart_719,1}$.a3))

$\rightarrow$ *[simplify]*

[19.1] div3 == div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p3,
asType<**int**>($heap$_{funcstart_719,1}$.a3))

$\rightarrow$ *[const static or extern object]*

[19.2] div3 == div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p3,
asType<**int**>($heap$_{init}$.a3))

$\rightarrow$ *[expand definition of constant 'a3' at prang.c (26,20)]*

[19.3] div3 == div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p3,
asType<**int**>(**asType**<**short int**>((**int**)178)))

$\rightarrow$ *[simplify]*

[19.6] div3 == div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p3, 178)

[Take given term]

[26.0] $\$heap_{719,1;729,8}$ == $\$heap_{funcstart\_719,1}$.**replace**(p1 → **asType<short int>**((**asType<int>**(**asType<short int>**(div1.rem)) * **asType<int>**($\$heap_{funcstart\_719,1}$.r1)) − (**asType<int>**(**asType<short int>**(div1.quot)) * **asType<int>**($\$heap_{funcstart\_719,1}$.b1))))

→ *[from term 5.6, div1 is equal to div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177)]*

[26.1] $\$heap_{719,1;729,8}$ == $\$heap_{funcstart\_719,1}$.**replace**(p1 → **asType<short int>**((**asType<int>**(**asType<short int>**(div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).rem)) * **asType<int>**($\$heap_{funcstart\_719,1}$.r1)) − (**asType<int>**(**asType<short int>**(div1.quot)) * **asType<int>**($\$heap_{funcstart\_719,1}$.b1))))

→ *[simplify]*

[26.3] $\$heap_{719,1;729,8}$ == $\$heap_{funcstart\_719,1}$.**replace**(p1 → **asType<short int>**((div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).rem * **asType<int>**($\$heap_{funcstart\_719,1}$.r1)) − (**asType<int>**(**asType<short int>**(div1.quot)) * **asType<int>**($\$heap_{funcstart\_719,1}$.b1))))

→ *[const static or extern object]*

[26.4] $\$heap_{719,1;729,8}$ == $\$heap_{funcstart\_719,1}$.**replace**(p1 → **asType<short int>**((div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).rem * **asType<int>**($\$heap_{init}$.r1)) − (**asType<int>**(**asType<short int>**(div1.quot)) * **asType<int>**($\$heap_{funcstart\_719,1}$.b1))))

→ *[expand definition of constant 'r1' at prang.c (15,20)]*

[26.5] $\$heap_{719,1;729,8}$ == $\$heap_{funcstart\_719,1}$.**replace**(p1 → **asType<short int>**((div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).rem * **asType<int>**(**asType<short int>**((**int**)171))) − (**asType<int>**(**asType<short int>**(div1.quot)) * **asType<int>**($\$heap_{funcstart\_719,1}$.b1))))

→ *[simplify]*

[26.8] $\$heap_{719,1;729,8}$ == $\$heap_{funcstart\_719,1}$.**replace**(p1 → **asType<short int>**((div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).rem * 171) − (**asType<int>**(**asType<short int>**(div1.quot)) * **asType<int>**($\$heap_{funcstart\_719,1}$.b1))))

→ *[from term 5.6, div1 is equal to div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177)]*

[26.9] $\$heap_{719,1;729,8}$ == $\$heap_{funcstart\_719,1}$.**replace**(p1 → **asType<short int>**((171 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).rem) − (**asType<int>**(**asType<short int>**(div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot)) * **asType<int>**($\$heap_{funcstart\_719,1}$.b1))))

→ *[simplify]*

[26.11] $\$heap_{719,1;729,8}$ == $\$heap_{funcstart\_719,1}$.__replace__(p1 → __asType__<__short int__>((171 * div(__heapIs__ $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).rem) − (div(__heapIs__ $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot * __asType__<__int__>($\$heap_{funcstart\_719,1}$.b1))))

→ *[const static or extern object]*

[26.12] $\$heap_{719,1;729,8}$ == $\$heap_{funcstart\_719,1}$.__replace__(p1 → __asType__<__short int__>((171 * div(__heapIs__ $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).rem) − (div(__heapIs__ $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot * __asType__<__int__>($\$heap_{init}$.b1))))

→ *[expand definition of constant 'b1' at prang.c (17,20)]*

[26.13] $\$heap_{719,1;729,8}$ == $\$heap_{funcstart\_719,1}$.__replace__(p1 → __asType__<__short int__>((171 * div(__heapIs__ $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).rem) − (div(__heapIs__ $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot * __asType__<__int__>(__asType__<__short int__>((__int__)2)))))

→ *[simplify]*

[26.19] $\$heap_{719,1;729,8}$ == $\$heap_{funcstart\_719,1}$.__replace__(p1 → ((-2 * div(__heapIs__ $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(__heapIs__ $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).rem)))

[Take given term]

[31.0] $\$heap_{719,1;730,8}$ == $\$heap_{719,1;729,8}$.__replace__(p2 → __asType__<__short int__>((__asType__<__int__>(__asType__<__short int__>(div2.rem)) * __asType__<__int__>($\$heap_{719,1;729,8}$.r2)) − (__asType__<__int__>(__asType__<__short int__>(div2.quot)) * __asType__<__int__>($\$heap_{719,1;729,8}$.b2))))

→ *[from term 26.19, $heap_{719,1;729,8}$ is equal to $heap_{funcstart\_719,1}$.__replace__(p1 → (-2 * div(__heapIs__ $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(__heapIs__ $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p1, 177).rem))]*

[31.1] $\$heap_{719,1;730,8}$ == $\$heap_{funcstart\_719,1}$.__replace__(p1 → ((-2 * div(__heapIs__ $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(__heapIs__ $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).rem))).__replace__(p2 → __asType__<__short int__>((__asType__<__int__>(__asType__<__short int__>(div2.rem)) * __asType__<__int__>($\$heap_{719,1;729,8}$.r2)) − (__asType__<__int__>(__asType__<__short int__>(div2.quot)) * __asType__<__int__>($\$heap_{719,1;729,8}$.b2))))

→ *[from term 12.6, div2 is equal to div(__heapIs__ $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p2, 176)]*

[31.2] $\$heap_{719,1;730,8}$ == $\$heap_{funcstart\_719,1}$.__replace__(p1 → ((-2 * div(__heapIs__ $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(__heapIs__ $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1,

177).rem))).‗**replace**(p2 → **asType<short int>**((**asType<int>**(**asType<short int>**(div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).rem)) * **asType<int>**($\$heap_{719,1;729,8}$.r2)) − (**asType<int>**(**asType<short int>**(div2.quot)) * **asType<int>**($\$heap_{719,1;729,8}$.b2)))))

→ *[simplify]*

[31.4] $\$heap_{719,1;730,8}$ == $\$heap_{funcstart\_719,1}$.‗**replace**(p1 → ((-2 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).rem))).‗**replace**(p2 → **asType<short int>**((div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).rem * **asType<int>**($\$heap_{719,1;729,8}$.r2)) − (**asType<int>**(**asType<short int>**(div2.quot)) * **asType<int>**($\$heap_{719,1;729,8}$.b2)))))

→ *[from term 26.19, $\$heap_{719,1;729,8}$ is equal to $\$heap_{funcstart\_719,1}$.‗**replace***(p1 → (-2 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).rem))]*

[31.5] $\$heap_{719,1;730,8}$ == $\$heap_{funcstart\_719,1}$.‗**replace**(p1 → ((-2 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).rem))).‗**replace**(p2 → **asType<short int>**((div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).rem * **asType<int>**($\$heap_{funcstart\_719,1}$.‗**replace**(p1 → ((-2 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).rem))).r2)) − (**asType<int>**(**asType<short int>**(div2.quot)) * **asType<int>**($\$heap_{719,1;729,8}$.b2)))))

→ *[const member of object with modified fields]*

[31.6] $\$heap_{719,1;730,8}$ == $\$heap_{funcstart\_719,1}$.‗**replace**(p1 → ((-2 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).rem))).‗**replace**(p2 → **asType<short int>**((div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).rem * **asType<int>**($\$heap_{funcstart\_719,1}$.r2)) − (**asType<int>**(**asType<short int>**(div2.quot)) * **asType<int>**($\$heap_{719,1;729,8}$.b2)))))

→ *[const static or extern object]*

[31.7] $\$heap_{719,1;730,8}$ == $\$heap_{funcstart\_719,1}$.‗**replace**(p1 → ((-2 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).rem))).‗**replace**(p2 → **asType<short int>**((div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).rem * **asType<int>**($\$heap_{init}$.r2)) − (**asType<int>**(**asType<short int>**

int>(div2.quot)) * **asType**<**int**>($heap$_{719,1;729,8}$.b2))))

→ *[expand definition of constant 'r2' at prang.c (20,20)]*

[31.8] $heap$_{719,1;730,8}$ == $heap$_{funcstart_719,1}$.**replace**(p1 → ((-2 *
div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1, 177).quot) + (171 *
div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1,
177).rem))).**replace**(p2 → **asType**<**short int**>((div(**heapIs**
$heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p2, 176).rem *
asType<**int**>(**asType**<**short int**>((**int**)172))) −
(**asType**<**int**>(**asType**<**short int**>(div2.quot)) *
asType<**int**>($heap$_{719,1;729,8}$.b2))))

→ *[simplify]*

[31.11] $heap$_{719,1;730,8}$ == $heap$_{funcstart_719,1}$.**replace**(p1 → ((-2 *
div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1, 177).quot) + (171 *
div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1,
177).rem))).**replace**(p2 → **asType**<**short int**>((div(**heapIs**
$heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p2, 176).rem * 172) −
(**asType**<**int**>(**asType**<**short int**>(div2.quot)) *
asType<**int**>($heap$_{719,1;729,8}$.b2))))

→ *[from term 12.6, div2 is equal to div(**heapIs** $heap$_{funcstart_719,1}$,
$heap$_{funcstart_719,1}$.p2, 176)]*

[31.12] $heap$_{719,1;730,8}$ == $heap$_{funcstart_719,1}$.**replace**(p1 → ((-2 *
div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1, 177).quot) + (171 *
div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1,
177).rem))).**replace**(p2 → **asType**<**short int**>((172 * div(**heapIs**
$heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p2, 176).rem) −
(**asType**<**int**>(**asType**<**short int**>(div(**heapIs** $heap$_{funcstart_719,1}$,
$heap$_{funcstart_719,1}$.p2, 176).quot)) * **asType**<**int**>($heap$_{719,1;729,8}$.b2))))

→ *[simplify]*

[31.14] $heap$_{719,1;730,8}$ == $heap$_{funcstart_719,1}$.**replace**(p1 → ((-2 *
div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1, 177).quot) + (171 *
div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1,
177).rem))).**replace**(p2 → **asType**<**short int**>((172 * div(**heapIs**
$heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p2, 176).rem) − (div(**heapIs**
$heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p2, 176).quot *
asType<**int**>($heap$_{719,1;729,8}$.b2))))

→ *[from term 26.19, $heap$_{719,1;729,8}$ is equal to
$heap$_{funcstart_719,1}$.**replace**(p1 → (-2 * div(**heapIs** $heap$_{funcstart_719,1}$,
$heap$_{funcstart_719,1}$.p1, 177).quot) + (171 * div(**heapIs** $heap$_{funcstart_719,1}$,
$heap$_{funcstart_719,1}$.p1, 177).rem))]*

[31.15] $heap$_{719,1;730,8}$ == $heap$_{funcstart_719,1}$.**replace**(p1 → ((-2 *
div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1, 177).quot) + (171 *

div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1,
177).rem))).**_replace**(p2 → **asType<short int>**((172 * div(**heapIs**
$\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).rem) − (div(**heapIs**
$\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).quot *
asType<int>($\$heap_{funcstart\_719,1}$.**_replace**(p1 → ((-2 * div(**heapIs**
$\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs**
$\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).rem))).b2))))

→ *[const member of object with modified fields]*

[31.16] $\$heap_{719,1;730,8}$ == $\$heap_{funcstart\_719,1}$.**_replace**(p1 → ((-2 *
div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1,
177).rem))).**_replace**(p2 → **asType<short int>**((172 * div(**heapIs**
$\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).rem) − (div(**heapIs**
$\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).quot *
asType<int>($\$heap_{funcstart\_719,1}$.b2))))

→ *[const static or extern object]*

[31.17] $\$heap_{719,1;730,8}$ == $\$heap_{funcstart\_719,1}$.**_replace**(p1 → ((-2 *
div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1,
177).rem))).**_replace**(p2 → **asType<short int>**((172 * div(**heapIs**
$\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).rem) − (div(**heapIs**
$\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).quot *
asType<int>($\$heap_{init}$.b2))))

→ *[expand definition of constant 'b2' at prang.c (22,20)]*

[31.18] $\$heap_{719,1;730,8}$ == $\$heap_{funcstart\_719,1}$.**_replace**(p1 → ((-2 *
div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1,
177).rem))).**_replace**(p2 → **asType<short int>**((172 * div(**heapIs**
$\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).rem) − (div(**heapIs**
$\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).quot *
asType<int>(**asType<short int>**((**int**)35)))))

→ *[simplify]*

[31.24] $\$heap_{719,1;730,8}$ == $\$heap_{funcstart\_719,1}$.**_replace**(p1 → ((-2 *
div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1,
177).rem))).**_replace**(p2 → ((-35 * div(**heapIs** $\$heap_{funcstart\_719,1}$,
$\$heap_{funcstart\_719,1}$.p2, 176).quot) + (172 * div(**heapIs** $\$heap_{funcstart\_719,1}$,
$\$heap_{funcstart\_719,1}$.p2, 176).rem)))

[Take given term]

[36.0] $\$heap_{719,1;731,8}$ == $\$heap_{719,1;730,8}$.**_replace**(p3 → **asType<short
int>**((**asType<int>**(**asType<short int>**(div3.rem)) *

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asType<int>($heap$_{719,1;730,8}$.r3)) − (**asType<int>**(**asType<short int>**(div3.quot)) * **asType<int>**($heap$_{719,1;730,8}$.b3))))

→ *[from term 31.24, $heap$_{719,1;730,8}$ is equal to*
*$heap$_{funcstart_719,1}$.**replace**(p1 → ((-2 * div(**heapIs** $heap$_{funcstart_719,1}$,*
*$heap$_{funcstart_719,1}$.p1, 177).quot) + (171 * div(**heapIs** $heap$_{funcstart_719,1}$,*
*$heap$_{funcstart_719,1}$.p1, 177).rem))).**replace**(p2 → (-35 * div(**heapIs***
*$heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p2, 176).quot) + (172 * div(**heapIs***
$heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p2, 176).rem))]

[36.1] $heap$_{719,1;731,8}$ == $heap$_{funcstart_719,1}$.**replace**(p1 → ((-2 *
div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1, 177).quot) + (171 *
div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1,
177).rem))).**replace**(p2 → ((-35 * div(**heapIs** $heap$_{funcstart_719,1}$,
$heap$_{funcstart_719,1}$.p2, 176).quot) + (172 * div(**heapIs** $heap$_{funcstart_719,1}$,
$heap$_{funcstart_719,1}$.p2, 176).rem))).**replace**(p3 → **asType<short
int>**((**asType<int>**(**asType<short int>**(div3.rem)) *
asType<int>($heap$_{719,1;730,8}$.r3)) − (**asType<int>**(**asType<short
int>**(div3.quot)) * **asType<int>**($heap$_{719,1;730,8}$.b3))))

→ *[from term 19.6, div3 is equal to div(**heapIs** $heap$_{funcstart_719,1}$,*
$heap$_{funcstart_719,1}$.p3, 178)]

[36.2] $heap$_{719,1;731,8}$ == $heap$_{funcstart_719,1}$.**replace**(p1 → ((-2 *
div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1, 177).quot) + (171 *
div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1,
177).rem))).**replace**(p2 → ((-35 * div(**heapIs** $heap$_{funcstart_719,1}$,
$heap$_{funcstart_719,1}$.p2, 176).quot) + (172 * div(**heapIs** $heap$_{funcstart_719,1}$,
$heap$_{funcstart_719,1}$.p2, 176).rem))).**replace**(p3 → **asType<short
int>**((**asType<int>**(**asType<short int>**(div(**heapIs** $heap$_{funcstart_719,1}$,
$heap$_{funcstart_719,1}$.p3, 178).rem)) * **asType<int>**($heap$_{719,1;730,8}$.r3)) −
(**asType<int>**(**asType<short int>**(div3.quot)) *
asType<int>($heap$_{719,1;730,8}$.b3))))

→ *[simplify]*

[36.4] $heap$_{719,1;731,8}$ == $heap$_{funcstart_719,1}$.**replace**(p1 → ((-2 *
div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1, 177).quot) + (171 *
div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1,
177).rem))).**replace**(p2 → ((-35 * div(**heapIs** $heap$_{funcstart_719,1}$,
$heap$_{funcstart_719,1}$.p2, 176).quot) + (172 * div(**heapIs** $heap$_{funcstart_719,1}$,
$heap$_{funcstart_719,1}$.p2, 176).rem))).**replace**(p3 → **asType<short
int>**((div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p3, 178).rem *
asType<int>($heap$_{719,1;730,8}$.r3)) − (**asType<int>**(**asType<short
int>**(div3.quot)) * **asType<int>**($heap$_{719,1;730,8}$.b3))))

→ *[from term 31.24, $heap$_{719,1;730,8}$ is equal to*
*$heap$_{funcstart_719,1}$.**replace**(p1 → ((-2 * div(**heapIs** $heap$_{funcstart_719,1}$,*
*$heap$_{funcstart_719,1}$.p1, 177).quot) + (171 * div(**heapIs** $heap$_{funcstart_719,1}$,*
*$heap$_{funcstart_719,1}$.p1, 177).rem))).**replace**(p2 → (-35 * div(**heapIs***

$\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}.p2$, 176).quot) + (172 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}.p2$, 176).rem))]*

[36.5] $\$heap_{719,1;731,8}$ == $\$heap_{funcstart\_719,1}$.**replace**(p1 → ((-2 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}.p1$, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}.p1$, 177).rem))).**replace**(p2 → ((-35 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}.p2$, 176).quot) + (172 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}.p2$, 176).rem))).**replace**(p3 → **asType**<**short int**>((div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}.p3$, 178).rem * **asType**<**int**>($\$heap_{funcstart\_719,1}$.**replace**(p1 → ((-2 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}.p1$, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}.p1$, 177).rem))).**replace**(p2 → ((-35 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}.p2$, 176).quot) + (172 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}.p2$, 176).rem))).r3)) − (**asType**<**int**>(**asType**<**short int**>(div3.quot)) * **asType**<**int**>($\$heap_{719,1;730,8}.b3$)))))

→ *[const member of object with modified fields]*

[36.7] $\$heap_{719,1;731,8}$ == $\$heap_{funcstart\_719,1}$.**replace**(p1 → ((-2 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}.p1$, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}.p1$, 177).rem))).**replace**(p2 → ((-35 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}.p2$, 176).quot) + (172 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}.p2$, 176).rem))).**replace**(p3 → **asType**<**short int**>((div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}.p3$, 178).rem * **asType**<**int**>($\$heap_{funcstart\_719,1}.r3$)) − (**asType**<**int**>(**asType**<**short int**>(div3.quot)) * **asType**<**int**>($\$heap_{719,1;730,8}.b3$)))))

→ *[const static or extern object]*

[36.8] $\$heap_{719,1;731,8}$ == $\$heap_{funcstart\_719,1}$.**replace**(p1 → ((-2 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}.p1$, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}.p1$, 177).rem))).**replace**(p2 → ((-35 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}.p2$, 176).quot) + (172 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}.p2$, 176).rem))).**replace**(p3 → **asType**<**short int**>((div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}.p3$, 178).rem * **asType**<**int**>($\$heap_{init}.r3$)) − (**asType**<**int**>(**asType**<**short int**>(div3.quot)) * **asType**<**int**>($\$heap_{719,1;730,8}.b3$)))))

→ *[expand definition of constant 'r3' at prang.c (25,20)]*

[36.9] $\$heap_{719,1;731,8}$ == $\$heap_{funcstart\_719,1}$.**replace**(p1 → ((-2 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}.p1$, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}.p1$, 177).rem))).**replace**(p2 → ((-35 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}.p2$, 176).quot) + (172 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}.p2$, 176).rem))).**replace**(p3 → **asType**<**short**

int>((div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p3, 178).rem *
asType\<int>(**asType\<short int>**((**int**)170))) −
(**asType\<int>**(**asType\<short int>**(div3.quot)) *
asType\<int>($\$heap_{719,1;730,8}$.b3)))))

→ *[simplify]*

[36.12] $\$heap_{719,1;731,8}$ == $\$heap_{funcstart\_719,1}$.**replace**(p1 → ((-2 *
div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1,
177).rem))).**replace**(p2 → ((-35 * div(**heapIs** $\$heap_{funcstart\_719,1}$,
$\$heap_{funcstart\_719,1}$.p2, 176).quot) + (172 * div(**heapIs** $\$heap_{funcstart\_719,1}$,
$\$heap_{funcstart\_719,1}$.p2, 176).rem))).**replace**(p3 → **asType\<short
int>**((div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p3, 178).rem * 170)
− (**asType\<int>**(**asType\<short int>**(div3.quot)) *
asType\<int>($\$heap_{719,1;730,8}$.b3)))))

→ *[from term 19.6, div3 is equal to div(**heapIs** $\$heap_{funcstart\_719,1}$,
$\$heap_{funcstart\_719,1}$.p3, 178)]*

[36.13] $\$heap_{719,1;731,8}$ == $\$heap_{funcstart\_719,1}$.**replace**(p1 → ((-2 *
div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1,
177).rem))).**replace**(p2 → ((-35 * div(**heapIs** $\$heap_{funcstart\_719,1}$,
$\$heap_{funcstart\_719,1}$.p2, 176).quot) + (172 * div(**heapIs** $\$heap_{funcstart\_719,1}$,
$\$heap_{funcstart\_719,1}$.p2, 176).rem))).**replace**(p3 → **asType\<short int>**((170
* div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p3, 178).rem) −
(**asType\<int>**(**asType\<short int>**(div(**heapIs** $\$heap_{funcstart\_719,1}$,
$\$heap_{funcstart\_719,1}$.p3, 178).quot)) * **asType\<int>**($\$heap_{719,1;730,8}$.b3)))))

→ *[simplify]*

[36.15] $\$heap_{719,1;731,8}$ == $\$heap_{funcstart\_719,1}$.**replace**(p1 → ((-2 *
div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1,
177).rem))).**replace**(p2 → ((-35 * div(**heapIs** $\$heap_{funcstart\_719,1}$,
$\$heap_{funcstart\_719,1}$.p2, 176).quot) + (172 * div(**heapIs** $\$heap_{funcstart\_719,1}$,
$\$heap_{funcstart\_719,1}$.p2, 176).rem))).**replace**(p3 → **asType\<short int>**((170
* div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p3, 178).rem) −
(div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p3, 178).quot *
asType\<int>($\$heap_{719,1;730,8}$.b3)))))

→ *[from term 31.24, $\$heap_{719,1;730,8}$ is equal to
$\$heap_{funcstart\_719,1}$.**replace**(p1 → ((-2 * div(**heapIs** $\$heap_{funcstart\_719,1}$,
$\$heap_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_719,1}$,
$\$heap_{funcstart\_719,1}$.p1, 177).rem))).**replace**(p2 → (-35 * div(**heapIs**
$\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).quot) + (172 * div(**heapIs**
$\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).rem))]*

[36.16] $\$heap_{719,1;731,8}$ == $\$heap_{funcstart\_719,1}$.**replace**(p1 → ((-2 *

div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).rem))).**_replace**(p2 → ((-35 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).quot) + (172 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).rem))).**_replace**(p3 → **asType**<**short int**>((170 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p3, 178).rem) − (div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p3, 178).quot * **asType**<**int**>($\$heap_{funcstart\_719,1}$.**_replace**(p1 → ((-2 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).rem))).**_replace**(p2 → ((-35 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).quot) + (172 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).rem))).b3))))

→ *[const member of object with modified fields]*

[36.18] $\$heap_{719,1;731,8}$ == $\$heap_{funcstart\_719,1}$.**_replace**(p1 → ((-2 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).rem))).**_replace**(p2 → ((-35 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).quot) + (172 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).rem))).**_replace**(p3 → **asType**<**short int**>((170 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p3, 178).rem) − (div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p3, 178).quot * **asType**<**int**>($\$heap_{funcstart\_719,1}$.b3))))

→ *[const static or extern object]*

[36.19] $\$heap_{719,1;731,8}$ == $\$heap_{funcstart\_719,1}$.**_replace**(p1 → ((-2 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).rem))).**_replace**(p2 → ((-35 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).quot) + (172 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).rem))).**_replace**(p3 → **asType**<**short int**>((170 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p3, 178).rem) − (div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p3, 178).quot * **asType**<**int**>($\$heap_{init}$.b3))))

→ *[expand definition of constant 'b3' at prang.c (27,20)]*

[36.20] $\$heap_{719,1;731,8}$ == $\$heap_{funcstart\_719,1}$.**_replace**(p1 → ((-2 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).rem))).**_replace**(p2 → ((-35 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).quot) + (172 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).rem))).**_replace**(p3 → **asType**<**short int**>((170 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p3, 178).rem) − (div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p3, 178).quot * **asType**<**int**>(**asType**<**short int**>((**int**)63)))))

→ *[simplify]*

[36.26] $\text{\$heap}_{719,1;731,8}$ == $\text{\$heap}_{funcstart\_719,1}.$**replace**(p1 → ((-2 *
div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}.$p1, 177).quot) + (171 *
div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}.$p1,
177).rem))).**replace**(p2 → ((-35 * div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$,
$\text{\$heap}_{funcstart\_719,1}.$p2, 176).quot) + (172 * div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$,
$\text{\$heap}_{funcstart\_719,1}.$p2, 176).rem))).**replace**(p3 → ((-63 * div(**heapIs**
$\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}.$p3, 178).quot) + (170 * div(**heapIs**
$\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}.$p3, 178).rem)))

[Take goal term]

[1.0] **static_cast<integer>**(**asType<int>**($\text{\$heap}_{719,1;731,8}.$p1) < (**int**)0) ≤
maxof(**int**)

→ *[from term 36.26, $heap_{719,1;731,8}$ is equal to*
*$heap_{funcstart\_719,1}.$**replace***(p1 → ((-2 * div(**heapIs** $heap_{funcstart\_719,1}$,*
*$heap_{funcstart\_719,1}.$p1, 177).quot) + (171 * div(**heapIs** $heap_{funcstart\_719,1}$,*
*$heap_{funcstart\_719,1}.$p1, 177).rem))).**replace***(p2 → ((-35 * div(**heapIs***
*$heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}.$p2, 176).quot) + (172 * div(**heapIs***
*$heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}.$p2, 176).rem))).**replace***(p3 → (-63 **
*div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}.$p3, 178).quot) + (170 **
*div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}.$p3, 178).rem))]*

[1.1] **static_cast<integer>**(**asType<int>**($\text{\$heap}_{funcstart\_719,1}.$**replace**(p1
→ ((-2 * div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}.$p1, 177).quot) +
(171 * div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}.$p1,
177).rem))).**replace**(p2 → ((-35 * div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$,
$\text{\$heap}_{funcstart\_719,1}.$p2, 176).quot) + (172 * div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$,
$\text{\$heap}_{funcstart\_719,1}.$p2, 176).rem))).**replace**(p3 → ((-63 * div(**heapIs**
$\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}.$p3, 178).quot) + (170 * div(**heapIs**
$\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}.$p3, 178).rem)))).p1) < (**int**)0) ≤
maxof(**int**)

→ *[simplify]*

[1.13] ([0 < ((-171 * div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}.$p1,
177).rem) + (2 * div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}.$p1,
177).quot))]: 1, []: 0) ≤ **maxof**(**int**)

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

[1.14] ([0 < ((-171 * div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}.$p1,
177).rem) + (2 * div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}.$p1,
177).quot))]: 1, [!(0 < ((-171 * div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$,
$\text{\$heap}_{funcstart\_719,1}.$p1, 177).rem) + (2 * div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$,
$\text{\$heap}_{funcstart\_719,1}.$p1, 177).quot)))]: 0) ≤ **maxof**(**int**)

→ *[simplify]*

[1.21] (-1 + ([0 < ((-171 * div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$,
$\text{\$heap}_{funcstart\_719,1}.$p1, 177).rem) + (2 * div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$,

$\text{heap}_{funcstart\_719,1}.\text{p1}, 177).\text{quot})]: 1, [-1 < ((-2 * \text{div}(\textbf{heapIs}$
$\text{heap}_{funcstart\_719,1}, \$\text{heap}_{funcstart\_719,1}.\text{p1}, 177).\text{quot}) + (171 * \text{div}(\textbf{heapIs}$
$\text{heap}_{funcstart\_719,1}, \$\text{heap}_{funcstart\_719,1}.\text{p1}, 177).\text{rem})]: 0)) < 32767$

$\rightarrow$ *[move guard outside expression]*

[1.22] ([0 < ((-171 * div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}.\text{p1}$,
177).rem) + (2 * div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}.\text{p1}$,
177).quot))]: -1 + 1, [-1 < ((-2 * div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$,
$\$\text{heap}_{funcstart\_719,1}.\text{p1}$, 177).quot) + (171 * div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$,
$\$\text{heap}_{funcstart\_719,1}.\text{p1}$, 177).rem))]: -1 + 0) < 32767

$\rightarrow$ *[simplify]*

[1.25] 0 < (32767 + −([0 < ((-171 * div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$,
$\$\text{heap}_{funcstart\_719,1}.\text{p1}$, 177).rem) + (2 * div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$,
$\$\text{heap}_{funcstart\_719,1}.\text{p1}$, 177).quot))]: 0, [-1 < ((-2 * div(**heapIs**
$\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}.\text{p1}$, 177).quot) + (171 * div(**heapIs**
$\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}.\text{p1}$, 177).rem))]: -1))

$\rightarrow$ *[move guard outside expression]*

[1.26] 0 < (32767 + ([0 < ((-171 * div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$,
$\$\text{heap}_{funcstart\_719,1}.\text{p1}$, 177).rem) + (2 * div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$,
$\$\text{heap}_{funcstart\_719,1}.\text{p1}$, 177).quot))]: −0, [-1 < ((-2 * div(**heapIs**
$\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}.\text{p1}$, 177).quot) + (171 * div(**heapIs**
$\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}.\text{p1}$, 177).rem))]: −-1))

$\rightarrow$ *[simplify]*

[1.28] 0 < (32767 + ([0 < ((-171 * div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$,
$\$\text{heap}_{funcstart\_719,1}.\text{p1}$, 177).rem) + (2 * div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$,
$\$\text{heap}_{funcstart\_719,1}.\text{p1}$, 177).quot))]: 0, [-1 < ((-2 * div(**heapIs**
$\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}.\text{p1}$, 177).quot) + (171 * div(**heapIs**
$\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}.\text{p1}$, 177).rem))]: 1))

$\rightarrow$ *[move guard outside expression]*

[1.29] 0 < ([0 < ((-171 * div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$,
$\$\text{heap}_{funcstart\_719,1}.\text{p1}$, 177).rem) + (2 * div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$,
$\$\text{heap}_{funcstart\_719,1}.\text{p1}$, 177).quot))]: 0 + 32767, [-1 < ((-2 * div(**heapIs**
$\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}.\text{p1}$, 177).quot) + (171 * div(**heapIs**
$\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}.\text{p1}$, 177).rem))]: 1 + 32767)

$\rightarrow$ *[simplify]*

[1.31] 0 < ([0 < ((-171 * div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$,
$\$\text{heap}_{funcstart\_719,1}.\text{p1}$, 177).rem) + (2 * div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$,
$\$\text{heap}_{funcstart\_719,1}.\text{p1}$, 177).quot))]: 32767, [-1 < ((-2 * div(**heapIs**
$\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}.\text{p1}$, 177).quot) + (171 * div(**heapIs**
$\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}.\text{p1}$, 177).rem))]: 32768)

$\rightarrow$ *[move guard outside expression]*

[1.32] ([0 < ((-171 * div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}$.p1, 177).rem) + (2 * div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}$.p1, 177).quot))]: 0 < 32767, [-1 < ((-2 * div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}$.p1, 177).rem))]: 0 < 32768)

$\rightarrow$ *[simplify]*

[1.34] ([0 < ((-171 * div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}$.p1, 177).rem) + (2 * div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}$.p1, 177).quot))]: **true**, [-1 < ((-2 * div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}$.p1, 177).rem))]: **true**)

$\rightarrow$ *[all guards have equal guarded terms]*

[1.35] **true**

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

Condition generated at: C:\Escher\Customers\prang\prang.c (51,25)

Condition defined at:

To prove: minof(int) $\leq$ (**asType\<int\>**($\$\text{heap}_{719,1;731,8}$.M1) * **asType\<int\>**(**static_cast\<integer\>**(**asType\<int\>**($\$\text{heap}_{719,1;731,8}$.p1) < (**int**)0)))

Given:

$\$\text{heap}_{init}$.LIMIT == (**int**)80

$\$\text{heap}_{init}$.M1 == **asType\<short int\>**((**int**)30269)

$\$\text{heap}_{init}$.r1 == **asType\<short int\>**((**int**)171)

$\$\text{heap}_{init}$.a1 == **asType\<short int\>**((**int**)177)

$\$\text{heap}_{init}$.b1 == **asType\<short int\>**((**int**)2)

$\$\text{heap}_{init}$.M2 == **asType\<short int\>**((**int**)30307)

$\$\text{heap}_{init}$.r2 == **asType\<short int\>**((**int**)172)

$\$\text{heap}_{init}$.a2 == **asType\<short int\>**((**int**)176)

$\$\text{heap}_{init}$.b2 == **asType\<short int\>**((**int**)35)

$\$\text{heap}_{init}$.M3 == **asType\<short int\>**((**int**)30323)

$\$\text{heap}_{init}$.r3 == **asType\<short int\>**((**int**)170)

$\$\text{heap}_{init}$.a3 == **asType\<short int\>**((**int**)178)

$\$\text{heap}_{init}$.b3 == **asType\<short int\>**((**int**)63)

$\$\text{heap}_{init}$.p1 == **asType\<short int\>**((**int**)1)

$\$\text{heap}_{init}.\text{p2} == \textbf{asType}\textbf{<short int>}((\textbf{int})2)$

$\$\text{heap}_{init}.\text{p3} == \textbf{asType}\textbf{<short int>}((\textbf{int})3)$

$\text{div1} == \text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_719,1},$
$\textbf{asType}\textbf{<int>}(\$\text{heap}_{funcstart\_719,1}.\text{p1}),$
$\textbf{asType}\textbf{<int>}(\$\text{heap}_{funcstart\_719,1}.\text{a1}))$

$(\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<int>}(\$\text{heap}_{funcstart\_719,1}.\text{p1}))\;/$
$\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<int>}(\$\text{heap}_{funcstart\_719,1}.\text{a1}))) ==$
$\textbf{asType}\textbf{<integer>}(\text{div1.quot})$

$(\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<int>}(\$\text{heap}_{funcstart\_719,1}.\text{p1}))\;\%$
$\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<int>}(\$\text{heap}_{funcstart\_719,1}.\text{a1}))) ==$
$\textbf{asType}\textbf{<integer>}(\text{div1.rem})$

$\text{div2} == \text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_719,1},$
$\textbf{asType}\textbf{<int>}(\$\text{heap}_{funcstart\_719,1}.\text{p2}),$
$\textbf{asType}\textbf{<int>}(\$\text{heap}_{funcstart\_719,1}.\text{a2}))$

$(\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<int>}(\$\text{heap}_{funcstart\_719,1}.\text{p2}))\;/$
$\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<int>}(\$\text{heap}_{funcstart\_719,1}.\text{a2}))) ==$
$\textbf{asType}\textbf{<integer>}(\text{div2.quot})$

$(\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<int>}(\$\text{heap}_{funcstart\_719,1}.\text{p2}))\;\%$
$\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<int>}(\$\text{heap}_{funcstart\_719,1}.\text{a2}))) ==$
$\textbf{asType}\textbf{<integer>}(\text{div2.rem})$

$\text{div3} == \text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_719,1},$
$\textbf{asType}\textbf{<int>}(\$\text{heap}_{funcstart\_719,1}.\text{p3}),$
$\textbf{asType}\textbf{<int>}(\$\text{heap}_{funcstart\_719,1}.\text{a3}))$

$(\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<int>}(\$\text{heap}_{funcstart\_719,1}.\text{p3}))\;/$
$\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<int>}(\$\text{heap}_{funcstart\_719,1}.\text{a3}))) ==$
$\textbf{asType}\textbf{<integer>}(\text{div3.quot})$

$(\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<int>}(\$\text{heap}_{funcstart\_719,1}.\text{p3}))\;\%$
$\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<int>}(\$\text{heap}_{funcstart\_719,1}.\text{a3}))) ==$
$\textbf{asType}\textbf{<integer>}(\text{div3.rem})$

$\$\text{heap}_{719,1;729,8} == \$\text{heap}_{funcstart\_719,1}.\_\textbf{replace}(\text{p1} \rightarrow \textbf{asType}\textbf{<short}$
$\textbf{int>}((\textbf{asType}\textbf{<int>}(\textbf{asType}\textbf{<short int>}(\text{div1.rem}))\;*$
$\textbf{asType}\textbf{<int>}(\$\text{heap}_{funcstart\_719,1}.\text{r1})) - (\textbf{asType}\textbf{<int>}(\textbf{asType}\textbf{<short}$
$\textbf{int>}(\text{div1.quot}))\;*\;\textbf{asType}\textbf{<int>}(\$\text{heap}_{funcstart\_719,1}.\text{b1}))))$

$\$\text{heap}_{719,1;730,8} == \$\text{heap}_{719,1;729,8}.\_\textbf{replace}(\text{p2} \rightarrow \textbf{asType}\textbf{<short}$
$\textbf{int>}((\textbf{asType}\textbf{<int>}(\textbf{asType}\textbf{<short int>}(\text{div2.rem}))\;*$
$\textbf{asType}\textbf{<int>}(\$\text{heap}_{719,1;729,8}.\text{r2})) - (\textbf{asType}\textbf{<int>}(\textbf{asType}\textbf{<short}$
$\textbf{int>}(\text{div2.quot}))\;*\;\textbf{asType}\textbf{<int>}(\$\text{heap}_{719,1;729,8}.\text{b2}))))$

$\$\text{heap}_{719,1;731,8} == \$\text{heap}_{719,1;730,8}.\_\textbf{replace}(\text{p3} \rightarrow \textbf{asType}\textbf{<short}$
$\textbf{int>}((\textbf{asType}\textbf{<int>}(\textbf{asType}\textbf{<short int>}(\text{div3.rem}))\;*$
$\textbf{asType}\textbf{<int>}(\$\text{heap}_{719,1;730,8}.\text{r3})) - (\textbf{asType}\textbf{<int>}(\textbf{asType}\textbf{<short}$

int>(div3.quot)) * **asType**<**int**>($heap$_{719,1;730,8}$.b3))))

Proof:

[Take given term]

[5.0] div1 == div(**heapIs** $heap$_{funcstart_719,1}$,
asType<**int**>($heap$_{funcstart_719,1}$.p1),
asType<**int**>($heap$_{funcstart_719,1}$.a1))

→ *[simplify]*

[5.1] div1 == div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1,
asType<**int**>($heap$_{funcstart_719,1}$.a1))

→ *[const static or extern object]*

[5.2] div1 == div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1,
asType<**int**>($heap$_{init}$.a1))

→ *[expand definition of constant 'a1' at prang.c (16,20)]*

[5.3] div1 == div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1,
asType<**int**>(**asType**<**short int**>((**int**)177)))

→ *[simplify]*

[5.6] div1 == div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1, 177)

[Take given term]

[12.0] div2 == div(**heapIs** $heap$_{funcstart_719,1}$,
asType<**int**>($heap$_{funcstart_719,1}$.p2),
asType<**int**>($heap$_{funcstart_719,1}$.a2))

→ *[simplify]*

[12.1] div2 == div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p2,
asType<**int**>($heap$_{funcstart_719,1}$.a2))

→ *[const static or extern object]*

[12.2] div2 == div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p2,
asType<**int**>($heap$_{init}$.a2))

→ *[expand definition of constant 'a2' at prang.c (21,20)]*

[12.3] div2 == div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p2,
asType<**int**>(**asType**<**short int**>((**int**)176)))

→ *[simplify]*

[12.6] div2 == div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p2, 176)

[Take given term]

[19.0] div3 == div(**heapIs** $heap$_{funcstart_719,1}$,
asType<**int**>($heap$_{funcstart_719,1}$.p3),
asType<**int**>($heap$_{funcstart_719,1}$.a3))

$\rightarrow$ *[simplify]*

[19.1] div3 == div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p3, **asType**<**int**>($\$heap_{funcstart\_719,1}$.a3))

$\rightarrow$ *[const static or extern object]*

[19.2] div3 == div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p3, **asType**<**int**>($\$heap_{init}$.a3))

$\rightarrow$ *[expand definition of constant 'a3' at prang.c (26,20)]*

[19.3] div3 == div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p3, **asType**<**int**>(**asType**<**short int**>((**int**)178)))

$\rightarrow$ *[simplify]*

[19.6] div3 == div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p3, 178)

[Take given term]

[26.0] $\$heap_{719,1;729,8}$ == $\$heap_{funcstart\_719,1}$.**replace**(p1 $\rightarrow$ **asType**<**short int**>((**asType**<**int**>(**asType**<**short int**>(div1.rem)) * **asType**<**int**>($\$heap_{funcstart\_719,1}$.r1)) − (**asType**<**int**>(**asType**<**short int**>(div1.quot)) * **asType**<**int**>($\$heap_{funcstart\_719,1}$.b1)))))

$\rightarrow$ *[from term 5.6, div1 is equal to div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177)]*

[26.1] $\$heap_{719,1;729,8}$ == $\$heap_{funcstart\_719,1}$.**replace**(p1 $\rightarrow$ **asType**<**short int**>((**asType**<**int**>(**asType**<**short int**>(div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).rem)) * **asType**<**int**>($\$heap_{funcstart\_719,1}$.r1)) − (**asType**<**int**>(**asType**<**short int**>(div1.quot)) * **asType**<**int**>($\$heap_{funcstart\_719,1}$.b1)))))

$\rightarrow$ *[simplify]*

[26.3] $\$heap_{719,1;729,8}$ == $\$heap_{funcstart\_719,1}$.**replace**(p1 $\rightarrow$ **asType**<**short int**>((div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).rem * **asType**<**int**>($\$heap_{funcstart\_719,1}$.r1)) − (**asType**<**int**>(**asType**<**short int**>(div1.quot)) * **asType**<**int**>($\$heap_{funcstart\_719,1}$.b1)))))

$\rightarrow$ *[const static or extern object]*

[26.4] $\$heap_{719,1;729,8}$ == $\$heap_{funcstart\_719,1}$.**replace**(p1 $\rightarrow$ **asType**<**short int**>((div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).rem * **asType**<**int**>($\$heap_{init}$.r1)) − (**asType**<**int**>(**asType**<**short int**>(div1.quot)) * **asType**<**int**>($\$heap_{funcstart\_719,1}$.b1)))))

$\rightarrow$ *[expand definition of constant 'r1' at prang.c (15,20)]*

[26.5] $\$heap_{719,1;729,8}$ == $\$heap_{funcstart\_719,1}$.**replace**(p1 $\rightarrow$ **asType**<**short int**>((div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).rem * **asType**<**int**>(**asType**<**short int**>((**int**)171))) − (**asType**<**int**>(**asType**<**short int**>(div1.quot)) *

asType$<$**int**$>$($\text{\$heap}_{funcstart\_719,1}.$b1))))

$\rightarrow$ *[simplify]*

[26.8] $\text{\$heap}_{719,1;729,8} ==$ $\text{\$heap}_{funcstart\_719,1}.$**_replace**(p1 $\rightarrow$ **asType**$<$**short int**$>$((div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}.$p1, 177).rem * 171) $-$ (**asType**$<$**int**$>$(**asType**$<$**short int**$>$(div1.quot)) * **asType**$<$**int**$>$($\text{\$heap}_{funcstart\_719,1}.$b1))))

$\rightarrow$ *[from term 5.6, div1 is equal to div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}.$p1, 177)]*

[26.9] $\text{\$heap}_{719,1;729,8} ==$ $\text{\$heap}_{funcstart\_719,1}.$**_replace**(p1 $\rightarrow$ **asType**$<$**short int**$>$((171 * div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}.$p1, 177).rem) $-$ (**asType**$<$**int**$>$(**asType**$<$**short int**$>$(div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}.$p1, 177).quot)) * **asType**$<$**int**$>$($\text{\$heap}_{funcstart\_719,1}.$b1))))

$\rightarrow$ *[simplify]*

[26.11] $\text{\$heap}_{719,1;729,8} ==$ $\text{\$heap}_{funcstart\_719,1}.$**_replace**(p1 $\rightarrow$ **asType**$<$**short int**$>$((171 * div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}.$p1, 177).rem) $-$ (div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}.$p1, 177).quot * **asType**$<$**int**$>$($\text{\$heap}_{funcstart\_719,1}.$b1))))

$\rightarrow$ *[const static or extern object]*

[26.12] $\text{\$heap}_{719,1;729,8} ==$ $\text{\$heap}_{funcstart\_719,1}.$**_replace**(p1 $\rightarrow$ **asType**$<$**short int**$>$((171 * div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}.$p1, 177).rem) $-$ (div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}.$p1, 177).quot * **asType**$<$**int**$>$($\text{\$heap}_{init}.$b1))))

$\rightarrow$ *[expand definition of constant 'b1' at prang.c (17,20)]*

[26.13] $\text{\$heap}_{719,1;729,8} ==$ $\text{\$heap}_{funcstart\_719,1}.$**_replace**(p1 $\rightarrow$ **asType**$<$**short int**$>$((171 * div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}.$p1, 177).rem) $-$ (div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}.$p1, 177).quot * **asType**$<$**int**$>$(**asType**$<$**short int**$>$((**int**)2)))))

$\rightarrow$ *[simplify]*

[26.19] $\text{\$heap}_{719,1;729,8} ==$ $\text{\$heap}_{funcstart\_719,1}.$**_replace**(p1 $\rightarrow$ ((-2 * div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}.$p1, 177).quot) + (171 * div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}.$p1, 177).rem)))

[Take given term]

[31.0] $\text{\$heap}_{719,1;730,8} ==$ $\text{\$heap}_{719,1;729,8}.$**_replace**(p2 $\rightarrow$ **asType**$<$**short int**$>$((**asType**$<$**int**$>$(**asType**$<$**short int**$>$(div2.rem)) * **asType**$<$**int**$>$($\text{\$heap}_{719,1;729,8}.$r2)) $-$ (**asType**$<$**int**$>$(**asType**$<$**short int**$>$(div2.quot)) * **asType**$<$**int**$>$($\text{\$heap}_{719,1;729,8}.$b2))))

$\rightarrow$ *[from term 26.19, $\text{\$heap}_{719,1;729,8}$ is equal to $\text{\$heap}_{funcstart\_719,1}.$**_replace**(p1 $\rightarrow$ (-2 * div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$,*

$heap_{funcstart\_719,1}.p1, 177).quot) + (171 * div(\textbf{heapIs} \$heap_{funcstart\_719,1},$
$\$heap_{funcstart\_719,1}.p1, 177).rem))]$

[31.1] $\$heap_{719,1;730,8} ==$ $\$heap_{funcstart\_719,1}.\textbf{\_replace}(p1 \rightarrow ((-2 *$
div(\textbf{heapIs} $\$heap_{funcstart\_719,1}, \$heap_{funcstart\_719,1}.p1, 177).quot) + (171 *$
div(\textbf{heapIs} $\$heap_{funcstart\_719,1}, \$heap_{funcstart\_719,1}.p1,$
$177).rem))).\textbf{\_replace}(p2 \rightarrow \textbf{asType<short}$
$\textbf{int>}((\textbf{asType<int>}(\textbf{asType<short int>}(div2.rem)) *$
$\textbf{asType<int>}(\$heap_{719,1;729,8}.r2)) - (\textbf{asType<int>}(\textbf{asType<short}$
$\textbf{int>}(div2.quot)) * \textbf{asType<int>}(\$heap_{719,1;729,8}.b2))))$

$\rightarrow$ *[from term 12.6, div2 is equal to div(\textbf{heapIs} $heap_{funcstart\_719,1},$*
$\$heap_{funcstart\_719,1}.p2, 176)]$

[31.2] $\$heap_{719,1;730,8} ==$ $\$heap_{funcstart\_719,1}.\textbf{\_replace}(p1 \rightarrow ((-2 *$
div(\textbf{heapIs} $\$heap_{funcstart\_719,1}, \$heap_{funcstart\_719,1}.p1, 177).quot) + (171 *$
div(\textbf{heapIs} $\$heap_{funcstart\_719,1}, \$heap_{funcstart\_719,1}.p1,$
$177).rem))).\textbf{\_replace}(p2 \rightarrow \textbf{asType<short}$
$\textbf{int>}((\textbf{asType<int>}(\textbf{asType<short int>}(div(\textbf{heapIs} \$heap_{funcstart\_719,1},$
$\$heap_{funcstart\_719,1}.p2, 176).rem)) * \textbf{asType<int>}(\$heap_{719,1;729,8}.r2)) -$
$(\textbf{asType<int>}(\textbf{asType<short int>}(div2.quot)) *$
$\textbf{asType<int>}(\$heap_{719,1;729,8}.b2))))$

$\rightarrow$ *[simplify]*

[31.4] $\$heap_{719,1;730,8} ==$ $\$heap_{funcstart\_719,1}.\textbf{\_replace}(p1 \rightarrow ((-2 *$
div(\textbf{heapIs} $\$heap_{funcstart\_719,1}, \$heap_{funcstart\_719,1}.p1, 177).quot) + (171 *$
div(\textbf{heapIs} $\$heap_{funcstart\_719,1}, \$heap_{funcstart\_719,1}.p1,$
$177).rem))).\textbf{\_replace}(p2 \rightarrow \textbf{asType<short int>}((div(\textbf{heapIs}$
$\$heap_{funcstart\_719,1}, \$heap_{funcstart\_719,1}.p2, 176).rem *$
$\textbf{asType<int>}(\$heap_{719,1;729,8}.r2)) - (\textbf{asType<int>}(\textbf{asType<short}$
$\textbf{int>}(div2.quot)) * \textbf{asType<int>}(\$heap_{719,1;729,8}.b2))))$

$\rightarrow$ *[from term 26.19, $heap_{719,1;729,8}$ is equal to*
*$\$heap_{funcstart\_719,1}.\textbf{\_replace}(p1 \rightarrow (-2 * div(\textbf{heapIs} \$heap_{funcstart\_719,1},$*
*$\$heap_{funcstart\_719,1}.p1, 177).quot) + (171 * div(\textbf{heapIs} \$heap_{funcstart\_719,1},$*
$\$heap_{funcstart\_719,1}.p1, 177).rem))]$

[31.5] $\$heap_{719,1;730,8} ==$ $\$heap_{funcstart\_719,1}.\textbf{\_replace}(p1 \rightarrow ((-2 *$
div(\textbf{heapIs} $\$heap_{funcstart\_719,1}, \$heap_{funcstart\_719,1}.p1, 177).quot) + (171 *$
div(\textbf{heapIs} $\$heap_{funcstart\_719,1}, \$heap_{funcstart\_719,1}.p1,$
$177).rem))).\textbf{\_replace}(p2 \rightarrow \textbf{asType<short int>}((div(\textbf{heapIs}$
$\$heap_{funcstart\_719,1}, \$heap_{funcstart\_719,1}.p2, 176).rem *$
$\textbf{asType<int>}(\$heap_{funcstart\_719,1}.\textbf{\_replace}(p1 \rightarrow ((-2 * div(\textbf{heapIs}$
$\$heap_{funcstart\_719,1}, \$heap_{funcstart\_719,1}.p1, 177).quot) + (171 * div(\textbf{heapIs}$
$\$heap_{funcstart\_719,1}, \$heap_{funcstart\_719,1}.p1, 177).rem))).r2)) -$
$(\textbf{asType<int>}(\textbf{asType<short int>}(div2.quot)) *$
$\textbf{asType<int>}(\$heap_{719,1;729,8}.b2))))$

$\rightarrow$ *[const member of object with modified fields]*

[31.6] $\$heap_{719,1;730,8} == \$heap_{funcstart\_719,1}.\textbf{replace}$(p1 → ((-2 *
div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1,
177).rem)))._**replace**(p2 → **asType**<**short int**>((div(**heapIs**
$\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).rem *
asType<**int**>($\$heap_{funcstart\_719,1}$.r2)) − (**asType**<**int**>(**asType**<**short
int**>(div2.quot)) * **asType**<**int**>($\$heap_{719,1;729,8}$.b2))))

→ *[const static or extern object]*

[31.7] $\$heap_{719,1;730,8} == \$heap_{funcstart\_719,1}.\textbf{replace}$(p1 → ((-2 *
div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1,
177).rem)))._**replace**(p2 → **asType**<**short int**>((div(**heapIs**
$\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).rem *
asType<**int**>($\$heap_{init}$.r2)) − (**asType**<**int**>(**asType**<**short
int**>(div2.quot)) * **asType**<**int**>($\$heap_{719,1;729,8}$.b2))))

→ *[expand definition of constant 'r2' at prang.c (20,20)]*

[31.8] $\$heap_{719,1;730,8} == \$heap_{funcstart\_719,1}.\textbf{replace}$(p1 → ((-2 *
div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1,
177).rem)))._**replace**(p2 → **asType**<**short int**>((div(**heapIs**
$\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).rem *
asType<**int**>(**asType**<**short int**>((**int**)172))) −
(**asType**<**int**>(**asType**<**short int**>(div2.quot)) *
asType<**int**>($\$heap_{719,1;729,8}$.b2))))

→ *[simplify]*

[31.11] $\$heap_{719,1;730,8} == \$heap_{funcstart\_719,1}.\textbf{replace}$(p1 → ((-2 *
div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1,
177).rem)))._**replace**(p2 → **asType**<**short int**>((div(**heapIs**
$\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).rem * 172) −
(**asType**<**int**>(**asType**<**short int**>(div2.quot)) *
asType<**int**>($\$heap_{719,1;729,8}$.b2))))

→ *[from term 12.6, div2 is equal to div(**heapIs** $\$heap_{funcstart\_719,1}$,
$\$heap_{funcstart\_719,1}$.p2, 176)]*

[31.12] $\$heap_{719,1;730,8} == \$heap_{funcstart\_719,1}.\textbf{replace}$(p1 → ((-2 *
div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1,
177).rem)))._**replace**(p2 → **asType**<**short int**>((172 * div(**heapIs**
$\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).rem) −
(**asType**<**int**>(**asType**<**short int**>(div(**heapIs** $\$heap_{funcstart\_719,1}$,
$\$heap_{funcstart\_719,1}$.p2, 176).quot)) * **asType**<**int**>($\$heap_{719,1;729,8}$.b2))))

→ *[simplify]*

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[31.14] $\$heap_{719,1;730,8}$ == $\$heap_{funcstart\_719,1}$._**replace**(p1 → ((-2 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).rem)))._**replace**(p2 → **asType**<**short int**>((172 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).rem) − (div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).quot * **asType**<**int**>($\$heap_{719,1;729,8}$.b2))))

→ *[from term 26.19, $\$heap_{719,1;729,8}$ is equal to $\$heap_{funcstart\_719,1}$._**replace**(p1 → (-2 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).rem))]*

[31.15] $\$heap_{719,1;730,8}$ == $\$heap_{funcstart\_719,1}$._**replace**(p1 → ((-2 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).rem)))._**replace**(p2 → **asType**<**short int**>((172 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).rem) − (div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).quot * **asType**<**int**>($\$heap_{funcstart\_719,1}$._**replace**(p1 → ((-2 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).rem))).b2))))

→ *[const member of object with modified fields]*

[31.16] $\$heap_{719,1;730,8}$ == $\$heap_{funcstart\_719,1}$._**replace**(p1 → ((-2 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).rem)))._**replace**(p2 → **asType**<**short int**>((172 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).rem) − (div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).quot * **asType**<**int**>($\$heap_{funcstart\_719,1}$.b2))))

→ *[const static or extern object]*

[31.17] $\$heap_{719,1;730,8}$ == $\$heap_{funcstart\_719,1}$._**replace**(p1 → ((-2 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).rem)))._**replace**(p2 → **asType**<**short int**>((172 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).rem) − (div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).quot * **asType**<**int**>($\$heap_{init}$.b2))))

→ *[expand definition of constant 'b2' at prang.c (22,20)]*

[31.18] $\$heap_{719,1;730,8}$ == $\$heap_{funcstart\_719,1}$._**replace**(p1 → ((-2 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).rem)))._**replace**(p2 → **asType**<**short int**>((172 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).rem) − (div(**heapIs**

$\text{heap}_{funcstart\_719,1}$, $\text{heap}_{funcstart\_719,1}$.p2, 176).quot *
asType<int>(asType<short int>((int)35)))))

→ *[simplify]*

[31.24] $\text{heap}_{719,1;730,8}$ == $\text{heap}_{funcstart\_719,1}$.**replace**(p1 → ((-2 *
div(**heapIs** $\text{heap}_{funcstart\_719,1}$, $\text{heap}_{funcstart\_719,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\text{heap}_{funcstart\_719,1}$, $\text{heap}_{funcstart\_719,1}$.p1,
177).rem))).**replace**(p2 → ((-35 * div(**heapIs** $\text{heap}_{funcstart\_719,1}$,
$\text{heap}_{funcstart\_719,1}$.p2, 176).quot) + (172 * div(**heapIs** $\text{heap}_{funcstart\_719,1}$,
$\text{heap}_{funcstart\_719,1}$.p2, 176).rem)))

[Take given term]

[36.0] $\text{heap}_{719,1;731,8}$ == $\text{heap}_{719,1;730,8}$.**replace**(p3 → **asType<short
int>**((**asType<int>(asType<short int>**(div3.rem)) *
asType<int>($\text{heap}_{719,1;730,8}$.r3)) − (**asType<int>(asType<short
int>**(div3.quot)) * **asType<int>**($\text{heap}_{719,1;730,8}$.b3)))))

→ *[from term 31.24, $heap_{719,1;730,8}$ is equal to*
*$heap_{funcstart\_719,1}$.**replace**(p1 → ((-2 * div(**heapIs** $heap_{funcstart\_719,1}$,*
*$heap_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs** $heap_{funcstart\_719,1}$,*
*$heap_{funcstart\_719,1}$.p1, 177).rem))).**replace**(p2 → (-35 * div(**heapIs***
*$heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p2, 176).quot) + (172 * div(**heapIs***
$heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p2, 176).rem))]

[36.1] $\text{heap}_{719,1;731,8}$ == $\text{heap}_{funcstart\_719,1}$.**replace**(p1 → ((-2 *
div(**heapIs** $\text{heap}_{funcstart\_719,1}$, $\text{heap}_{funcstart\_719,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\text{heap}_{funcstart\_719,1}$, $\text{heap}_{funcstart\_719,1}$.p1,
177).rem))).**replace**(p2 → ((-35 * div(**heapIs** $\text{heap}_{funcstart\_719,1}$,
$\text{heap}_{funcstart\_719,1}$.p2, 176).quot) + (172 * div(**heapIs** $\text{heap}_{funcstart\_719,1}$,
$\text{heap}_{funcstart\_719,1}$.p2, 176).rem))).**replace**(p3 → **asType<short
int>**((**asType<int>(asType<short int>**(div3.rem)) *
asType<int>($\text{heap}_{719,1;730,8}$.r3)) − (**asType<int>(asType<short
int>**(div3.quot)) * **asType<int>**($\text{heap}_{719,1;730,8}$.b3)))))

→ *[from term 19.6, div3 is equal to div(**heapIs** $heap_{funcstart\_719,1}$,*
$heap_{funcstart\_719,1}$.p3, 178)]

[36.2] $\text{heap}_{719,1;731,8}$ == $\text{heap}_{funcstart\_719,1}$.**replace**(p1 → ((-2 *
div(**heapIs** $\text{heap}_{funcstart\_719,1}$, $\text{heap}_{funcstart\_719,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\text{heap}_{funcstart\_719,1}$, $\text{heap}_{funcstart\_719,1}$.p1,
177).rem))).**replace**(p2 → ((-35 * div(**heapIs** $\text{heap}_{funcstart\_719,1}$,
$\text{heap}_{funcstart\_719,1}$.p2, 176).quot) + (172 * div(**heapIs** $\text{heap}_{funcstart\_719,1}$,
$\text{heap}_{funcstart\_719,1}$.p2, 176).rem))).**replace**(p3 → **asType<short
int>**((**asType<int>(asType<short int>**(div(**heapIs** $\text{heap}_{funcstart\_719,1}$,
$\text{heap}_{funcstart\_719,1}$.p3, 178).rem)) * **asType<int>**($\text{heap}_{719,1;730,8}$.r3)) −
(**asType<int>(asType<short int>**(div3.quot)) *
asType<int>($\text{heap}_{719,1;730,8}$.b3)))))

→ *[simplify]*

[36.4] $\$heap_{719,1;731,8}$ == $\$heap_{funcstart\_719,1}$.__**replace**(p1 → ((-2 *
div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1,
177).rem))).__**replace**(p2 → ((-35 * div(**heapIs** $\$heap_{funcstart\_719,1}$,
$\$heap_{funcstart\_719,1}$.p2, 176).quot) + (172 * div(**heapIs** $\$heap_{funcstart\_719,1}$,
$\$heap_{funcstart\_719,1}$.p2, 176).rem))).__**replace**(p3 → **asType**<**short
int**>((div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p3, 178).rem *
asType<**int**>($\$heap_{719,1;730,8}$.r3)) − (**asType**<**int**>(**asType**<**short
int**>(div3.quot)) * **asType**<**int**>($\$heap_{719,1;730,8}$.b3)))))

→ *[from term 31.24, $\$heap_{719,1;730,8}$ is equal to
$\$heap_{funcstart\_719,1}$.__**replace**(p1 → ((-2 * div(**heapIs** $\$heap_{funcstart\_719,1}$,
$\$heap_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_719,1}$,
$\$heap_{funcstart\_719,1}$.p1, 177).rem))).__**replace**(p2 → (-35 * div(**heapIs**
$\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).quot) + (172 * div(**heapIs**
$\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).rem))]*

[36.5] $\$heap_{719,1;731,8}$ == $\$heap_{funcstart\_719,1}$.__**replace**(p1 → ((-2 *
div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1,
177).rem))).__**replace**(p2 → ((-35 * div(**heapIs** $\$heap_{funcstart\_719,1}$,
$\$heap_{funcstart\_719,1}$.p2, 176).quot) + (172 * div(**heapIs** $\$heap_{funcstart\_719,1}$,
$\$heap_{funcstart\_719,1}$.p2, 176).rem))).__**replace**(p3 → **asType**<**short
int**>((div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p3, 178).rem *
asType<**int**>($\$heap_{funcstart\_719,1}$.__**replace**(p1 → ((-2 * div(**heapIs**
$\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs**
$\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).rem))).__**replace**(p2 → ((-35
* div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).quot) + (172 *
div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).rem))).r3)) −
(**asType**<**int**>(**asType**<**short int**>(div3.quot)) *
asType<**int**>($\$heap_{719,1;730,8}$.b3)))))

→ *[const member of object with modified fields]*

[36.7] $\$heap_{719,1;731,8}$ == $\$heap_{funcstart\_719,1}$.__**replace**(p1 → ((-2 *
div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1,
177).rem))).__**replace**(p2 → ((-35 * div(**heapIs** $\$heap_{funcstart\_719,1}$,
$\$heap_{funcstart\_719,1}$.p2, 176).quot) + (172 * div(**heapIs** $\$heap_{funcstart\_719,1}$,
$\$heap_{funcstart\_719,1}$.p2, 176).rem))).__**replace**(p3 → **asType**<**short
int**>((div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p3, 178).rem *
asType<**int**>($\$heap_{funcstart\_719,1}$.r3)) − (**asType**<**int**>(**asType**<**short
int**>(div3.quot)) * **asType**<**int**>($\$heap_{719,1;730,8}$.b3)))))

→ *[const static or extern object]*

[36.8] $\$heap_{719,1;731,8}$ == $\$heap_{funcstart\_719,1}$.__**replace**(p1 → ((-2 *
div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1,

177).rem))). **replace**(p2 → ((-35 * div(**heapIs** $heap_{funcstart\_719,1}$,
$heap_{funcstart\_719,1}$.p2, 176).quot) + (172 * div(**heapIs** $heap_{funcstart\_719,1}$,
$heap_{funcstart\_719,1}$.p2, 176).rem))). **replace**(p3 → **asType<short
int>**((div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p3, 178).rem *
asType<int>($heap_{init}$.r3)) − (**asType<int>**(**asType<short
int>**(div3.quot)) * **asType<int>**($heap_{719,1;730,8}$.b3)))))

→ *[expand definition of constant 'r3' at prang.c (25,20)]*

[36.9] $heap_{719,1;731,8}$ == $heap_{funcstart\_719,1}$. **replace**(p1 → ((-2 *
div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p1, 177).quot) + (171 *
div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p1,
177).rem))). **replace**(p2 → ((-35 * div(**heapIs** $heap_{funcstart\_719,1}$,
$heap_{funcstart\_719,1}$.p2, 176).quot) + (172 * div(**heapIs** $heap_{funcstart\_719,1}$,
$heap_{funcstart\_719,1}$.p2, 176).rem))). **replace**(p3 → **asType<short
int>**((div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p3, 178).rem *
asType<int>(**asType<short int>**((**int**)170))) −
(**asType<int>**(**asType<short int>**(div3.quot)) *
asType<int>($heap_{719,1;730,8}$.b3)))))

→ *[simplify]*

[36.12] $heap_{719,1;731,8}$ == $heap_{funcstart\_719,1}$. **replace**(p1 → ((-2 *
div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p1, 177).quot) + (171 *
div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p1,
177).rem))). **replace**(p2 → ((-35 * div(**heapIs** $heap_{funcstart\_719,1}$,
$heap_{funcstart\_719,1}$.p2, 176).quot) + (172 * div(**heapIs** $heap_{funcstart\_719,1}$,
$heap_{funcstart\_719,1}$.p2, 176).rem))). **replace**(p3 → **asType<short
int>**((div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p3, 178).rem * 170)
− (**asType<int>**(**asType<short int>**(div3.quot)) *
asType<int>($heap_{719,1;730,8}$.b3)))))

→ *[from term 19.6, div3 is equal to div(**heapIs** $heap_{funcstart\_719,1}$,
$heap_{funcstart\_719,1}$.p3, 178)]*

[36.13] $heap_{719,1;731,8}$ == $heap_{funcstart\_719,1}$. **replace**(p1 → ((-2 *
div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p1, 177).quot) + (171 *
div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p1,
177).rem))). **replace**(p2 → ((-35 * div(**heapIs** $heap_{funcstart\_719,1}$,
$heap_{funcstart\_719,1}$.p2, 176).quot) + (172 * div(**heapIs** $heap_{funcstart\_719,1}$,
$heap_{funcstart\_719,1}$.p2, 176).rem))). **replace**(p3 → **asType<short int>**((170
* div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p3, 178).rem) −
(**asType<int>**(**asType<short int>**(div(**heapIs** $heap_{funcstart\_719,1}$,
$heap_{funcstart\_719,1}$.p3, 178).quot)) * **asType<int>**($heap_{719,1;730,8}$.b3)))))

→ *[simplify]*

[36.15] $heap_{719,1;731,8}$ == $heap_{funcstart\_719,1}$. **replace**(p1 → ((-2 *
div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p1, 177).quot) + (171 *
div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p1,

177).rem))).**replace**(p2 → ((-35 * div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$,
$\$\text{heap}_{funcstart\_719,1}$.p2, 176).quot) + (172 * div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$,
$\$\text{heap}_{funcstart\_719,1}$.p2, 176).rem))).**replace**(p3 → **asType**<**short int**>((170
* div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}$.p3, 178).rem) −
(div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}$.p3, 178).quot *
asType<**int**>($\$\text{heap}_{719,1;730,8}$.b3))))

→ *[from term 31.24, $\$\text{heap}_{719,1;730,8}$ is equal to*
*$\$\text{heap}_{funcstart\_719,1}$.**replace***(p1 → ((-2 * div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$,*
*$\$\text{heap}_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$,*
*$\$\text{heap}_{funcstart\_719,1}$.p1, 177).rem))).**replace**(p2 → (-35 * div(**heapIs***
*$\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}$.p2, 176).quot) + (172 * div(**heapIs***
$\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}$.p2, 176).rem))]

[36.16] $\$\text{heap}_{719,1;731,8}$ == $\$\text{heap}_{funcstart\_719,1}$.**replace**(p1 → ((-2 *
div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}$.p1,
177).rem))).**replace**(p2 → ((-35 * div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$,
$\$\text{heap}_{funcstart\_719,1}$.p2, 176).quot) + (172 * div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$,
$\$\text{heap}_{funcstart\_719,1}$.p2, 176).rem))).**replace**(p3 → **asType**<**short int**>((170
* div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}$.p3, 178).rem) −
(div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}$.p3, 178).quot *
asType<**int**>($\$\text{heap}_{funcstart\_719,1}$.**replace**(p1 → ((-2 * div(**heapIs**
$\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs**
$\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}$.p1, 177).rem))).**replace**(p2 → ((-35
* div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}$.p2, 176).quot) + (172 *
div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}$.p2, 176).rem))).b3))))

→ *[const member of object with modified fields]*

[36.18] $\$\text{heap}_{719,1;731,8}$ == $\$\text{heap}_{funcstart\_719,1}$.**replace**(p1 → ((-2 *
div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}$.p1,
177).rem))).**replace**(p2 → ((-35 * div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$,
$\$\text{heap}_{funcstart\_719,1}$.p2, 176).quot) + (172 * div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$,
$\$\text{heap}_{funcstart\_719,1}$.p2, 176).rem))).**replace**(p3 → **asType**<**short int**>((170
* div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}$.p3, 178).rem) −
(div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}$.p3, 178).quot *
asType<**int**>($\$\text{heap}_{funcstart\_719,1}$.b3))))

→ *[const static or extern object]*

[36.19] $\$\text{heap}_{719,1;731,8}$ == $\$\text{heap}_{funcstart\_719,1}$.**replace**(p1 → ((-2 *
div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}$.p1,
177).rem))).**replace**(p2 → ((-35 * div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$,
$\$\text{heap}_{funcstart\_719,1}$.p2, 176).quot) + (172 * div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$,
$\$\text{heap}_{funcstart\_719,1}$.p2, 176).rem))).**replace**(p3 → **asType**<**short int**>((170
* div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}$.p3, 178).rem) −

(div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p3, 178).quot *
asType<**int**>($\$heap_{init}$.b3)))))

→ *[expand definition of constant 'b3' at prang.c (27,20)]*

[36.20] $\$heap_{719,1;731,8}$ == $\$heap_{funcstart\_719,1}$.**replace**(p1 → ((-2 *
div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1,
177).rem))).**replace**(p2 → ((-35 * div(**heapIs** $\$heap_{funcstart\_719,1}$,
$\$heap_{funcstart\_719,1}$.p2, 176).quot) + (172 * div(**heapIs** $\$heap_{funcstart\_719,1}$,
$\$heap_{funcstart\_719,1}$.p2, 176).rem))).**replace**(p3 → **asType**<**short int**>((170
* div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p3, 178).rem) −
(div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p3, 178).quot *
asType<**int**>(**asType**<**short int**>((**int**)63)))))

→ *[simplify]*

[36.26] $\$heap_{719,1;731,8}$ == $\$heap_{funcstart\_719,1}$.**replace**(p1 → ((-2 *
div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1,
177).rem))).**replace**(p2 → ((-35 * div(**heapIs** $\$heap_{funcstart\_719,1}$,
$\$heap_{funcstart\_719,1}$.p2, 176).quot) + (172 * div(**heapIs** $\$heap_{funcstart\_719,1}$,
$\$heap_{funcstart\_719,1}$.p2, 176).rem))).**replace**(p3 → ((-63 * div(**heapIs**
$\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p3, 178).quot) + (170 * div(**heapIs**
$\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p3, 178).rem)))

[Take goal term]

[1.0] **minof**(**int**) ≤ (**asType**<**int**>($\$heap_{719,1;731,8}$.M1) *
asType<**int**>(**static_cast**<**integer**>(**asType**<**int**>($\$heap_{719,1;731,8}$.p1) <
(**int**)0)))

→ *[simplify]*

[1.1] -32768 ≤ (**asType**<**int**>($\$heap_{719,1;731,8}$.M1) *
asType<**int**>(**static_cast**<**integer**>(**asType**<**int**>($\$heap_{719,1;731,8}$.p1) <
(**int**)0)))

→ *[from term 36.26, $\$heap_{719,1;731,8}$ is equal to
$\$heap_{funcstart\_719,1}$.**replace**(p1 → ((-2 * div(**heapIs** $\$heap_{funcstart\_719,1}$,
$\$heap_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_719,1}$,
$\$heap_{funcstart\_719,1}$.p1, 177).rem))).**replace**(p2 → ((-35 * div(**heapIs**
$\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).quot) + (172 * div(**heapIs**
$\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).rem))).**replace**(p3 → (-63 *
div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p3, 178).quot) + (170 *
div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p3, 178).rem))]*

[1.2] -32768 ≤ (**asType**<**int**>($\$heap_{funcstart\_719,1}$.**replace**(p1 → ((-2 *
div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1,
177).rem))).**replace**(p2 → ((-35 * div(**heapIs** $\$heap_{funcstart\_719,1}$,

$heap_{funcstart\_719,1}$.p2, 176).quot) + (172 * div(**heapIs** $heap_{funcstart\_719,1}$,
$heap_{funcstart\_719,1}$.p2, 176).rem))).**_replace**(p3 → ((-63 * div(**heapIs**
$heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p3, 178).quot) + (170 * div(**heapIs**
$heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p3, 178).rem))).M1) *
asType<**int**>(**static_cast**<**integer**>(**asType**<**int**>($heap_{719,1;731,8}$.p1) <
(**int**)0)))

→ [const member of object with modified fields]

[1.5] -32768 ≤ (**asType**<**int**>($heap_{funcstart\_719,1}$.M1) *
asType<**int**>(**static_cast**<**integer**>(**asType**<**int**>($heap_{719,1;731,8}$.p1) <
(**int**)0)))

→ [const static or extern object]

[1.6] -32768 ≤ (**asType**<**int**>($heap_{init}$.M1) *
asType<**int**>(**static_cast**<**integer**>(**asType**<**int**>($heap_{719,1;731,8}$.p1) <
(**int**)0)))

→ [expand definition of constant 'M1' at prang.c (14,20)]

[1.7] -32768 ≤ (**asType**<**int**>(**asType**<**short int**>((**int**)30269)) *
asType<**int**>(**static_cast**<**integer**>(**asType**<**int**>($heap_{719,1;731,8}$.p1) <
(**int**)0)))

→ [simplify]

[1.10] -32768 ≤ (30269 *
asType<**int**>(**static_cast**<**integer**>(**asType**<**int**>($heap_{719,1;731,8}$.p1) <
(**int**)0)))

→ [from term 36.26, $heap_{719,1;731,8}$ is equal to
$heap_{funcstart\_719,1}$.**_replace**(p1 → ((-2 * div(**heapIs** $heap_{funcstart\_719,1}$,
$heap_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs** $heap_{funcstart\_719,1}$,
$heap_{funcstart\_719,1}$.p1, 177).rem))).**_replace**(p2 → ((-35 * div(**heapIs**
$heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p2, 176).quot) + (172 * div(**heapIs**
$heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p2, 176).rem))).**_replace**(p3 → (-63 *
div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p3, 178).quot) + (170 *
div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p3, 178).rem))]

[1.11] -32768 ≤ (30269 *
asType<**int**>(**static_cast**<**integer**>(**asType**<**int**>($heap_{funcstart\_719,1}$.**_replace**(p1
→ ((-2 * div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p1, 177).quot) +
(171 * div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p1,
177).rem))).**_replace**(p2 → ((-35 * div(**heapIs** $heap_{funcstart\_719,1}$,
$heap_{funcstart\_719,1}$.p2, 176).quot) + (172 * div(**heapIs** $heap_{funcstart\_719,1}$,
$heap_{funcstart\_719,1}$.p2, 176).rem))).**_replace**(p3 → ((-63 * div(**heapIs**
$heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p3, 178).quot) + (170 * div(**heapIs**
$heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p3, 178).rem))).p1) < (**int**)0)))

→ [simplify]

[1.23] -32768 ≤ (30269 * **asType**<**int**>(((0 < ((-171 * div(**heapIs**

$\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}.\text{p1}$, 177).rem) + (2 * div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}.\text{p1}$, 177).quot))]: 1, []: 0)))

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

[1.24] -32768 ≤ (30269 * **asType<int>**((([0 < ((-171 * div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}.\text{p1}$, 177).rem) + (2 * div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}.\text{p1}$, 177).quot))]: 1, [!(0 < ((-171 * div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}.\text{p1}$, 177).rem) + (2 * div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}.\text{p1}$, 177).quot)))]: 0)))

→ [simplify]

[1.30] -32768 ≤ (30269 * ([0 < ((-171 * div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}.\text{p1}$, 177).rem) + (2 * div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}.\text{p1}$, 177).quot))]: 1, [-1 < ((-2 * div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}.\text{p1}$, 177).quot) + (171 * div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}.\text{p1}$, 177).rem))]: 0))

→ [move guard outside expression]

[1.31] -32768 ≤ ([0 < ((-171 * div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}.\text{p1}$, 177).rem) + (2 * div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}.\text{p1}$, 177).quot))]: 1 * 30269, [-1 < ((-2 * div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}.\text{p1}$, 177).quot) + (171 * div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}.\text{p1}$, 177).rem))]: 0 * 30269)

→ [simplify]

[1.35] -32769 < ([0 < ((-171 * div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}.\text{p1}$, 177).rem) + (2 * div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}.\text{p1}$, 177).quot))]: 30269, [-1 < ((-2 * div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}.\text{p1}$, 177).quot) + (171 * div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}.\text{p1}$, 177).rem))]: 0)

→ [move guard outside expression]

[1.36] ([0 < ((-171 * div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}.\text{p1}$, 177).rem) + (2 * div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}.\text{p1}$, 177).quot))]: -32769 < 30269, [-1 < ((-2 * div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}.\text{p1}$, 177).quot) + (171 * div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}.\text{p1}$, 177).rem))]: -32769 < 0)

→ [simplify]

[1.38] ([0 < ((-171 * div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}.\text{p1}$, 177).rem) + (2 * div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}.\text{p1}$, 177).quot))]: **true**, [-1 < ((-2 * div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}.\text{p1}$, 177).quot) + (171 * div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}.\text{p1}$, 177).rem))]: **true**)

→ [all guards have equal guarded terms]

[1.39] **true**

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

Condition generated at: C:\Escher\Customers\prang\prang.c (51,25)

Condition defined at:

To prove: (asType\<int\>($heap$_{719,1;731,8}$.M1) * asType\<int\>(static_cast\<integer\>(asType\<int\>($heap$_{719,1;731,8}$.p1) < (int)0))) ≤ 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)**

$heap$_{init}$.b1 == **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)**

$heap$_{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)**

$heap$_{init}$.b3 == **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)**

div1 == div(**heapIs** $heap$_{funcstart_719,1}$,
asType\<int\>($heap$_{funcstart_719,1}$.p1),
asType\<int\>($heap$_{funcstart_719,1}$.a1))

(**asType\<integer\>(asType\<int\>**($heap$_{funcstart_719,1}$.p1)) /
asType\<integer\>(asType\<int\>($heap$_{funcstart_719,1}$.a1))) ==
asType\<integer\>(div1.quot)

(**asType\<integer\>(asType\<int\>**($heap$_{funcstart_719,1}$.p1)) %
asType\<integer\>(asType\<int\>($heap$_{funcstart_719,1}$.a1))) ==
asType\<integer\>(div1.rem)

div2 == div(**heapIs** $heap$_{funcstart_719,1}$,
asType\<int\>($heap$_{funcstart_719,1}$.p2),
asType\<int\>($heap$_{funcstart_719,1}$.a2))

$(\mathbf{asType{<}integer{>}}(\mathbf{asType{<}int{>}}(\$\text{heap}_{funcstart\_719,1}.\text{p2}))\ /$
$\mathbf{asType{<}integer{>}}(\mathbf{asType{<}int{>}}(\$\text{heap}_{funcstart\_719,1}.\text{a2})))\ ==$
$\mathbf{asType{<}integer{>}}(\text{div2.quot})$

$(\mathbf{asType{<}integer{>}}(\mathbf{asType{<}int{>}}(\$\text{heap}_{funcstart\_719,1}.\text{p2}))\ \%$
$\mathbf{asType{<}integer{>}}(\mathbf{asType{<}int{>}}(\$\text{heap}_{funcstart\_719,1}.\text{a2})))\ ==$
$\mathbf{asType{<}integer{>}}(\text{div2.rem})$

$\text{div3} == \text{div}(\mathbf{heapIs}\ \$\text{heap}_{funcstart\_719,1},$
$\mathbf{asType{<}int{>}}(\$\text{heap}_{funcstart\_719,1}.\text{p3}),$
$\mathbf{asType{<}int{>}}(\$\text{heap}_{funcstart\_719,1}.\text{a3}))$

$(\mathbf{asType{<}integer{>}}(\mathbf{asType{<}int{>}}(\$\text{heap}_{funcstart\_719,1}.\text{p3}))\ /$
$\mathbf{asType{<}integer{>}}(\mathbf{asType{<}int{>}}(\$\text{heap}_{funcstart\_719,1}.\text{a3})))\ ==$
$\mathbf{asType{<}integer{>}}(\text{div3.quot})$

$(\mathbf{asType{<}integer{>}}(\mathbf{asType{<}int{>}}(\$\text{heap}_{funcstart\_719,1}.\text{p3}))\ \%$
$\mathbf{asType{<}integer{>}}(\mathbf{asType{<}int{>}}(\$\text{heap}_{funcstart\_719,1}.\text{a3})))\ ==$
$\mathbf{asType{<}integer{>}}(\text{div3.rem})$

$\$\text{heap}_{719,1;729,8} == \$\text{heap}_{funcstart\_719,1}.\mathbf{replace}(\text{p1} \to \mathbf{asType{<}short}$
$\mathbf{int{>}}((\mathbf{asType{<}int{>}}(\mathbf{asType{<}short\ int{>}}(\text{div1.rem}))\ *$
$\mathbf{asType{<}int{>}}(\$\text{heap}_{funcstart\_719,1}.\text{r1})) - (\mathbf{asType{<}int{>}}(\mathbf{asType{<}short}$
$\mathbf{int{>}}(\text{div1.quot})\ *\ \mathbf{asType{<}int{>}}(\$\text{heap}_{funcstart\_719,1}.\text{b1}))))$

$\$\text{heap}_{719,1;730,8} == \$\text{heap}_{719,1;729,8}.\mathbf{replace}(\text{p2} \to \mathbf{asType{<}short}$
$\mathbf{int{>}}((\mathbf{asType{<}int{>}}(\mathbf{asType{<}short\ int{>}}(\text{div2.rem}))\ *$
$\mathbf{asType{<}int{>}}(\$\text{heap}_{719,1;729,8}.\text{r2})) - (\mathbf{asType{<}int{>}}(\mathbf{asType{<}short}$
$\mathbf{int{>}}(\text{div2.quot})\ *\ \mathbf{asType{<}int{>}}(\$\text{heap}_{719,1;729,8}.\text{b2}))))$

$\$\text{heap}_{719,1;731,8} == \$\text{heap}_{719,1;730,8}.\mathbf{replace}(\text{p3} \to \mathbf{asType{<}short}$
$\mathbf{int{>}}((\mathbf{asType{<}int{>}}(\mathbf{asType{<}short\ int{>}}(\text{div3.rem}))\ *$
$\mathbf{asType{<}int{>}}(\$\text{heap}_{719,1;730,8}.\text{r3})) - (\mathbf{asType{<}int{>}}(\mathbf{asType{<}short}$
$\mathbf{int{>}}(\text{div3.quot})\ *\ \mathbf{asType{<}int{>}}(\$\text{heap}_{719,1;730,8}.\text{b3}))))$

Proof:

[Take given term]

[5.0] $\text{div1} == \text{div}(\mathbf{heapIs}\ \$\text{heap}_{funcstart\_719,1},$
$\mathbf{asType{<}int{>}}(\$\text{heap}_{funcstart\_719,1}.\text{p1}),$
$\mathbf{asType{<}int{>}}(\$\text{heap}_{funcstart\_719,1}.\text{a1}))$

$\to$ *[simplify]*

[5.1] $\text{div1} == \text{div}(\mathbf{heapIs}\ \$\text{heap}_{funcstart\_719,1},\ \$\text{heap}_{funcstart\_719,1}.\text{p1},$
$\mathbf{asType{<}int{>}}(\$\text{heap}_{funcstart\_719,1}.\text{a1}))$

$\to$ *[const static or extern object]*

[5.2] $\text{div1} == \text{div}(\mathbf{heapIs}\ \$\text{heap}_{funcstart\_719,1},\ \$\text{heap}_{funcstart\_719,1}.\text{p1},$
$\mathbf{asType{<}int{>}}(\$\text{heap}_{init}.\text{a1}))$

$\to$ *[expand definition of constant 'a1' at prang.c (16,20)]*

[5.3] div1 == div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p1,
asType\<int\>(**asType\<short int\>**((**int**)177)))

→ *[simplify]*

[5.6] div1 == div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p1, 177)

[Take given term]

[12.0] div2 == div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$,
asType\<int\>($\text{\$heap}_{funcstart\_719,1}$.p2),
asType\<int\>($\text{\$heap}_{funcstart\_719,1}$.a2))

→ *[simplify]*

[12.1] div2 == div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p2,
asType\<int\>($\text{\$heap}_{funcstart\_719,1}$.a2))

→ *[const static or extern object]*

[12.2] div2 == div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p2,
asType\<int\>($\text{\$heap}_{init}$.a2))

→ *[expand definition of constant 'a2' at prang.c (21,20)]*

[12.3] div2 == div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p2,
asType\<int\>(**asType\<short int\>**((**int**)176)))

→ *[simplify]*

[12.6] div2 == div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p2, 176)

[Take given term]

[19.0] div3 == div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$,
asType\<int\>($\text{\$heap}_{funcstart\_719,1}$.p3),
asType\<int\>($\text{\$heap}_{funcstart\_719,1}$.a3))

→ *[simplify]*

[19.1] div3 == div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p3,
asType\<int\>($\text{\$heap}_{funcstart\_719,1}$.a3))

→ *[const static or extern object]*

[19.2] div3 == div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p3,
asType\<int\>($\text{\$heap}_{init}$.a3))

→ *[expand definition of constant 'a3' at prang.c (26,20)]*

[19.3] div3 == div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p3,
asType\<int\>(**asType\<short int\>**((**int**)178)))

→ *[simplify]*

[19.6] div3 == div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p3, 178)

[Take given term]

[26.0] $\text{\$heap}_{719,1;729,8}$ == $\text{\$heap}_{funcstart\_719,1}$.**replace**(p1 → **asType\<short**

472

int>((**asType**<**int**>(**asType**<**short int**>(div1.rem)) * **asType**<**int**>($heap$_{funcstart_719,1}$.r1)) − (**asType**<**int**>(**asType**<**short int**>(div1.quot)) * **asType**<**int**>($heap$_{funcstart\_719,1}$.b1))))

→ *[from term 5.6, div1 is equal to div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1, 177)]*

[26.1] $heap$_{719,1;729,8}$ == $heap$_{funcstart_719,1}$._**replace**(p1 → **asType**<**short int**>((**asType**<**int**>(**asType**<**short int**>(div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1, 177).rem)) * **asType**<**int**>($heap$_{funcstart\_719,1}$.r1)) − (**asType**<**int**>(**asType**<**short int**>(div1.quot)) * **asType**<**int**>($heap$_{funcstart_719,1}$.b1))))

→ *[simplify]*

[26.3] $heap$_{719,1;729,8}$ == $heap$_{funcstart_719,1}$._**replace**(p1 → **asType**<**short int**>((div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1, 177).rem * **asType**<**int**>($heap$_{funcstart\_719,1}$.r1)) − (**asType**<**int**>(**asType**<**short int**>(div1.quot)) * **asType**<**int**>($heap$_{funcstart_719,1}$.b1))))

→ *[const static or extern object]*

[26.4] $heap$_{719,1;729,8}$ == $heap$_{funcstart_719,1}$._**replace**(p1 → **asType**<**short int**>((div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1, 177).rem * **asType**<**int**>($heap$_{init}$.r1)) − (**asType**<**int**>(**asType**<**short int**>(div1.quot)) * **asType**<**int**>($heap$_{funcstart_719,1}$.b1))))

→ *[expand definition of constant 'r1' at prang.c (15,20)]*

[26.5] $heap$_{719,1;729,8}$ == $heap$_{funcstart_719,1}$._**replace**(p1 → **asType**<**short int**>((div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1, 177).rem * **asType**<**int**>(**asType**<**short int**>((**int**)171))) − (**asType**<**int**>(**asType**<**short int**>(div1.quot)) * **asType**<**int**>($heap$_{funcstart\_719,1}$.b1))))

→ *[simplify]*

[26.8] $heap$_{719,1;729,8}$ == $heap$_{funcstart_719,1}$._**replace**(p1 → **asType**<**short int**>((div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1, 177).rem * 171) − (**asType**<**int**>(**asType**<**short int**>(div1.quot)) * **asType**<**int**>($heap$_{funcstart\_719,1}$.b1))))

→ *[from term 5.6, div1 is equal to div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1, 177)]*

[26.9] $heap$_{719,1;729,8}$ == $heap$_{funcstart_719,1}$._**replace**(p1 → **asType**<**short int**>((171 * div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1, 177).rem) − (**asType**<**int**>(**asType**<**short int**>(div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1, 177).quot)) * **asType**<**int**>($heap$_{funcstart\_719,1}$.b1))))

→ *[simplify]*

[26.11] $heap$_{719,1;729,8}$ == $heap$_{funcstart_719,1}$._**replace**(p1 → **asType**<**short**

int>((171 * div(**heapIs** \$heap$_{funcstart\_719,1}$, \$heap$_{funcstart\_719,1}$.p1, 177).rem) − (div(**heapIs** \$heap$_{funcstart\_719,1}$, \$heap$_{funcstart\_719,1}$.p1, 177).quot * **asType**<**int**>(\$heap$_{funcstart\_719,1}$.b1))))

→ *[const static or extern object]*

[26.12] \$heap$_{719,1;729,8}$ == \$heap$_{funcstart\_719,1}$.**replace**(p1 → **asType**<**short int**>((171 * div(**heapIs** \$heap$_{funcstart\_719,1}$, \$heap$_{funcstart\_719,1}$.p1, 177).rem) − (div(**heapIs** \$heap$_{funcstart\_719,1}$, \$heap$_{funcstart\_719,1}$.p1, 177).quot * **asType**<**int**>(\$heap$_{init}$.b1))))

→ *[expand definition of constant 'b1' at prang.c (17,20)]*

[26.13] \$heap$_{719,1;729,8}$ == \$heap$_{funcstart\_719,1}$.**replace**(p1 → **asType**<**short int**>((171 * div(**heapIs** \$heap$_{funcstart\_719,1}$, \$heap$_{funcstart\_719,1}$.p1, 177).rem) − (div(**heapIs** \$heap$_{funcstart\_719,1}$, \$heap$_{funcstart\_719,1}$.p1, 177).quot * **asType**<**int**>(**asType**<**short int**>((**int**)2)))))

→ *[simplify]*

[26.19] \$heap$_{719,1;729,8}$ == \$heap$_{funcstart\_719,1}$.**replace**(p1 → ((-2 * div(**heapIs** \$heap$_{funcstart\_719,1}$, \$heap$_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs** \$heap$_{funcstart\_719,1}$, \$heap$_{funcstart\_719,1}$.p1, 177).rem)))

[Take given term]

[31.0] \$heap$_{719,1;730,8}$ == \$heap$_{719,1;729,8}$.**replace**(p2 → **asType**<**short int**>((**asType**<**int**>(**asType**<**short int**>(div2.rem)) * **asType**<**int**>(\$heap$_{719,1;729,8}$.r2)) − (**asType**<**int**>(**asType**<**short int**>(div2.quot)) * **asType**<**int**>(\$heap$_{719,1;729,8}$.b2))))

→ *[from term 26.19, \$heap$_{719,1;729,8}$ is equal to \$heap$_{funcstart\_719,1}$.**replace**(p1 → (-2 * div(**heapIs** \$heap$_{funcstart\_719,1}$, \$heap$_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs** \$heap$_{funcstart\_719,1}$, \$heap$_{funcstart\_719,1}$.p1, 177).rem))]*

[31.1] \$heap$_{719,1;730,8}$ == \$heap$_{funcstart\_719,1}$.**replace**(p1 → ((-2 * div(**heapIs** \$heap$_{funcstart\_719,1}$, \$heap$_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs** \$heap$_{funcstart\_719,1}$, \$heap$_{funcstart\_719,1}$.p1, 177).rem))).**replace**(p2 → **asType**<**short int**>((**asType**<**int**>(**asType**<**short int**>(div2.rem)) * **asType**<**int**>(\$heap$_{719,1;729,8}$.r2)) − (**asType**<**int**>(**asType**<**short int**>(div2.quot)) * **asType**<**int**>(\$heap$_{719,1;729,8}$.b2))))

→ *[from term 12.6, div2 is equal to div(**heapIs** \$heap$_{funcstart\_719,1}$, \$heap$_{funcstart\_719,1}$.p2, 176)]*

[31.2] \$heap$_{719,1;730,8}$ == \$heap$_{funcstart\_719,1}$.**replace**(p1 → ((-2 * div(**heapIs** \$heap$_{funcstart\_719,1}$, \$heap$_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs** \$heap$_{funcstart\_719,1}$, \$heap$_{funcstart\_719,1}$.p1, 177).rem))).**replace**(p2 → **asType**<**short int**>((**asType**<**int**>(**asType**<**short int**>(div(**heapIs** \$heap$_{funcstart\_719,1}$, \$heap$_{funcstart\_719,1}$.p2, 176).rem)) * **asType**<**int**>(\$heap$_{719,1;729,8}$.r2)) −

(**asType**<**int**>(**asType**<**short int**>(div2.quot)) *
asType<**int**>($heap$_{719,1;729,8}$.b2))))

→ *[simplify]*

[31.4] $heap$_{719,1;730,8}$ == $heap$_{funcstart_719,1}$._**replace**(p1 → ((-2 *
div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1, 177).quot) + (171 *
div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1,
177).rem)))._**replace**(p2 → **asType**<**short int**>((div(**heapIs**
$heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p2, 176).rem *
asType<**int**>($heap$_{719,1;729,8}$.r2)) − (**asType**<**int**>(**asType**<**short
int**>(div2.quot)) * **asType**<**int**>($heap$_{719,1;729,8}$.b2))))

→ *[from term 26.19, $heap$_{719,1;729,8}$ is equal to
$heap$_{funcstart_719,1}$._**replace**(p1 → (-2 * div(**heapIs** $heap$_{funcstart_719,1}$,
$heap$_{funcstart_719,1}$.p1, 177).quot) + (171 * div(**heapIs** $heap$_{funcstart_719,1}$,
$heap$_{funcstart_719,1}$.p1, 177).rem))]*

[31.5] $heap$_{719,1;730,8}$ == $heap$_{funcstart_719,1}$._**replace**(p1 → ((-2 *
div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1, 177).quot) + (171 *
div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1,
177).rem)))._**replace**(p2 → **asType**<**short int**>((div(**heapIs**
$heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p2, 176).rem *
asType<**int**>($heap$_{funcstart_719,1}$._**replace**(p1 → ((-2 * div(**heapIs**
$heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1, 177).quot) + (171 * div(**heapIs**
$heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1, 177).rem))).r2)) −
(**asType**<**int**>(**asType**<**short int**>(div2.quot)) *
asType<**int**>($heap$_{719,1;729,8}$.b2))))

→ *[const member of object with modified fields]*

[31.6] $heap$_{719,1;730,8}$ == $heap$_{funcstart_719,1}$._**replace**(p1 → ((-2 *
div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1, 177).quot) + (171 *
div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1,
177).rem)))._**replace**(p2 → **asType**<**short int**>((div(**heapIs**
$heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p2, 176).rem *
asType<**int**>($heap$_{funcstart_719,1}$.r2)) − (**asType**<**int**>(**asType**<**short
int**>(div2.quot)) * **asType**<**int**>($heap$_{719,1;729,8}$.b2))))

→ *[const static or extern object]*

[31.7] $heap$_{719,1;730,8}$ == $heap$_{funcstart_719,1}$._**replace**(p1 → ((-2 *
div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1, 177).quot) + (171 *
div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1,
177).rem)))._**replace**(p2 → **asType**<**short int**>((div(**heapIs**
$heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p2, 176).rem *
asType<**int**>($heap$_{init}$.r2)) − (**asType**<**int**>(**asType**<**short
int**>(div2.quot)) * **asType**<**int**>($heap$_{719,1;729,8}$.b2))))

→ *[expand definition of constant 'r2' at prang.c (20,20)]*

[31.8] $\text{\$heap}_{719,1;730,8}$ == $\text{\$heap}_{funcstart\_719,1}$._**replace**(p1 → ((-2 *
div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p1,
177).rem)))._**replace**(p2 → **asType<short int>**((div(**heapIs**
$\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p2, 176).rem *
asType<int>(**asType<short int>**((**int**)172))) −
(**asType<int>**(**asType<short int>**(div2.quot)) *
asType<int>($\text{\$heap}_{719,1;729,8}$.b2))))

→ *[simplify]*

[31.11] $\text{\$heap}_{719,1;730,8}$ == $\text{\$heap}_{funcstart\_719,1}$._**replace**(p1 → ((-2 *
div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p1,
177).rem)))._**replace**(p2 → **asType<short int>**((div(**heapIs**
$\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p2, 176).rem * 172) −
(**asType<int>**(**asType<short int>**(div2.quot)) *
asType<int>($\text{\$heap}_{719,1;729,8}$.b2))))

→ *[from term 12.6, div2 is equal to div(**heapIs** $heap_{funcstart\_719,1}$,*
$heap_{funcstart\_719,1}$.p2, 176)]

[31.12] $\text{\$heap}_{719,1;730,8}$ == $\text{\$heap}_{funcstart\_719,1}$._**replace**(p1 → ((-2 *
div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p1,
177).rem)))._**replace**(p2 → **asType<short int>**((172 * div(**heapIs**
$\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p2, 176).rem) −
(**asType<int>**(**asType<short int>**(div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$,
$\text{\$heap}_{funcstart\_719,1}$.p2, 176).quot)) * **asType<int>**($\text{\$heap}_{719,1;729,8}$.b2))))

→ *[simplify]*

[31.14] $\text{\$heap}_{719,1;730,8}$ == $\text{\$heap}_{funcstart\_719,1}$._**replace**(p1 → ((-2 *
div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p1,
177).rem)))._**replace**(p2 → **asType<short int>**((172 * div(**heapIs**
$\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p2, 176).rem) − (div(**heapIs**
$\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p2, 176).quot *
asType<int>($\text{\$heap}_{719,1;729,8}$.b2))))

→ *[from term 26.19, $heap_{719,1;729,8}$ is equal to*
*$heap_{funcstart\_719,1}$._**replace**(p1 → (-2 * div(**heapIs** $heap_{funcstart\_719,1}$,*
*$heap_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs** $heap_{funcstart\_719,1}$,*
$heap_{funcstart\_719,1}$.p1, 177).rem))]

[31.15] $\text{\$heap}_{719,1;730,8}$ == $\text{\$heap}_{funcstart\_719,1}$._**replace**(p1 → ((-2 *
div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p1,
177).rem)))._**replace**(p2 → **asType<short int>**((172 * div(**heapIs**
$\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p2, 176).rem) − (div(**heapIs**

$\text{heap}_{funcstart\_719,1}$, $\text{heap}_{funcstart\_719,1}.p2, 176).quot *$
asType$<$**int**$>$($\text{heap}_{funcstart\_719,1}$.**replace**(p1 $\rightarrow$ ((-2 * div(**heapIs**
$\text{heap}_{funcstart\_719,1}$, $\text{heap}_{funcstart\_719,1}.p1, 177).quot) + (171 * div($**heapIs**
$\text{heap}_{funcstart\_719,1}$, $\text{heap}_{funcstart\_719,1}.p1, 177).rem))).b2))))$

$\rightarrow$ *[const member of object with modified fields]*

[31.16] $\text{heap}_{719,1;730,8} == \text{heap}_{funcstart\_719,1}$.**replace**(p1 $\rightarrow$ ((-2 *
div(**heapIs** $\text{heap}_{funcstart\_719,1}$, $\text{heap}_{funcstart\_719,1}.p1, 177).quot) + (171 *$
div(**heapIs** $\text{heap}_{funcstart\_719,1}$, $\text{heap}_{funcstart\_719,1}.p1$,
177).rem))).**replace**(p2 $\rightarrow$ **asType**$<$**short int**$>$((172 * div(**heapIs**
$\text{heap}_{funcstart\_719,1}$, $\text{heap}_{funcstart\_719,1}.p2, 176).rem) - (div($**heapIs**
$\text{heap}_{funcstart\_719,1}$, $\text{heap}_{funcstart\_719,1}.p2, 176).quot *$
asType$<$**int**$>$($\text{heap}_{funcstart\_719,1}.b2))))$

$\rightarrow$ *[const static or extern object]*

[31.17] $\text{heap}_{719,1;730,8} == \text{heap}_{funcstart\_719,1}$.**replace**(p1 $\rightarrow$ ((-2 *
div(**heapIs** $\text{heap}_{funcstart\_719,1}$, $\text{heap}_{funcstart\_719,1}.p1, 177).quot) + (171 *$
div(**heapIs** $\text{heap}_{funcstart\_719,1}$, $\text{heap}_{funcstart\_719,1}.p1$,
177).rem))).**replace**(p2 $\rightarrow$ **asType**$<$**short int**$>$((172 * div(**heapIs**
$\text{heap}_{funcstart\_719,1}$, $\text{heap}_{funcstart\_719,1}.p2, 176).rem) - (div($**heapIs**
$\text{heap}_{funcstart\_719,1}$, $\text{heap}_{funcstart\_719,1}.p2, 176).quot *$
asType$<$**int**$>$($\text{heap}_{init}.b2))))$

$\rightarrow$ *[expand definition of constant 'b2' at prang.c (22,20)]*

[31.18] $\text{heap}_{719,1;730,8} == \text{heap}_{funcstart\_719,1}$.**replace**(p1 $\rightarrow$ ((-2 *
div(**heapIs** $\text{heap}_{funcstart\_719,1}$, $\text{heap}_{funcstart\_719,1}.p1, 177).quot) + (171 *$
div(**heapIs** $\text{heap}_{funcstart\_719,1}$, $\text{heap}_{funcstart\_719,1}.p1$,
177).rem))).**replace**(p2 $\rightarrow$ **asType**$<$**short int**$>$((172 * div(**heapIs**
$\text{heap}_{funcstart\_719,1}$, $\text{heap}_{funcstart\_719,1}.p2, 176).rem) - (div($**heapIs**
$\text{heap}_{funcstart\_719,1}$, $\text{heap}_{funcstart\_719,1}.p2, 176).quot *$
asType$<$**int**$>$(**asType**$<$**short int**$>$((**int**)35)))))

$\rightarrow$ *[simplify]*

[31.24] $\text{heap}_{719,1;730,8} == \text{heap}_{funcstart\_719,1}$.**replace**(p1 $\rightarrow$ ((-2 *
div(**heapIs** $\text{heap}_{funcstart\_719,1}$, $\text{heap}_{funcstart\_719,1}.p1, 177).quot) + (171 *$
div(**heapIs** $\text{heap}_{funcstart\_719,1}$, $\text{heap}_{funcstart\_719,1}.p1$,
177).rem))).**replace**(p2 $\rightarrow$ ((-35 * div(**heapIs** $\text{heap}_{funcstart\_719,1}$,
$\text{heap}_{funcstart\_719,1}.p2, 176).quot) + (172 * div($**heapIs** $\text{heap}_{funcstart\_719,1}$,
$\text{heap}_{funcstart\_719,1}.p2, 176).rem)))$

[Take given term]

[36.0] $\text{heap}_{719,1;731,8} == \text{heap}_{719,1;730,8}$.**replace**(p3 $\rightarrow$ **asType**$<$**short**
int$>$((**asType**$<$**int**$>$(**asType**$<$**short int**$>$(div3.rem)) *
asType$<$**int**$>$($\text{heap}_{719,1;730,8}.r3)) - ($**asType**$<$**int**$>$(**asType**$<$**short**
int$>$(div3.quot)) * **asType**$<$**int**$>$($\text{heap}_{719,1;730,8}.b3))))$

$\rightarrow$ *[from term 31.24, $\text{heap}_{719,1;730,8}$ is equal to*

$\$heap_{funcstart\_719,1}.$**replace**$(p1 \rightarrow ((-2 * div($**heapIs** $\$heap_{funcstart\_719,1},$
$\$heap_{funcstart\_719,1}.p1, 177).quot) + (171 * div($**heapIs** $\$heap_{funcstart\_719,1},$
$\$heap_{funcstart\_719,1}.p1, 177).rem))).$**replace**$(p2 \rightarrow (-35 * div($**heapIs**
$\$heap_{funcstart\_719,1}, \$heap_{funcstart\_719,1}.p2, 176).quot) + (172 * div($**heapIs**
$\$heap_{funcstart\_719,1}, \$heap_{funcstart\_719,1}.p2, 176).rem))]$

[36.1] $\$heap_{719,1;731,8} ==$ $\$heap_{funcstart\_719,1}.$**replace**$(p1 \rightarrow ((-2 *$
div(**heapIs** $\$heap_{funcstart\_719,1}, \$heap_{funcstart\_719,1}.p1, 177).quot) + (171 *$
div(**heapIs** $\$heap_{funcstart\_719,1}, \$heap_{funcstart\_719,1}.p1,$
$177).rem))).$**replace**$(p2 \rightarrow ((-35 * div($**heapIs** $\$heap_{funcstart\_719,1},$
$\$heap_{funcstart\_719,1}.p2, 176).quot) + (172 * div($**heapIs** $\$heap_{funcstart\_719,1},$
$\$heap_{funcstart\_719,1}.p2, 176).rem))).$**replace**$(p3 \rightarrow$ **asType**$<$**short**
int$>((\text{**asType**}<\text{**int**}>(\text{**asType**}<\text{**short int**}>(div3.rem)) *$
asType$<$**int**$>(\$heap_{719,1;730,8}.r3)) - (\text{**asType**}<\text{**int**}>(\text{**asType**}<\text{**short**}$
int$>(div3.quot)) *$ **asType**$<$**int**$>(\$heap_{719,1;730,8}.b3))))$

$\rightarrow$ *[from term 19.6, div3 is equal to* **div**(**heapIs** *$\$heap_{funcstart\_719,1},$*
$\$heap_{funcstart\_719,1}.p3, 178)]$

[36.2] $\$heap_{719,1;731,8} ==$ $\$heap_{funcstart\_719,1}.$**replace**$(p1 \rightarrow ((-2 *$
div(**heapIs** $\$heap_{funcstart\_719,1}, \$heap_{funcstart\_719,1}.p1, 177).quot) + (171 *$
div(**heapIs** $\$heap_{funcstart\_719,1}, \$heap_{funcstart\_719,1}.p1,$
$177).rem))).$**replace**$(p2 \rightarrow ((-35 * div($**heapIs** $\$heap_{funcstart\_719,1},$
$\$heap_{funcstart\_719,1}.p2, 176).quot) + (172 * div($**heapIs** $\$heap_{funcstart\_719,1},$
$\$heap_{funcstart\_719,1}.p2, 176).rem))).$**replace**$(p3 \rightarrow$ **asType**$<$**short**
int$>((\text{**asType**}<\text{**int**}>(\text{**asType**}<\text{**short int**}>(div($**heapIs** $\$heap_{funcstart\_719,1},$
$\$heap_{funcstart\_719,1}.p3, 178).rem)) *$ **asType**$<$**int**$>(\$heap_{719,1;730,8}.r3)) -$
$(\text{**asType**}<\text{**int**}>(\text{**asType**}<\text{**short int**}>(div3.quot)) *$
asType$<$**int**$>(\$heap_{719,1;730,8}.b3))))$

$\rightarrow$ *[simplify]*

[36.4] $\$heap_{719,1;731,8} ==$ $\$heap_{funcstart\_719,1}.$**replace**$(p1 \rightarrow ((-2 *$
div(**heapIs** $\$heap_{funcstart\_719,1}, \$heap_{funcstart\_719,1}.p1, 177).quot) + (171 *$
div(**heapIs** $\$heap_{funcstart\_719,1}, \$heap_{funcstart\_719,1}.p1,$
$177).rem))).$**replace**$(p2 \rightarrow ((-35 * div($**heapIs** $\$heap_{funcstart\_719,1},$
$\$heap_{funcstart\_719,1}.p2, 176).quot) + (172 * div($**heapIs** $\$heap_{funcstart\_719,1},$
$\$heap_{funcstart\_719,1}.p2, 176).rem))).$**replace**$(p3 \rightarrow$ **asType**$<$**short**
int$>((div($**heapIs** $\$heap_{funcstart\_719,1}, \$heap_{funcstart\_719,1}.p3, 178).rem *$
asType$<$**int**$>(\$heap_{719,1;730,8}.r3)) - (\text{**asType**}<\text{**int**}>(\text{**asType**}<\text{**short**}$
int$>(div3.quot)) *$ **asType**$<$**int**$>(\$heap_{719,1;730,8}.b3))))$

$\rightarrow$ *[from term 31.24, $\$heap_{719,1;730,8}$ is equal to*
$\$heap_{funcstart\_719,1}.$**replace***(p1 \rightarrow ((-2 * div(***heapIs** *$\$heap_{funcstart\_719,1},$
*$\$heap_{funcstart\_719,1}.p1, 177).quot) + (171 * div(***heapIs** *$\$heap_{funcstart_719,1},$*
*$\$heap_{funcstart\_719,1}.p1, 177).rem))).$**replace***(p2 \rightarrow (-35 * div(***heapIs**
*$\$heap_{funcstart_719,1}, \$heap_{funcstart_719,1}.p2, 176).quot) + (172 * div(***heapIs**
$\$heap_{funcstart\_719,1}, \$heap_{funcstart\_719,1}.p2, 176).rem))]$

[36.5] $\$heap_{719,1;731,8} ==$ $\$heap_{funcstart\_719,1}.$**replace**$(p1 \rightarrow ((-2 *$

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div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1,
177).rem))).**_replace**(p2 → ((-35 * div(**heapIs** $\$heap_{funcstart\_719,1}$,
$\$heap_{funcstart\_719,1}$.p2, 176).quot) + (172 * div(**heapIs** $\$heap_{funcstart\_719,1}$,
$\$heap_{funcstart\_719,1}$.p2, 176).rem))).**_replace**(p3 → **asType**<**short
int**>((div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p3, 178).rem *
asType<**int**>($\$heap_{funcstart\_719,1}$.**_replace**(p1 → ((-2 * div(**heapIs**
$\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs**
$\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).rem))).**_replace**(p2 → ((-35
* div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).quot) + (172 *
div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).rem))).r3)) −
(**asType**<**int**>(**asType**<**short int**>(div3.quot)) *
asType<**int**>($\$heap_{719,1;730,8}$.b3)))))

→ *[const member of object with modified fields]*

[36.7] $\$heap_{719,1;731,8}$ == $\$heap_{funcstart\_719,1}$.**_replace**(p1 → ((-2 *
div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1,
177).rem))).**_replace**(p2 → ((-35 * div(**heapIs** $\$heap_{funcstart\_719,1}$,
$\$heap_{funcstart\_719,1}$.p2, 176).quot) + (172 * div(**heapIs** $\$heap_{funcstart\_719,1}$,
$\$heap_{funcstart\_719,1}$.p2, 176).rem))).**_replace**(p3 → **asType**<**short
int**>((div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p3, 178).rem *
asType<**int**>($\$heap_{funcstart\_719,1}$.r3)) − (**asType**<**int**>(**asType**<**short
int**>(div3.quot)) * **asType**<**int**>($\$heap_{719,1;730,8}$.b3)))))

→ *[const static or extern object]*

[36.8] $\$heap_{719,1;731,8}$ == $\$heap_{funcstart\_719,1}$.**_replace**(p1 → ((-2 *
div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1,
177).rem))).**_replace**(p2 → ((-35 * div(**heapIs** $\$heap_{funcstart\_719,1}$,
$\$heap_{funcstart\_719,1}$.p2, 176).quot) + (172 * div(**heapIs** $\$heap_{funcstart\_719,1}$,
$\$heap_{funcstart\_719,1}$.p2, 176).rem))).**_replace**(p3 → **asType**<**short
int**>((div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p3, 178).rem *
asType<**int**>($\$heap_{init}$.r3)) − (**asType**<**int**>(**asType**<**short
int**>(div3.quot)) * **asType**<**int**>($\$heap_{719,1;730,8}$.b3)))))

→ *[expand definition of constant 'r3' at prang.c (25,20)]*

[36.9] $\$heap_{719,1;731,8}$ == $\$heap_{funcstart\_719,1}$.**_replace**(p1 → ((-2 *
div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1,
177).rem))).**_replace**(p2 → ((-35 * div(**heapIs** $\$heap_{funcstart\_719,1}$,
$\$heap_{funcstart\_719,1}$.p2, 176).quot) + (172 * div(**heapIs** $\$heap_{funcstart\_719,1}$,
$\$heap_{funcstart\_719,1}$.p2, 176).rem))).**_replace**(p3 → **asType**<**short
int**>((div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p3, 178).rem *
asType<**int**>(**asType**<**short int**>((**int**)170))) −
(**asType**<**int**>(**asType**<**short int**>(div3.quot)) *

asType<**int**>($heap$_{719,1;730,8}$.b3))))

→ *[simplify]*

[36.12] $heap$_{719,1;731,8}$ == $heap$_{funcstart_719,1}$.**_replace**(p1 → ((-2 *
div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1, 177).quot) + (171 *
div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1,
177).rem))).**_replace**(p2 → ((-35 * div(**heapIs** $heap$_{funcstart_719,1}$,
$heap$_{funcstart_719,1}$.p2, 176).quot) + (172 * div(**heapIs** $heap$_{funcstart_719,1}$,
$heap$_{funcstart_719,1}$.p2, 176).rem))).**_replace**(p3 → **asType**<**short
int**>((div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p3, 178).rem * 170)
− (**asType**<**int**>(**asType**<**short int**>(div3.quot)) *
asType<**int**>($heap$_{719,1;730,8}$.b3))))

→ *[from term 19.6, div3 is equal to div(**heapIs** $heap$_{funcstart_719,1}$,
$heap$_{funcstart_719,1}$.p3, 178)]*

[36.13] $heap$_{719,1;731,8}$ == $heap$_{funcstart_719,1}$.**_replace**(p1 → ((-2 *
div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1, 177).quot) + (171 *
div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1,
177).rem))).**_replace**(p2 → ((-35 * div(**heapIs** $heap$_{funcstart_719,1}$,
$heap$_{funcstart_719,1}$.p2, 176).quot) + (172 * div(**heapIs** $heap$_{funcstart_719,1}$,
$heap$_{funcstart_719,1}$.p2, 176).rem))).**_replace**(p3 → **asType**<**short int**>((170
* div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p3, 178).rem) −
(**asType**<**int**>(**asType**<**short int**>(div(**heapIs** $heap$_{funcstart_719,1}$,
$heap$_{funcstart_719,1}$.p3, 178).quot)) * **asType**<**int**>($heap$_{719,1;730,8}$.b3))))

→ *[simplify]*

[36.15] $heap$_{719,1;731,8}$ == $heap$_{funcstart_719,1}$.**_replace**(p1 → ((-2 *
div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1, 177).quot) + (171 *
div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1,
177).rem))).**_replace**(p2 → ((-35 * div(**heapIs** $heap$_{funcstart_719,1}$,
$heap$_{funcstart_719,1}$.p2, 176).quot) + (172 * div(**heapIs** $heap$_{funcstart_719,1}$,
$heap$_{funcstart_719,1}$.p2, 176).rem))).**_replace**(p3 → **asType**<**short int**>((170
* div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p3, 178).rem) −
(div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p3, 178).quot *
asType<**int**>($heap$_{719,1;730,8}$.b3))))

→ *[from term 31.24, $heap$_{719,1;730,8}$ is equal to
$heap$_{funcstart_719,1}$.**_replace**(p1 → ((-2 * div(**heapIs** $heap$_{funcstart_719,1}$,
$heap$_{funcstart_719,1}$.p1, 177).quot) + (171 * div(**heapIs** $heap$_{funcstart_719,1}$,
$heap$_{funcstart_719,1}$.p1, 177).rem))).**_replace**(p2 → (-35 * div(**heapIs**
$heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p2, 176).quot) + (172 * div(**heapIs**
$heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p2, 176).rem))]*

[36.16] $heap$_{719,1;731,8}$ == $heap$_{funcstart_719,1}$.**_replace**(p1 → ((-2 *
div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1, 177).quot) + (171 *
div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1,
177).rem))).**_replace**(p2 → ((-35 * div(**heapIs** $heap$_{funcstart_719,1}$,

$\text{\$heap}_{funcstart\_719,1}.\text{p2}, 176).\text{quot}) + (172 * \text{div}(\textbf{heapIs } \text{\$heap}_{funcstart\_719,1},$
$\text{\$heap}_{funcstart\_719,1}.\text{p2}, 176).\text{rem}))).\underline{\textbf{replace}}(\text{p3} \rightarrow \textbf{asType}\text{<short int>}((170$
$* \text{div}(\textbf{heapIs } \text{\$heap}_{funcstart\_719,1}, \text{\$heap}_{funcstart\_719,1}.\text{p3}, 178).\text{rem}) -$
$(\text{div}(\textbf{heapIs } \text{\$heap}_{funcstart\_719,1}, \text{\$heap}_{funcstart\_719,1}.\text{p3}, 178).\text{quot} *$
$\textbf{asType}\text{<int>}(\text{\$heap}_{funcstart\_719,1}.\underline{\textbf{replace}}(\text{p1} \rightarrow ((-2 * \text{div}(\textbf{heapIs}$
$\text{\$heap}_{funcstart\_719,1}, \text{\$heap}_{funcstart\_719,1}.\text{p1}, 177).\text{quot}) + (171 * \text{div}(\textbf{heapIs}$
$\text{\$heap}_{funcstart\_719,1}, \text{\$heap}_{funcstart\_719,1}.\text{p1}, 177).\text{rem}))).\underline{\textbf{replace}}(\text{p2} \rightarrow ((-35$
$* \text{div}(\textbf{heapIs } \text{\$heap}_{funcstart\_719,1}, \text{\$heap}_{funcstart\_719,1}.\text{p2}, 176).\text{quot}) + (172 *$
$\text{div}(\textbf{heapIs } \text{\$heap}_{funcstart\_719,1}, \text{\$heap}_{funcstart\_719,1}.\text{p2}, 176).\text{rem}))).\text{b3})))$

$\rightarrow$ *[const member of object with modified fields]*

[36.18] $\text{\$heap}_{719,1;731,8} == \text{\$heap}_{funcstart\_719,1}.\underline{\textbf{replace}}(\text{p1} \rightarrow ((-2 *$
$\text{div}(\textbf{heapIs } \text{\$heap}_{funcstart\_719,1}, \text{\$heap}_{funcstart\_719,1}.\text{p1}, 177).\text{quot}) + (171 *$
$\text{div}(\textbf{heapIs } \text{\$heap}_{funcstart\_719,1}, \text{\$heap}_{funcstart\_719,1}.\text{p1},$
$177).\text{rem}))).\underline{\textbf{replace}}(\text{p2} \rightarrow ((-35 * \text{div}(\textbf{heapIs } \text{\$heap}_{funcstart\_719,1},$
$\text{\$heap}_{funcstart\_719,1}.\text{p2}, 176).\text{quot}) + (172 * \text{div}(\textbf{heapIs } \text{\$heap}_{funcstart\_719,1},$
$\text{\$heap}_{funcstart\_719,1}.\text{p2}, 176).\text{rem}))).\underline{\textbf{replace}}(\text{p3} \rightarrow \textbf{asType}\text{<short int>}((170$
$* \text{div}(\textbf{heapIs } \text{\$heap}_{funcstart\_719,1}, \text{\$heap}_{funcstart\_719,1}.\text{p3}, 178).\text{rem}) -$
$(\text{div}(\textbf{heapIs } \text{\$heap}_{funcstart\_719,1}, \text{\$heap}_{funcstart\_719,1}.\text{p3}, 178).\text{quot} *$
$\textbf{asType}\text{<int>}(\text{\$heap}_{funcstart\_719,1}.\text{b3})))$

$\rightarrow$ *[const static or extern object]*

[36.19] $\text{\$heap}_{719,1;731,8} == \text{\$heap}_{funcstart\_719,1}.\underline{\textbf{replace}}(\text{p1} \rightarrow ((-2 *$
$\text{div}(\textbf{heapIs } \text{\$heap}_{funcstart\_719,1}, \text{\$heap}_{funcstart\_719,1}.\text{p1}, 177).\text{quot}) + (171 *$
$\text{div}(\textbf{heapIs } \text{\$heap}_{funcstart\_719,1}, \text{\$heap}_{funcstart\_719,1}.\text{p1},$
$177).\text{rem}))).\underline{\textbf{replace}}(\text{p2} \rightarrow ((-35 * \text{div}(\textbf{heapIs } \text{\$heap}_{funcstart\_719,1},$
$\text{\$heap}_{funcstart\_719,1}.\text{p2}, 176).\text{quot}) + (172 * \text{div}(\textbf{heapIs } \text{\$heap}_{funcstart\_719,1},$
$\text{\$heap}_{funcstart\_719,1}.\text{p2}, 176).\text{rem}))).\underline{\textbf{replace}}(\text{p3} \rightarrow \textbf{asType}\text{<short int>}((170$
$* \text{div}(\textbf{heapIs } \text{\$heap}_{funcstart\_719,1}, \text{\$heap}_{funcstart\_719,1}.\text{p3}, 178).\text{rem}) -$
$(\text{div}(\textbf{heapIs } \text{\$heap}_{funcstart\_719,1}, \text{\$heap}_{funcstart\_719,1}.\text{p3}, 178).\text{quot} *$
$\textbf{asType}\text{<int>}(\text{\$heap}_{init}.\text{b3})))$

$\rightarrow$ *[expand definition of constant 'b3' at prang.c (27,20)]*

[36.20] $\text{\$heap}_{719,1;731,8} == \text{\$heap}_{funcstart\_719,1}.\underline{\textbf{replace}}(\text{p1} \rightarrow ((-2 *$
$\text{div}(\textbf{heapIs } \text{\$heap}_{funcstart\_719,1}, \text{\$heap}_{funcstart\_719,1}.\text{p1}, 177).\text{quot}) + (171 *$
$\text{div}(\textbf{heapIs } \text{\$heap}_{funcstart\_719,1}, \text{\$heap}_{funcstart\_719,1}.\text{p1},$
$177).\text{rem}))).\underline{\textbf{replace}}(\text{p2} \rightarrow ((-35 * \text{div}(\textbf{heapIs } \text{\$heap}_{funcstart\_719,1},$
$\text{\$heap}_{funcstart\_719,1}.\text{p2}, 176).\text{quot}) + (172 * \text{div}(\textbf{heapIs } \text{\$heap}_{funcstart\_719,1},$
$\text{\$heap}_{funcstart\_719,1}.\text{p2}, 176).\text{rem}))).\underline{\textbf{replace}}(\text{p3} \rightarrow \textbf{asType}\text{<short int>}((170$
$* \text{div}(\textbf{heapIs } \text{\$heap}_{funcstart\_719,1}, \text{\$heap}_{funcstart\_719,1}.\text{p3}, 178).\text{rem}) -$
$(\text{div}(\textbf{heapIs } \text{\$heap}_{funcstart\_719,1}, \text{\$heap}_{funcstart\_719,1}.\text{p3}, 178).\text{quot} *$
$\textbf{asType}\text{<int>}(\textbf{asType}\text{<short int>}((\textbf{int})63)))))$

$\rightarrow$ *[simplify]*

[36.26] $\text{\$heap}_{719,1;731,8} == \text{\$heap}_{funcstart\_719,1}.\underline{\textbf{replace}}(\text{p1} \rightarrow ((-2 *$
$\text{div}(\textbf{heapIs } \text{\$heap}_{funcstart\_719,1}, \text{\$heap}_{funcstart\_719,1}.\text{p1}, 177).\text{quot}) + (171 *$

div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).rem))).**_replace**(p2 → ((-35 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).quot) + (172 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).rem))).**_replace**(p3 → ((-63 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p3, 178).quot) + (170 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p3, 178).rem)))

[Take goal term]

[1.0] (**asType\<int\>**($\$heap_{719,1;731,8}$.M1) *
asType\<int\>(**static_cast\<integer\>**(**asType\<int\>**($\$heap_{719,1;731,8}$.p1) <
(**int**)0))) ≤ **maxof(int)**

→ *[from term 36.26, $heap_{719,1;731,8}$ is equal to*
*$heap_{funcstart\_719,1}$.**_replace**(p1 → ((-2 * div(**heapIs** $heap_{funcstart\_719,1}$,*
*$heap_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs** $heap_{funcstart\_719,1}$,*
*$heap_{funcstart\_719,1}$.p1, 177).rem))).**_replace**(p2 → ((-35 * div(**heapIs***
*$heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p2, 176).quot) + (172 * div(**heapIs***
*$heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p2, 176).rem))).**_replace**(p3 → (-63 ***
*div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p3, 178).quot) + (170 ***
*div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p3, 178).rem))]*

[1.1] (**asType\<int\>**($\$heap_{funcstart\_719,1}$.**_replace**(p1 → ((-2 * div(**heapIs**
$\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs**
$\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).rem))).**_replace**(p2 → ((-35
* div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).quot) + (172 *
div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2,
176).rem))).**_replace**(p3 → ((-63 * div(**heapIs** $\$heap_{funcstart\_719,1}$,
$\$heap_{funcstart\_719,1}$.p3, 178).quot) + (170 * div(**heapIs** $\$heap_{funcstart\_719,1}$,
$\$heap_{funcstart\_719,1}$.p3, 178).rem))).M1) *
asType\<int\>(**static_cast\<integer\>**(**asType\<int\>**($\$heap_{719,1;731,8}$.p1) <
(**int**)0))) ≤ **maxof(int)**

→ *[const member of object with modified fields]*

[1.4] (**asType\<int\>**($\$heap_{funcstart\_719,1}$.M1) *
asType\<int\>(**static_cast\<integer\>**(**asType\<int\>**($\$heap_{719,1;731,8}$.p1) <
(**int**)0))) ≤ **maxof(int)**

→ *[const static or extern object]*

[1.5] (**asType\<int\>**($\$heap_{init}$.M1) *
asType\<int\>(**static_cast\<integer\>**(**asType\<int\>**($\$heap_{719,1;731,8}$.p1) <
(**int**)0))) ≤ **maxof(int)**

→ *[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\>**($\$heap_{719,1;731,8}$.p1) <
(**int**)0))) ≤ **maxof(int)**

→ *[simplify]*

[1.9] (30269 *
asType<int>(**static_cast<integer>**(**asType<int>**($heap$_{719,1;731,8}$·p1) <
(**int**)0))) ≤ **maxof**(**int**)

→ *[from term 36.26, $heap$_{719,1;731,8}$ is equal to*
*$heap$_{funcstart_719,1}$·**replace**(p1 → ((-2 * div(**heapIs** $heap$_{funcstart_719,1}$,*
*$heap$_{funcstart_719,1}$·p1, 177).quot) + (171 * div(**heapIs** $heap$_{funcstart_719,1}$,*
*$heap$_{funcstart_719,1}$·p1, 177).rem)))._**replace**(p2 → ((-35 * div(**heapIs***
*$heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$·p2, 176).quot) + (172 * div(**heapIs***
*$heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$·p2, 176).rem)))._**replace**(p3 → (-63 **
*div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$·p3, 178).quot) + (170 **
*div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$·p3, 178).rem))]*

[1.10] (30269 *
asType<int>(**static_cast<integer>**(**asType<int>**($heap$_{funcstart_719,1}$·**replace**(p1
→ ((-2 * div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$·p1, 177).quot) +
(171 * div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$·p1,
177).rem)))._**replace**(p2 → ((-35 * div(**heapIs** $heap$_{funcstart_719,1}$,
$heap$_{funcstart_719,1}$·p2, 176).quot) + (172 * div(**heapIs** $heap$_{funcstart_719,1}$,
$heap$_{funcstart_719,1}$·p2, 176).rem)))._**replace**(p3 → ((-63 * div(**heapIs**
$heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$·p3, 178).quot) + (170 * div(**heapIs**
$heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$·p3, 178).rem))).p1) < (**int**)0))) ≤
maxof(**int**)

→ *[simplify]*

[1.22] (30269 * **asType<int>**(([0 < ((-171 * div(**heapIs** $heap$_{funcstart_719,1}$,
$heap$_{funcstart_719,1}$·p1, 177).rem) + (2 * div(**heapIs** $heap$_{funcstart_719,1}$,
$heap$_{funcstart_719,1}$·p1, 177).quot))]: 1, []: 0))) ≤ **maxof**(**int**)

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

[1.23] (30269 * **asType<int>**(([0 < ((-171 * div(**heapIs** $heap$_{funcstart_719,1}$,
$heap$_{funcstart_719,1}$·p1, 177).rem) + (2 * div(**heapIs** $heap$_{funcstart_719,1}$,
$heap$_{funcstart_719,1}$·p1, 177).quot))]: 1, [!(0 < ((-171 * div(**heapIs**
$heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$·p1, 177).rem) + (2 * div(**heapIs**
$heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$·p1, 177).quot)))]: 0))) ≤ **maxof**(**int**)

→ *[simplify]*

[1.29] (30269 * ([0 < ((-171 * div(**heapIs** $heap$_{funcstart_719,1}$,
$heap$_{funcstart_719,1}$·p1, 177).rem) + (2 * div(**heapIs** $heap$_{funcstart_719,1}$,
$heap$_{funcstart_719,1}$·p1, 177).quot))]: 1, [-1 < ((-2 * div(**heapIs**
$heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$·p1, 177).quot) + (171 * div(**heapIs**
$heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$·p1, 177).rem))]: 0)) ≤ **maxof**(**int**)

→ *[move guard outside expression]*

[1.30] ([0 < ((-171 * div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$·p1,
177).rem) + (2 * div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$·p1,
177).quot))]: 1 * 30269, [-1 < ((-2 * div(**heapIs** $heap$_{funcstart_719,1}$,

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$heap_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs** $heap_{funcstart\_719,1}$,
$heap_{funcstart\_719,1}$.p1, 177).rem))]: 0 * 30269) $\leq$ **maxof(int)**

$\rightarrow$ *[simplify]*

[1.34] (-1 + ([0 < ((-171 * div(**heapIs** $heap_{funcstart\_719,1}$,
$heap_{funcstart\_719,1}$.p1, 177).rem) + (2 * div(**heapIs** $heap_{funcstart\_719,1}$,
$heap_{funcstart\_719,1}$.p1, 177).quot))]: 30269, [-1 < ((-2 * div(**heapIs**
$heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs**
$heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p1, 177).rem))]: 0)) < 32767

$\rightarrow$ *[move guard outside expression]*

[1.35] ([0 < ((-171 * div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p1,
177).rem) + (2 * div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p1,
177).quot))]: -1 + 30269, [-1 < ((-2 * div(**heapIs** $heap_{funcstart\_719,1}$,
$heap_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs** $heap_{funcstart\_719,1}$,
$heap_{funcstart\_719,1}$.p1, 177).rem))]: -1 + 0) < 32767

$\rightarrow$ *[simplify]*

[1.38] 0 < (32767 + $-$([0 < ((-171 * div(**heapIs** $heap_{funcstart\_719,1}$,
$heap_{funcstart\_719,1}$.p1, 177).rem) + (2 * div(**heapIs** $heap_{funcstart\_719,1}$,
$heap_{funcstart\_719,1}$.p1, 177).quot))]: 30268, [-1 < ((-2 * div(**heapIs**
$heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs**
$heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p1, 177).rem))]: -1))

$\rightarrow$ *[move guard outside expression]*

[1.39] 0 < (32767 + ([0 < ((-171 * div(**heapIs** $heap_{funcstart\_719,1}$,
$heap_{funcstart\_719,1}$.p1, 177).rem) + (2 * div(**heapIs** $heap_{funcstart\_719,1}$,
$heap_{funcstart\_719,1}$.p1, 177).quot))]: -30268, [-1 < ((-2 * div(**heapIs**
$heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs**
$heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p1, 177).rem))]: $--1$))

$\rightarrow$ *[simplify]*

[1.41] 0 < (32767 + ([0 < ((-171 * div(**heapIs** $heap_{funcstart\_719,1}$,
$heap_{funcstart\_719,1}$.p1, 177).rem) + (2 * div(**heapIs** $heap_{funcstart\_719,1}$,
$heap_{funcstart\_719,1}$.p1, 177).quot))]: -30268, [-1 < ((-2 * div(**heapIs**
$heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs**
$heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p1, 177).rem))]: 1))

$\rightarrow$ *[move guard outside expression]*

[1.42] 0 < ([0 < ((-171 * div(**heapIs** $heap_{funcstart\_719,1}$,
$heap_{funcstart\_719,1}$.p1, 177).rem) + (2 * div(**heapIs** $heap_{funcstart\_719,1}$,
$heap_{funcstart\_719,1}$.p1, 177).quot))]: -30268 + 32767, [-1 < ((-2 * div(**heapIs**
$heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs**
$heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p1, 177).rem))]: 1 + 32767)

$\rightarrow$ *[simplify]*

[1.44] 0 < ([0 < ((-171 * div(**heapIs** $heap_{funcstart\_719,1}$,

$\text{\$heap}_{funcstart\_719,1}.\text{p1, 177).rem)} + (2 * \text{div}(\textbf{heapIs } \text{\$heap}_{funcstart\_719,1},$
$\text{\$heap}_{funcstart\_719,1}.\text{p1, 177).quot))]: 2499, [-1} < ((-2 * \text{div}(\textbf{heapIs}$
$\text{\$heap}_{funcstart\_719,1}, \text{\$heap}_{funcstart\_719,1}.\text{p1, 177).quot)} + (171 * \text{div}(\textbf{heapIs}$
$\text{\$heap}_{funcstart\_719,1}, \text{\$heap}_{funcstart\_719,1}.\text{p1, 177).rem))]: 32768)}$

$\rightarrow$ *[move guard outside expression]*

[1.45] $([0 < ((-171 * \text{div}(\textbf{heapIs } \text{\$heap}_{funcstart\_719,1}, \text{\$heap}_{funcstart\_719,1}.\text{p1},$
$177).\text{rem)} + (2 * \text{div}(\textbf{heapIs } \text{\$heap}_{funcstart\_719,1}, \text{\$heap}_{funcstart\_719,1}.\text{p1},$
$177).\text{quot))]: } 0 < 2499, [-1 < ((-2 * \text{div}(\textbf{heapIs } \text{\$heap}_{funcstart\_719,1},$
$\text{\$heap}_{funcstart\_719,1}.\text{p1, 177).quot)} + (171 * \text{div}(\textbf{heapIs } \text{\$heap}_{funcstart\_719,1},$
$\text{\$heap}_{funcstart\_719,1}.\text{p1, 177).rem))]: } 0 < 32768)$

$\rightarrow$ *[simplify]*

[1.47] $([0 < ((-171 * \text{div}(\textbf{heapIs } \text{\$heap}_{funcstart\_719,1}, \text{\$heap}_{funcstart\_719,1}.\text{p1},$
$177).\text{rem)} + (2 * \text{div}(\textbf{heapIs } \text{\$heap}_{funcstart\_719,1}, \text{\$heap}_{funcstart\_719,1}.\text{p1},$
$177).\text{quot))]: } \textbf{true}, [-1 < ((-2 * \text{div}(\textbf{heapIs } \text{\$heap}_{funcstart\_719,1},$
$\text{\$heap}_{funcstart\_719,1}.\text{p1, 177).quot)} + (171 * \text{div}(\textbf{heapIs } \text{\$heap}_{funcstart\_719,1},$
$\text{\$heap}_{funcstart\_719,1}.\text{p1, 177).rem))]: } \textbf{true})$

$\rightarrow$ *[all guards have equal guarded terms]*

[1.48] **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 (51,5)

Condition defined at:

To prove: minof(int) $\leq$ $\text{\$heap}_{719,1;731,8}.\text{p1}$

Given:

$\text{\$heap}_{init}.\text{LIMIT} == (\textbf{int})80$

$\text{\$heap}_{init}.\text{M1} == \textbf{asType}<\textbf{short int}>((\textbf{int})30269)$

$\text{\$heap}_{init}.\text{r1} == \textbf{asType}<\textbf{short int}>((\textbf{int})171)$

$\text{\$heap}_{init}.\text{a1} == \textbf{asType}<\textbf{short int}>((\textbf{int})177)$

$\text{\$heap}_{init}.\text{b1} == \textbf{asType}<\textbf{short int}>((\textbf{int})2)$

$\text{\$heap}_{init}.\text{M2} == \textbf{asType}<\textbf{short int}>((\textbf{int})30307)$

$\text{\$heap}_{init}.\text{r2} == \textbf{asType}<\textbf{short int}>((\textbf{int})172)$

$\text{\$heap}_{init}.\text{a2} == \textbf{asType}<\textbf{short int}>((\textbf{int})176)$

$\text{\$heap}_{init}.\text{b2} == \textbf{asType}<\textbf{short int}>((\textbf{int})35)$

$\text{\$heap}_{init}.\text{M3} == \textbf{asType}<\textbf{short int}>((\textbf{int})30323)$

$\text{\$heap}_{init}.\text{r3} == \textbf{asType}<\textbf{short int}>((\textbf{int})170)$

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

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

$\$heap_{init}.p1 == \textbf{asType}\textbf{<short int>}((\textbf{int})1)$

$\$heap_{init}.p2 == \textbf{asType}\textbf{<short int>}((\textbf{int})2)$

$\$heap_{init}.p3 == \textbf{asType}\textbf{<short int>}((\textbf{int})3)$

div1 == div(**heapIs** $\$heap_{funcstart\_719,1}$,
asType<int>($\$heap_{funcstart\_719,1}.p1$),
asType<int>($\$heap_{funcstart\_719,1}.a1$))

(**asType<integer>**(**asType<int>**($\$heap_{funcstart\_719,1}.p1$)) /
asType<integer>(**asType<int>**($\$heap_{funcstart\_719,1}.a1$))) ==
asType<integer>(div1.quot)

(**asType<integer>**(**asType<int>**($\$heap_{funcstart\_719,1}.p1$)) %
asType<integer>(**asType<int>**($\$heap_{funcstart\_719,1}.a1$))) ==
asType<integer>(div1.rem)

div2 == div(**heapIs** $\$heap_{funcstart\_719,1}$,
asType<int>($\$heap_{funcstart\_719,1}.p2$),
asType<int>($\$heap_{funcstart\_719,1}.a2$))

(**asType<integer>**(**asType<int>**($\$heap_{funcstart\_719,1}.p2$)) /
asType<integer>(**asType<int>**($\$heap_{funcstart\_719,1}.a2$))) ==
asType<integer>(div2.quot)

(**asType<integer>**(**asType<int>**($\$heap_{funcstart\_719,1}.p2$)) %
asType<integer>(**asType<int>**($\$heap_{funcstart\_719,1}.a2$))) ==
asType<integer>(div2.rem)

div3 == div(**heapIs** $\$heap_{funcstart\_719,1}$,
asType<int>($\$heap_{funcstart\_719,1}.p3$),
asType<int>($\$heap_{funcstart\_719,1}.a3$))

(**asType<integer>**(**asType<int>**($\$heap_{funcstart\_719,1}.p3$)) /
asType<integer>(**asType<int>**($\$heap_{funcstart\_719,1}.a3$))) ==
asType<integer>(div3.quot)

(**asType<integer>**(**asType<int>**($\$heap_{funcstart\_719,1}.p3$)) %
asType<integer>(**asType<int>**($\$heap_{funcstart\_719,1}.a3$))) ==
asType<integer>(div3.rem)

$\$heap_{719,1;729,8}$ == $\$heap_{funcstart\_719,1}$.**replace**(p1 → **asType<short
int>**((**asType<int>**(**asType<short int>**(div1.rem)) *
asType<int>($\$heap_{funcstart\_719,1}.r1$)) − (**asType<int>**(**asType<short
int>**(div1.quot)) * **asType<int>**($\$heap_{funcstart\_719,1}.b1$))))

$\$heap_{719,1;730,8}$ == $\$heap_{719,1;729,8}$.**replace**(p2 → **asType<short
int>**((**asType<int>**(**asType<short int>**(div2.rem)) *
asType<int>($\$heap_{719,1;729,8}.r2$)) − (**asType<int>**(**asType<short

int>(div2.quot)) * **asType**<**int**>($heap$_{719,1;729,8}$.b2))))

$heap$_{719,1;731,8}$ == $heap$_{719,1;730,8}$._**replace**(p3 → **asType**<**short int**>((**asType**<**int**>(**asType**<**short int**>(div3.rem)) * **asType**<**int**>($heap$_{719,1;730,8}$.r3)) − (**asType**<**int**>(**asType**<**short int**>(div3.quot)) * **asType**<**int**>($heap$_{719,1;730,8}$.b3))))

Proof:

[Take given term]

[5.0] div1 == div(**heapIs** $heap$_{funcstart_719,1}$,
asType<**int**>($heap$_{funcstart_719,1}$.p1),
asType<**int**>($heap$_{funcstart_719,1}$.a1))

→ *[simplify]*

[5.1] div1 == div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1,
asType<**int**>($heap$_{funcstart_719,1}$.a1))

→ *[const static or extern object]*

[5.2] div1 == div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1,
asType<**int**>($heap$_{init}$.a1))

→ *[expand definition of constant 'a1' at prang.c (16,20)]*

[5.3] div1 == div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1,
asType<**int**>(**asType**<**short int**>((**int**)177)))

→ *[simplify]*

[5.6] div1 == div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1, 177)

[Assume known post-assertion, class invariant or type constraint for term 5.6]

[9.0] $heap$_{funcstart_719,1}$.p1 ≤ **maxof**(**short int**)

→ *[simplify]*

[9.9] -32768 < −$heap$_{funcstart_719,1}$.p1

[Assume known post-assertion, class invariant or type constraint for term 5.6]

[10.0] (**asType**<**integer**>($heap$_{funcstart_719,1}$.p1) /
asType<**integer**>(177)) == **asType**<**integer**>(div(**heapIs**
$heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1, 177).quot)

→ *[simplify]*

[10.2] ($heap$_{funcstart_719,1}$.p1 / 177) == **asType**<**integer**>(div(**heapIs**
$heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1, 177).quot)

→ *[expand definition of operator './' in class 'int' at built in declaration]*

[10.3] ([**asType**<**integer**>($heap$_{funcstart_719,1}$.p1) < 0]:
−(−**asType**<**integer**>($heap$_{funcstart_719,1}$.p1) / 177), []:
asType<**integer**>($heap$_{funcstart_719,1}$.p1) / 177) ==

asType<**integer**>(div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}$.p1, 177).quot)

$\rightarrow$ *[explicitly assert falsehood of skipped guards in subsequent guards]*

[10.4] ([**asType**<**integer**>($\$\text{heap}_{funcstart\_719,1}$.p1) < 0]: $-(-$**asType**<**integer**>($\$\text{heap}_{funcstart\_719,1}$.p1) / 177), [!(**asType**<**integer**>($\$\text{heap}_{funcstart\_719,1}$.p1) < 0)]: **asType**<**integer**>($\$\text{heap}_{funcstart\_719,1}$.p1) / 177) == **asType**<**integer**>(div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}$.p1, 177).quot)

$\rightarrow$ *[simplify]*

[10.17] 0 == ($-$([0 < $-\$\text{heap}_{funcstart\_719,1}$.p1]: $-(-\$\text{heap}_{funcstart\_719,1}$.p1 / 177), [-1 < $\$\text{heap}_{funcstart\_719,1}$.p1]: $\$\text{heap}_{funcstart\_719,1}$.p1 / 177) + div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}$.p1, 177).quot)

$\rightarrow$ *[move guard outside expression]*

[10.18] 0 == (([0 < $-\$\text{heap}_{funcstart\_719,1}$.p1]: $-(-(-\$\text{heap}_{funcstart\_719,1}$.p1 / 177)), [-1 < $\$\text{heap}_{funcstart\_719,1}$.p1]: $-(\$\text{heap}_{funcstart\_719,1}$.p1 / 177)) + div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}$.p1, 177).quot)

$\rightarrow$ *[simplify]*

[10.19] 0 == (([0 < $-\$\text{heap}_{funcstart\_719,1}$.p1]: $-\$\text{heap}_{funcstart\_719,1}$.p1 / 177, [-1 < $\$\text{heap}_{funcstart\_719,1}$.p1]: $-(\$\text{heap}_{funcstart\_719,1}$.p1 / 177)) + div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}$.p1, 177).quot)

$\rightarrow$ *[move guard outside expression]*

[10.21] ([0 < $-\$\text{heap}_{funcstart\_719,1}$.p1]: 0 == (($-\$\text{heap}_{funcstart\_719,1}$.p1 / 177) + div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}$.p1, 177).quot), [-1 < $\$\text{heap}_{funcstart\_719,1}$.p1]: 0 == ($-(\$\text{heap}_{funcstart\_719,1}$.p1 / 177) + div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}$.p1, 177).quot))

[Assume known post-assertion, class invariant or type constraint for term 5.6]

[11.0] (**asType**<**integer**>($\$\text{heap}_{funcstart\_719,1}$.p1) % **asType**<**integer**>(177)) == **asType**<**integer**>(div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}$.p1, 177).rem)

$\rightarrow$ *[simplify]*

[11.2] ($\$\text{heap}_{funcstart\_719,1}$.p1 % 177) == **asType**<**integer**>(div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}$.p1, 177).rem)

$\rightarrow$ *[expand definition of operator '.%' in class 'int' at built in declaration]*

[11.3] ([**asType**<**integer**>($\$\text{heap}_{funcstart\_719,1}$.p1) < 0]: $-(-$**asType**<**integer**>($\$\text{heap}_{funcstart\_719,1}$.p1) % 177), []: **asType**<**integer**>($\$\text{heap}_{funcstart\_719,1}$.p1) % 177) == **asType**<**integer**>(div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}$.p1, 177).rem)

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

[11.4] ([**asType**<**integer**>($\text{heap}_{funcstart\_719,1}$.p1) < 0]:
−(−**asType**<**integer**>($\text{heap}_{funcstart\_719,1}$.p1) % 177),
[!(**asType**<**integer**>($\text{heap}_{funcstart\_719,1}$.p1) < 0)]:
asType<**integer**>($\text{heap}_{funcstart\_719,1}$.p1) % 177) ==
asType<**integer**>(div(**heapIs** $\text{heap}_{funcstart\_719,1}$, $\text{heap}_{funcstart\_719,1}$.p1,
177).rem)

→ *[simplify]*

[11.14] ([0 < −$\text{heap}_{funcstart\_719,1}$.p1]: −(−$\text{heap}_{funcstart\_719,1}$.p1 % 177), [-1
< $\text{heap}_{funcstart\_719,1}$.p1]: **asType**<**integer**>($\text{heap}_{funcstart\_719,1}$.p1) % 177)
== **asType**<**integer**>(div(**heapIs** $\text{heap}_{funcstart\_719,1}$,
$\text{heap}_{funcstart\_719,1}$.p1, 177).rem)

→ *[remainder of negation]*

[11.15] ([0 < −$\text{heap}_{funcstart\_719,1}$.p1]: −([0 == ($\text{heap}_{funcstart\_719,1}$.p1 %
177)]: 0, []: 177 + −($\text{heap}_{funcstart\_719,1}$.p1 % 177)), [-1 <
$\text{heap}_{funcstart\_719,1}$.p1]: **asType**<**integer**>($\text{heap}_{funcstart\_719,1}$.p1) % 177)
== **asType**<**integer**>(div(**heapIs** $\text{heap}_{funcstart\_719,1}$,
$\text{heap}_{funcstart\_719,1}$.p1, 177).rem)

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

[11.16] ([0 < −$\text{heap}_{funcstart\_719,1}$.p1]: −([0 == ($\text{heap}_{funcstart\_719,1}$.p1 %
177)]: 0, [!(0 == ($\text{heap}_{funcstart\_719,1}$.p1 % 177))]: 177 +
−($\text{heap}_{funcstart\_719,1}$.p1 % 177)), [-1 < $\text{heap}_{funcstart\_719,1}$.p1]:
asType<**integer**>($\text{heap}_{funcstart\_719,1}$.p1) % 177) ==
asType<**integer**>(div(**heapIs** $\text{heap}_{funcstart\_719,1}$, $\text{heap}_{funcstart\_719,1}$.p1,
177).rem)

→ *[move guard outside expression]*

[11.17] ([0 < −$\text{heap}_{funcstart\_719,1}$.p1]: ([0 == ($\text{heap}_{funcstart\_719,1}$.p1 %
177)]: −0, [!(0 == ($\text{heap}_{funcstart\_719,1}$.p1 % 177))]: −(177 +
−($\text{heap}_{funcstart\_719,1}$.p1 % 177))), [-1 < $\text{heap}_{funcstart\_719,1}$.p1]:
asType<**integer**>($\text{heap}_{funcstart\_719,1}$.p1) % 177) ==
asType<**integer**>(div(**heapIs** $\text{heap}_{funcstart\_719,1}$, $\text{heap}_{funcstart\_719,1}$.p1,
177).rem)

→ *[simplify]*

[11.24] 0 == (−([0 < −$\text{heap}_{funcstart\_719,1}$.p1]: ([0 ==
($\text{heap}_{funcstart\_719,1}$.p1 % 177)]: 0, [!(0 == ($\text{heap}_{funcstart\_719,1}$.p1 % 177))]:
-177 + ($\text{heap}_{funcstart\_719,1}$.p1 % 177)), [-1 < $\text{heap}_{funcstart\_719,1}$.p1]:
$\text{heap}_{funcstart\_719,1}$.p1 % 177) + div(**heapIs** $\text{heap}_{funcstart\_719,1}$,
$\text{heap}_{funcstart\_719,1}$.p1, 177).rem)

→ *[move guard outside expression]*

[11.26] 0 == (([0 < −$\text{heap}_{funcstart\_719,1}$.p1]: ([0 == ($\text{heap}_{funcstart\_719,1}$.p1

% 177)]: -0, [!(0 == ($heap$_{funcstart_719,1}$.p1 % 177))]: $-(-177 +$
($heap$_{funcstart_719,1}$.p1 % 177))), [-1 < $heap$_{funcstart_719,1}$.p1]:
$-(\$heap_{funcstart\_719,1}$.p1 % 177)) + div(**heapIs** $heap$_{funcstart_719,1}$,
$heap$_{funcstart_719,1}$.p1, 177).rem)

$\rightarrow$ *[simplify]*

[11.29] $0 == (([0 < -\$heap_{funcstart\_719,1}$.p1]: ([0 == ($heap$_{funcstart_719,1}$.p1
% 177)]: 0, [!(0 == ($heap$_{funcstart_719,1}$.p1 % 177))]: 177 +
$-(\$heap_{funcstart\_719,1}$.p1 % 177)), [-1 < $heap$_{funcstart_719,1}$.p1]:
$-(\$heap_{funcstart\_719,1}$.p1 % 177)) + div(**heapIs** $heap$_{funcstart_719,1}$,
$heap$_{funcstart_719,1}$.p1, 177).rem)

$\rightarrow$ *[move guard outside expression]*

[11.31] $0 == ([0 < -\$heap_{funcstart\_719,1}$.p1]: ([0 == ($heap$_{funcstart_719,1}$.p1 %
177)]: 0 + div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1, 177).rem,
[!(0 == ($heap$_{funcstart_719,1}$.p1 % 177))]: (177 + $-(\$heap_{funcstart\_719,1}$.p1 %
177)) + div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1, 177).rem), [-1
< $heap$_{funcstart_719,1}$.p1]: $-(\$heap_{funcstart\_719,1}$.p1 % 177) + div(**heapIs**
$heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1, 177).rem)

$\rightarrow$ *[simplify]*

[11.33] $0 == ([0 < -\$heap_{funcstart\_719,1}$.p1]: ([0 == ($heap$_{funcstart_719,1}$.p1
% 177)]: div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1, 177).rem,
[!(0 == ($heap$_{funcstart_719,1}$.p1 % 177))]: 177 + $-(\$heap_{funcstart\_719,1}$.p1 %
177) + div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1, 177).rem), [-1
< $heap$_{funcstart_719,1}$.p1]: $-(\$heap_{funcstart\_719,1}$.p1 % 177) + div(**heapIs**
$heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1, 177).rem)

$\rightarrow$ *[move guard outside expression]*

[11.35] ([0 < -\$heap_{funcstart_719,1}$.p1]: ([0 == ($heap$_{funcstart\_719,1}$.p1 % 177)]:
$0 == $ div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1, 177).rem, [!(0
== ($heap$_{funcstart_719,1}$.p1 % 177))]: $0 == (177 + -(\$heap_{funcstart\_719,1}$.p1
% 177) + div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1, 177).rem)),
[-1 < $heap$_{funcstart_719,1}$.p1]: $0 == (-(\$heap_{funcstart\_719,1}$.p1 % 177) +
div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1, 177).rem))

$\rightarrow$ *[simplify]*

[11.40] ([0 < -\$heap_{funcstart_719,1}$.p1]: ([0 == ($heap$_{funcstart\_719,1}$.p1 %
177)]: $0 ==$ div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1, 177).rem,
[!(0 == ($heap$_{funcstart_719,1}$.p1 % 177))]: 177 == (($heap$_{funcstart\_719,1}$.p1 %
177) + $-$div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1, 177).rem)),
[-1 < $heap$_{funcstart_719,1}$.p1]: $0 == (-(\$heap_{funcstart\_719,1}$.p1 % 177) +
div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1, 177).rem))

[Take given term]

[12.0] div2 == div(**heapIs** $heap$_{funcstart_719,1}$,
asType<**int**>($heap$_{funcstart_719,1}$.p2),

asType<int>($heap$_{funcstart_719,1}$.a2))

→ *[simplify]*

[12.1] div2 == div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p2,
asType<int>($heap$_{funcstart_719,1}$.a2))

→ *[const static or extern object]*

[12.2] div2 == div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p2,
asType<int>($heap$_{init}$.a2))

→ *[expand definition of constant 'a2' at prang.c (21,20)]*

[12.3] div2 == div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p2,
asType<int>(**asType<short int>**((**int**)176)))

→ *[simplify]*

[12.6] div2 == div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p2, 176)

[Take given term]

[19.0] div3 == div(**heapIs** $heap$_{funcstart_719,1}$,
asType<int>($heap$_{funcstart_719,1}$.p3),
asType<int>($heap$_{funcstart_719,1}$.a3))

→ *[simplify]*

[19.1] div3 == div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p3,
asType<int>($heap$_{funcstart_719,1}$.a3))

→ *[const static or extern object]*

[19.2] div3 == div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p3,
asType<int>($heap$_{init}$.a3))

→ *[expand definition of constant 'a3' at prang.c (26,20)]*

[19.3] div3 == div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p3,
asType<int>(**asType<short int>**((**int**)178)))

→ *[simplify]*

[19.6] div3 == div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p3, 178)

[Take given term]

[26.0] $heap$_{719,1;729,8}$ == $heap$_{funcstart_719,1}$.**replace**(p1 → **asType<short
int>**((**asType<int>**(**asType<short int>**(div1.rem)) *
asType<int>($heap$_{funcstart_719,1}$.r1)) − (**asType<int>**(**asType<short
int>**(div1.quot)) * **asType<int>**($heap$_{funcstart_719,1}$.b1)))))

→ *[from term 5.6, div1 is equal to div(**heapIs** $heap$_{funcstart_719,1}$,
$heap$_{funcstart_719,1}$.p1, 177)]*

[26.1] $heap$_{719,1;729,8}$ == $heap$_{funcstart_719,1}$.**replace**(p1 → **asType<short
int>**((**asType<int>**(**asType<short int>**(div(**heapIs** $heap$_{funcstart_719,1}$,

$\$\text{heap}_{funcstart\_719,1}.\text{p1}, 177).\text{rem})) * \textbf{asType}\textbf{<int>}(\$\text{heap}_{funcstart\_719,1}.\text{r1})) -$
$(\textbf{asType}\textbf{<int>}(\textbf{asType}\textbf{<short int>}(\text{div1.quot})) *$
$\textbf{asType}\textbf{<int>}(\$\text{heap}_{funcstart\_719,1}.\text{b1}))))$

$\rightarrow$ *[simplify]*

[26.3] $\$\text{heap}_{719,1;729,8} == \$\text{heap}_{funcstart\_719,1}.\textbf{replace}(\text{p1} \rightarrow \textbf{asType}\textbf{<short int>}((\text{div}(\textbf{heapIs} \$\text{heap}_{funcstart\_719,1}, \$\text{heap}_{funcstart\_719,1}.\text{p1}, 177).\text{rem} * \textbf{asType}\textbf{<int>}(\$\text{heap}_{funcstart\_719,1}.\text{r1})) - (\textbf{asType}\textbf{<int>}(\textbf{asType}\textbf{<short int>}(\text{div1.quot})) * \textbf{asType}\textbf{<int>}(\$\text{heap}_{funcstart\_719,1}.\text{b1}))))$

$\rightarrow$ *[const static or extern object]*

[26.4] $\$\text{heap}_{719,1;729,8} == \$\text{heap}_{funcstart\_719,1}.\textbf{replace}(\text{p1} \rightarrow \textbf{asType}\textbf{<short int>}((\text{div}(\textbf{heapIs} \$\text{heap}_{funcstart\_719,1}, \$\text{heap}_{funcstart\_719,1}.\text{p1}, 177).\text{rem} * \textbf{asType}\textbf{<int>}(\$\text{heap}_{init}.\text{r1})) - (\textbf{asType}\textbf{<int>}(\textbf{asType}\textbf{<short int>}(\text{div1.quot})) * \textbf{asType}\textbf{<int>}(\$\text{heap}_{funcstart\_719,1}.\text{b1}))))$

$\rightarrow$ *[expand definition of constant 'r1' at prang.c (15,20)]*

[26.5] $\$\text{heap}_{719,1;729,8} == \$\text{heap}_{funcstart\_719,1}.\textbf{replace}(\text{p1} \rightarrow \textbf{asType}\textbf{<short int>}((\text{div}(\textbf{heapIs} \$\text{heap}_{funcstart\_719,1}, \$\text{heap}_{funcstart\_719,1}.\text{p1}, 177).\text{rem} * \textbf{asType}\textbf{<int>}(\textbf{asType}\textbf{<short int>}((\textbf{int})171))) - (\textbf{asType}\textbf{<int>}(\textbf{asType}\textbf{<short int>}(\text{div1.quot})) * \textbf{asType}\textbf{<int>}(\$\text{heap}_{funcstart\_719,1}.\text{b1}))))$

$\rightarrow$ *[simplify]*

[26.8] $\$\text{heap}_{719,1;729,8} == \$\text{heap}_{funcstart\_719,1}.\textbf{replace}(\text{p1} \rightarrow \textbf{asType}\textbf{<short int>}((\text{div}(\textbf{heapIs} \$\text{heap}_{funcstart\_719,1}, \$\text{heap}_{funcstart\_719,1}.\text{p1}, 177).\text{rem} * 171) - (\textbf{asType}\textbf{<int>}(\textbf{asType}\textbf{<short int>}(\text{div1.quot})) * \textbf{asType}\textbf{<int>}(\$\text{heap}_{funcstart\_719,1}.\text{b1}))))$

$\rightarrow$ *[from term 5.6, div1 is equal to div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}.p1$, 177)]*

[26.9] $\$\text{heap}_{719,1;729,8} == \$\text{heap}_{funcstart\_719,1}.\textbf{replace}(\text{p1} \rightarrow \textbf{asType}\textbf{<short int>}((171 * \text{div}(\textbf{heapIs} \$\text{heap}_{funcstart\_719,1}, \$\text{heap}_{funcstart\_719,1}.\text{p1}, 177).\text{rem}) - (\textbf{asType}\textbf{<int>}(\textbf{asType}\textbf{<short int>}(\text{div}(\textbf{heapIs} \$\text{heap}_{funcstart\_719,1}, \$\text{heap}_{funcstart\_719,1}.\text{p1}, 177).\text{quot})) * \textbf{asType}\textbf{<int>}(\$\text{heap}_{funcstart\_719,1}.\text{b1}))))$

$\rightarrow$ *[simplify]*

[26.11] $\$\text{heap}_{719,1;729,8} == \$\text{heap}_{funcstart\_719,1}.\textbf{replace}(\text{p1} \rightarrow \textbf{asType}\textbf{<short int>}((171 * \text{div}(\textbf{heapIs} \$\text{heap}_{funcstart\_719,1}, \$\text{heap}_{funcstart\_719,1}.\text{p1}, 177).\text{rem}) - (\text{div}(\textbf{heapIs} \$\text{heap}_{funcstart\_719,1}, \$\text{heap}_{funcstart\_719,1}.\text{p1}, 177).\text{quot} * \textbf{asType}\textbf{<int>}(\$\text{heap}_{funcstart\_719,1}.\text{b1}))))$

$\rightarrow$ *[const static or extern object]*

[26.12] $\$\text{heap}_{719,1;729,8} == \$\text{heap}_{funcstart\_719,1}.\textbf{replace}(\text{p1} \rightarrow \textbf{asType}\textbf{<short int>}((171 * \text{div}(\textbf{heapIs} \$\text{heap}_{funcstart\_719,1}, \$\text{heap}_{funcstart\_719,1}.\text{p1}, 177).\text{rem}) - (\text{div}(\textbf{heapIs} \$\text{heap}_{funcstart\_719,1}, \$\text{heap}_{funcstart\_719,1}.\text{p1}, 177).\text{quot} *$

asType<int>($heap$_{init}$.b1))))

→ *[expand definition of constant 'b1' at prang.c (17,20)]*

[26.13] $heap$_{719,1;729,8}$ == $heap$_{funcstart_719,1}$._**replace**_(p1 → **asType<short int>**((171 * div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1, 177).rem) − (div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1, 177).quot * **asType<int>**(**asType<short int>**((**int**)2)))))

→ *[simplify]*

[26.19] $heap$_{719,1;729,8}$ == $heap$_{funcstart_719,1}$._**replace**_(p1 → ((-2 * div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1, 177).quot) + (171 * div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1, 177).rem)))

[Take given term]

[31.0] $heap$_{719,1;730,8}$ == $heap$_{719,1;729,8}$._**replace**_(p2 → **asType<short int>**((**asType<int>**(**asType<short int>**(div2.rem)) * **asType<int>**($heap$_{719,1;729,8}$.r2)) − (**asType<int>**(**asType<short int>**(div2.quot)) * **asType<int>**($heap$_{719,1;729,8}$.b2))))

→ *[from term 26.19, $heap$_{719,1;729,8}$ is equal to $heap$_{funcstart_719,1}$._**replace**_(p1 → (-2 * div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1, 177).quot) + (171 * div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1, 177).rem))]*

[31.1] $heap$_{719,1;730,8}$ == $heap$_{funcstart_719,1}$._**replace**_(p1 → ((-2 * div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1, 177).quot) + (171 * div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1, 177).rem)))._**replace**_(p2 → **asType<short int>**((**asType<int>**(**asType<short int>**(div2.rem)) * **asType<int>**($heap$_{719,1;729,8}$.r2)) − (**asType<int>**(**asType<short int>**(div2.quot)) * **asType<int>**($heap$_{719,1;729,8}$.b2))))

→ *[from term 12.6, div2 is equal to div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p2, 176)]*

[31.2] $heap$_{719,1;730,8}$ == $heap$_{funcstart_719,1}$._**replace**_(p1 → ((-2 * div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1, 177).quot) + (171 * div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1, 177).rem)))._**replace**_(p2 → **asType<short int>**((**asType<int>**(**asType<short int>**(div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p2, 176).rem)) * **asType<int>**($heap$_{719,1;729,8}$.r2)) − (**asType<int>**(**asType<short int>**(div2.quot)) * **asType<int>**($heap$_{719,1;729,8}$.b2))))

→ *[simplify]*

[31.4] $heap$_{719,1;730,8}$ == $heap$_{funcstart_719,1}$._**replace**_(p1 → ((-2 * div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1, 177).quot) + (171 * div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1, 177).rem)))._**replace**_(p2 → **asType<short int>**((div(**heapIs**

$\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).rem *
asType<int>($\$heap_{719,1;729,8}$.r2)) − (**asType<int>**(**asType<short int>**(div2.quot)) * **asType<int>**($\$heap_{719,1;729,8}$.b2))))

→ *[from term 26.19, $\$heap_{719,1;729,8}$ is equal to*
*$\$heap_{funcstart\_719,1}$.__replace__(p1 → (-2 * div(__heapIs__ $\$heap_{funcstart\_719,1}$,*
*$\$heap_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(__heapIs__ $\$heap_{funcstart\_719,1}$,*
$\$heap_{funcstart\_719,1}$.p1, 177).rem))]

[31.5] $\$heap_{719,1;730,8}$ == $\$heap_{funcstart\_719,1}$.**replace**(p1 → ((-2 *
div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1,
177).rem))).**replace**(p2 → **asType<short int>**((div(**heapIs**
$\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).rem *
asType<int>($\$heap_{funcstart\_719,1}$.**replace**(p1 → ((-2 * div(**heapIs**
$\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs**
$\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).rem))).r2)) −
(**asType<int>**(**asType<short int>**(div2.quot)) *
asType<int>($\$heap_{719,1;729,8}$.b2))))

→ *[const member of object with modified fields]*

[31.6] $\$heap_{719,1;730,8}$ == $\$heap_{funcstart\_719,1}$.**replace**(p1 → ((-2 *
div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1,
177).rem))).**replace**(p2 → **asType<short int>**((div(**heapIs**
$\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).rem *
asType<int>($\$heap_{funcstart\_719,1}$.r2)) − (**asType<int>**(**asType<short int>**(div2.quot)) * **asType<int>**($\$heap_{719,1;729,8}$.b2))))

→ *[const static or extern object]*

[31.7] $\$heap_{719,1;730,8}$ == $\$heap_{funcstart\_719,1}$.**replace**(p1 → ((-2 *
div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1,
177).rem))).**replace**(p2 → **asType<short int>**((div(**heapIs**
$\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).rem *
asType<int>($\$heap_{init}$.r2)) − (**asType<int>**(**asType<short int>**(div2.quot)) * **asType<int>**($\$heap_{719,1;729,8}$.b2))))

→ *[expand definition of constant 'r2' at prang.c (20,20)]*

[31.8] $\$heap_{719,1;730,8}$ == $\$heap_{funcstart\_719,1}$.**replace**(p1 → ((-2 *
div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1,
177).rem))).**replace**(p2 → **asType<short int>**((div(**heapIs**
$\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).rem *
asType<int>(**asType<short int>**((**int**)172))) −
(**asType<int>**(**asType<short int>**(div2.quot)) *
asType<int>($\$heap_{719,1;729,8}$.b2))))

$\rightarrow$ *[simplify]*

[31.11] $\$heap_{719,1;730,8}$ == $\$heap_{funcstart\_719,1}.$**replace**(p1 $\rightarrow$ ((-2 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}.$p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}.$p1, 177).rem))).**replace**(p2 $\rightarrow$ **asType<short int>**((div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}.$p2, 176).rem * 172) $-$ (**asType<int>**(**asType<short int>**(div2.quot)) * **asType<int>**($\$heap_{719,1;729,8}.$b2)))))

$\rightarrow$ *[from term 12.6, div2 is equal to div(***heapIs*** $\$heap_{funcstart\_719,1}$,* $\$heap_{funcstart\_719,1}.p2, 176)]$

[31.12] $\$heap_{719,1;730,8}$ == $\$heap_{funcstart\_719,1}.$**replace**(p1 $\rightarrow$ ((-2 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}.$p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}.$p1, 177).rem))).**replace**(p2 $\rightarrow$ **asType<short int>**((172 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}.$p2, 176).rem) $-$ (**asType<int>**(**asType<short int>**(div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}.$p2, 176).quot)) * **asType<int>**($\$heap_{719,1;729,8}.$b2)))))

$\rightarrow$ *[simplify]*

[31.14] $\$heap_{719,1;730,8}$ == $\$heap_{funcstart\_719,1}.$**replace**(p1 $\rightarrow$ ((-2 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}.$p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}.$p1, 177).rem))).**replace**(p2 $\rightarrow$ **asType<short int>**((172 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}.$p2, 176).rem) $-$ (div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}.$p2, 176).quot * **asType<int>**($\$heap_{719,1;729,8}.$b2)))))

$\rightarrow$ *[from term 26.19,* $\$heap_{719,1;729,8}$ *is equal to* $\$heap_{funcstart\_719,1}.$**replace***(p1 $\rightarrow$ (-2 * div(***heapIs*** $\$heap_{funcstart\_719,1}$,* $\$heap_{funcstart_719,1}.p1, 177).quot) + (171 * div(***heapIs*** $\$heap_{funcstart\_719,1}$,* $\$heap_{funcstart\_719,1}.p1, 177).rem))]$

[31.15] $\$heap_{719,1;730,8}$ == $\$heap_{funcstart\_719,1}.$**replace**(p1 $\rightarrow$ ((-2 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}.$p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}.$p1, 177).rem))).**replace**(p2 $\rightarrow$ **asType<short int>**((172 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}.$p2, 176).rem) $-$ (div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}.$p2, 176).quot * **asType<int>**($\$heap_{funcstart\_719,1}.$**replace**(p1 $\rightarrow$ ((-2 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}.$p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}.$p1, 177).rem))).b2)))).

$\rightarrow$ *[const member of object with modified fields]*

[31.16] $\$heap_{719,1;730,8}$ == $\$heap_{funcstart\_719,1}.$**replace**(p1 $\rightarrow$ ((-2 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}.$p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}.$p1,

177).rem))).**replace**(p2 → **asType<short int>**((172 * div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}$.p2, 176).rem) − (div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}$.p2, 176).quot * **asType<int>**($\$\text{heap}_{funcstart\_719,1}$.b2))))

→ *[const static or extern object]*

[31.17] $\$\text{heap}_{719,1;730,8}$ == $\$\text{heap}_{funcstart\_719,1}$.**replace**(p1 → ((-2 * div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}$.p1, 177).rem))).**replace**(p2 → **asType<short int>**((172 * div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}$.p2, 176).rem) − (div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}$.p2, 176).quot * **asType<int>**($\$\text{heap}_{init}$.b2))))

→ *[expand definition of constant 'b2' at prang.c (22,20)]*

[31.18] $\$\text{heap}_{719,1;730,8}$ == $\$\text{heap}_{funcstart\_719,1}$.**replace**(p1 → ((-2 * div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}$.p1, 177).rem))).**replace**(p2 → **asType<short int>**((172 * div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}$.p2, 176).rem) − (div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}$.p2, 176).quot * **asType<int>**(**asType<short int>**((**int**)35)))))

→ *[simplify]*

[31.24] $\$\text{heap}_{719,1;730,8}$ == $\$\text{heap}_{funcstart\_719,1}$.**replace**(p1 → ((-2 * div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}$.p1, 177).rem))).**replace**(p2 → ((-35 * div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}$.p2, 176).quot) + (172 * div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}$.p2, 176).rem)))

[Take given term]

[36.0] $\$\text{heap}_{719,1;731,8}$ == $\$\text{heap}_{719,1;730,8}$.**replace**(p3 → **asType<short int>**((**asType<int>**(**asType<short int>**(div3.rem)) * **asType<int>**($\$\text{heap}_{719,1;730,8}$.r3)) − (**asType<int>**(**asType<short int>**(div3.quot)) * **asType<int>**($\$\text{heap}_{719,1;730,8}$.b3))))

→ *[from term 31.24, $\$heap_{719,1;730,8}$ is equal to $\$heap_{funcstart\_719,1}$.**replace**(p1 → ((-2 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).rem))).**replace**(p2 → (-35 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).quot) + (172 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).rem))]*

[36.1] $\$\text{heap}_{719,1;731,8}$ == $\$\text{heap}_{funcstart\_719,1}$.**replace**(p1 → ((-2 * div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}$.p1,

177).rem))).**replace**(p2 → ((-35 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).quot) + (172 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).rem))).**replace**(p3 → **asType<short int>**((**asType<int>**(**asType<short int>**(div3.rem)) * **asType<int>**($\$heap_{719,1;730,8}$.r3)) − (**asType<int>**(**asType<short int>**(div3.quot)) * **asType<int>**($\$heap_{719,1;730,8}$.b3))))

→ *[from term 19.6, div3 is equal to div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p3, 178)]*

[36.2] $\$heap_{719,1;731,8}$ == $\$heap_{funcstart\_719,1}$.**replace**(p1 → ((-2 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).rem))).**replace**(p2 → ((-35 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).quot) + (172 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).rem))).**replace**(p3 → **asType<short int>**((**asType<int>**(**asType<short int>**(div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p3, 178).rem)) * **asType<int>**($\$heap_{719,1;730,8}$.r3)) − (**asType<int>**(**asType<short int>**(div3.quot)) * **asType<int>**($\$heap_{719,1;730,8}$.b3))))

→ *[simplify]*

[36.4] $\$heap_{719,1;731,8}$ == $\$heap_{funcstart\_719,1}$.**replace**(p1 → ((-2 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).rem))).**replace**(p2 → ((-35 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).quot) + (172 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).rem))).**replace**(p3 → **asType<short int>**((div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p3, 178).rem * **asType<int>**($\$heap_{719,1;730,8}$.r3)) − (**asType<int>**(**asType<short int>**(div3.quot)) * **asType<int>**($\$heap_{719,1;730,8}$.b3))))

→ *[from term 31.24, $\$heap_{719,1;730,8}$ is equal to $\$heap_{funcstart\_719,1}$.**replace**(p1 → ((-2 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).rem))).**replace**(p2 → (-35 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).quot) + (172 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).rem))]*

[36.5] $\$heap_{719,1;731,8}$ == $\$heap_{funcstart\_719,1}$.**replace**(p1 → ((-2 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).rem))).**replace**(p2 → ((-35 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).quot) + (172 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).rem))).**replace**(p3 → **asType<short int>**((div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p3, 178).rem * **asType<int>**($\$heap_{funcstart\_719,1}$.**replace**(p1 → ((-2 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs**

$\text{heap}_{funcstart\_719,1}$, $\text{heap}_{funcstart\_719,1}$.p1, 177).rem))). **_replace**(p2 $\rightarrow$ ((-35 * div(**heapIs** $\text{heap}_{funcstart\_719,1}$, $\text{heap}_{funcstart\_719,1}$.p2, 176).quot) + (172 * div(**heapIs** $\text{heap}_{funcstart\_719,1}$, $\text{heap}_{funcstart\_719,1}$.p2, 176).rem))).r3)) $-$ (**asType<int>**(**asType<short int>**(div3.quot)) * **asType<int>**($\text{heap}_{719,1;730,8}$.b3)))))

$\rightarrow$ *[const member of object with modified fields]*

[36.7] $\text{heap}_{719,1;731,8}$ == $\text{heap}_{funcstart\_719,1}$. **_replace**(p1 $\rightarrow$ ((-2 * div(**heapIs** $\text{heap}_{funcstart\_719,1}$, $\text{heap}_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs** $\text{heap}_{funcstart\_719,1}$, $\text{heap}_{funcstart\_719,1}$.p1, 177).rem))). **_replace**(p2 $\rightarrow$ ((-35 * div(**heapIs** $\text{heap}_{funcstart\_719,1}$, $\text{heap}_{funcstart\_719,1}$.p2, 176).quot) + (172 * div(**heapIs** $\text{heap}_{funcstart\_719,1}$, $\text{heap}_{funcstart\_719,1}$.p2, 176).rem))). **_replace**(p3 $\rightarrow$ **asType<short int>**((div(**heapIs** $\text{heap}_{funcstart\_719,1}$, $\text{heap}_{funcstart\_719,1}$.p3, 178).rem * **asType<int>**($\text{heap}_{funcstart\_719,1}$.r3)) $-$ (**asType<int>**(**asType<short int>**(div3.quot)) * **asType<int>**($\text{heap}_{719,1;730,8}$.b3)))))

$\rightarrow$ *[const static or extern object]*

[36.8] $\text{heap}_{719,1;731,8}$ == $\text{heap}_{funcstart\_719,1}$. **_replace**(p1 $\rightarrow$ ((-2 * div(**heapIs** $\text{heap}_{funcstart\_719,1}$, $\text{heap}_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs** $\text{heap}_{funcstart\_719,1}$, $\text{heap}_{funcstart\_719,1}$.p1, 177).rem))). **_replace**(p2 $\rightarrow$ ((-35 * div(**heapIs** $\text{heap}_{funcstart\_719,1}$, $\text{heap}_{funcstart\_719,1}$.p2, 176).quot) + (172 * div(**heapIs** $\text{heap}_{funcstart\_719,1}$, $\text{heap}_{funcstart\_719,1}$.p2, 176).rem))). **_replace**(p3 $\rightarrow$ **asType<short int>**((div(**heapIs** $\text{heap}_{funcstart\_719,1}$, $\text{heap}_{funcstart\_719,1}$.p3, 178).rem * **asType<int>**(heap_{init}.r3)) $-$ (**asType<int>**(**asType<short int>**(div3.quot)) * **asType<int>**($\text{heap}_{719,1;730,8}$.b3)))))

$\rightarrow$ *[expand definition of constant 'r3' at prang.c (25,20)]*

[36.9] $\text{heap}_{719,1;731,8}$ == $\text{heap}_{funcstart\_719,1}$. **_replace**(p1 $\rightarrow$ ((-2 * div(**heapIs** $\text{heap}_{funcstart\_719,1}$, $\text{heap}_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs** $\text{heap}_{funcstart\_719,1}$, $\text{heap}_{funcstart\_719,1}$.p1, 177).rem))). **_replace**(p2 $\rightarrow$ ((-35 * div(**heapIs** $\text{heap}_{funcstart\_719,1}$, $\text{heap}_{funcstart\_719,1}$.p2, 176).quot) + (172 * div(**heapIs** $\text{heap}_{funcstart\_719,1}$, $\text{heap}_{funcstart\_719,1}$.p2, 176).rem))). **_replace**(p3 $\rightarrow$ **asType<short int>**((div(**heapIs** $\text{heap}_{funcstart\_719,1}$, $\text{heap}_{funcstart\_719,1}$.p3, 178).rem * **asType<int>**(**asType<short int>**((**int**)170))) $-$ (**asType<int>**(**asType<short int>**(div3.quot)) * **asType<int>**($\text{heap}_{719,1;730,8}$.b3)))))

$\rightarrow$ *[simplify]*

[36.12] $\text{heap}_{719,1;731,8}$ == $\text{heap}_{funcstart\_719,1}$. **_replace**(p1 $\rightarrow$ ((-2 * div(**heapIs** $\text{heap}_{funcstart\_719,1}$, $\text{heap}_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs** $\text{heap}_{funcstart\_719,1}$, $\text{heap}_{funcstart\_719,1}$.p1, 177).rem))). **_replace**(p2 $\rightarrow$ ((-35 * div(**heapIs** $\text{heap}_{funcstart\_719,1}$, $\text{heap}_{funcstart\_719,1}$.p2, 176).quot) + (172 * div(**heapIs** $\text{heap}_{funcstart\_719,1}$,

$heap_{funcstart\_719,1}$.p2, 176).rem))).**_replace**(p3 → **asType<short int>**((div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p3, 178).rem * 170) − (**asType<int>**(**asType<short int>**(div3.quot)) * **asType<int>**($heap_{719,1;730,8}$.b3)))))

→ *[from term 19.6, div3 is equal to div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p3, 178)]*

[36.13] $heap_{719,1;731,8}$ == $heap_{funcstart\_719,1}$.**_replace**(p1 → ((-2 * div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p1, 177).rem))).**_replace**(p2 → ((-35 * div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p2, 176).quot) + (172 * div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p2, 176).rem))).**_replace**(p3 → **asType<short int>**((170 * div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p3, 178).rem) − (**asType<int>**(**asType<short int>**(div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p3, 178).quot)) * **asType<int>**($heap_{719,1;730,8}$.b3)))))

→ *[simplify]*

[36.15] $heap_{719,1;731,8}$ == $heap_{funcstart\_719,1}$.**_replace**(p1 → ((-2 * div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p1, 177).rem))).**_replace**(p2 → ((-35 * div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p2, 176).quot) + (172 * div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p2, 176).rem))).**_replace**(p3 → **asType<short int>**((170 * div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p3, 178).rem) − (div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p3, 178).quot * **asType<int>**($heap_{719,1;730,8}$.b3)))))

→ *[from term 31.24, $heap_{719,1;730,8}$ is equal to $heap_{funcstart\_719,1}$.**_replace**(p1 → ((-2 * div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p1, 177).rem))).**_replace**(p2 → (-35 * div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p2, 176).quot) + (172 * div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p2, 176).rem))]*

[36.16] $heap_{719,1;731,8}$ == $heap_{funcstart\_719,1}$.**_replace**(p1 → ((-2 * div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p1, 177).rem))).**_replace**(p2 → ((-35 * div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p2, 176).quot) + (172 * div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p2, 176).rem))).**_replace**(p3 → **asType<short int>**((170 * div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p3, 178).rem) − (div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p3, 178).quot * **asType<int>**($heap_{funcstart\_719,1}$.**_replace**(p1 → ((-2 * div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p1, 177).rem))).**_replace**(p2 → ((-35 * div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p2, 176).quot) + (172 *

div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).rem))).b3))))

→ *[const member of object with modified fields]*

[36.18] $\$heap_{719,1;731,8}$ == $\$heap_{funcstart\_719,1}$.__**replace**(p1 → ((-2 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).rem))).__**replace**(p2 → ((-35 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).quot) + (172 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).rem))).__**replace**(p3 → **asType**<**short int**>((170 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p3, 178).rem) − (div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p3, 178).quot * **asType**<**int**>($\$heap_{funcstart\_719,1}$.b3))))

→ *[const static or extern object]*

[36.19] $\$heap_{719,1;731,8}$ == $\$heap_{funcstart\_719,1}$.__**replace**(p1 → ((-2 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).rem))).__**replace**(p2 → ((-35 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).quot) + (172 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).rem))).__**replace**(p3 → **asType**<**short int**>((170 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p3, 178).rem) − (div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p3, 178).quot * **asType**<**int**>($\$heap_{init}$.b3))))

→ *[expand definition of constant 'b3' at prang.c (27,20)]*

[36.20] $\$heap_{719,1;731,8}$ == $\$heap_{funcstart\_719,1}$.__**replace**(p1 → ((-2 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).rem))).__**replace**(p2 → ((-35 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).quot) + (172 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).rem))).__**replace**(p3 → **asType**<**short int**>((170 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p3, 178).rem) − (div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p3, 178).quot * **asType**<**int**>(**asType**<**short int**>((**int**)63)))))

→ *[simplify]*

[36.26] $\$heap_{719,1;731,8}$ == $\$heap_{funcstart\_719,1}$.__**replace**(p1 → ((-2 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).rem))).__**replace**(p2 → ((-35 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).quot) + (172 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).rem))).__**replace**(p3 → ((-63 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p3, 178).quot) + (170 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p3, 178).rem)))

[Take goal term]

[1.0] **minof**(**int**) $\leq$ \$heap$_{719,1;731,8}$.p1

$\rightarrow$ *[simplify]*

[1.1] -32768 $\leq$ \$heap$_{719,1;731,8}$.p1

$\rightarrow$ *[from term 36.26, \$heap$_{719,1;731,8}$ is equal to*
*\$heap$_{funcstart\_719,1}$.__replace(p1 $\rightarrow$ ((-2 * div(**heapIs** \$heap$_{funcstart\_719,1}$,*
*\$heap$_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs** \$heap$_{funcstart\_719,1}$,*
*\$heap$_{funcstart\_719,1}$.p1, 177).rem))).__replace(p2 $\rightarrow$ ((-35 * div(**heapIs***
*\$heap$_{funcstart\_719,1}$, \$heap$_{funcstart\_719,1}$.p2, 176).quot) + (172 * div(**heapIs***
\$heap$_{funcstart\_719,1}$, \$heap$_{funcstart\_719,1}$.p2, 176).rem))).__replace(p3 $\rightarrow$ (-63 *
*div(**heapIs** \$heap$_{funcstart\_719,1}$, \$heap$_{funcstart\_719,1}$.p3, 178).quot) + (170 **
*div(**heapIs** \$heap$_{funcstart\_719,1}$, \$heap$_{funcstart\_719,1}$.p3, 178).rem))]*

[1.2] -32768 $\leq$ \$heap$_{funcstart\_719,1}$.__**replace**(p1 $\rightarrow$ ((-2 * div(**heapIs**
\$heap$_{funcstart\_719,1}$, \$heap$_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs**
\$heap$_{funcstart\_719,1}$, \$heap$_{funcstart\_719,1}$.p1, 177).rem))).__**replace**(p2 $\rightarrow$ ((-35
* div(**heapIs** \$heap$_{funcstart\_719,1}$, \$heap$_{funcstart\_719,1}$.p2, 176).quot) + (172 *
div(**heapIs** \$heap$_{funcstart\_719,1}$, \$heap$_{funcstart\_719,1}$.p2,
176).rem))).__**replace**(p3 $\rightarrow$ ((-63 * div(**heapIs** \$heap$_{funcstart\_719,1}$,
\$heap$_{funcstart\_719,1}$.p3, 178).quot) + (170 * div(**heapIs** \$heap$_{funcstart\_719,1}$,
\$heap$_{funcstart\_719,1}$.p3, 178).rem))).p1

$\rightarrow$ *[simplify]*

[1.7] -32769 < ((-2 * div(**heapIs** \$heap$_{funcstart\_719,1}$, \$heap$_{funcstart\_719,1}$.p1,
177).quot) + (171 * div(**heapIs** \$heap$_{funcstart\_719,1}$, \$heap$_{funcstart\_719,1}$.p1,
177).rem))

$\rightarrow$ *[negate goal and search for contradiction]*

[1.8] !(-32769 < ((-2 * div(**heapIs** \$heap$_{funcstart\_719,1}$, \$heap$_{funcstart\_719,1}$.p1,
177).quot) + (171 * div(**heapIs** \$heap$_{funcstart\_719,1}$, \$heap$_{funcstart\_719,1}$.p1,
177).rem)))

$\rightarrow$ *[simplify]*

[1.13] 32768 < ((2 * div(**heapIs** \$heap$_{funcstart\_719,1}$, \$heap$_{funcstart\_719,1}$.p1,
177).quot) + (-171 * div(**heapIs** \$heap$_{funcstart\_719,1}$, \$heap$_{funcstart\_719,1}$.p1,
177).rem))

[Branch on disjunction or conditional in term 10.21]

[41.0] (0 == ((−\$heap$_{funcstart\_719,1}$.p1 / 177) + div(**heapIs**
\$heap$_{funcstart\_719,1}$, \$heap$_{funcstart\_719,1}$.p1, 177).quot)) $\lor$ (0 ==
(−(\$heap$_{funcstart\_719,1}$.p1 / 177) + div(**heapIs** \$heap$_{funcstart\_719,1}$,
\$heap$_{funcstart\_719,1}$.p1, 177).quot)) $\lor$ (-1 < \$heap$_{funcstart\_719,1}$.p1)

[Branch on disjunction or conditional in term 10.21]

[42.0] (0 < −\$heap$_{funcstart\_719,1}$.p1) $\lor$ (0 == (−(\$heap$_{funcstart\_719,1}$.p1 /
177) + div(**heapIs** \$heap$_{funcstart\_719,1}$, \$heap$_{funcstart\_719,1}$.p1, 177).quot)) $\lor$
(-1 < \$heap$_{funcstart\_719,1}$.p1)

[Copy term 11.40]

[43.0] ([0 < −$heap$_{funcstart_719,1}$.p1]: ([0 == ($heap$_{funcstart\_719,1}$.p1 % 177)]:
0 == div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1, 177).rem, [!(0
== ($heap$_{funcstart_719,1}$.p1 % 177))]: 177 == (−div(**heapIs**
$heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1, 177).rem +
($heap$_{funcstart_719,1}$.p1 % 177))), [-1 < $heap$_{funcstart_719,1}$.p1]: 0 ==
(−($heap$_{funcstart_719,1}$.p1 % 177) + div(**heapIs** $heap$_{funcstart_719,1}$,
$heap$_{funcstart_719,1}$.p1, 177).rem)) ∨ (0 == (−($heap$_{funcstart\_719,1}$.p1 / 177)
+ div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1, 177).quot)) ∨ (-1 <
$heap$_{funcstart_719,1}$.p1)

→ *[from term 42.0, literala < −$heap$_{funcstart_719,1}$.p1 is true whenever (-1 +
literala) < 0]*

Proof of rule precondition:

[43.0.0] (-1 + 0) < 0

→ *[simplify]*

[43.0.2] **true**

[43.1] ([**true**]: ([0 == ($heap$_{funcstart_719,1}$.p1 % 177)]: 0 == div(**heapIs**
$heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1, 177).rem, [!(0 ==
($heap$_{funcstart_719,1}$.p1 % 177))]: 177 == (−div(**heapIs** $heap$_{funcstart_719,1}$,
$heap$_{funcstart_719,1}$.p1, 177).rem + ($heap$_{funcstart\_719,1}$.p1 % 177))), [-1 <
$heap$_{funcstart_719,1}$.p1]: 0 == (−($heap$_{funcstart\_719,1}$.p1 % 177) + div(**heapIs**
$heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1, 177).rem)) ∨ ...

→ *[simplify]*

[43.3] ([0 == ($heap$_{funcstart_719,1}$.p1 % 177)]: 0 == div(**heapIs**
$heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1, 177).rem, [!(0 ==
($heap$_{funcstart_719,1}$.p1 % 177))]: 177 == (−div(**heapIs** $heap$_{funcstart_719,1}$,
$heap$_{funcstart_719,1}$.p1, 177).rem + ($heap$_{funcstart\_719,1}$.p1 % 177))) ∨ ...

[Branch on disjunction or conditional in term 43.3]

[44.0] (0 == div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1, 177).rem)
∨ (0 == (−($heap$_{funcstart_719,1}$.p1 / 177) + div(**heapIs** $heap$_{funcstart_719,1}$,
$heap$_{funcstart_719,1}$.p1, 177).quot)) ∨ (-1 < $heap$_{funcstart_719,1}$.p1) ∨ (177 ==
(−div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1, 177).rem +
($heap$_{funcstart_719,1}$.p1 % 177))) ∨ !(0 == ($heap$_{funcstart\_719,1}$.p1 % 177))

[Copy term 1.13]

[46.0] (32768 < ((-171 * div(**heapIs** $heap$_{funcstart_719,1}$,
$heap$_{funcstart_719,1}$.p1, 177).rem) + (2 * div(**heapIs** $heap$_{funcstart_719,1}$,
$heap$_{funcstart_719,1}$.p1, 177).quot))) ∨ (0 == (−($heap$_{funcstart\_719,1}$.p1 / 177)
+ div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1, 177).quot)) ∨ (-1 <
$heap$_{funcstart_719,1}$.p1) ∨ (177 == (−div(**heapIs** $heap$_{funcstart_719,1}$,
$heap$_{funcstart_719,1}$.p1, 177).rem + ($heap$_{funcstart\_719,1}$.p1 % 177))) ∨ !(0 ==

($heap$_{funcstart_719,1}$.p1 % 177))

→ *[from term 44.0, div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1, 177).rem is equal to 0]*

[46.1] (32768 < ((-171 * 0) + (2 * div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1, 177).quot))) ∨ ...

→ *[simplify]*

[46.3] (32768 < (2 * div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1, 177).quot)) ∨ ...

→ *[literal comparison of product]*

[46.4] ([2 < 0]: (32768 / -2) < −div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1, 177).quot, [0 < 2]: (32768 / 2) < div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1, 177).quot, [0 == 2]: 32768 < 0) ∨ ...

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

[46.5] ([2 < 0]: (32768 / -2) < −div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1, 177).quot, [(0 < 2) ∧ !(2 < 0)]: (32768 / 2) < div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1, 177).quot, [(0 == 2) ∧ !(0 < 2) ∧ !(2 < 0)]: 32768 < 0) ∨ ...

→ *[simplify]*

[46.13] (16384 < div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1, 177).quot) ∨ ...

[Create new term from terms 46.13, 41.0 using rule: transitivity 15]

[68.0] ((0 + 16384) < −(−$heap$_{funcstart_719,1}$.p1 / 177)) ∨ (0 == (−($heap$_{funcstart\_719,1}$.p1 / 177) + div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1, 177).quot)) ∨ (-1 < $heap$_{funcstart_719,1}$.p1) ∨ (177 == (−div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1, 177).rem + ($heap$_{funcstart\_719,1}$.p1 % 177))) ∨ !(0 == ($heap$_{funcstart_719,1}$.p1 % 177))

→ *[simplify]*

[68.8] (2899968 < $heap$_{funcstart_719,1}$.p1) ∨ ...

→ *[from term 42.0, literala < $heap$_{funcstart_719,1}$.p1 is false whenever -2 < (0 + literala)]*

Proof of rule precondition:

[68.8.0] -2 < (0 + 2899968)

→ *[simplify]*

[68.8.2] **true**

[68.9] **false** ∨ ...

[Remove 'false' term 68.9 and fetch new term from containing clause]

[69.0] (177 == (−div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p1, 177).rem + ($heap_{funcstart\_719,1}$.p1 % 177))) ∨ (0 == (−($heap_{funcstart\_719,1}$.p1 / 177) + div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p1, 177).quot)) ∨ (-1 < $heap_{funcstart\_719,1}$.p1)

[Copy term 1.13]

[72.0] (32768 < ((-171 * div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p1, 177).rem) + (2 * div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p1, 177).quot))) ∨ (0 == (−($heap_{funcstart\_719,1}$.p1 / 177) + div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p1, 177).quot)) ∨ (-1 < $heap_{funcstart\_719,1}$.p1)

→ *[from term 69.0, div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p1, 177).rem is equal to -177 + ($heap_{funcstart\_719,1}$.p1 % 177)]*

[72.1] (32768 < ((-171 * (-177 + ($heap_{funcstart\_719,1}$.p1 % 177))) + (2 * div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p1, 177).quot))) ∨ ...

→ *[simplify]*

[72.6] (2501 < ((-171 * ($heap_{funcstart\_719,1}$.p1 % 177)) + (2 * div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p1, 177).quot))) ∨ ...

[Create new term from term 41.0 using rule: condition for equality of division]

[80.0] ((−$heap_{funcstart\_719,1}$.p1 < (177 * (0 + 1 + −div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p1, 177).quot))) ∧ ((177 * (0 + −div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p1, 177).quot)) < (1 + −$heap_{funcstart\_719,1}$.p1))) ∨ (0 == (−($heap_{funcstart\_719,1}$.p1 / 177) + div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p1, 177).quot)) ∨ (-1 < $heap_{funcstart\_719,1}$.p1)

→ *[simplify]*

[80.18] ((-177 < ((-177 * div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p1, 177).quot) + $heap_{funcstart\_719,1}$.p1)) ∧ (-1 < (−$heap_{funcstart\_719,1}$.p1 + (177 * div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p1, 177).quot)))) ∨ ...

→ *[separate conjunction and work on first sub-term]*

[80.19] (-177 < ((-177 * div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p1, 177).quot) + $heap_{funcstart\_719,1}$.p1)) ∨ ...

[Create new term from terms 80.19, 42.0 using rule: transitivity 2]

[83.0] ((-177 + 0 + 1) < (-177 * div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p1, 177).quot)) ∨ (0 == (−($heap_{funcstart\_719,1}$.p1 / 177) + div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p1, 177).quot)) ∨ (-1 < $heap_{funcstart\_719,1}$.p1)

→ *[simplify]*

[83.1] (-176 < (-177 * div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p1,

177).quot)) ∨ ...

→ *[literal comparison of product]*

[83.2] ([-177 < 0]: (-176 / 177) < −div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot, [0 < -177]: (-176 / -177) < div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot, [-177 == 0]: -176 < 0) ∨ ...

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

[83.3] ([-177 < 0]: (-176 / 177) < −div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot, [(0 < -177) ∧ !(-177 < 0)]: (-176 / -177) < div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot, [(-177 == 0) ∧ !(-177 < 0) ∧ !(0 < -177)]: -176 < 0) ∨ ...

→ *[simplify]*

[83.7] (-1 < −div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot) ∨ ...

[Create new term from terms 83.7, 72.6 using rule: transitivity 5]

[92.0] (2501 < ((-171 * ($\$heap_{funcstart\_719,1}$.p1 % 177)) + (2 * −(-1 + 1)))) ∨ (0 == (−($\$heap_{funcstart\_719,1}$.p1 / 177) + div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot)) ∨ (-1 < $\$heap_{funcstart\_719,1}$.p1)

→ *[simplify]*

[92.4] (2501 < (-171 * ($\$heap_{funcstart\_719,1}$.p1 % 177))) ∨ ...

→ *[literal comparison of product]*

[92.5] ([-171 < 0]: (2501 / 171) < −($\$heap_{funcstart\_719,1}$.p1 % 177), [0 < -171]: (2501 / -171) < ($\$heap_{funcstart\_719,1}$.p1 % 177), [-171 == 0]: 2501 < 0) ∨ ...

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

[92.6] ([-171 < 0]: (2501 / 171) < −($\$heap_{funcstart\_719,1}$.p1 % 177), [(0 < -171) ∧ !(-171 < 0)]: (2501 / -171) < ($\$heap_{funcstart\_719,1}$.p1 % 177), [(-171 == 0) ∧ !(-171 < 0) ∧ !(0 < -171)]: 2501 < 0) ∨ ...

→ *[simplify]*

[92.11] **false** ∨ ...

[Remove 'false' term 92.11 and fetch new term from containing clause]

[94.0] 0 == (−($\$heap_{funcstart\_719,1}$.p1 / 177) + div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot)

[Remove 'false' term 92.11 and fetch new term from containing clause]

[95.0] -1 < $\$heap_{funcstart\_719,1}$.p1

[Assume known post-assertion, class invariant or type constraint for term 5.6]

[11.40] ([0 < −$\$heap_{funcstart\_719,1}$.p1]: ([0 == ($\$heap_{funcstart\_719,1}$.p1 %

177)]: 0 == div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}$.p1, 177).rem, [!(0 == ($\$\text{heap}_{funcstart\_719,1}$.p1 % 177))]: 177 == (($\$\text{heap}_{funcstart\_719,1}$.p1 % 177) + −div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}$.p1, 177).rem)), [-1 < $\$\text{heap}_{funcstart\_719,1}$.p1]: 0 == (−($\$\text{heap}_{funcstart\_719,1}$.p1 % 177) + div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}$.p1, 177).rem))

→ *[from term 95.0, literala < −$\$\text{heap}_{funcstart\_719,1}$.p1 is false whenever -2 < (-1 + literala)]*

Proof of rule precondition:

[11.40.0] -2 < (-1 + 0)

→ *[simplify]*

[11.40.2] **true**

[11.41] ([**false**]: ([0 == ($\$\text{heap}_{funcstart\_719,1}$.p1 % 177)]: 0 == div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}$.p1, 177).rem, [!(0 == ($\$\text{heap}_{funcstart\_719,1}$.p1 % 177))]: 177 == (−div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}$.p1, 177).rem + ($\$\text{heap}_{funcstart\_719,1}$.p1 % 177))), [-1 < $\$\text{heap}_{funcstart\_719,1}$.p1]: 0 == (−($\$\text{heap}_{funcstart\_719,1}$.p1 % 177) + div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}$.p1, 177).rem))

→ *[from term 95.0, literala < $\$\text{heap}_{funcstart\_719,1}$.p1 is true whenever (-1 + literala) < -1]*

Proof of rule precondition:

[11.41.0] (-1 + -1) < -1

→ *[simplify]*

[11.41.2] **true**

[11.42] ([**false**]: ([0 == ($\$\text{heap}_{funcstart\_719,1}$.p1 % 177)]: 0 == div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}$.p1, 177).rem, [!(0 == ($\$\text{heap}_{funcstart\_719,1}$.p1 % 177))]: 177 == (−div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}$.p1, 177).rem + ($\$\text{heap}_{funcstart\_719,1}$.p1 % 177))), [**true**]: 0 == (−($\$\text{heap}_{funcstart\_719,1}$.p1 % 177) + div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}$.p1, 177).rem))

→ *[simplify]*

[11.44] 0 == (−($\$\text{heap}_{funcstart\_719,1}$.p1 % 177) + div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}$.p1, 177).rem)

[Copy term 1.13]

[98.0] 32768 < ((-171 * div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}$.p1, 177).rem) + (2 * div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}$.p1, 177).quot))

→ *[from term 11.44, div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}$.p1, 177).rem is equal to $\$\text{heap}_{funcstart\_719,1}$.p1 % 177]*

[98.1] 32768 < ((-171 * ($heap$_{funcstart_719,1}$.p1 % 177)) + (2 * div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1, 177).quot))

[Create new term from term 94.0 using rule: condition for equality of division]

[103.0] (0 < (1 + (177 * (0 + −div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1, 177).quot)) + $heap$_{funcstart_719,1}$.p1)) ∧ ($heap$_{funcstart\_719,1}$.p1 < (177 * (0 + 1 + div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1, 177).quot)))

→ *[simplify]*

[103.12] (-1 < ((-177 * div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1, 177).quot) + $heap$_{funcstart_719,1}$.p1)) ∧ (-177 < (−$heap$_{funcstart\_719,1}$.p1 + (177 * div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1, 177).quot)))

[Work on sub-term 2 of conjunction in term 103.12]

[104.0] -1 < ((-177 * div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1, 177).quot) + $heap$_{funcstart_719,1}$.p1)

[Create new term from terms 104.0, 9.9 using rule: transitivity 2]

[106.0] (-32768 + -1 + 1) < (-177 * div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1, 177).quot)

→ *[simplify]*

[106.1] -32768 < (-177 * div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1, 177).quot)

→ *[literal comparison of product]*

[106.2] ([-177 < 0]: (-32768 / 177) < −div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1, 177).quot, [0 < -177]: (-32768 / -177) < div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1, 177).quot, [-177 == 0]: -32768 < 0)

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

[106.3] ([-177 < 0]: (-32768 / 177) < −div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1, 177).quot, [(0 < -177) ∧ !(-177 < 0)]: (-32768 / -177) < div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1, 177).quot, [(-177 == 0) ∧ !(-177 < 0) ∧ !(0 < -177)]: -32768 < 0)

→ *[simplify]*

[106.7] -186 < −div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1, 177).quot

[Create new term from terms 106.7, 98.1 using rule: transitivity 5]

[108.0] 32768 < ((-171 * ($heap$_{funcstart_719,1}$.p1 % 177)) + (2 * −(-186 + 1)))

→ *[simplify]*

[108.5] 32398 < (-171 * ($heap$_{funcstart_719,1}$.p1 % 177))

$\rightarrow$ *[literal comparison of product]*

[108.6] ([-171 < 0]: (32398 / 171) < $-(\$heap_{funcstart\_719,1}.p1 \% 177)$, [0 < -171]: (32398 / -171) < ($\$heap_{funcstart\_719,1}.p1 \% 177$), [-171 == 0]: 32398 < 0)

$\rightarrow$ *[explicitly assert falsehood of skipped guards in subsequent guards]*

[108.7] ([-171 < 0]: (32398 / 171) < $-(\$heap_{funcstart\_719,1}.p1 \% 177)$, [(0 < -171) $\wedge$!(-171 < 0)]: (32398 / -171) < ($\$heap_{funcstart\_719,1}.p1 \% 177$), [(-171 == 0) $\wedge$!(-171 < 0) $\wedge$!(0 < -171)]: 32398 < 0)

$\rightarrow$ *[simplify]*

[108.12] **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 (51,5)

Condition defined at:

To prove: $\$heap_{719,1;731,8}.p1 \leq \mathbf{maxof(int)}$

Given:

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

$\$heap_{init}.M1 == \mathbf{asType}\mathbf{<short\ int>}((\mathbf{int})30269)$

$\$heap_{init}.r1 == \mathbf{asType}\mathbf{<short\ int>}((\mathbf{int})171)$

$\$heap_{init}.a1 == \mathbf{asType}\mathbf{<short\ int>}((\mathbf{int})177)$

$\$heap_{init}.b1 == \mathbf{asType}\mathbf{<short\ int>}((\mathbf{int})2)$

$\$heap_{init}.M2 == \mathbf{asType}\mathbf{<short\ int>}((\mathbf{int})30307)$

$\$heap_{init}.r2 == \mathbf{asType}\mathbf{<short\ int>}((\mathbf{int})172)$

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

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

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

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

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

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

$\$heap_{init}.p1 == \mathbf{asType}\mathbf{<short\ int>}((\mathbf{int})1)$

$\$heap_{init}.p2 == \mathbf{asType}\mathbf{<short\ int>}((\mathbf{int})2)$

$\$heap_{init}.p3 == \mathbf{asType}\mathbf{<short\ int>}((\mathbf{int})3)$

div1 == div(**heapIs** $\$heap_{funcstart\_719,1}$,

$\mathbf{asType\langle int \rangle}(\$heap_{funcstart\_719,1}.p1),$
$\mathbf{asType\langle int \rangle}(\$heap_{funcstart\_719,1}.a1))$

$(\mathbf{asType\langle integer \rangle}(\mathbf{asType\langle int \rangle}(\$heap_{funcstart\_719,1}.p1))\ /$
$\mathbf{asType\langle integer \rangle}(\mathbf{asType\langle int \rangle}(\$heap_{funcstart\_719,1}.a1))) ==$
$\mathbf{asType\langle integer \rangle}(div1.quot)$

$(\mathbf{asType\langle integer \rangle}(\mathbf{asType\langle int \rangle}(\$heap_{funcstart\_719,1}.p1))\ \%$
$\mathbf{asType\langle integer \rangle}(\mathbf{asType\langle int \rangle}(\$heap_{funcstart\_719,1}.a1))) ==$
$\mathbf{asType\langle integer \rangle}(div1.rem)$

$div2 == div(\mathbf{heapIs}\ \$heap_{funcstart\_719,1},$
$\mathbf{asType\langle int \rangle}(\$heap_{funcstart\_719,1}.p2),$
$\mathbf{asType\langle int \rangle}(\$heap_{funcstart\_719,1}.a2))$

$(\mathbf{asType\langle integer \rangle}(\mathbf{asType\langle int \rangle}(\$heap_{funcstart\_719,1}.p2))\ /$
$\mathbf{asType\langle integer \rangle}(\mathbf{asType\langle int \rangle}(\$heap_{funcstart\_719,1}.a2))) ==$
$\mathbf{asType\langle integer \rangle}(div2.quot)$

$(\mathbf{asType\langle integer \rangle}(\mathbf{asType\langle int \rangle}(\$heap_{funcstart\_719,1}.p2))\ \%$
$\mathbf{asType\langle integer \rangle}(\mathbf{asType\langle int \rangle}(\$heap_{funcstart\_719,1}.a2))) ==$
$\mathbf{asType\langle integer \rangle}(div2.rem)$

$div3 == div(\mathbf{heapIs}\ \$heap_{funcstart\_719,1},$
$\mathbf{asType\langle int \rangle}(\$heap_{funcstart\_719,1}.p3),$
$\mathbf{asType\langle int \rangle}(\$heap_{funcstart\_719,1}.a3))$

$(\mathbf{asType\langle integer \rangle}(\mathbf{asType\langle int \rangle}(\$heap_{funcstart\_719,1}.p3))\ /$
$\mathbf{asType\langle integer \rangle}(\mathbf{asType\langle int \rangle}(\$heap_{funcstart\_719,1}.a3))) ==$
$\mathbf{asType\langle integer \rangle}(div3.quot)$

$(\mathbf{asType\langle integer \rangle}(\mathbf{asType\langle int \rangle}(\$heap_{funcstart\_719,1}.p3))\ \%$
$\mathbf{asType\langle integer \rangle}(\mathbf{asType\langle int \rangle}(\$heap_{funcstart\_719,1}.a3))) ==$
$\mathbf{asType\langle integer \rangle}(div3.rem)$

$\$heap_{719,1;729,8} == \$heap_{funcstart\_719,1}.\mathbf{replace}(p1 \rightarrow \mathbf{asType\langle short}$
$\mathbf{int \rangle}((\mathbf{asType\langle int \rangle}(\mathbf{asType\langle short\ int \rangle}(div1.rem))\ *$
$\mathbf{asType\langle int \rangle}(\$heap_{funcstart\_719,1}.r1)) - (\mathbf{asType\langle int \rangle}(\mathbf{asType\langle short}$
$\mathbf{int \rangle}(div1.quot))\ *\ \mathbf{asType\langle int \rangle}(\$heap_{funcstart\_719,1}.b1))))$

$\$heap_{719,1;730,8} == \$heap_{719,1;729,8}.\mathbf{replace}(p2 \rightarrow \mathbf{asType\langle short}$
$\mathbf{int \rangle}((\mathbf{asType\langle int \rangle}(\mathbf{asType\langle short\ int \rangle}(div2.rem))\ *$
$\mathbf{asType\langle int \rangle}(\$heap_{719,1;729,8}.r2)) - (\mathbf{asType\langle int \rangle}(\mathbf{asType\langle short}$
$\mathbf{int \rangle}(div2.quot))\ *\ \mathbf{asType\langle int \rangle}(\$heap_{719,1;729,8}.b2))))$

$\$heap_{719,1;731,8} == \$heap_{719,1;730,8}.\mathbf{replace}(p3 \rightarrow \mathbf{asType\langle short}$
$\mathbf{int \rangle}((\mathbf{asType\langle int \rangle}(\mathbf{asType\langle short\ int \rangle}(div3.rem))\ *$
$\mathbf{asType\langle int \rangle}(\$heap_{719,1;730,8}.r3)) - (\mathbf{asType\langle int \rangle}(\mathbf{asType\langle short}$
$\mathbf{int \rangle}(div3.quot))\ *\ \mathbf{asType\langle int \rangle}(\$heap_{719,1;730,8}.b3))))$

Proof:

[Take given term]

[5.0] div1 == div(**heapIs** $\$heap_{funcstart\_719,1}$,
asType<int>($\$heap_{funcstart\_719,1}$.p1),
asType<int>($\$heap_{funcstart\_719,1}$.a1))

$\rightarrow$ *[simplify]*

[5.1] div1 == div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1,
asType<int>($\$heap_{funcstart\_719,1}$.a1))

$\rightarrow$ *[const static or extern object]*

[5.2] div1 == div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1,
asType<int>($\$heap_{init}$.a1))

$\rightarrow$ *[expand definition of constant 'a1' at prang.c (16,20)]*

[5.3] div1 == div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1,
asType<int>(**asType<short int>**(**(int)**177)))

$\rightarrow$ *[simplify]*

[5.6] div1 == div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177)

[Assume known post-assertion, class invariant or type constraint for term 5.6]

[8.0] **minof(short int)** $\leq \$heap_{funcstart\_719,1}$.p1

$\rightarrow$ *[simplify]*

[8.3] -32769 $< \$heap_{funcstart\_719,1}$.p1

[Assume known post-assertion, class invariant or type constraint for term 5.6]

[10.0] (**asType<integer>**($\$heap_{funcstart\_719,1}$.p1) /
asType<integer>(177)) == **asType<integer>**(div(**heapIs**
$\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot)

$\rightarrow$ *[simplify]*

[10.2] ($\$heap_{funcstart\_719,1}$.p1 / 177) == **asType<integer>**(div(**heapIs**
$\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot)

$\rightarrow$ *[expand definition of operator './' in class 'int' at built in declaration]*

[10.3] ([**asType<integer>**($\$heap_{funcstart\_719,1}$.p1) < 0]:
$-(-$**asType<integer>**($\$heap_{funcstart\_719,1}$.p1) / 177), []:
asType<integer>($\$heap_{funcstart\_719,1}$.p1) / 177) ==
asType<integer>(div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1,
177).quot)

$\rightarrow$ *[explicitly assert falsehood of skipped guards in subsequent guards]*

[10.4] ([**asType<integer>**($\$heap_{funcstart\_719,1}$.p1) < 0]:
$-(-$**asType<integer>**($\$heap_{funcstart\_719,1}$.p1) / 177),
[!(**asType<integer>**($\$heap_{funcstart\_719,1}$.p1) < 0)]:
asType<integer>($\$heap_{funcstart\_719,1}$.p1) / 177) ==
asType<integer>(div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1,

177).quot)

→ *[simplify]*

[10.17] $0 == (-([0 < -\$heap_{funcstart\_719,1}.p1]: -(-\$heap_{funcstart\_719,1}.p1 /$
$177), [-1 < \$heap_{funcstart\_719,1}.p1]: \$heap_{funcstart\_719,1}.p1 / 177) +$
$\mathrm{div}(\mathbf{heapIs}\ \$heap_{funcstart\_719,1}, \$heap_{funcstart\_719,1}.p1, 177).quot)$

→ *[move guard outside expression]*

[10.18] $0 == (([0 < -\$heap_{funcstart\_719,1}.p1]: -(-(-\$heap_{funcstart\_719,1}.p1 /$
$177)), [-1 < \$heap_{funcstart\_719,1}.p1]: -(\$heap_{funcstart\_719,1}.p1 / 177)) +$
$\mathrm{div}(\mathbf{heapIs}\ \$heap_{funcstart\_719,1}, \$heap_{funcstart\_719,1}.p1, 177).quot)$

→ *[simplify]*

[10.19] $0 == (([0 < -\$heap_{funcstart\_719,1}.p1]: -\$heap_{funcstart\_719,1}.p1 / 177,$
$[-1 < \$heap_{funcstart\_719,1}.p1]: -(\$heap_{funcstart\_719,1}.p1 / 177)) + \mathrm{div}(\mathbf{heapIs}$
$\$heap_{funcstart\_719,1}, \$heap_{funcstart\_719,1}.p1, 177).quot)$

→ *[move guard outside expression]*

[10.21] $([0 < -\$heap_{funcstart\_719,1}.p1]: 0 == ((-\$heap_{funcstart\_719,1}.p1 / 177)$
$+ \mathrm{div}(\mathbf{heapIs}\ \$heap_{funcstart\_719,1}, \$heap_{funcstart\_719,1}.p1, 177).quot), [-1 <$
$\$heap_{funcstart\_719,1}.p1]: 0 == (-(\$heap_{funcstart\_719,1}.p1 / 177) + \mathrm{div}(\mathbf{heapIs}$
$\$heap_{funcstart\_719,1}, \$heap_{funcstart\_719,1}.p1, 177).quot))$

[Assume known post-assertion, class invariant or type constraint for term 5.6]

[11.0] $(\mathbf{asType}{<}\mathbf{integer}{>}(\$heap_{funcstart\_719,1}.p1)\ \%$
$\mathbf{asType}{<}\mathbf{integer}{>}(177)) == \mathbf{asType}{<}\mathbf{integer}{>}(\mathrm{div}(\mathbf{heapIs}$
$\$heap_{funcstart\_719,1}, \$heap_{funcstart\_719,1}.p1, 177).rem)$

→ *[simplify]*

[11.2] $(\$heap_{funcstart\_719,1}.p1\ \%\ 177) == \mathbf{asType}{<}\mathbf{integer}{>}(\mathrm{div}(\mathbf{heapIs}$
$\$heap_{funcstart\_719,1}, \$heap_{funcstart\_719,1}.p1, 177).rem)$

→ *[expand definition of operator '.%' in class 'int' at built in declaration]*

[11.3] $([\mathbf{asType}{<}\mathbf{integer}{>}(\$heap_{funcstart\_719,1}.p1) < 0]:$
$-(-\mathbf{asType}{<}\mathbf{integer}{>}(\$heap_{funcstart\_719,1}.p1)\ \%\ 177), []:$
$\mathbf{asType}{<}\mathbf{integer}{>}(\$heap_{funcstart\_719,1}.p1)\ \%\ 177) ==$
$\mathbf{asType}{<}\mathbf{integer}{>}(\mathrm{div}(\mathbf{heapIs}\ \$heap_{funcstart\_719,1}, \$heap_{funcstart\_719,1}.p1,$
$177).rem)$

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

[11.4] $([\mathbf{asType}{<}\mathbf{integer}{>}(\$heap_{funcstart\_719,1}.p1) < 0]:$
$-(-\mathbf{asType}{<}\mathbf{integer}{>}(\$heap_{funcstart\_719,1}.p1)\ \%\ 177),$
$[!(\mathbf{asType}{<}\mathbf{integer}{>}(\$heap_{funcstart\_719,1}.p1) < 0)]:$
$\mathbf{asType}{<}\mathbf{integer}{>}(\$heap_{funcstart\_719,1}.p1)\ \%\ 177) ==$
$\mathbf{asType}{<}\mathbf{integer}{>}(\mathrm{div}(\mathbf{heapIs}\ \$heap_{funcstart\_719,1}, \$heap_{funcstart\_719,1}.p1,$
$177).rem)$

→ *[simplify]*

[11.14] $([0 < -\$\text{heap}_{funcstart\_719,1}.\text{p1}]$: $-(-\$\text{heap}_{funcstart\_719,1}.\text{p1}$ % 177)$, [\text{-1} < \$\text{heap}_{funcstart\_719,1}.\text{p1}]$: **asType**<**integer**>$(\$\text{heap}_{funcstart\_719,1}.\text{p1})$ % 177) == **asType**<**integer**>(div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}.\text{p1}$, 177).rem)

→ *[remainder of negation]*

[11.15] $([0 < -\$\text{heap}_{funcstart\_719,1}.\text{p1}]$: $-([0 == (\$\text{heap}_{funcstart\_719,1}.\text{p1}$ % 177)]: 0, []: 177 + $-(\$\text{heap}_{funcstart\_719,1}.\text{p1}$ % 177))$, [\text{-1} < \$\text{heap}_{funcstart\_719,1}.\text{p1}]$: **asType**<**integer**>$(\$\text{heap}_{funcstart\_719,1}.\text{p1})$ % 177) == **asType**<**integer**>(div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}.\text{p1}$, 177).rem)

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

[11.16] $([0 < -\$\text{heap}_{funcstart\_719,1}.\text{p1}]$: $-([0 == (\$\text{heap}_{funcstart\_719,1}.\text{p1}$ % 177)]: 0, [!(0 == (\$\text{heap}_{funcstart_719,1}.\text{p1}$ % 177))]: 177 + $-(\$\text{heap}_{funcstart\_719,1}.\text{p1}$ % 177))$, [\text{-1} < \$\text{heap}_{funcstart\_719,1}.\text{p1}]$: **asType**<**integer**>$(\$\text{heap}_{funcstart\_719,1}.\text{p1})$ % 177) == **asType**<**integer**>(div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}.\text{p1}$, 177).rem)

→ *[move guard outside expression]*

[11.17] $([0 < -\$\text{heap}_{funcstart\_719,1}.\text{p1}]$: $([0 == (\$\text{heap}_{funcstart\_719,1}.\text{p1}$ % 177)]: -0, [!(0 == (\$\text{heap}_{funcstart_719,1}.\text{p1}$ % 177))]: $-(177 + -(\$\text{heap}_{funcstart\_719,1}.\text{p1}$ % 177)))$, [\text{-1} < \$\text{heap}_{funcstart\_719,1}.\text{p1}]$: **asType**<**integer**>$(\$\text{heap}_{funcstart\_719,1}.\text{p1})$ % 177) == **asType**<**integer**>(div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}.\text{p1}$, 177).rem)

→ *[simplify]*

[11.24] $0 == (-([0 < -\$\text{heap}_{funcstart\_719,1}.\text{p1}]$: $([0 == (\$\text{heap}_{funcstart\_719,1}.\text{p1}$ % 177)]: 0, [!(0 == (\$\text{heap}_{funcstart_719,1}.\text{p1}$ % 177))]: $-177 + (\$\text{heap}_{funcstart\_719,1}.\text{p1}$ % 177))$, [\text{-1} < \$\text{heap}_{funcstart\_719,1}.\text{p1}]$: $\$\text{heap}_{funcstart\_719,1}.\text{p1}$ % 177) + div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}.\text{p1}$, 177).rem)

→ *[move guard outside expression]*

[11.26] $0 == (([0 < -\$\text{heap}_{funcstart\_719,1}.\text{p1}]$: $([0 == (\$\text{heap}_{funcstart\_719,1}.\text{p1}$ % 177)]: -0, [!(0 == (\$\text{heap}_{funcstart_719,1}.\text{p1}$ % 177))]: $-(-177 + (\$\text{heap}_{funcstart\_719,1}.\text{p1}$ % 177)))$, [\text{-1} < \$\text{heap}_{funcstart\_719,1}.\text{p1}]$: $-(\$\text{heap}_{funcstart\_719,1}.\text{p1}$ % 177)) + div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}.\text{p1}$, 177).rem)

→ *[simplify]*

[11.29] $0 == (([0 < -\$\text{heap}_{funcstart\_719,1}.\text{p1}]$: $([0 == (\$\text{heap}_{funcstart\_719,1}.\text{p1}$ % 177)]: 0, [!(0 == \$\text{heap}_{funcstart_719,1}.\text{p1}$ % 177))]: 177 +

$-(\$\text{heap}_{funcstart\_719,1}.\text{p1} \% 177)), [-1 < \$\text{heap}_{funcstart\_719,1}.\text{p1}]:$
$-(\$\text{heap}_{funcstart\_719,1}.\text{p1} \% 177)) + \text{div}(\textbf{heapIs} \ \$\text{heap}_{funcstart\_719,1},$
$\$\text{heap}_{funcstart\_719,1}.\text{p1}, 177).\text{rem})$

$\rightarrow$ *[move guard outside expression]*

[11.31] $0 == ([0 < -\$\text{heap}_{funcstart\_719,1}.\text{p1}]: ([0 == (\$\text{heap}_{funcstart\_719,1}.\text{p1} \%$
$177)]: 0 + \text{div}(\textbf{heapIs} \ \$\text{heap}_{funcstart\_719,1}, \$\text{heap}_{funcstart\_719,1}.\text{p1}, 177).\text{rem},$
$[!(0 == (\$\text{heap}_{funcstart\_719,1}.\text{p1} \% 177))]: (177 + -\$\text{heap}_{funcstart\_719,1}.\text{p1} \%$
$177)) + \text{div}(\textbf{heapIs} \ \$\text{heap}_{funcstart\_719,1}, \$\text{heap}_{funcstart\_719,1}.\text{p1}, 177).\text{rem}), [-1$
$< \$\text{heap}_{funcstart\_719,1}.\text{p1}]: -(\$\text{heap}_{funcstart\_719,1}.\text{p1} \% 177) + \text{div}(\textbf{heapIs}$
$\$\text{heap}_{funcstart\_719,1}, \$\text{heap}_{funcstart\_719,1}.\text{p1}, 177).\text{rem})$

$\rightarrow$ *[simplify]*

[11.33] $0 == ([0 < -\$\text{heap}_{funcstart\_719,1}.\text{p1}]: ([0 == (\$\text{heap}_{funcstart\_719,1}.\text{p1}$
$\% 177)]: \text{div}(\textbf{heapIs} \ \$\text{heap}_{funcstart\_719,1}, \$\text{heap}_{funcstart\_719,1}.\text{p1}, 177).\text{rem},$
$[!(0 == (\$\text{heap}_{funcstart\_719,1}.\text{p1} \% 177))]: 177 + -(\$\text{heap}_{funcstart\_719,1}.\text{p1} \%$
$177) + \text{div}(\textbf{heapIs} \ \$\text{heap}_{funcstart\_719,1}, \$\text{heap}_{funcstart\_719,1}.\text{p1}, 177).\text{rem}), [-1$
$< \$\text{heap}_{funcstart\_719,1}.\text{p1}]: -(\$\text{heap}_{funcstart\_719,1}.\text{p1} \% 177) + \text{div}(\textbf{heapIs}$
$\$\text{heap}_{funcstart\_719,1}, \$\text{heap}_{funcstart\_719,1}.\text{p1}, 177).\text{rem})$

$\rightarrow$ *[move guard outside expression]*

[11.35] $([0 < -\$\text{heap}_{funcstart\_719,1}.\text{p1}]: ([0 == (\$\text{heap}_{funcstart\_719,1}.\text{p1} \% 177)]:$
$0 == \text{div}(\textbf{heapIs} \ \$\text{heap}_{funcstart\_719,1}, \$\text{heap}_{funcstart\_719,1}.\text{p1}, 177).\text{rem}, [!(0$
$== (\$\text{heap}_{funcstart\_719,1}.\text{p1} \% 177))]: 0 == (177 + -\$\text{heap}_{funcstart\_719,1}.\text{p1}$
$\% 177) + \text{div}(\textbf{heapIs} \ \$\text{heap}_{funcstart\_719,1}, \$\text{heap}_{funcstart\_719,1}.\text{p1}, 177).\text{rem})),$
$[-1 < \$\text{heap}_{funcstart\_719,1}.\text{p1}]: 0 == (-(\$\text{heap}_{funcstart\_719,1}.\text{p1} \% 177) +$
$\text{div}(\textbf{heapIs} \ \$\text{heap}_{funcstart\_719,1}, \$\text{heap}_{funcstart\_719,1}.\text{p1}, 177).\text{rem}))$

$\rightarrow$ *[simplify]*

[11.40] $([0 < -\$\text{heap}_{funcstart\_719,1}.\text{p1}]: ([0 == (\$\text{heap}_{funcstart\_719,1}.\text{p1} \%$
$177)]: 0 == \text{div}(\textbf{heapIs} \ \$\text{heap}_{funcstart\_719,1}, \$\text{heap}_{funcstart\_719,1}.\text{p1}, 177).\text{rem},$
$[!(0 == (\$\text{heap}_{funcstart\_719,1}.\text{p1} \% 177))]: 177 == ((\$\text{heap}_{funcstart\_719,1}.\text{p1} \%$
$177) + -\text{div}(\textbf{heapIs} \ \$\text{heap}_{funcstart\_719,1}, \$\text{heap}_{funcstart\_719,1}.\text{p1}, 177).\text{rem})),$
$[-1 < \$\text{heap}_{funcstart\_719,1}.\text{p1}]: 0 == (-(\$\text{heap}_{funcstart\_719,1}.\text{p1} \% 177) +$
$\text{div}(\textbf{heapIs} \ \$\text{heap}_{funcstart\_719,1}, \$\text{heap}_{funcstart\_719,1}.\text{p1}, 177).\text{rem}))$

[Take given term]

[12.0] $\text{div2} == \text{div}(\textbf{heapIs} \ \$\text{heap}_{funcstart\_719,1},$
$\textbf{asType}\!<\!\textbf{int}\!>\!(\$\text{heap}_{funcstart\_719,1}.\text{p2}),$
$\textbf{asType}\!<\!\textbf{int}\!>\!(\$\text{heap}_{funcstart\_719,1}.\text{a2}))$

$\rightarrow$ *[simplify]*

[12.1] $\text{div2} == \text{div}(\textbf{heapIs} \ \$\text{heap}_{funcstart\_719,1}, \$\text{heap}_{funcstart\_719,1}.\text{p2},$
$\textbf{asType}\!<\!\textbf{int}\!>\!(\$\text{heap}_{funcstart\_719,1}.\text{a2}))$

$\rightarrow$ *[const static or extern object]*

[12.2] $\text{div2} == \text{div}(\textbf{heapIs} \ \$\text{heap}_{funcstart\_719,1}, \$\text{heap}_{funcstart\_719,1}.\text{p2},$

asType\<int\>($heap$_{init}$.a2))

→ *[expand definition of constant 'a2' at prang.c (21,20)]*

[12.3] div2 == div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p2,
asType\<int\>(**asType\<short int\>**((**int**)176)))

→ *[simplify]*

[12.6] div2 == div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p2, 176)

[Take given term]

[19.0] div3 == div(**heapIs** $heap$_{funcstart_719,1}$,
asType\<int\>($heap$_{funcstart_719,1}$.p3),
asType\<int\>($heap$_{funcstart_719,1}$.a3))

→ *[simplify]*

[19.1] div3 == div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p3,
asType\<int\>($heap$_{funcstart_719,1}$.a3))

→ *[const static or extern object]*

[19.2] div3 == div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p3,
asType\<int\>($heap$_{init}$.a3))

→ *[expand definition of constant 'a3' at prang.c (26,20)]*

[19.3] div3 == div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p3,
asType\<int\>(**asType\<short int\>**((**int**)178)))

→ *[simplify]*

[19.6] div3 == div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p3, 178)

[Take given term]

[26.0] $heap$_{719,1;729,8}$ == $heap$_{funcstart_719,1}$.**replace**(p1 → **asType\<short
int\>**((**asType\<int\>**(**asType\<short int\>**(div1.rem)) *
asType\<int\>($heap$_{funcstart_719,1}$.r1)) − (**asType\<int\>**(**asType\<short
int\>**(div1.quot)) * **asType\<int\>**($heap$_{funcstart_719,1}$.b1))))

→ *[from term 5.6, div1 is equal to div(**heapIs** $heap$_{funcstart_719,1}$,
$heap$_{funcstart_719,1}$.p1, 177)]*

[26.1] $heap$_{719,1;729,8}$ == $heap$_{funcstart_719,1}$.**replace**(p1 → **asType\<short
int\>**((**asType\<int\>**(**asType\<short int\>**(div(**heapIs** $heap$_{funcstart_719,1}$,
$heap$_{funcstart_719,1}$.p1, 177).rem)) * **asType\<int\>**($heap$_{funcstart\_719,1}$.r1)) −
(**asType\<int\>**(**asType\<short int\>**(div1.quot)) *
asType\<int\>($heap$_{funcstart_719,1}$.b1))))

→ *[simplify]*

[26.3] $heap$_{719,1;729,8}$ == $heap$_{funcstart_719,1}$.**replace**(p1 → **asType\<short
int\>**((div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1, 177).rem *
asType\<int\>($heap$_{funcstart_719,1}$.r1)) − (**asType\<int\>**(**asType\<short

int>(div1.quot)) * **asType**<**int**>($heap$_{funcstart_719,1}$.b1))))

$\rightarrow$ *[const static or extern object]*

[26.4] $heap$_{719,1;729,8}$ == $heap$_{funcstart_719,1}$.**replace**(p1 $\rightarrow$ **asType**<**short int**>((div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1, 177).rem * **asType**<**int**>($heap$_{init}$.r1)) − (**asType**<**int**>(**asType**<**short int**>(div1.quot)) * **asType**<**int**>($heap$_{funcstart_719,1}$.b1))))

$\rightarrow$ *[expand definition of constant 'r1' at prang.c (15,20)]*

[26.5] $heap$_{719,1;729,8}$ == $heap$_{funcstart_719,1}$.**replace**(p1 $\rightarrow$ **asType**<**short int**>((div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1, 177).rem * **asType**<**int**>(**asType**<**short int**>((**int**)171))) − (**asType**<**int**>(**asType**<**short int**>(div1.quot)) * **asType**<**int**>($heap$_{funcstart\_719,1}$.b1))))

$\rightarrow$ *[simplify]*

[26.8] $heap$_{719,1;729,8}$ == $heap$_{funcstart_719,1}$.**replace**(p1 $\rightarrow$ **asType**<**short int**>((div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1, 177).rem * 171) − (**asType**<**int**>(**asType**<**short int**>(div1.quot)) * **asType**<**int**>($heap$_{funcstart\_719,1}$.b1))))

$\rightarrow$ *[from term 5.6, div1 is equal to div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1, 177)]*

[26.9] $heap$_{719,1;729,8}$ == $heap$_{funcstart_719,1}$.**replace**(p1 $\rightarrow$ **asType**<**short int**>((171 * div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1, 177).rem) − (**asType**<**int**>(**asType**<**short int**>(div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1, 177).quot)) * **asType**<**int**>($heap$_{funcstart\_719,1}$.b1))))

$\rightarrow$ *[simplify]*

[26.11] $heap$_{719,1;729,8}$ == $heap$_{funcstart_719,1}$.**replace**(p1 $\rightarrow$ **asType**<**short int**>((171 * div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1, 177).rem) − (div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1, 177).quot * **asType**<**int**>($heap$_{funcstart\_719,1}$.b1))))

$\rightarrow$ *[const static or extern object]*

[26.12] $heap$_{719,1;729,8}$ == $heap$_{funcstart_719,1}$.**replace**(p1 $\rightarrow$ **asType**<**short int**>((171 * div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1, 177).rem) − (div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1, 177).quot * **asType**<**int**>($heap$_{init}$.b1))))

$\rightarrow$ *[expand definition of constant 'b1' at prang.c (17,20)]*

[26.13] $heap$_{719,1;729,8}$ == $heap$_{funcstart_719,1}$.**replace**(p1 $\rightarrow$ **asType**<**short int**>((171 * div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1, 177).rem) − (div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1, 177).quot * **asType**<**int**>(**asType**<**short int**>((**int**)2)))))

→ *[simplify]*

[26.19] $\$heap_{719,1;729,8}$ == $\$heap_{funcstart\_719,1}.$**replace**(p1 → ((-2 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}.$p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}.$p1, 177).rem)))

[Take given term]

[31.0] $\$heap_{719,1;730,8}$ == $\$heap_{719,1;729,8}.$**replace**(p2 → **asType<short int>**((**asType<int>**(**asType<short int>**(div2.rem)) * **asType<int>**($\$heap_{719,1;729,8}.$r2)) − (**asType<int>**(**asType<short int>**(div2.quot)) * **asType<int>**($\$heap_{719,1;729,8}.$b2))))

→ *[from term 26.19, $\$heap_{719,1;729,8}$ is equal to $\$heap_{funcstart\_719,1}.$**replace**(p1 → (-2 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}.$p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}.$p1, 177).rem))]*

[31.1] $\$heap_{719,1;730,8}$ == $\$heap_{funcstart\_719,1}.$**replace**(p1 → ((-2 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}.$p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}.$p1, 177).rem))).**replace**(p2 → **asType<short int>**((**asType<int>**(**asType<short int>**(div2.rem)) * **asType<int>**($\$heap_{719,1;729,8}.$r2)) − (**asType<int>**(**asType<short int>**(div2.quot)) * **asType<int>**($\$heap_{719,1;729,8}.$b2))))

→ *[from term 12.6, div2 is equal to div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}.$p2, 176)]*

[31.2] $\$heap_{719,1;730,8}$ == $\$heap_{funcstart\_719,1}.$**replace**(p1 → ((-2 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}.$p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}.$p1, 177).rem))).**replace**(p2 → **asType<short int>**((**asType<int>**(**asType<short int>**(div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}.$p2, 176).rem)) * **asType<int>**($\$heap_{719,1;729,8}.$r2)) − (**asType<int>**(**asType<short int>**(div2.quot)) * **asType<int>**($\$heap_{719,1;729,8}.$b2))))

→ *[simplify]*

[31.4] $\$heap_{719,1;730,8}$ == $\$heap_{funcstart\_719,1}.$**replace**(p1 → ((-2 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}.$p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}.$p1, 177).rem))).**replace**(p2 → **asType<short int>**((div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}.$p2, 176).rem * **asType<int>**($\$heap_{719,1;729,8}.$r2)) − (**asType<int>**(**asType<short int>**(div2.quot)) * **asType<int>**($\$heap_{719,1;729,8}.$b2))))

→ *[from term 26.19, $\$heap_{719,1;729,8}$ is equal to $\$heap_{funcstart\_719,1}.$**replace**(p1 → (-2 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}.$p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_719,1}$,*

$\$heap_{funcstart\_719,1}.p1,\ 177).rem))]$

[31.5] $\$heap_{719,1;730,8}$ == $\$heap_{funcstart\_719,1}.$**replace**(p1 → ((-2 *
div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}.$p1, 177).quot) + (171 *
div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}.$p1,
177).rem))).**replace**(p2 → **asType**<**short int**>((div(**heapIs**
$\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}.$p2, 176).rem *
asType<**int**>($\$heap_{funcstart\_719,1}.$**replace**(p1 → ((-2 * div(**heapIs**
$\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}.$p1, 177).quot) + (171 * div(**heapIs**
$\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}.$p1, 177).rem))).r2)) −
(**asType**<**int**>(**asType**<**short int**>(div2.quot)) *
asType<**int**>($\$heap_{719,1;729,8}.$b2))))

→ *[const member of object with modified fields]*

[31.6] $\$heap_{719,1;730,8}$ == $\$heap_{funcstart\_719,1}.$**replace**(p1 → ((-2 *
div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}.$p1, 177).quot) + (171 *
div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}.$p1,
177).rem))).**replace**(p2 → **asType**<**short int**>((div(**heapIs**
$\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}.$p2, 176).rem *
asType<**int**>($\$heap_{funcstart\_719,1}.$r2)) − (**asType**<**int**>(**asType**<**short
int**>(div2.quot)) * **asType**<**int**>($\$heap_{719,1;729,8}.$b2))))

→ *[const static or extern object]*

[31.7] $\$heap_{719,1;730,8}$ == $\$heap_{funcstart\_719,1}.$**replace**(p1 → ((-2 *
div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}.$p1, 177).quot) + (171 *
div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}.$p1,
177).rem))).**replace**(p2 → **asType**<**short int**>((div(**heapIs**
$\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}.$p2, 176).rem *
asType<**int**>($\$heap_{init}.$r2)) − (**asType**<**int**>(**asType**<**short
int**>(div2.quot)) * **asType**<**int**>($\$heap_{719,1;729,8}.$b2))))

→ *[expand definition of constant 'r2' at prang.c (20,20)]*

[31.8] $\$heap_{719,1;730,8}$ == $\$heap_{funcstart\_719,1}.$**replace**(p1 → ((-2 *
div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}.$p1, 177).quot) + (171 *
div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}.$p1,
177).rem))).**replace**(p2 → **asType**<**short int**>((div(**heapIs**
$\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}.$p2, 176).rem *
asType<**int**>(**asType**<**short int**>((**int**)172))) −
(**asType**<**int**>(**asType**<**short int**>(div2.quot)) *
asType<**int**>($\$heap_{719,1;729,8}.$b2))))

→ *[simplify]*

[31.11] $\$heap_{719,1;730,8}$ == $\$heap_{funcstart\_719,1}.$**replace**(p1 → ((-2 *
div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}.$p1, 177).quot) + (171 *
div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}.$p1,
177).rem))).**replace**(p2 → **asType**<**short int**>((div(**heapIs**
$\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}.$p2, 176).rem * 172) −

(**asType$<$int$>$**(**asType$<$short int$>$**(div2.quot)) *
asType$<$int$>$($\text{\$heap}_{719,1;729,8}$.b2))))

$\rightarrow$ *[from term 12.6, div2 is equal to div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$,*
$\text{\$heap}_{funcstart\_719,1}$.p2, 176)]

[31.12] $\text{\$heap}_{719,1;730,8}$ == $\text{\$heap}_{funcstart\_719,1}$._**replace**(p1 $\rightarrow$ ((-2 *
div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p1,
177).rem)))._**replace**(p2 $\rightarrow$ **asType$<$short int$>$**((172 * div(**heapIs**
$\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p2, 176).rem) $-$
(**asType$<$int$>$**(**asType$<$short int$>$**(div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$,
$\text{\$heap}_{funcstart\_719,1}$.p2, 176).quot)) * **asType$<$int$>$**($\text{\$heap}_{719,1;729,8}$.b2))))

$\rightarrow$ *[simplify]*

[31.14] $\text{\$heap}_{719,1;730,8}$ == $\text{\$heap}_{funcstart\_719,1}$._**replace**(p1 $\rightarrow$ ((-2 *
div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p1,
177).rem)))._**replace**(p2 $\rightarrow$ **asType$<$short int$>$**((172 * div(**heapIs**
$\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p2, 176).rem) $-$ (div(**heapIs**
$\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p2, 176).quot *
asType$<$int$>$($\text{\$heap}_{719,1;729,8}$.b2))))

$\rightarrow$ *[from term 26.19, $\text{\$heap}_{719,1;729,8}$ is equal to*
*$\text{\$heap}_{funcstart\_719,1}$._**replace**(p1 $\rightarrow$ (-2 * div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$,*
*$\text{\$heap}_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$,*
$\text{\$heap}_{funcstart\_719,1}$.p1, 177).rem))]

[31.15] $\text{\$heap}_{719,1;730,8}$ == $\text{\$heap}_{funcstart\_719,1}$._**replace**(p1 $\rightarrow$ ((-2 *
div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p1,
177).rem)))._**replace**(p2 $\rightarrow$ **asType$<$short int$>$**((172 * div(**heapIs**
$\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p2, 176).rem) $-$ (div(**heapIs**
$\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p2, 176).quot *
asType$<$int$>$($\text{\$heap}_{funcstart\_719,1}$._**replace**(p1 $\rightarrow$ ((-2 * div(**heapIs**
$\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs**
$\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p1, 177).rem)))).b2))))

$\rightarrow$ *[const member of object with modified fields]*

[31.16] $\text{\$heap}_{719,1;730,8}$ == $\text{\$heap}_{funcstart\_719,1}$._**replace**(p1 $\rightarrow$ ((-2 *
div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p1,
177).rem)))._**replace**(p2 $\rightarrow$ **asType$<$short int$>$**((172 * div(**heapIs**
$\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p2, 176).rem) $-$ (div(**heapIs**
$\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p2, 176).quot *
asType$<$int$>$($\text{\$heap}_{funcstart\_719,1}$.b2))))

$\rightarrow$ *[const static or extern object]*

[31.17] $\text{\$heap}_{719,1;730,8} == \text{\$heap}_{funcstart\_719,1}.$ **replace**(p1 → ((-2 *
div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}.$p1, 177).quot) + (171 *
div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}.$p1,
177).rem))). **replace**(p2 → **asType**<**short int**>((172 * div(**heapIs**
$\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}.$p2, 176).rem) − (div(**heapIs**
$\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}.$p2, 176).quot *
asType<**int**>($\text{\$heap}_{init}.$b2))))

→ *[expand definition of constant 'b2' at prang.c (22,20)]*

[31.18] $\text{\$heap}_{719,1;730,8} == \text{\$heap}_{funcstart\_719,1}.$ **replace**(p1 → ((-2 *
div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}.$p1, 177).quot) + (171 *
div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}.$p1,
177).rem))). **replace**(p2 → **asType**<**short int**>((172 * div(**heapIs**
$\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}.$p2, 176).rem) − (div(**heapIs**
$\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}.$p2, 176).quot *
asType<**int**>(**asType**<**short int**>((**int**)35)))))

→ *[simplify]*

[31.24] $\text{\$heap}_{719,1;730,8} == \text{\$heap}_{funcstart\_719,1}.$ **replace**(p1 → ((-2 *
div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}.$p1, 177).quot) + (171 *
div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}.$p1,
177).rem))). **replace**(p2 → ((-35 * div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$,
$\text{\$heap}_{funcstart\_719,1}.$p2, 176).quot) + (172 * div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$,
$\text{\$heap}_{funcstart\_719,1}.$p2, 176).rem)))

[Take given term]

[36.0] $\text{\$heap}_{719,1;731,8} == \text{\$heap}_{719,1;730,8}.$ **replace**(p3 → **asType**<**short
int**>((**asType**<**int**>(**asType**<**short int**>(div3.rem)) *
asType<**int**>($\text{\$heap}_{719,1;730,8}.$r3)) − (**asType**<**int**>(**asType**<**short
int**>(div3.quot)) * **asType**<**int**>($\text{\$heap}_{719,1;730,8}.$b3))))

→ *[from term 31.24, $heap_{719,1;730,8}$ is equal to
$heap_{funcstart\_719,1}.$ replace(p1 → ((-2 * div(heapIs $heap_{funcstart\_719,1}$,
$heap_{funcstart\_719,1}.$p1, 177).quot) + (171 * div(heapIs $heap_{funcstart\_719,1}$,
$heap_{funcstart\_719,1}.$p1, 177).rem))). replace(p2 → (-35 * div(heapIs
$heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}.$p2, 176).quot) + (172 * div(heapIs
$heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}.$p2, 176).rem))]*

[36.1] $\text{\$heap}_{719,1;731,8} == \text{\$heap}_{funcstart\_719,1}.$ **replace**(p1 → ((-2 *
div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}.$p1, 177).quot) + (171 *
div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}.$p1,
177).rem))). **replace**(p2 → ((-35 * div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$,
$\text{\$heap}_{funcstart\_719,1}.$p2, 176).quot) + (172 * div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$,
$\text{\$heap}_{funcstart\_719,1}.$p2, 176).rem))). **replace**(p3 → **asType**<**short
int**>((**asType**<**int**>(**asType**<**short int**>(div3.rem)) *
asType<**int**>($\text{\$heap}_{719,1;730,8}.$r3)) − (**asType**<**int**>(**asType**<**short
int**>(div3.quot)) * **asType**<**int**>($\text{\$heap}_{719,1;730,8}.$b3))))

$\rightarrow$ *[from term 19.6, div3 is equal to div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p3, 178)]*

[36.2] $heap_{719,1;731,8}$ == $heap_{funcstart\_719,1}$.**replace**(p1 $\rightarrow$ ((-2 * div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p1, 177).rem))).**replace**(p2 $\rightarrow$ ((-35 * div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p2, 176).quot) + (172 * div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p2, 176).rem))).**replace**(p3 $\rightarrow$ **asType**<**short int**>((**asType**<**int**>(**asType**<**short int**>(div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p3, 178).rem)) * **asType**<**int**>($heap_{719,1;730,8}$.r3)) $-$ (**asType**<**int**>(**asType**<**short int**>(div3.quot)) * **asType**<**int**>($heap_{719,1;730,8}$.b3)))))

$\rightarrow$ *[simplify]*

[36.4] $heap_{719,1;731,8}$ == $heap_{funcstart\_719,1}$.**replace**(p1 $\rightarrow$ ((-2 * div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p1, 177).rem))).**replace**(p2 $\rightarrow$ ((-35 * div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p2, 176).quot) + (172 * div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p2, 176).rem))).**replace**(p3 $\rightarrow$ **asType**<**short int**>((div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p3, 178).rem * **asType**<**int**>($heap_{719,1;730,8}$.r3)) $-$ (**asType**<**int**>(**asType**<**short int**>(div3.quot)) * **asType**<**int**>($heap_{719,1;730,8}$.b3)))))

$\rightarrow$ *[from term 31.24, $heap_{719,1;730,8}$ is equal to $heap_{funcstart\_719,1}$.**replace**(p1 $\rightarrow$ ((-2 * div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p1, 177).rem))).**replace**(p2 $\rightarrow$ (-35 * div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p2, 176).quot) + (172 * div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p2, 176).rem))]*

[36.5] $heap_{719,1;731,8}$ == $heap_{funcstart\_719,1}$.**replace**(p1 $\rightarrow$ ((-2 * div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p1, 177).rem))).**replace**(p2 $\rightarrow$ ((-35 * div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p2, 176).quot) + (172 * div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p2, 176).rem))).**replace**(p3 $\rightarrow$ **asType**<**short int**>((div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p3, 178).rem * **asType**<**int**>($heap_{funcstart\_719,1}$.**replace**(p1 $\rightarrow$ ((-2 * div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p1, 177).rem))).**replace**(p2 $\rightarrow$ ((-35 * div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p2, 176).quot) + (172 * div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p2, 176).rem))).r3)) $-$ (**asType**<**int**>(**asType**<**short int**>(div3.quot)) * **asType**<**int**>($heap_{719,1;730,8}$.b3)))))

$\rightarrow$ *[const member of object with modified fields]*

[36.7] $\text{\$heap}_{719,1;731,8}$ == $\text{\$heap}_{funcstart\_719,1}$.**replace**(p1 → ((-2 *
div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p1,
177).rem))).**replace**(p2 → ((-35 * div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$,
$\text{\$heap}_{funcstart\_719,1}$.p2, 176).quot) + (172 * div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$,
$\text{\$heap}_{funcstart\_719,1}$.p2, 176).rem))).**replace**(p3 → **asType**<**short
int**>((div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p3, 178).rem *
asType<**int**>($\text{\$heap}_{funcstart\_719,1}$.r3)) − (**asType**<**int**>(**asType**<**short
int**>(div3.quot)) * **asType**<**int**>($\text{\$heap}_{719,1;730,8}$.b3)))))

→ *[const static or extern object]*

[36.8] $\text{\$heap}_{719,1;731,8}$ == $\text{\$heap}_{funcstart\_719,1}$.**replace**(p1 → ((-2 *
div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p1,
177).rem))).**replace**(p2 → ((-35 * div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$,
$\text{\$heap}_{funcstart\_719,1}$.p2, 176).quot) + (172 * div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$,
$\text{\$heap}_{funcstart\_719,1}$.p2, 176).rem))).**replace**(p3 → **asType**<**short
int**>((div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p3, 178).rem *
asType<**int**>($\text{\$heap}_{init}$.r3)) − (**asType**<**int**>(**asType**<**short
int**>(div3.quot)) * **asType**<**int**>($\text{\$heap}_{719,1;730,8}$.b3)))))

→ *[expand definition of constant 'r3' at prang.c (25,20)]*

[36.9] $\text{\$heap}_{719,1;731,8}$ == $\text{\$heap}_{funcstart\_719,1}$.**replace**(p1 → ((-2 *
div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p1,
177).rem))).**replace**(p2 → ((-35 * div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$,
$\text{\$heap}_{funcstart\_719,1}$.p2, 176).quot) + (172 * div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$,
$\text{\$heap}_{funcstart\_719,1}$.p2, 176).rem))).**replace**(p3 → **asType**<**short
int**>((div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p3, 178).rem *
asType<**int**>(**asType**<**short int**>((**int**)170))) −
(**asType**<**int**>(**asType**<**short int**>(div3.quot)) *
asType<**int**>($\text{\$heap}_{719,1;730,8}$.b3)))))

→ *[simplify]*

[36.12] $\text{\$heap}_{719,1;731,8}$ == $\text{\$heap}_{funcstart\_719,1}$.**replace**(p1 → ((-2 *
div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p1,
177).rem))).**replace**(p2 → ((-35 * div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$,
$\text{\$heap}_{funcstart\_719,1}$.p2, 176).quot) + (172 * div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$,
$\text{\$heap}_{funcstart\_719,1}$.p2, 176).rem))).**replace**(p3 → **asType**<**short
int**>((div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p3, 178).rem * 170)
− (**asType**<**int**>(**asType**<**short int**>(div3.quot)) *
asType<**int**>($\text{\$heap}_{719,1;730,8}$.b3)))))

→ *[from term 19.6, div3 is equal to div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$,
$\text{\$heap}_{funcstart\_719,1}$.p3, 178)]*

[36.13] $\$heap_{719,1;731,8}$ == $\$heap_{funcstart\_719,1}$.**replace**(p1 → ((-2 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).rem))).**replace**(p2 → ((-35 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).quot) + (172 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).rem))).**replace**(p3 → **asType**<**short int**>((170 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p3, 178).rem) − (**asType**<**int**>(**asType**<**short int**>(div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p3, 178).quot)) * **asType**<**int**>($\$heap_{719,1;730,8}$.b3)))))

→ *[simplify]*

[36.15] $\$heap_{719,1;731,8}$ == $\$heap_{funcstart\_719,1}$.**replace**(p1 → ((-2 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).rem))).**replace**(p2 → ((-35 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).quot) + (172 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).rem))).**replace**(p3 → **asType**<**short int**>((170 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p3, 178).rem) − (div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p3, 178).quot * **asType**<**int**>($\$heap_{719,1;730,8}$.b3)))))

→ *[from term 31.24, $\$heap_{719,1;730,8}$ is equal to $\$heap_{funcstart\_719,1}$.**replace**(p1 → ((-2 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).rem))).**replace**(p2 → (-35 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).quot) + (172 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).rem))]*

[36.16] $\$heap_{719,1;731,8}$ == $\$heap_{funcstart\_719,1}$.**replace**(p1 → ((-2 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).rem))).**replace**(p2 → ((-35 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).quot) + (172 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).rem))).**replace**(p3 → **asType**<**short int**>((170 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p3, 178).rem) − (div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p3, 178).quot * **asType**<**int**>($\$heap_{funcstart\_719,1}$.**replace**(p1 → ((-2 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).rem))).**replace**(p2 → ((-35 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).quot) + (172 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).rem))).b3)))))

→ *[const member of object with modified fields]*

[36.18] $\$heap_{719,1;731,8}$ == $\$heap_{funcstart\_719,1}$.**replace**(p1 → ((-2 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).rem))).**replace**(p2 → ((-35 * div(**heapIs** $\$heap_{funcstart\_719,1}$,

$\text{\$heap}_{funcstart\_719,1}.\text{p2}, 176).\text{quot}) + (172 * \text{div}(\textbf{heapIs }\text{\$heap}_{funcstart\_719,1},$
$\text{\$heap}_{funcstart\_719,1}.\text{p2}, 176).\text{rem}))).\_\textbf{replace}(\text{p3} \rightarrow \textbf{asType}\text{<}\textbf{short int}\text{>}((170$
$* \text{div}(\textbf{heapIs }\text{\$heap}_{funcstart\_719,1}, \text{\$heap}_{funcstart\_719,1}.\text{p3}, 178).\text{rem}) -$
$(\text{div}(\textbf{heapIs }\text{\$heap}_{funcstart\_719,1}, \text{\$heap}_{funcstart\_719,1}.\text{p3}, 178).\text{quot} *$
$\textbf{asType}\text{<}\textbf{int}\text{>}(\text{\$heap}_{funcstart\_719,1}.\text{b3}))))$

$\rightarrow$ *[const static or extern object]*

[36.19] $\text{\$heap}_{719,1;731,8} == \text{\$heap}_{funcstart\_719,1}.\_\textbf{replace}(\text{p1} \rightarrow ((\text{-2 } *$
$\text{div}(\textbf{heapIs }\text{\$heap}_{funcstart\_719,1}, \text{\$heap}_{funcstart\_719,1}.\text{p1}, 177).\text{quot}) + (171 *$
$\text{div}(\textbf{heapIs }\text{\$heap}_{funcstart\_719,1}, \text{\$heap}_{funcstart\_719,1}.\text{p1},$
$177).\text{rem}))).\_\textbf{replace}(\text{p2} \rightarrow ((\text{-35 } * \text{div}(\textbf{heapIs }\text{\$heap}_{funcstart\_719,1},$
$\text{\$heap}_{funcstart\_719,1}.\text{p2}, 176).\text{quot}) + (172 * \text{div}(\textbf{heapIs }\text{\$heap}_{funcstart\_719,1},$
$\text{\$heap}_{funcstart\_719,1}.\text{p2}, 176).\text{rem}))).\_\textbf{replace}(\text{p3} \rightarrow \textbf{asType}\text{<}\textbf{short int}\text{>}((170$
$* \text{div}(\textbf{heapIs }\text{\$heap}_{funcstart\_719,1}, \text{\$heap}_{funcstart\_719,1}.\text{p3}, 178).\text{rem}) -$
$(\text{div}(\textbf{heapIs }\text{\$heap}_{funcstart\_719,1}, \text{\$heap}_{funcstart\_719,1}.\text{p3}, 178).\text{quot} *$
$\textbf{asType}\text{<}\textbf{int}\text{>}(\text{\$heap}_{init}.\text{b3}))))$

$\rightarrow$ *[expand definition of constant 'b3' at prang.c (27,20)]*

[36.20] $\text{\$heap}_{719,1;731,8} == \text{\$heap}_{funcstart\_719,1}.\_\textbf{replace}(\text{p1} \rightarrow ((\text{-2 } *$
$\text{div}(\textbf{heapIs }\text{\$heap}_{funcstart\_719,1}, \text{\$heap}_{funcstart\_719,1}.\text{p1}, 177).\text{quot}) + (171 *$
$\text{div}(\textbf{heapIs }\text{\$heap}_{funcstart\_719,1}, \text{\$heap}_{funcstart\_719,1}.\text{p1},$
$177).\text{rem}))).\_\textbf{replace}(\text{p2} \rightarrow ((\text{-35 } * \text{div}(\textbf{heapIs }\text{\$heap}_{funcstart\_719,1},$
$\text{\$heap}_{funcstart\_719,1}.\text{p2}, 176).\text{quot}) + (172 * \text{div}(\textbf{heapIs }\text{\$heap}_{funcstart\_719,1},$
$\text{\$heap}_{funcstart\_719,1}.\text{p2}, 176).\text{rem}))).\_\textbf{replace}(\text{p3} \rightarrow \textbf{asType}\text{<}\textbf{short int}\text{>}((170$
$* \text{div}(\textbf{heapIs }\text{\$heap}_{funcstart\_719,1}, \text{\$heap}_{funcstart\_719,1}.\text{p3}, 178).\text{rem}) -$
$(\text{div}(\textbf{heapIs }\text{\$heap}_{funcstart\_719,1}, \text{\$heap}_{funcstart\_719,1}.\text{p3}, 178).\text{quot} *$
$\textbf{asType}\text{<}\textbf{int}\text{>}(\textbf{asType}\text{<}\textbf{short int}\text{>}((\textbf{int})63)))))$

$\rightarrow$ *[simplify]*

[36.26] $\text{\$heap}_{719,1;731,8} == \text{\$heap}_{funcstart\_719,1}.\_\textbf{replace}(\text{p1} \rightarrow ((\text{-2 } *$
$\text{div}(\textbf{heapIs }\text{\$heap}_{funcstart\_719,1}, \text{\$heap}_{funcstart\_719,1}.\text{p1}, 177).\text{quot}) + (171 *$
$\text{div}(\textbf{heapIs }\text{\$heap}_{funcstart\_719,1}, \text{\$heap}_{funcstart\_719,1}.\text{p1},$
$177).\text{rem}))).\_\textbf{replace}(\text{p2} \rightarrow ((\text{-35 } * \text{div}(\textbf{heapIs }\text{\$heap}_{funcstart\_719,1},$
$\text{\$heap}_{funcstart\_719,1}.\text{p2}, 176).\text{quot}) + (172 * \text{div}(\textbf{heapIs }\text{\$heap}_{funcstart\_719,1},$
$\text{\$heap}_{funcstart\_719,1}.\text{p2}, 176).\text{rem}))).\_\textbf{replace}(\text{p3} \rightarrow ((\text{-63 } * \text{div}(\textbf{heapIs}$
$\text{\$heap}_{funcstart\_719,1}, \text{\$heap}_{funcstart\_719,1}.\text{p3}, 178).\text{quot}) + (170 * \text{div}(\textbf{heapIs}$
$\text{\$heap}_{funcstart\_719,1}, \text{\$heap}_{funcstart\_719,1}.\text{p3}, 178).\text{rem})))$

[Take goal term]

[1.0] $\text{\$heap}_{719,1;731,8}.\text{p1} \leq \textbf{maxof}(\textbf{int})$

$\rightarrow$ *[from term 36.26, $heap_{719,1;731,8}$ is equal to*
*$heap_{funcstart\_719,1}.\_\textbf{replace}(p1 \rightarrow ((\text{-2 } * div(\textbf{heapIs } \$heap_{funcstart\_719,1},$*
*$\$heap_{funcstart\_719,1}.p1, 177).quot) + (171 * div(\textbf{heapIs } \$heap_{funcstart\_719,1},$*
*$\$heap_{funcstart\_719,1}.p1, 177).rem))).\_\textbf{replace}(p2 \rightarrow ((\text{-35 } * div(\textbf{heapIs}$*
*$\$heap_{funcstart\_719,1}, \$heap_{funcstart\_719,1}.p2, 176).quot) + (172 * div(\textbf{heapIs}$*
*$\$heap_{funcstart\_719,1}, \$heap_{funcstart\_719,1}.p2, 176).rem))).\_\textbf{replace}(p3 \rightarrow (\text{-63 } *$*

*div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p3, 178).quot) + (170 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p3, 178).rem))]*

[1.1] $\$heap_{funcstart\_719,1}$.__replace__(p1 → ((-2 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).rem))).__replace__(p2 → ((-35 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).quot) + (172 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).rem))).__replace__(p3 → ((-63 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p3, 178).quot) + (170 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p3, 178).rem))).p1 ≤ **maxof**(**int**)

→ *[simplify]*

[1.18] -32768 < ((-171 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).rem) + (2 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot))

→ *[negate goal and search for contradiction]*

[1.19] !(-32768 < ((-171 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).rem) + (2 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot)))

→ *[simplify]*

[1.24] 32767 < ((171 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).rem) + (-2 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot))

[Branch on disjunction or conditional in term 10.21]

[41.0] (0 == ((−$\$heap_{funcstart\_719,1}$.p1 / 177) + div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot)) ∨ (0 == (−($\$heap_{funcstart\_719,1}$.p1 / 177) + div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot)) ∨ (-1 < $\$heap_{funcstart\_719,1}$.p1)

[Branch on disjunction or conditional in term 10.21]

[42.0] (0 < −$\$heap_{funcstart\_719,1}$.p1) ∨ (0 == (−($\$heap_{funcstart\_719,1}$.p1 / 177) + div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot)) ∨ (-1 < $\$heap_{funcstart\_719,1}$.p1)

[Copy term 11.40]

[43.0] ([0 < −$\$heap_{funcstart\_719,1}$.p1]: ([0 == ($\$heap_{funcstart\_719,1}$.p1 % 177)]: 0 == div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).rem, [!(0 == ($\$heap_{funcstart\_719,1}$.p1 % 177))]: 177 == (−div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).rem + ($\$heap_{funcstart\_719,1}$.p1 % 177))), [-1 < $\$heap_{funcstart\_719,1}$.p1]: 0 == (−($\$heap_{funcstart\_719,1}$.p1 % 177) + div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).rem)) ∨ (0 == (−($\$heap_{funcstart\_719,1}$.p1 / 177) + div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot)) ∨ (-1 <

$\text{\$heap}_{funcstart\_719,1}.\text{p1})$

$\rightarrow$ *[from term 42.0, literala* $< -\text{\$heap}_{funcstart\_719,1}.p1$ *is true whenever (-1 + literala) < 0]*

Proof of rule precondition:

[43.0.0] (-1 + 0) < 0

$\rightarrow$ *[simplify]*

[43.0.2] **true**

[43.1] ([**true**]: ([0 == ($\text{\$heap}_{funcstart\_719,1}.\text{p1}$ % 177)]: 0 == div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}.\text{p1}$, 177).rem, [!(0 == ($\text{\$heap}_{funcstart\_719,1}.\text{p1}$ % 177))]: 177 == ($-$div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}.\text{p1}$, 177).rem + ($\text{\$heap}_{funcstart\_719,1}.\text{p1}$ % 177))), [-1 < $\text{\$heap}_{funcstart\_719,1}.\text{p1}$]: 0 == ($-$($\text{\$heap}_{funcstart\_719,1}.\text{p1}$ % 177) + div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}.\text{p1}$, 177).rem)) $\vee$ ...

$\rightarrow$ *[simplify]*

[43.3] ([0 == ($\text{\$heap}_{funcstart\_719,1}.\text{p1}$ % 177)]: 0 == div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}.\text{p1}$, 177).rem, [!(0 == ($\text{\$heap}_{funcstart\_719,1}.\text{p1}$ % 177))]: 177 == ($-$div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}.\text{p1}$, 177).rem + ($\text{\$heap}_{funcstart\_719,1}.\text{p1}$ % 177))) $\vee$ ...

[Branch on disjunction or conditional in term 43.3]

[44.0] (0 == div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}.\text{p1}$, 177).rem) $\vee$ (0 == ($-$($\text{\$heap}_{funcstart\_719,1}.\text{p1}$ / 177) + div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}.\text{p1}$, 177).quot)) $\vee$ (-1 < $\text{\$heap}_{funcstart\_719,1}.\text{p1}$) $\vee$ (177 == ($-$div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}.\text{p1}$, 177).rem + ($\text{\$heap}_{funcstart\_719,1}.\text{p1}$ % 177))) $\vee$!(0 == ($\text{\$heap}_{funcstart\_719,1}.\text{p1}$ % 177))

[Copy term 1.24]

[46.0] (32767 < ((-2 * div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}.\text{p1}$, 177).quot) + (171 * div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}.\text{p1}$, 177).rem))) $\vee$ (0 == ($-$($\text{\$heap}_{funcstart\_719,1}.\text{p1}$ / 177) + div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}.\text{p1}$, 177).quot)) $\vee$ (-1 < $\text{\$heap}_{funcstart\_719,1}.\text{p1}$) $\vee$ (177 == ($-$div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}.\text{p1}$, 177).rem + ($\text{\$heap}_{funcstart\_719,1}.\text{p1}$ % 177))) $\vee$!(0 == ($\text{\$heap}_{funcstart\_719,1}.\text{p1}$ % 177))

$\rightarrow$ *[from term 44.0, div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}.p1$, 177).rem is equal to 0]*

[46.1] (32767 < ((-2 * div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}.\text{p1}$, 177).quot) + (171 * 0))) $\vee$ ...

$\rightarrow$ *[simplify]*

[46.3] (32767 < (-2 * div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}.\text{p1}$, 177).quot)) $\vee$ ...

→ *[literal comparison of product]*

[46.4] ([-2 < 0]: (32767 / 2) < −div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}$.p1, 177).quot, [0 < -2]: (32767 / -2) < div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}$.p1, 177).quot, [-2 == 0]: 32767 < 0) ∨ ...

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

[46.5] ([-2 < 0]: (32767 / 2) < −div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}$.p1, 177).quot, [(0 < -2) ∧ !(-2 < 0)]: (32767 / -2) < div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}$.p1, 177).quot, [(-2 == 0) ∧ !(-2 < 0) ∧ !(0 < -2)]: 32767 < 0) ∨ ...

→ *[simplify]*

[46.9] (16383 < −div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}$.p1, 177).quot) ∨ ...

[Create new term from terms 46.9, 41.0 using rule: transitivity 16]

[68.0] ((0 + 16383) < (−$\$\text{heap}_{funcstart\_719,1}$.p1 / 177)) ∨ (0 == (−($\$\text{heap}_{funcstart\_719,1}$.p1 / 177) + div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}$.p1, 177).quot)) ∨ (-1 < $\$\text{heap}_{funcstart\_719,1}$.p1) ∨ (177 == (−div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}$.p1, 177).rem + ($\$\text{heap}_{funcstart\_719,1}$.p1 % 177))) ∨ !(0 == ($\$\text{heap}_{funcstart\_719,1}$.p1 % 177))

→ *[simplify]*

[68.8] (2899967 < −$\$\text{heap}_{funcstart\_719,1}$.p1) ∨ ...

→ *[from term 8.3, literala < −$\$heap_{funcstart\_719,1}$.p1 is false whenever -2 < (-32769 + literala)]*

Proof of rule precondition:

[68.8.0] -2 < (-32769 + 2899967)

→ *[simplify]*

[68.8.2] **true**

[68.9] **false** ∨ ...

[Remove 'false' term 68.9 and fetch new term from containing clause]

[69.0] (177 == (−div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}$.p1, 177).rem + ($\$\text{heap}_{funcstart\_719,1}$.p1 % 177))) ∨ (0 == (−($\$\text{heap}_{funcstart\_719,1}$.p1 / 177) + div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}$.p1, 177).quot)) ∨ (-1 < $\$\text{heap}_{funcstart\_719,1}$.p1)

[Remove 'false' term 68.9 and fetch new term from containing clause]

[70.0] !(0 == ($\$\text{heap}_{funcstart\_719,1}$.p1 % 177)) ∨ (0 == (−($\$\text{heap}_{funcstart\_719,1}$.p1 / 177) + div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}$.p1, 177).quot)) ∨ (-1 < $\$\text{heap}_{funcstart\_719,1}$.p1)

[Copy term 1.24]

[72.0] (32767 < ((-2 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).rem))) ∨ (0 == (−($\$heap_{funcstart\_719,1}$.p1 / 177) + div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot)) ∨ (-1 < $\$heap_{funcstart\_719,1}$.p1)

→ *[from term 69.0, div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).rem is equal to -177 + ($\$heap_{funcstart\_719,1}$.p1 % 177)]*

[72.1] (32767 < ((-2 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot) + (171 * (-177 + ($\$heap_{funcstart\_719,1}$.p1 % 177)))))) ∨ ...

→ *[simplify]*

[72.6] (63034 < ((-2 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot) + (171 * ($\$heap_{funcstart\_719,1}$.p1 % 177)))) ∨ ...

[Create new term from term 70.0 using rule: try to prove equality by contradiction]

[76.0] ((0 < ($\$heap_{funcstart\_719,1}$.p1 % 177)) ∨ (($\$heap_{funcstart\_719,1}$.p1 % 177) < 0)) ∨ (0 == (−($\$heap_{funcstart\_719,1}$.p1 / 177) + div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot)) ∨ (-1 < $\$heap_{funcstart\_719,1}$.p1)

→ *[simplify]*

[76.1] ((([-1 < 0]: ∃ **integer** n • (0 < ($\$heap_{funcstart\_719,1}$.p1 + (177 * n))) ∧ (($\$heap_{funcstart\_719,1}$.p1 + (177 * n)) < 177), []: **true**) ∨ (($\$heap_{funcstart\_719,1}$.p1 % 177) < 0)) ∨ ...

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

[76.2] ((([-1 < 0]: ∃ **integer** n • (0 < ($\$heap_{funcstart\_719,1}$.p1 + (177 * n))) ∧ (($\$heap_{funcstart\_719,1}$.p1 + (177 * n)) < 177), [!(-1 < 0)]: **true**) ∨ (($\$heap_{funcstart\_719,1}$.p1 % 177) < 0)) ∨ ...

→ *[simplify]*

[76.15] (∃ **integer** n • (-177 < (−$\$heap_{funcstart\_719,1}$.p1 + (-177 * n))) ∧ (0 < ((177 * n) + $\$heap_{funcstart\_719,1}$.p1))) ∨ ...

→ *[introduce skolem term and eliminate 'exists']*

[76.16] ((-177 < (−$\$heap_{funcstart\_719,1}$.p1 + (-177 * $a_n))) ∧ (0 < ((177 * $a_n) + $\$heap_{funcstart\_719,1}$.p1))) ∨ ...

→ *[separate conjunction and work on first sub-term]*

[76.17] (-177 < (−$\$heap_{funcstart\_719,1}$.p1 + (-177 * $a_n))) ∨ ...

[Work on sub-term 2 of conjunction in term 76.16]

[77.0] (0 < ((177 * $a_n) + $\$heap_{funcstart\_719,1}$.p1)) ∨ (0 == (−($\$heap_{funcstart\_719,1}$.p1 / 177) + div(**heapIs** $\$heap_{funcstart\_719,1}$,

$\$\mathrm{heap}_{funcstart\_719,1}.\mathrm{p1},\ 177).\mathrm{quot})) \vee (\text{-}1 < \$\mathrm{heap}_{funcstart\_719,1}.\mathrm{p1})$

[Create new term from term 41.0 using rule: condition for equality of division]

[80.0] $((-\$\mathrm{heap}_{funcstart\_719,1}.\mathrm{p1} < (177 * (0 + 1 + -\mathrm{div}(\textbf{heapIs}$
$\$\mathrm{heap}_{funcstart\_719,1},\ \$\mathrm{heap}_{funcstart\_719,1}.\mathrm{p1},\ 177).\mathrm{quot}))) \wedge ((177 * (0 +$
$-\mathrm{div}(\textbf{heapIs}\ \$\mathrm{heap}_{funcstart\_719,1},\ \$\mathrm{heap}_{funcstart\_719,1}.\mathrm{p1},\ 177).\mathrm{quot})) < (1 +$
$-\$\mathrm{heap}_{funcstart\_719,1}.\mathrm{p1}))) \vee (0 == (-(\$\mathrm{heap}_{funcstart\_719,1}.\mathrm{p1}\ /\ 177) +$
$\mathrm{div}(\textbf{heapIs}\ \$\mathrm{heap}_{funcstart\_719,1},\ \$\mathrm{heap}_{funcstart\_719,1}.\mathrm{p1},\ 177).\mathrm{quot})) \vee (\text{-}1 <$
$\$\mathrm{heap}_{funcstart\_719,1}.\mathrm{p1})$

$\rightarrow$ *[simplify]*

[80.18] $((\text{-}177 < ((\text{-}177 * \mathrm{div}(\textbf{heapIs}\ \$\mathrm{heap}_{funcstart\_719,1},$
$\$\mathrm{heap}_{funcstart\_719,1}.\mathrm{p1},\ 177).\mathrm{quot}) + \$\mathrm{heap}_{funcstart\_719,1}.\mathrm{p1})) \wedge (\text{-}1 <$
$(-\$\mathrm{heap}_{funcstart\_719,1}.\mathrm{p1} + (177 * \mathrm{div}(\textbf{heapIs}\ \$\mathrm{heap}_{funcstart\_719,1},$
$\$\mathrm{heap}_{funcstart\_719,1}.\mathrm{p1},\ 177).\mathrm{quot})))) \vee \ldots$

$\rightarrow$ *[separate conjunction and work on first sub-term]*

[80.19] $(\text{-}177 < ((\text{-}177 * \mathrm{div}(\textbf{heapIs}\ \$\mathrm{heap}_{funcstart\_719,1},$
$\$\mathrm{heap}_{funcstart\_719,1}.\mathrm{p1},\ 177).\mathrm{quot}) + \$\mathrm{heap}_{funcstart\_719,1}.\mathrm{p1})) \vee \ldots$

[Work on sub-term 2 of conjunction in term 80.18]

[81.0] $(\text{-}1 < (-\$\mathrm{heap}_{funcstart\_719,1}.\mathrm{p1} + (177 * \mathrm{div}(\textbf{heapIs}$
$\$\mathrm{heap}_{funcstart\_719,1},\ \$\mathrm{heap}_{funcstart\_719,1}.\mathrm{p1},\ 177).\mathrm{quot}))) \vee (0 ==$
$(-(\$\mathrm{heap}_{funcstart\_719,1}.\mathrm{p1}\ /\ 177) + \mathrm{div}(\textbf{heapIs}\ \$\mathrm{heap}_{funcstart\_719,1},$
$\$\mathrm{heap}_{funcstart\_719,1}.\mathrm{p1},\ 177).\mathrm{quot})) \vee (\text{-}1 < \$\mathrm{heap}_{funcstart\_719,1}.\mathrm{p1})$

[Create new term from terms 80.19, 76.17 using rule: transitivity 1]

[82.0] $((\text{-}177 + \text{-}177 + 1) < ((\text{-}177 * \mathrm{div}(\textbf{heapIs}\ \$\mathrm{heap}_{funcstart\_719,1},$
$\$\mathrm{heap}_{funcstart\_719,1}.\mathrm{p1},\ 177).\mathrm{quot}) + (\text{-}177 * \$\mathrm{a\_n}))) \vee (0 ==$
$(-(\$\mathrm{heap}_{funcstart\_719,1}.\mathrm{p1}\ /\ 177) + \mathrm{div}(\textbf{heapIs}\ \$\mathrm{heap}_{funcstart\_719,1},$
$\$\mathrm{heap}_{funcstart\_719,1}.\mathrm{p1},\ 177).\mathrm{quot})) \vee (\text{-}1 < \$\mathrm{heap}_{funcstart\_719,1}.\mathrm{p1})$

$\rightarrow$ *[simplify]*

[82.1] $(\text{-}353 < ((\text{-}177 * \mathrm{div}(\textbf{heapIs}\ \$\mathrm{heap}_{funcstart\_719,1},\ \$\mathrm{heap}_{funcstart\_719,1}.\mathrm{p1},$
$177).\mathrm{quot}) + (\text{-}177 * \$\mathrm{a\_n}))) \vee \ldots$

$\rightarrow$ *[cancel common factor]*

Proof of rule precondition 1:

[82.1.0.0] $!(\text{-}177 == 0)$

$\rightarrow$ *[simplify]*

[82.1.0.2] **true**

Proof of rule precondition 2:

[82.1.1.0] $1 < \$\mathrm{gcf}(\text{-}177,\ \text{-}177)$

$\rightarrow$ *[simplify]*

[82.1.1.2] **true**

[82.2] ((-353 / $gcf(-177, -177)) < (((-177 / $gcf(-177, -177)) * div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1, 177).quot) + ((-177 / $gcf(-177, -177)) * $a_n))) ∨ ...

→ *[simplify]*

[82.10] (-2 < (−div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1, 177).quot + −$a_n)) ∨ ...

[Create new term from terms 81.0, 77.0 using rule: transitivity 1]

[86.0] ((-1 + 0 + 1) < ((177 * div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1, 177).quot) + (177 * $a_n))) ∨ (0 == (−($heap$_{funcstart\_719,1}$.p1 / 177) + div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1, 177).quot)) ∨ (-1 < $heap$_{funcstart_719,1}$.p1)

→ *[simplify]*

[86.1] (0 < ((177 * div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1, 177).quot) + (177 * $a_n))) ∨ ...

→ *[cancel common factor]*

Proof of rule precondition 1:

[86.1.0.0] !(0 == 177)

→ *[simplify]*

[86.1.0.2] **true**

Proof of rule precondition 2:

[86.1.1.0] 1 < $gcf(177, 177)

→ *[simplify]*

[86.1.1.2] **true**

[86.2] ((0 / $gcf(177, 177)) < (((177 / $gcf(177, 177)) * div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1, 177).quot) + ((177 / $gcf(177, 177)) * $a_n))) ∨ ...

→ *[simplify]*

[86.10] (0 < (div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1, 177).quot + $a_n)) ∨ ...

→ *[from term 82.10, 0 < (div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1, 177).quot + $a_n) is true if and only if -1 == (−div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1, 177).quot + −$a_n)]*

[86.11] (-1 == (−div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1, 177).quot + −$a_n)) ∨ ...

→ *[simplify]*

[86.15] (1 == (div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}$.p1, 177).quot + $\$a\_n$)) ∨ ...

[Create new term from terms 76.17, 8.3 using rule: transitivity 2]

[78.0] ((-32769 + -177 + 1) < (-177 * $\$a\_n$)) ∨ (0 == ($-(\$\text{heap}_{funcstart\_719,1}$.p1 / 177) + div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}$.p1, 177).quot)) ∨ (-1 < $\$\text{heap}_{funcstart\_719,1}$.p1)

→ *[simplify]*

[78.1] (-32945 < (-177 * $\$a\_n$)) ∨ ...

→ *[literal comparison of product]*

[78.2] ([-177 < 0]: (-32945 / 177) < $-\$a\_n$, [0 < -177]: (-32945 / -177) < $\$a\_n$, [-177 == 0]: -32945 < 0) ∨ ...

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

[78.3] ([-177 < 0]: (-32945 / 177) < $-\$a\_n$, [(0 < -177) ∧ !(-177 < 0)]: (-32945 / -177) < $\$a\_n$, [(-177 == 0) ∧ !(-177 < 0) ∧ !(0 < -177)]: -32945 < 0) ∨ ...

→ *[simplify]*

[78.7] (-187 < $-\$a\_n$) ∨ ...

→ *[from term 86.15, $\$a\_n$ is equal to 1 + $-div$(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot]*

[78.8] (-187 < $-$(1 + $-div$(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}$.p1, 177).quot)) ∨ ...

→ *[simplify]*

[78.13] (-186 < div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}$.p1, 177).quot) ∨ ...

[Create new term from terms 78.13, 72.6 using rule: transitivity 11]

[90.0] ((1 + 63034 + (-186 * 2)) < (171 * ($\$\text{heap}_{funcstart\_719,1}$.p1 % 177))) ∨ (0 == ($-(\$\text{heap}_{funcstart\_719,1}$.p1 / 177) + div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}$.p1, 177).quot)) ∨ (-1 < $\$\text{heap}_{funcstart\_719,1}$.p1)

→ *[simplify]*

[90.2] (62663 < (171 * ($\$\text{heap}_{funcstart\_719,1}$.p1 % 177))) ∨ ...

→ *[literal comparison of product]*

[90.3] ([171 < 0]: (62663 / -171) < $-(\$\text{heap}_{funcstart\_719,1}$.p1 % 177), [0 < 171]: (62663 / 171) < ($\$\text{heap}_{funcstart\_719,1}$.p1 % 177), [0 == 171]: 62663 < 0) ∨ ...

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

[90.4] ([171 < 0]: (62663 / -171) < $-(\$\text{heap}_{funcstart\_719,1}$.p1 % 177), [(0 < 171) ∧ !(171 < 0)]: (62663 / 171) < ($\$\text{heap}_{funcstart\_719,1}$.p1 % 177), [(0 ==

171) $\land$!(0 < 171) $\land$!(171 < 0)]: 62663 < 0) $\lor$ ...

$\rightarrow$ *[simplify]*

[90.13] **false** $\lor$ ...

[Remove 'false' term 90.13 and fetch new term from containing clause]

[91.0] 0 == ($-$($\$$heap$_{funcstart\_719,1}$.p1 / 177) + div(**heapIs**
$\$$heap$_{funcstart\_719,1}$, $\$$heap$_{funcstart\_719,1}$.p1, 177).quot)

[Remove 'false' term 90.13 and fetch new term from containing clause]

[92.0] -1 < $\$$heap$_{funcstart\_719,1}$.p1

[Assume known post-assertion, class invariant or type constraint for term 5.6]

[11.40] ([0 < $-$$\$$heap$_{funcstart\_719,1}$.p1]: ([0 == ($\$$heap$_{funcstart\_719,1}$.p1 %
177)]: 0 == div(**heapIs** $\$$heap$_{funcstart\_719,1}$, $\$$heap$_{funcstart\_719,1}$.p1, 177).rem,
[!(0 == ($\$$heap$_{funcstart\_719,1}$.p1 % 177))]: 177 == (($\$$heap$_{funcstart\_719,1}$.p1 %
177) + $-$div(**heapIs** $\$$heap$_{funcstart\_719,1}$, $\$$heap$_{funcstart\_719,1}$.p1, 177).rem)),
[-1 < $\$$heap$_{funcstart\_719,1}$.p1]: 0 == ($-$($\$$heap$_{funcstart\_719,1}$.p1 % 177) +
div(**heapIs** $\$$heap$_{funcstart\_719,1}$, $\$$heap$_{funcstart\_719,1}$.p1, 177).rem))

$\rightarrow$ *[from term 92.0, literala < $-$$heap$_{funcstart\_719,1}$.p1 is false whenever -2 <
(-1 + literala)]*

Proof of rule precondition:

[11.40.0] -2 < (-1 + 0)

$\rightarrow$ *[simplify]*

[11.40.2] **true**

[11.41] ([**false**]: ([0 == ($\$$heap$_{funcstart\_719,1}$.p1 % 177)]: 0 == div(**heapIs**
$\$$heap$_{funcstart\_719,1}$, $\$$heap$_{funcstart\_719,1}$.p1, 177).rem, [!(0 ==
($\$$heap$_{funcstart\_719,1}$.p1 % 177))]: 177 == ($-$div(**heapIs** $\$$heap$_{funcstart\_719,1}$,
$\$$heap$_{funcstart\_719,1}$.p1, 177).rem + ($\$$heap$_{funcstart\_719,1}$.p1 % 177))), [-1 <
$\$$heap$_{funcstart\_719,1}$.p1]: 0 == ($-$($\$$heap$_{funcstart\_719,1}$.p1 % 177) + div(**heapIs**
$\$$heap$_{funcstart\_719,1}$, $\$$heap$_{funcstart\_719,1}$.p1, 177).rem))

$\rightarrow$ *[from term 92.0, literala < $heap$_{funcstart_719,1}$.p1 is true whenever (-1 +
literala) < -1]*

Proof of rule precondition:

[11.41.0] (-1 + -1) < -1

$\rightarrow$ *[simplify]*

[11.41.2] **true**

[11.42] ([**false**]: ([0 == ($\$$heap$_{funcstart\_719,1}$.p1 % 177)]: 0 == div(**heapIs**
$\$$heap$_{funcstart\_719,1}$, $\$$heap$_{funcstart\_719,1}$.p1, 177).rem, [!(0 ==
($\$$heap$_{funcstart\_719,1}$.p1 % 177))]: 177 == ($-$div(**heapIs** $\$$heap$_{funcstart\_719,1}$,
$\$$heap$_{funcstart\_719,1}$.p1, 177).rem + ($\$$heap$_{funcstart\_719,1}$.p1 % 177))), [**true**]: 0

$== (-(\$\text{heap}_{funcstart\_719,1}.p1 \% 177) + \text{div}(\textbf{heapIs}\ \$\text{heap}_{funcstart\_719,1},$
$\$\text{heap}_{funcstart\_719,1}.p1, 177).\text{rem}))$

$\rightarrow$ *[simplify]*

[11.44] $0 == (-(\$\text{heap}_{funcstart\_719,1}.p1 \% 177) + \text{div}(\textbf{heapIs}$
$\$\text{heap}_{funcstart\_719,1}, \$\text{heap}_{funcstart\_719,1}.p1, 177).\text{rem})$

[Copy term 1.24]

[94.0] $32767 < ((\text{-2} * \text{div}(\textbf{heapIs}\ \$\text{heap}_{funcstart\_719,1}, \$\text{heap}_{funcstart\_719,1}.p1,$
$177).\text{quot}) + (171 * \text{div}(\textbf{heapIs}\ \$\text{heap}_{funcstart\_719,1}, \$\text{heap}_{funcstart\_719,1}.p1,$
$177).\text{rem}))$

$\rightarrow$ *[from term 11.44, div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}.p1$,*
177).rem is equal to $\$heap_{funcstart\_719,1}.p1 \% 177$]

[94.1] $32767 < ((\text{-2} * \text{div}(\textbf{heapIs}\ \$\text{heap}_{funcstart\_719,1}, \$\text{heap}_{funcstart\_719,1}.p1,$
$177).\text{quot}) + (171 * (\$\text{heap}_{funcstart\_719,1}.p1 \% 177)))$

[Create new term from term 91.0 using rule: condition for equality of division]

[102.0] $(0 < (1 + (177 * (0 + -\text{div}(\textbf{heapIs}\ \$\text{heap}_{funcstart\_719,1},$
$\$\text{heap}_{funcstart\_719,1}.p1, 177).\text{quot})) + \$\text{heap}_{funcstart\_719,1}.p1)) \wedge$
$(\$\text{heap}_{funcstart\_719,1}.p1 < (177 * (0 + 1 + \text{div}(\textbf{heapIs}\ \$\text{heap}_{funcstart\_719,1},$
$\$\text{heap}_{funcstart\_719,1}.p1, 177).\text{quot})))$

$\rightarrow$ *[simplify]*

[102.12] $(\text{-1} < ((\text{-177} * \text{div}(\textbf{heapIs}\ \$\text{heap}_{funcstart\_719,1}, \$\text{heap}_{funcstart\_719,1}.p1,$
$177).\text{quot}) + \$\text{heap}_{funcstart\_719,1}.p1)) \wedge (\text{-177} < (-\$\text{heap}_{funcstart\_719,1}.p1 +$
$(177 * \text{div}(\textbf{heapIs}\ \$\text{heap}_{funcstart\_719,1}, \$\text{heap}_{funcstart\_719,1}.p1, 177).\text{quot})))$

$\rightarrow$ *[separate conjunction and work on first sub-term]*

[102.13] $\text{-177} < (-\$\text{heap}_{funcstart\_719,1}.p1 + (177 * \text{div}(\textbf{heapIs}$
$\$\text{heap}_{funcstart\_719,1}, \$\text{heap}_{funcstart\_719,1}.p1, 177).\text{quot}))$

[Create new term from terms 102.13, 92.0 using rule: transitivity 2]

[104.0] $(\text{-177} + \text{-1} + 1) < (177 * \text{div}(\textbf{heapIs}\ \$\text{heap}_{funcstart\_719,1},$
$\$\text{heap}_{funcstart\_719,1}.p1, 177).\text{quot})$

$\rightarrow$ *[simplify]*

[104.1] $\text{-177} < (177 * \text{div}(\textbf{heapIs}\ \$\text{heap}_{funcstart\_719,1}, \$\text{heap}_{funcstart\_719,1}.p1,$
$177).\text{quot})$

$\rightarrow$ *[literal comparison of product]*

[104.2] $([177 < 0]: (\text{-177} / \text{-177}) < -\text{div}(\textbf{heapIs}\ \$\text{heap}_{funcstart\_719,1},$
$\$\text{heap}_{funcstart\_719,1}.p1, 177).\text{quot}, [0 < 177]: (\text{-177} / 177) < \text{div}(\textbf{heapIs}$
$\$\text{heap}_{funcstart\_719,1}, \$\text{heap}_{funcstart\_719,1}.p1, 177).\text{quot}, [0 == 177]: \text{-177} < 0)$

$\rightarrow$ *[explicitly assert falsehood of skipped guards in subsequent guards]*

[104.3] $([177 < 0]: (\text{-177} / \text{-177}) < -\text{div}(\textbf{heapIs}\ \$\text{heap}_{funcstart\_719,1},$

$\text{heap}_{funcstart\_719,1}$.p1, 177).quot, [(0 < 177) ∧ !(177 < 0)]: (-177 / 177) < div(**heapIs** $\text{heap}_{funcstart\_719,1}$, $\text{heap}_{funcstart\_719,1}$.p1, 177).quot, [(0 == 177) ∧ !(0 < 177) ∧ !(177 < 0)]: -177 < 0)

→ *[simplify]*

[104.11] -1 < div(**heapIs** $\text{heap}_{funcstart\_719,1}$, $\text{heap}_{funcstart\_719,1}$.p1, 177).quot

[Create new term from terms 104.11, 94.1 using rule: transitivity 11]

[107.0] (1 + 32767 + (-1 * 2)) < (171 * ($\text{heap}_{funcstart\_719,1}$.p1 % 177))

→ *[simplify]*

[107.2] 32766 < (171 * ($\text{heap}_{funcstart\_719,1}$.p1 % 177))

→ *[literal comparison of product]*

[107.3] ([171 < 0]: (32766 / -171) < −($\text{heap}_{funcstart\_719,1}$.p1 % 177), [0 < 171]: (32766 / 171) < ($\text{heap}_{funcstart\_719,1}$.p1 % 177), [0 == 171]: 32766 < 0)

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

[107.4] ([171 < 0]: (32766 / -171) < −($\text{heap}_{funcstart\_719,1}$.p1 % 177), [(0 < 171) ∧ !(171 < 0)]: (32766 / 171) < ($\text{heap}_{funcstart\_719,1}$.p1 % 177), [(0 == 171) ∧ !(0 < 171) ∧ !(171 < 0)]: 32766 < 0)

→ *[simplify]*

[107.13] **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 (51,8)

Condition defined at:

To prove: minof(short int) ≤ ((**asType**<**int**>($\text{heap}_{719,1;731,8}$.M1) * **asType**<**int**>(**static_cast**<**integer**>(**asType**<**int**>($\text{heap}_{719,1;731,8}$.p1) < (**int**)0))) + **asType**<**int**>($\text{heap}_{719,1;731,8}$.p1))

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)

heap_{init}.M2 == **asType**<**short int**>((**int**)30307)

heap_{init}.r2 == **asType**<**short int**>((**int**)172)

$\$\text{heap}_{init}.a2 == \textbf{asType}\textbf{<short int>}((\textbf{int})176)$

$\$\text{heap}_{init}.b2 == \textbf{asType}\textbf{<short int>}((\textbf{int})35)$

$\$\text{heap}_{init}.M3 == \textbf{asType}\textbf{<short int>}((\textbf{int})30323)$

$\$\text{heap}_{init}.r3 == \textbf{asType}\textbf{<short int>}((\textbf{int})170)$

$\$\text{heap}_{init}.a3 == \textbf{asType}\textbf{<short int>}((\textbf{int})178)$

$\$\text{heap}_{init}.b3 == \textbf{asType}\textbf{<short int>}((\textbf{int})63)$

$\$\text{heap}_{init}.p1 == \textbf{asType}\textbf{<short int>}((\textbf{int})1)$

$\$\text{heap}_{init}.p2 == \textbf{asType}\textbf{<short int>}((\textbf{int})2)$

$\$\text{heap}_{init}.p3 == \textbf{asType}\textbf{<short int>}((\textbf{int})3)$

div1 == div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$,
asType<int>($\$\text{heap}_{funcstart\_719,1}.p1$),
asType<int>($\$\text{heap}_{funcstart\_719,1}.a1$))

(**asType<integer>**(**asType<int>**($\$\text{heap}_{funcstart\_719,1}.p1$)) /
asType<integer>(**asType<int>**($\$\text{heap}_{funcstart\_719,1}.a1$))) ==
asType<integer>(div1.quot)

(**asType<integer>**(**asType<int>**($\$\text{heap}_{funcstart\_719,1}.p1$)) %
asType<integer>(**asType<int>**($\$\text{heap}_{funcstart\_719,1}.a1$))) ==
asType<integer>(div1.rem)

div2 == div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$,
asType<int>($\$\text{heap}_{funcstart\_719,1}.p2$),
asType<int>($\$\text{heap}_{funcstart\_719,1}.a2$))

(**asType<integer>**(**asType<int>**($\$\text{heap}_{funcstart\_719,1}.p2$)) /
asType<integer>(**asType<int>**($\$\text{heap}_{funcstart\_719,1}.a2$))) ==
asType<integer>(div2.quot)

(**asType<integer>**(**asType<int>**($\$\text{heap}_{funcstart\_719,1}.p2$)) %
asType<integer>(**asType<int>**($\$\text{heap}_{funcstart\_719,1}.a2$))) ==
asType<integer>(div2.rem)

div3 == div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$,
asType<int>($\$\text{heap}_{funcstart\_719,1}.p3$),
asType<int>($\$\text{heap}_{funcstart\_719,1}.a3$))

(**asType<integer>**(**asType<int>**($\$\text{heap}_{funcstart\_719,1}.p3$)) /
asType<integer>(**asType<int>**($\$\text{heap}_{funcstart\_719,1}.a3$))) ==
asType<integer>(div3.quot)

(**asType<integer>**(**asType<int>**($\$\text{heap}_{funcstart\_719,1}.p3$)) %
asType<integer>(**asType<int>**($\$\text{heap}_{funcstart\_719,1}.a3$))) ==
asType<integer>(div3.rem)

$\$\text{heap}_{719,1;729,8} == \$\text{heap}_{funcstart\_719,1}.$**replace**(p1 $\rightarrow$ **asType<short int>**((**asType<int>**(**asType<short int>**(div1.rem)) *

asType\<int\>($heap$_{funcstart_719,1}$.r1)) − (**asType\<int\>**(**asType\<short int\>**(div1.quot)) * **asType\<int\>**($heap$_{funcstart\_719,1}$.b1)))))

$heap$_{719,1;730,8}$ == $heap$_{719,1;729,8}$._**replace**(p2 → **asType\<short int\>**((**asType\<int\>**(**asType\<short int\>**(div2.rem)) * **asType\<int\>**($heap$_{719,1;729,8}$.r2)) − (**asType\<int\>**(**asType\<short int\>**(div2.quot)) * **asType\<int\>**($heap$_{719,1;729,8}$.b2)))))

$heap$_{719,1;731,8}$ == $heap$_{719,1;730,8}$._**replace**(p3 → **asType\<short int\>**((**asType\<int\>**(**asType\<short int\>**(div3.rem)) * **asType\<int\>**($heap$_{719,1;730,8}$.r3)) − (**asType\<int\>**(**asType\<short int\>**(div3.quot)) * **asType\<int\>**($heap$_{719,1;730,8}$.b3)))))

Proof:

[Take given term]

[5.0] div1 == div(**heapIs** $heap$_{funcstart_719,1}$,
asType\<int\>($heap$_{funcstart_719,1}$.p1),
asType\<int\>($heap$_{funcstart_719,1}$.a1))

→ *[simplify]*

[5.1] div1 == div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1,
asType\<int\>($heap$_{funcstart_719,1}$.a1))

→ *[const static or extern object]*

[5.2] div1 == div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1,
asType\<int\>($heap$_{init}$.a1))

→ *[expand definition of constant 'a1' at prang.c (16,20)]*

[5.3] div1 == div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1,
asType\<int\>(**asType\<short int\>**((**int**)177)))

→ *[simplify]*

[5.6] div1 == div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1, 177)

[Assume known post-assertion, class invariant or type constraint for term 5.6]

[9.0] $heap$_{funcstart_719,1}$.p1 ≤ **maxof**(**short int**)

→ *[simplify]*

[9.9] -32768 < −$heap$_{funcstart_719,1}$.p1

[Assume known post-assertion, class invariant or type constraint for term 5.6]

[10.0] (**asType\<integer\>**($heap$_{funcstart_719,1}$.p1) /
asType\<integer\>(177)) == **asType\<integer\>**(div(**heapIs**
$heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1, 177).quot)

→ *[simplify]*

[10.2] ($heap$_{funcstart_719,1}$.p1 / 177) == **asType\<integer\>**(div(**heapIs**
$heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1, 177).quot)

$\rightarrow$ *[expand definition of operator './' in class 'int' at built in declaration]*

[10.3] ([**asType**<**integer**>($\text{heap}_{funcstart\_719,1}$.p1) < 0]:
$-(-$**asType**<**integer**>($\text{heap}_{funcstart\_719,1}$.p1) / 177), []:
asType<**integer**>($\text{heap}_{funcstart\_719,1}$.p1) / 177) ==
asType<**integer**>(div(**heapIs** $\text{heap}_{funcstart\_719,1}$, $\text{heap}_{funcstart\_719,1}$.p1, 177).quot)

$\rightarrow$ *[explicitly assert falsehood of skipped guards in subsequent guards]*

[10.4] ([**asType**<**integer**>($\text{heap}_{funcstart\_719,1}$.p1) < 0]:
$-(-$**asType**<**integer**>($\text{heap}_{funcstart\_719,1}$.p1) / 177),
[!(**asType**<**integer**>($\text{heap}_{funcstart\_719,1}$.p1) < 0)]:
asType<**integer**>($\text{heap}_{funcstart\_719,1}$.p1) / 177) ==
asType<**integer**>(div(**heapIs** $\text{heap}_{funcstart\_719,1}$, $\text{heap}_{funcstart\_719,1}$.p1, 177).quot)

$\rightarrow$ *[simplify]*

[10.17] 0 == ($-$([0 < $-$$\text{heap}_{funcstart\_719,1}$.p1]: $-(-$$\text{heap}_{funcstart_719,1}$.p1 / 177), [-1 < $\text{heap}_{funcstart\_719,1}$.p1]: $\text{heap}_{funcstart\_719,1}$.p1 / 177) + div(**heapIs** $\text{heap}_{funcstart\_719,1}$, $\text{heap}_{funcstart\_719,1}$.p1, 177).quot)

$\rightarrow$ *[move guard outside expression]*

[10.18] 0 == (([0 < $-$$\text{heap}_{funcstart\_719,1}$.p1]: $-(-(-$$\text{heap}_{funcstart_719,1}$.p1 / 177)), [-1 < $\text{heap}_{funcstart\_719,1}$.p1]: $-($\text{heap}_{funcstart_719,1}$.p1 / 177)) + div(**heapIs** $\text{heap}_{funcstart\_719,1}$, $\text{heap}_{funcstart\_719,1}$.p1, 177).quot)

$\rightarrow$ *[simplify]*

[10.19] 0 == (([0 < $-$$\text{heap}_{funcstart\_719,1}$.p1]: $-$$\text{heap}_{funcstart_719,1}$.p1 / 177, [-1 < $\text{heap}_{funcstart\_719,1}$.p1]: $-($\text{heap}_{funcstart_719,1}$.p1 / 177)) + div(**heapIs** $\text{heap}_{funcstart\_719,1}$, $\text{heap}_{funcstart\_719,1}$.p1, 177).quot)

$\rightarrow$ *[move guard outside expression]*

[10.21] ([0 < $-$$\text{heap}_{funcstart\_719,1}$.p1]: 0 == (($-$$\text{heap}_{funcstart_719,1}$.p1 / 177) + div(**heapIs** $\text{heap}_{funcstart\_719,1}$, $\text{heap}_{funcstart\_719,1}$.p1, 177).quot), [-1 < $\text{heap}_{funcstart\_719,1}$.p1]: 0 == ($-($\text{heap}_{funcstart_719,1}$.p1 / 177) + div(**heapIs** $\text{heap}_{funcstart\_719,1}$, $\text{heap}_{funcstart\_719,1}$.p1, 177).quot))

[Assume known post-assertion, class invariant or type constraint for term 5.6]

[11.0] (**asType**<**integer**>($\text{heap}_{funcstart\_719,1}$.p1) %
asType<**integer**>(177)) == **asType**<**integer**>(div(**heapIs**
$\text{heap}_{funcstart\_719,1}$, $\text{heap}_{funcstart\_719,1}$.p1, 177).rem)

$\rightarrow$ *[simplify]*

[11.2] ($\text{heap}_{funcstart\_719,1}$.p1 % 177) == **asType**<**integer**>(div(**heapIs**
$\text{heap}_{funcstart\_719,1}$, $\text{heap}_{funcstart\_719,1}$.p1, 177).rem)

$\rightarrow$ *[expand definition of operator '.%' in class 'int' at built in declaration]*

[11.3] ([**asType**<**integer**>($heap$_{funcstart_719,1}$.p1) < 0]:
−(−**asType**<**integer**>($heap$_{funcstart_719,1}$.p1) % 177), []:
asType<**integer**>($heap$_{funcstart_719,1}$.p1) % 177) ==
asType<**integer**>(div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1,
177).rem)

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

[11.4] ([**asType**<**integer**>($heap$_{funcstart_719,1}$.p1) < 0]:
−(−**asType**<**integer**>($heap$_{funcstart_719,1}$.p1) % 177),
[!(**asType**<**integer**>($heap$_{funcstart_719,1}$.p1) < 0)]:
asType<**integer**>($heap$_{funcstart_719,1}$.p1) % 177) ==
asType<**integer**>(div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1,
177).rem)

→ *[simplify]*

[11.14] ([0 < −$heap$_{funcstart_719,1}$.p1]: −(−$heap$_{funcstart\_719,1}$.p1 % 177), [-1
< $heap$_{funcstart_719,1}$.p1]: **asType**<**integer**>($heap$_{funcstart\_719,1}$.p1) % 177)
== **asType**<**integer**>(div(**heapIs** $heap$_{funcstart_719,1}$,
$heap$_{funcstart_719,1}$.p1, 177).rem)

→ *[remainder of negation]*

[11.15] ([0 < −$heap$_{funcstart_719,1}$.p1]: −([0 == ($heap$_{funcstart\_719,1}$.p1 %
177)]: 0, []: 177 + −($heap$_{funcstart_719,1}$.p1 % 177)), [-1 <
$heap$_{funcstart_719,1}$.p1]: **asType**<**integer**>($heap$_{funcstart\_719,1}$.p1) % 177)
== **asType**<**integer**>(div(**heapIs** $heap$_{funcstart_719,1}$,
$heap$_{funcstart_719,1}$.p1, 177).rem)

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

[11.16] ([0 < −$heap$_{funcstart_719,1}$.p1]: −([0 == ($heap$_{funcstart\_719,1}$.p1 %
177)]: 0, [!(0 == ($heap$_{funcstart_719,1}$.p1 % 177))]: 177 +
−($heap$_{funcstart_719,1}$.p1 % 177)), [-1 < $heap$_{funcstart_719,1}$.p1]:
asType<**integer**>($heap$_{funcstart_719,1}$.p1) % 177) ==
asType<**integer**>(div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1,
177).rem)

→ *[move guard outside expression]*

[11.17] ([0 < −$heap$_{funcstart_719,1}$.p1]: ([0 == ($heap$_{funcstart\_719,1}$.p1 %
177)]: −0, [!(0 == ($heap$_{funcstart_719,1}$.p1 % 177))]: −(177 +
−($heap$_{funcstart_719,1}$.p1 % 177))), [-1 < $heap$_{funcstart_719,1}$.p1]:
asType<**integer**>($heap$_{funcstart_719,1}$.p1) % 177) ==
asType<**integer**>(div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1,
177).rem)

→ *[simplify]*

[11.24] 0 == (−([0 < −$heap$_{funcstart_719,1}$.p1]: ([0 ==
($heap$_{funcstart_719,1}$.p1 % 177)]: 0, [!(0 == ($heap$_{funcstart\_719,1}$.p1 % 177))]:
-177 + ($heap$_{funcstart_719,1}$.p1 % 177)), [-1 < $heap$_{funcstart_719,1}$.p1]:

$heap$_{funcstart_719,1}$.p1 % 177) + div(**heapIs** $heap$_{funcstart_719,1}$,
$heap$_{funcstart_719,1}$.p1, 177).rem)

$\rightarrow$ *[move guard outside expression]*

[11.26] 0 == ((([0 < $-$$heap$_{funcstart\_719,1}$.p1]: ([0 == ($heap$_{funcstart_719,1}$.p1
% 177)]: $-$0, [!(0 == ($heap$_{funcstart\_719,1}$.p1 % 177))]: $-$($-$177 +
($heap$_{funcstart_719,1}$.p1 % 177))), [-1 < $heap$_{funcstart_719,1}$.p1]:
$-$($heap$_{funcstart_719,1}$.p1 % 177)) + div(**heapIs** $heap$_{funcstart_719,1}$,
$heap$_{funcstart_719,1}$.p1, 177).rem)

$\rightarrow$ *[simplify]*

[11.29] 0 == ((([0 < $-$$heap$_{funcstart\_719,1}$.p1]: ([0 == ($heap$_{funcstart_719,1}$.p1
% 177)]: 0, [!(0 == ($heap$_{funcstart_719,1}$.p1 % 177))]: 177 +
$-$($heap$_{funcstart_719,1}$.p1 % 177)), [-1 < $heap$_{funcstart_719,1}$.p1]:
$-$($heap$_{funcstart_719,1}$.p1 % 177)) + div(**heapIs** $heap$_{funcstart_719,1}$,
$heap$_{funcstart_719,1}$.p1, 177).rem)

$\rightarrow$ *[move guard outside expression]*

[11.31] 0 == ([0 < $-$$heap$_{funcstart\_719,1}$.p1]: ([0 == ($heap$_{funcstart_719,1}$.p1 %
177)]: 0 + div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1, 177).rem,
[!(0 == ($heap$_{funcstart_719,1}$.p1 % 177))]: (177 + $-$($heap$_{funcstart_719,1}$.p1 %
177)) + div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1, 177).rem), [-1
< $heap$_{funcstart_719,1}$.p1]: $-$($heap$_{funcstart_719,1}$.p1 % 177) + div(**heapIs**
$heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1, 177).rem)

$\rightarrow$ *[simplify]*

[11.33] 0 == ([0 < $-$$heap$_{funcstart\_719,1}$.p1]: ([0 == ($heap$_{funcstart_719,1}$.p1
% 177)]: div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1, 177).rem,
[!(0 == ($heap$_{funcstart_719,1}$.p1 % 177))]: 177 + $-$($heap$_{funcstart_719,1}$.p1 %
177) + div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1, 177).rem), [-1
< $heap$_{funcstart_719,1}$.p1]: $-$($heap$_{funcstart_719,1}$.p1 % 177) + div(**heapIs**
$heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1, 177).rem)

$\rightarrow$ *[move guard outside expression]*

[11.35] ([0 < $-$$heap$_{funcstart\_719,1}$.p1]: ([0 == ($heap$_{funcstart_719,1}$.p1 % 177)]:
0 == div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1, 177).rem, [!(0
== ($heap$_{funcstart_719,1}$.p1 % 177))]: 0 == (177 + $-$($heap$_{funcstart_719,1}$.p1
% 177) + div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1, 177).rem)),
[-1 < $heap$_{funcstart_719,1}$.p1]: 0 == ($-$($heap$_{funcstart\_719,1}$.p1 % 177) +
div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1, 177).rem))

$\rightarrow$ *[simplify]*

[11.40] ([0 < $-$$heap$_{funcstart\_719,1}$.p1]: ([0 == ($heap$_{funcstart_719,1}$.p1 %
177)]: 0 == div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1, 177).rem,
[!(0 == ($heap$_{funcstart_719,1}$.p1 % 177))]: 177 == (($heap$_{funcstart\_719,1}$.p1 %
177) + $-$div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1, 177).rem)),
[-1 < $heap$_{funcstart_719,1}$.p1]: 0 == ($-$($heap$_{funcstart\_719,1}$.p1 % 177) +

div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}.p1$, 177).rem))

[Take given term]

[12.0] div2 == div(**heapIs** $\$heap_{funcstart\_719,1}$,
asType<int>($\$heap_{funcstart\_719,1}.p2$),
asType<int>($\$heap_{funcstart\_719,1}.a2$))

$\rightarrow$ *[simplify]*

[12.1] div2 == div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}.p2$,
asType<int>($\$heap_{funcstart\_719,1}.a2$))

$\rightarrow$ *[const static or extern object]*

[12.2] div2 == div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}.p2$,
asType<int>($\$heap_{init}.a2$))

$\rightarrow$ *[expand definition of constant 'a2' at prang.c (21,20)]*

[12.3] div2 == div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}.p2$,
asType<int>(**asType<short int>**((**int**)176)))

$\rightarrow$ *[simplify]*

[12.6] div2 == div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}.p2$, 176)

[Take given term]

[19.0] div3 == div(**heapIs** $\$heap_{funcstart\_719,1}$,
asType<int>($\$heap_{funcstart\_719,1}.p3$),
asType<int>($\$heap_{funcstart\_719,1}.a3$))

$\rightarrow$ *[simplify]*

[19.1] div3 == div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}.p3$,
asType<int>($\$heap_{funcstart\_719,1}.a3$))

$\rightarrow$ *[const static or extern object]*

[19.2] div3 == div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}.p3$,
asType<int>($\$heap_{init}.a3$))

$\rightarrow$ *[expand definition of constant 'a3' at prang.c (26,20)]*

[19.3] div3 == div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}.p3$,
asType<int>(**asType<short int>**((**int**)178)))

$\rightarrow$ *[simplify]*

[19.6] div3 == div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}.p3$, 178)

[Take given term]

[26.0] $\$heap_{719,1;729,8}$ == $\$heap_{funcstart\_719,1}$.**_replace**(p1 $\rightarrow$ **asType<short int>**((**asType<int>**(**asType<short int>**(div1.rem)) *
asType<int>($\$heap_{funcstart\_719,1}.r1$)) $-$ (**asType<int>**(**asType<short int>**(div1.quot)) * **asType<int>**($\$heap_{funcstart\_719,1}.b1$))))

$\rightarrow$ *[from term 5.6, div1 is equal to div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart_719,1}.p1, 177)]*

[26.1] $heap_{719,1;729,8}$ == $heap_{funcstart\_719,1}$.**replace**(p1 $\rightarrow$ **asType<short int>**((**asType<int>**(**asType<short int>**(div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}.p1, 177).rem)) * **asType<int>**($heap_{funcstart_719,1}.r1)) $-$ (**asType<int>**(**asType<short int>**(div1.quot)) * **asType<int>**($heap_{funcstart_719,1}.b1))))

$\rightarrow$ *[simplify]*

[26.3] $heap_{719,1;729,8}$ == $heap_{funcstart\_719,1}$.**replace**(p1 $\rightarrow$ **asType<short int>**((div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}.p1, 177).rem * **asType<int>**($heap_{funcstart_719,1}.r1)) $-$ (**asType<int>**(**asType<short int>**(div1.quot)) * **asType<int>**($heap_{funcstart_719,1}.b1))))

$\rightarrow$ *[const static or extern object]*

[26.4] $heap_{719,1;729,8}$ == $heap_{funcstart\_719,1}$.**replace**(p1 $\rightarrow$ **asType<short int>**((div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}.p1, 177).rem * **asType<int>**($heap_{init}.r1)) $-$ (**asType<int>**(**asType<short int>**(div1.quot)) * **asType<int>**($heap_{funcstart_719,1}.b1))))

$\rightarrow$ *[expand definition of constant 'r1' at prang.c (15,20)]*

[26.5] $heap_{719,1;729,8}$ == $heap_{funcstart\_719,1}$.**replace**(p1 $\rightarrow$ **asType<short int>**((div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart_719,1}.p1, 177).rem * **asType<int>**(**asType<short int>**((**int**)171))) $-$ (**asType<int>**(**asType<short int>**(div1.quot)) * **asType<int>**($heap_{funcstart_719,1}.b1))))

$\rightarrow$ *[simplify]*

[26.8] $heap_{719,1;729,8}$ == $heap_{funcstart\_719,1}$.**replace**(p1 $\rightarrow$ **asType<short int>**((div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart_719,1}.p1, 177).rem * 171) $-$ (**asType<int>**(**asType<short int>**(div1.quot)) * **asType<int>**($heap_{funcstart_719,1}.b1))))

$\rightarrow$ *[from term 5.6, div1 is equal to div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart_719,1}.p1, 177)]*

[26.9] $heap_{719,1;729,8}$ == $heap_{funcstart\_719,1}$.**replace**(p1 $\rightarrow$ **asType<short int>**((171 * div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart_719,1}.p1, 177).rem) $-$ (**asType<int>**(**asType<short int>**(div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}.p1, 177).quot)) * **asType<int>**($heap_{funcstart_719,1}.b1))))

$\rightarrow$ *[simplify]*

[26.11] $heap_{719,1;729,8}$ == $heap_{funcstart\_719,1}$.**replace**(p1 $\rightarrow$ **asType<short int>**((171 * div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart_719,1}.p1, 177).rem) $-$ (div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}.p1, 177).quot * **asType<int>**($heap_{funcstart_719,1}.b1))))

$\rightarrow$ *[const static or extern object]*

[26.12] $\$heap_{719,1;729,8} == \$heap_{funcstart\_719,1}.$**replace**$(p1 \rightarrow$ **asType**$<$**short int**$>$((171 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}.$p1, 177).rem) − (div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}.$p1, 177).quot * **asType**$<$**int**$>$($\$heap_{init}.$b1))))

$\rightarrow$ *[expand definition of constant 'b1' at prang.c (17,20)]*

[26.13] $\$heap_{719,1;729,8} == \$heap_{funcstart\_719,1}.$**replace**$(p1 \rightarrow$ **asType**$<$**short int**$>$((171 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}.$p1, 177).rem) − (div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}.$p1, 177).quot * **asType**$<$**int**$>$(**asType**$<$**short int**$>$((**int**)2)))))

$\rightarrow$ *[simplify]*

[26.19] $\$heap_{719,1;729,8} == \$heap_{funcstart\_719,1}.$**replace**$(p1 \rightarrow$ ((-2 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}.$p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}.$p1, 177).rem)))

[Assume known post-assertion, class invariant or type constraint for term 26.19]

[28.0] div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}.$p1, 177).quot $\leq$ **maxof**(**int**)

$\rightarrow$ *[simplify]*

[28.9] -32768 $< -$div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}.$p1, 177).quot

[Take given term]

[31.0] $\$heap_{719,1;730,8} == \$heap_{719,1;729,8}.$**replace**$(p2 \rightarrow$ **asType**$<$**short int**$>$((**asType**$<$**int**$>$(**asType**$<$**short int**$>$(div2.rem)) * **asType**$<$**int**$>$($\$heap_{719,1;729,8}.$r2)) − (**asType**$<$**int**$>$(**asType**$<$**short int**$>$(div2.quot)) * **asType**$<$**int**$>$($\$heap_{719,1;729,8}.$b2))))

$\rightarrow$ *[from term 26.19, $\$heap_{719,1;729,8}$ is equal to $\$heap_{funcstart\_719,1}.$**replace**$(p1 \rightarrow$ (-2 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}.$p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}.$p1, 177).rem))]*

[31.1] $\$heap_{719,1;730,8} == \$heap_{funcstart\_719,1}.$**replace**$(p1 \rightarrow$ ((-2 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}.$p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}.$p1, 177).rem))).**replace**$(p2 \rightarrow$ **asType**$<$**short int**$>$((**asType**$<$**int**$>$(**asType**$<$**short int**$>$(div2.rem)) * **asType**$<$**int**$>$($\$heap_{719,1;729,8}.$r2)) − (**asType**$<$**int**$>$(**asType**$<$**short int**$>$(div2.quot)) * **asType**$<$**int**$>$($\$heap_{719,1;729,8}.$b2))))

$\rightarrow$ *[from term 12.6, div2 is equal to div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}.$p2, 176)]*

[31.2] $\text{\$heap}_{719,1;730,8}$ == $\text{\$heap}_{funcstart\_719,1}$._**replace**_(p1 → ((-2 *
div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p1,
177).rem)))._**replace**_(p2 → **asType<short
int>**((**asType<int>**(**asType<short int>**(div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$,
$\text{\$heap}_{funcstart\_719,1}$.p2, 176).rem)) * **asType<int>**($\text{\$heap}_{719,1;729,8}$.r2)) −
(**asType<int>**(**asType<short int>**(div2.quot)) *
asType<int>($\text{\$heap}_{719,1;729,8}$.b2))))

→ *[simplify]*

[31.4] $\text{\$heap}_{719,1;730,8}$ == $\text{\$heap}_{funcstart\_719,1}$._**replace**_(p1 → ((-2 *
div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p1,
177).rem)))._**replace**_(p2 → **asType<short int>**((div(**heapIs**
$\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p2, 176).rem *
asType<int>($\text{\$heap}_{719,1;729,8}$.r2)) − (**asType<int>**(**asType<short
int>**(div2.quot)) * **asType<int>**($\text{\$heap}_{719,1;729,8}$.b2))))

→ *[from term 26.19, $\text{\$heap}_{719,1;729,8}$ is equal to*
*$\text{\$heap}_{funcstart\_719,1}$._**replace**(p1 → (-2 * div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$,*
*$\text{\$heap}_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$,*
$\text{\$heap}_{funcstart\_719,1}$.p1, 177).rem))]

[31.5] $\text{\$heap}_{719,1;730,8}$ == $\text{\$heap}_{funcstart\_719,1}$._**replace**_(p1 → ((-2 *
div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p1,
177).rem)))._**replace**_(p2 → **asType<short int>**((div(**heapIs**
$\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p2, 176).rem *
asType<int>($\text{\$heap}_{funcstart\_719,1}$._**replace**_(p1 → ((-2 * div(**heapIs**
$\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs**
$\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p1, 177).rem))).r2)) −
(**asType<int>**(**asType<short int>**(div2.quot)) *
asType<int>($\text{\$heap}_{719,1;729,8}$.b2))))

→ *[const member of object with modified fields]*

[31.6] $\text{\$heap}_{719,1;730,8}$ == $\text{\$heap}_{funcstart\_719,1}$._**replace**_(p1 → ((-2 *
div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p1,
177).rem)))._**replace**_(p2 → **asType<short int>**((div(**heapIs**
$\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p2, 176).rem *
asType<int>($\text{\$heap}_{funcstart\_719,1}$.r2)) − (**asType<int>**(**asType<short
int>**(div2.quot)) * **asType<int>**($\text{\$heap}_{719,1;729,8}$.b2))))

→ *[const static or extern object]*

[31.7] $\text{\$heap}_{719,1;730,8}$ == $\text{\$heap}_{funcstart\_719,1}$._**replace**_(p1 → ((-2 *
div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p1,

177).rem))).**replace**(p2 → **asType<short int>**((div(**heapIs**
$\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}.$p2, 176).rem *
asType<int>($\$heap_{init}.$r2)) − (**asType<int>**(**asType<short
int>**(div2.quot)) * **asType<int>**($\$heap_{719,1;729,8}.$b2))))

→ *[expand definition of constant 'r2' at prang.c (20,20)]*

[31.8] $\$heap_{719,1;730,8}$ == $\$heap_{funcstart\_719,1}.$**replace**(p1 → ((-2 *
div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}.$p1, 177).quot) + (171 *
div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}.$p1,
177).rem))).**replace**(p2 → **asType<short int>**((div(**heapIs**
$\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}.$p2, 176).rem *
asType<int>(**asType<short int>**((**int**)172))) −
(**asType<int>**(**asType<short int>**(div2.quot)) *
asType<int>($\$heap_{719,1;729,8}.$b2))))

→ *[simplify]*

[31.11] $\$heap_{719,1;730,8}$ == $\$heap_{funcstart\_719,1}.$**replace**(p1 → ((-2 *
div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}.$p1, 177).quot) + (171 *
div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}.$p1,
177).rem))).**replace**(p2 → **asType<short int>**((div(**heapIs**
$\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}.$p2, 176).rem * 172) −
(**asType<int>**(**asType<short int>**(div2.quot)) *
asType<int>($\$heap_{719,1;729,8}.$b2))))

→ *[from term 12.6, div2 is equal to div(**heapIs** $\$heap_{funcstart\_719,1}$,
$\$heap_{funcstart\_719,1}.$p2, 176)]*

[31.12] $\$heap_{719,1;730,8}$ == $\$heap_{funcstart\_719,1}.$**replace**(p1 → ((-2 *
div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}.$p1, 177).quot) + (171 *
div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}.$p1,
177).rem))).**replace**(p2 → **asType<short int>**((172 * div(**heapIs**
$\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}.$p2, 176).rem) −
(**asType<int>**(**asType<short int>**(div(**heapIs** $\$heap_{funcstart\_719,1}$,
$\$heap_{funcstart\_719,1}.$p2, 176).quot)) * **asType<int>**($\$heap_{719,1;729,8}.$b2))))

→ *[simplify]*

[31.14] $\$heap_{719,1;730,8}$ == $\$heap_{funcstart\_719,1}.$**replace**(p1 → ((-2 *
div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}.$p1, 177).quot) + (171 *
div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}.$p1,
177).rem))).**replace**(p2 → **asType<short int>**((172 * div(**heapIs**
$\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}.$p2, 176).rem) − (div(**heapIs**
$\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}.$p2, 176).quot *
asType<int>($\$heap_{719,1;729,8}.$b2))))

→ *[from term 26.19, $\$heap_{719,1;729,8}$ is equal to
$\$heap_{funcstart\_719,1}.$**replace**(p1 → (-2 * div(**heapIs** $\$heap_{funcstart\_719,1}$,
$\$heap_{funcstart\_719,1}.$p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_719,1}$,
$\$heap_{funcstart\_719,1}.$p1, 177).rem))]*

[31.15] $\$heap_{719,1;730,8} == \$heap_{funcstart\_719,1}$.**replace**(p1 $\rightarrow$ ((-2 *
div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1,
177).rem))).**replace**(p2 $\rightarrow$ **asType**<**short int**>((172 * div(**heapIs**
$\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).rem) $-$ (div(**heapIs**
$\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).quot *
asType<**int**>($\$heap_{funcstart\_719,1}$.**replace**(p1 $\rightarrow$ ((-2 * div(**heapIs**
$\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs**
$\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).rem))).b2))))

$\rightarrow$ *[const member of object with modified fields]*

[31.16] $\$heap_{719,1;730,8} == \$heap_{funcstart\_719,1}$.**replace**(p1 $\rightarrow$ ((-2 *
div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1,
177).rem))).**replace**(p2 $\rightarrow$ **asType**<**short int**>((172 * div(**heapIs**
$\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).rem) $-$ (div(**heapIs**
$\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).quot *
asType<**int**>($\$heap_{funcstart\_719,1}$.b2))))

$\rightarrow$ *[const static or extern object]*

[31.17] $\$heap_{719,1;730,8} == \$heap_{funcstart\_719,1}$.**replace**(p1 $\rightarrow$ ((-2 *
div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1,
177).rem))).**replace**(p2 $\rightarrow$ **asType**<**short int**>((172 * div(**heapIs**
$\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).rem) $-$ (div(**heapIs**
$\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).quot *
asType<**int**>($\$heap_{init}$.b2))))

$\rightarrow$ *[expand definition of constant 'b2' at prang.c (22,20)]*

[31.18] $\$heap_{719,1;730,8} == \$heap_{funcstart\_719,1}$.**replace**(p1 $\rightarrow$ ((-2 *
div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1,
177).rem))).**replace**(p2 $\rightarrow$ **asType**<**short int**>((172 * div(**heapIs**
$\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).rem) $-$ (div(**heapIs**
$\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).quot *
asType<**int**>(**asType**<**short int**>((**int**)35)))))

$\rightarrow$ *[simplify]*

[31.24] $\$heap_{719,1;730,8} == \$heap_{funcstart\_719,1}$.**replace**(p1 $\rightarrow$ ((-2 *
div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1,
177).rem))).**replace**(p2 $\rightarrow$ ((-35 * div(**heapIs** $\$heap_{funcstart\_719,1}$,
$\$heap_{funcstart\_719,1}$.p2, 176).quot) + (172 * div(**heapIs** $\$heap_{funcstart\_719,1}$,
$\$heap_{funcstart\_719,1}$.p2, 176).rem)))

[Take given term]

[36.0] $\$heap_{719,1;731,8} == \$heap_{719,1;730,8}.$**replace**(p3 → **asType<short int>**((**asType<int>**(**asType<short int>**(div3.rem)) * **asType<int>**($\$heap_{719,1;730,8}.$r3)) − (**asType<int>**(**asType<short int>**(div3.quot)) * **asType<int>**($\$heap_{719,1;730,8}.$b3))))

→ *[from term 31.24, $\$heap_{719,1;730,8}$ is equal to $\$heap_{funcstart\_719,1}.$**replace**(p1 → ((-2 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}.$p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}.$p1, 177).rem))).**replace**(p2 → (-35 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}.$p2, 176).quot) + (172 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}.$p2, 176).rem))]*

[36.1] $\$heap_{719,1;731,8} == \$heap_{funcstart\_719,1}.$**replace**(p1 → ((-2 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}.$p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}.$p1, 177).rem))).**replace**(p2 → ((-35 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}.$p2, 176).quot) + (172 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}.$p2, 176).rem))).**replace**(p3 → **asType<short int>**((**asType<int>**(**asType<short int>**(div3.rem)) * **asType<int>**($\$heap_{719,1;730,8}.$r3)) − (**asType<int>**(**asType<short int>**(div3.quot)) * **asType<int>**($\$heap_{719,1;730,8}.$b3))))

→ *[from term 19.6, div3 is equal to div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}.$p3, 178)]*

[36.2] $\$heap_{719,1;731,8} == \$heap_{funcstart\_719,1}.$**replace**(p1 → ((-2 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}.$p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}.$p1, 177).rem))).**replace**(p2 → ((-35 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}.$p2, 176).quot) + (172 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}.$p2, 176).rem))).**replace**(p3 → **asType<short int>**((**asType<int>**(**asType<short int>**(div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}.$p3, 178).rem)) * **asType<int>**($\$heap_{719,1;730,8}.$r3)) − (**asType<int>**(**asType<short int>**(div3.quot)) * **asType<int>**($\$heap_{719,1;730,8}.$b3))))

→ *[simplify]*

[36.4] $\$heap_{719,1;731,8} == \$heap_{funcstart\_719,1}.$**replace**(p1 → ((-2 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}.$p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}.$p1, 177).rem))).**replace**(p2 → ((-35 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}.$p2, 176).quot) + (172 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}.$p2, 176).rem))).**replace**(p3 → **asType<short int>**((div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}.$p3, 178).rem * **asType<int>**($\$heap_{719,1;730,8}.$r3)) − (**asType<int>**(**asType<short int>**(div3.quot)) * **asType<int>**($\$heap_{719,1;730,8}.$b3))))

→ *[from term 31.24, $\$heap_{719,1;730,8}$ is equal to $\$heap_{funcstart\_719,1}.$**replace**(p1 → ((-2 * div(**heapIs** $\$heap_{funcstart\_719,1}$,*

$heap_{funcstart\_719,1}.p1, 177).quot) + (171 * div($\mathbf{heapIs}$ $heap_{funcstart\_719,1}$,
$heap_{funcstart\_719,1}.p1, 177).rem)))._\mathbf{replace}(p2 \to (-35 * div(\mathbf{heapIs}$
$heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}.p2, 176).quot) + (172 * div(\mathbf{heapIs}$
$heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}.p2, 176).rem))]$

$[36.5]$ \$heap$_{719,1;731,8}$ == \$heap$_{funcstart\_719,1}$._**replace**(p1 $\to$ ((-2 *
div(**heapIs** \$heap$_{funcstart\_719,1}$, \$heap$_{funcstart\_719,1}$.p1, 177).quot) + (171 *
div(**heapIs** \$heap$_{funcstart\_719,1}$, \$heap$_{funcstart\_719,1}$.p1,
177).rem)))._**replace**(p2 $\to$ ((-35 * div(**heapIs** \$heap$_{funcstart\_719,1}$,
\$heap$_{funcstart\_719,1}$.p2, 176).quot) + (172 * div(**heapIs** \$heap$_{funcstart\_719,1}$,
\$heap$_{funcstart\_719,1}$.p2, 176).rem)))._**replace**(p3 $\to$ **asType**<**short**
int>((div(**heapIs** \$heap$_{funcstart\_719,1}$, \$heap$_{funcstart\_719,1}$.p3, 178).rem *
asType<**int**>(\$heap$_{funcstart\_719,1}$._**replace**(p1 $\to$ ((-2 * div(**heapIs**
\$heap$_{funcstart\_719,1}$, \$heap$_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs**
\$heap$_{funcstart\_719,1}$, \$heap$_{funcstart\_719,1}$.p1, 177).rem)))._**replace**(p2 $\to$ ((-35
* div(**heapIs** \$heap$_{funcstart\_719,1}$, \$heap$_{funcstart\_719,1}$.p2, 176).quot) + (172 *
div(**heapIs** \$heap$_{funcstart\_719,1}$, \$heap$_{funcstart\_719,1}$.p2, 176).rem))).r3)) $-$
(**asType**<**int**>(**asType**<**short int**>(div3.quot)) *
asType<**int**>(\$heap$_{719,1;730,8}$.b3)))))

$\to$ *[const member of object with modified fields]*

$[36.7]$ \$heap$_{719,1;731,8}$ == \$heap$_{funcstart\_719,1}$._**replace**(p1 $\to$ ((-2 *
div(**heapIs** \$heap$_{funcstart\_719,1}$, \$heap$_{funcstart\_719,1}$.p1, 177).quot) + (171 *
div(**heapIs** \$heap$_{funcstart\_719,1}$, \$heap$_{funcstart\_719,1}$.p1,
177).rem)))._**replace**(p2 $\to$ ((-35 * div(**heapIs** \$heap$_{funcstart\_719,1}$,
\$heap$_{funcstart\_719,1}$.p2, 176).quot) + (172 * div(**heapIs** \$heap$_{funcstart\_719,1}$,
\$heap$_{funcstart\_719,1}$.p2, 176).rem)))._**replace**(p3 $\to$ **asType**<**short**
int>((div(**heapIs** \$heap$_{funcstart\_719,1}$, \$heap$_{funcstart\_719,1}$.p3, 178).rem *
asType<**int**>(\$heap$_{funcstart\_719,1}$.r3)) $-$ (**asType**<**int**>(**asType**<**short**
int>(div3.quot)) * **asType**<**int**>(\$heap$_{719,1;730,8}$.b3)))))

$\to$ *[const static or extern object]*

$[36.8]$ \$heap$_{719,1;731,8}$ == \$heap$_{funcstart\_719,1}$._**replace**(p1 $\to$ ((-2 *
div(**heapIs** \$heap$_{funcstart\_719,1}$, \$heap$_{funcstart\_719,1}$.p1, 177).quot) + (171 *
div(**heapIs** \$heap$_{funcstart\_719,1}$, \$heap$_{funcstart\_719,1}$.p1,
177).rem)))._**replace**(p2 $\to$ ((-35 * div(**heapIs** \$heap$_{funcstart\_719,1}$,
\$heap$_{funcstart\_719,1}$.p2, 176).quot) + (172 * div(**heapIs** \$heap$_{funcstart\_719,1}$,
\$heap$_{funcstart\_719,1}$.p2, 176).rem)))._**replace**(p3 $\to$ **asType**<**short**
int>((div(**heapIs** \$heap$_{funcstart\_719,1}$, \$heap$_{funcstart\_719,1}$.p3, 178).rem *
asType<**int**>(\$heap$_{init}$.r3)) $-$ (**asType**<**int**>(**asType**<**short**
int>(div3.quot)) * **asType**<**int**>(\$heap$_{719,1;730,8}$.b3)))))

$\to$ *[expand definition of constant 'r3' at prang.c (25,20)]*

$[36.9]$ \$heap$_{719,1;731,8}$ == \$heap$_{funcstart\_719,1}$._**replace**(p1 $\to$ ((-2 *
div(**heapIs** \$heap$_{funcstart\_719,1}$, \$heap$_{funcstart\_719,1}$.p1, 177).quot) + (171 *
div(**heapIs** \$heap$_{funcstart\_719,1}$, \$heap$_{funcstart\_719,1}$.p1,
177).rem)))._**replace**(p2 $\to$ ((-35 * div(**heapIs** \$heap$_{funcstart\_719,1}$,

$\$\text{heap}_{funcstart\_719,1}.\text{p2}, 176).\text{quot}) + (172 * \text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_719,1},$
$\$\text{heap}_{funcstart\_719,1}.\text{p2}, 176).\text{rem}))).\_\textbf{replace}(\text{p3} \rightarrow \textbf{asType}\textbf{<short}$
$\textbf{int}\textbf{>}((\text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_719,1}, \$\text{heap}_{funcstart\_719,1}.\text{p3}, 178).\text{rem} *$
$\textbf{asType}\textbf{<int>}(\textbf{asType}\textbf{<short int>}((\textbf{int})170))) -$
$(\textbf{asType}\textbf{<int>}(\textbf{asType}\textbf{<short int>}(\text{div3.quot})) *$
$\textbf{asType}\textbf{<int>}(\$\text{heap}_{719,1;730,8}.\text{b3})))))$

$\rightarrow$ *[simplify]*

[36.12] $\$\text{heap}_{719,1;731,8} == \$\text{heap}_{funcstart\_719,1}.\_\textbf{replace}(\text{p1} \rightarrow ((-2 *$
$\text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_719,1}, \$\text{heap}_{funcstart\_719,1}.\text{p1}, 177).\text{quot}) + (171 *$
$\text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_719,1}, \$\text{heap}_{funcstart\_719,1}.\text{p1},$
$177).\text{rem}))).\_\textbf{replace}(\text{p2} \rightarrow ((-35 * \text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_719,1},$
$\$\text{heap}_{funcstart\_719,1}.\text{p2}, 176).\text{quot}) + (172 * \text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_719,1},$
$\$\text{heap}_{funcstart\_719,1}.\text{p2}, 176).\text{rem}))).\_\textbf{replace}(\text{p3} \rightarrow \textbf{asType}\textbf{<short}$
$\textbf{int}\textbf{>}((\text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_719,1}, \$\text{heap}_{funcstart\_719,1}.\text{p3}, 178).\text{rem} * 170)$
$- (\textbf{asType}\textbf{<int>}(\textbf{asType}\textbf{<short int>}(\text{div3.quot})) *$
$\textbf{asType}\textbf{<int>}(\$\text{heap}_{719,1;730,8}.\text{b3})))))$

$\rightarrow$ *[from term 19.6, div3 is equal to div(**heapIs** $\$heap_{funcstart\_719,1},$*
$\$heap_{funcstart\_719,1}.p3, 178)]$

[36.13] $\$\text{heap}_{719,1;731,8} == \$\text{heap}_{funcstart\_719,1}.\_\textbf{replace}(\text{p1} \rightarrow ((-2 *$
$\text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_719,1}, \$\text{heap}_{funcstart\_719,1}.\text{p1}, 177).\text{quot}) + (171 *$
$\text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_719,1}, \$\text{heap}_{funcstart\_719,1}.\text{p1},$
$177).\text{rem}))).\_\textbf{replace}(\text{p2} \rightarrow ((-35 * \text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_719,1},$
$\$\text{heap}_{funcstart\_719,1}.\text{p2}, 176).\text{quot}) + (172 * \text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_719,1},$
$\$\text{heap}_{funcstart\_719,1}.\text{p2}, 176).\text{rem}))).\_\textbf{replace}(\text{p3} \rightarrow \textbf{asType}\textbf{<short int>}((170$
$* \text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_719,1}, \$\text{heap}_{funcstart\_719,1}.\text{p3}, 178).\text{rem}) -$
$(\textbf{asType}\textbf{<int>}(\textbf{asType}\textbf{<short int>}(\text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_719,1},$
$\$\text{heap}_{funcstart\_719,1}.\text{p3}, 178).\text{quot})) * \textbf{asType}\textbf{<int>}(\$\text{heap}_{719,1;730,8}.\text{b3})))))$

$\rightarrow$ *[simplify]*

[36.15] $\$\text{heap}_{719,1;731,8} == \$\text{heap}_{funcstart\_719,1}.\_\textbf{replace}(\text{p1} \rightarrow ((-2 *$
$\text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_719,1}, \$\text{heap}_{funcstart\_719,1}.\text{p1}, 177).\text{quot}) + (171 *$
$\text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_719,1}, \$\text{heap}_{funcstart\_719,1}.\text{p1},$
$177).\text{rem}))).\_\textbf{replace}(\text{p2} \rightarrow ((-35 * \text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_719,1},$
$\$\text{heap}_{funcstart\_719,1}.\text{p2}, 176).\text{quot}) + (172 * \text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_719,1},$
$\$\text{heap}_{funcstart\_719,1}.\text{p2}, 176).\text{rem}))).\_\textbf{replace}(\text{p3} \rightarrow \textbf{asType}\textbf{<short int>}((170$
$* \text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_719,1}, \$\text{heap}_{funcstart\_719,1}.\text{p3}, 178).\text{rem}) -$
$(\text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_719,1}, \$\text{heap}_{funcstart\_719,1}.\text{p3}, 178).\text{quot} *$
$\textbf{asType}\textbf{<int>}(\$\text{heap}_{719,1;730,8}.\text{b3}))))$

$\rightarrow$ *[from term 31.24, $\$heap_{719,1;730,8}$ is equal to*
*$\$heap_{funcstart\_719,1}.\_\textbf{replace}(p1 \rightarrow ((-2 * div(\textbf{heapIs } \$heap_{funcstart\_719,1},$*
*$\$heap_{funcstart\_719,1}.p1, 177).quot) + (171 * div(\textbf{heapIs } \$heap_{funcstart\_719,1},$*
*$\$heap_{funcstart\_719,1}.p1, 177).rem))).\_\textbf{replace}(p2 \rightarrow (-35 * div(\textbf{heapIs}$*
*$\$heap_{funcstart\_719,1}, \$heap_{funcstart\_719,1}.p2, 176).quot) + (172 * div(\textbf{heapIs}$*
$\$heap_{funcstart\_719,1}, \$heap_{funcstart\_719,1}.p2, 176).rem))]$

[36.16] $\text{\$heap}_{719,1;731,8}$ == $\text{\$heap}_{funcstart\_719,1}$.**replace**(p1 → ((-2 *
div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p1,
177).rem))).**replace**(p2 → ((-35 * div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$,
$\text{\$heap}_{funcstart\_719,1}$.p2, 176).quot) + (172 * div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$,
$\text{\$heap}_{funcstart\_719,1}$.p2, 176).rem))).**replace**(p3 → **asType**<**short int**>((170
* div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p3, 178).rem) −
(div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p3, 178).quot *
asType<**int**>($\text{\$heap}_{funcstart\_719,1}$.**replace**(p1 → ((-2 * div(**heapIs**
$\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs**
$\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p1, 177).rem))).**replace**(p2 → ((-35
* div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p2, 176).quot) + (172 *
div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p2, 176).rem))).b3))))

→ *[const member of object with modified fields]*

[36.18] $\text{\$heap}_{719,1;731,8}$ == $\text{\$heap}_{funcstart\_719,1}$.**replace**(p1 → ((-2 *
div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p1,
177).rem))).**replace**(p2 → ((-35 * div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$,
$\text{\$heap}_{funcstart\_719,1}$.p2, 176).quot) + (172 * div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$,
$\text{\$heap}_{funcstart\_719,1}$.p2, 176).rem))).**replace**(p3 → **asType**<**short int**>((170
* div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p3, 178).rem) −
(div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p3, 178).quot *
asType<**int**>($\text{\$heap}_{funcstart\_719,1}$.b3))))

→ *[const static or extern object]*

[36.19] $\text{\$heap}_{719,1;731,8}$ == $\text{\$heap}_{funcstart\_719,1}$.**replace**(p1 → ((-2 *
div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p1,
177).rem))).**replace**(p2 → ((-35 * div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$,
$\text{\$heap}_{funcstart\_719,1}$.p2, 176).quot) + (172 * div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$,
$\text{\$heap}_{funcstart\_719,1}$.p2, 176).rem))).**replace**(p3 → **asType**<**short int**>((170
* div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p3, 178).rem) −
(div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p3, 178).quot *
asType<**int**>($\text{\$heap}_{init}$.b3))))

→ *[expand definition of constant 'b3' at prang.c (27,20)]*

[36.20] $\text{\$heap}_{719,1;731,8}$ == $\text{\$heap}_{funcstart\_719,1}$.**replace**(p1 → ((-2 *
div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p1,
177).rem))).**replace**(p2 → ((-35 * div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$,
$\text{\$heap}_{funcstart\_719,1}$.p2, 176).quot) + (172 * div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$,
$\text{\$heap}_{funcstart\_719,1}$.p2, 176).rem))).**replace**(p3 → **asType**<**short int**>((170
* div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p3, 178).rem) −
(div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p3, 178).quot *
asType<**int**>(**asType**<**short int**>((**int**)63)))))

→ *[simplify]*

[36.26] $\$heap_{719,1;731,8} == \$heap_{funcstart\_719,1}$.**replace**(p1 → ((-2 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).rem))).**replace**(p2 → ((-35 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).quot) + (172 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).rem))).**replace**(p3 → ((-63 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p3, 178).quot) + (170 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p3, 178).rem)))

[Take goal term]

[1.0] **minof**(**short int**) ≤ ((**asType<int>**($\$heap_{719,1;731,8}$.M1) * **asType<int>**(**static_cast<integer>**(**asType<int>**($\$heap_{719,1;731,8}$.p1) < (**int**)0))) + **asType<int>**($\$heap_{719,1;731,8}$.p1))

→ *[simplify]*

[1.1] -32768 ≤ ((**asType<int>**($\$heap_{719,1;731,8}$.M1) * **asType<int>**(**static_cast<integer>**(**asType<int>**($\$heap_{719,1;731,8}$.p1) < (**int**)0))) + **asType<int>**($\$heap_{719,1;731,8}$.p1))

→ *[from term 36.26, $\$heap_{719,1;731,8}$ is equal to $\$heap_{funcstart\_719,1}$.**replace**(p1 → ((-2 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).rem))).**replace**(p2 → ((-35 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).quot) + (172 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).rem))).**replace**(p3 → (-63 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p3, 178).quot) + (170 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p3, 178).rem))]*

[1.2] -32768 ≤ ((**asType<int>**($\$heap_{funcstart\_719,1}$.**replace**(p1 → ((-2 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).rem))).**replace**(p2 → ((-35 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).quot) + (172 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).rem))).**replace**(p3 → ((-63 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p3, 178).quot) + (170 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p3, 178).rem))).M1) * **asType<int>**(**static_cast<integer>**(**asType<int>**($\$heap_{719,1;731,8}$.p1) < (**int**)0))) + **asType<int>**($\$heap_{719,1;731,8}$.p1))

→ *[const member of object with modified fields]*

[1.5] -32768 ≤ ((**asType<int>**($\$heap_{funcstart\_719,1}$.M1) * **asType<int>**(**static_cast<integer>**(**asType<int>**($\$heap_{719,1;731,8}$.p1) < (**int**)0))) + **asType<int>**($\$heap_{719,1;731,8}$.p1))

→ *[const static or extern object]*

[1.6] -32768 ≤ ((**asType<int>**($\$heap_{init}$.M1) *

asType<**int**>(**static_cast**<**integer**>(**asType**<**int**>($heap$_{719,1;731,8}$.p1) < (**int**)0))) + **asType**<**int**>($heap$_{719,1;731,8}$.p1))

$\rightarrow$ *[expand definition of constant 'M1' at prang.c (14,20)]*

[1.7] -32768 $\leq$ ((**asType**<**int**>(**asType**<**short int**>((**int**)30269)) * **asType**<**int**>(**static_cast**<**integer**>(**asType**<**int**>($heap$_{719,1;731,8}$.p1) < (**int**)0))) + **asType**<**int**>($heap$_{719,1;731,8}$.p1))

$\rightarrow$ *[simplify]*

[1.10] -32768 $\leq$ ((30269 * **asType**<**int**>(**static_cast**<**integer**>(**asType**<**int**>($heap$_{719,1;731,8}$.p1) < (**int**)0))) + **asType**<**int**>($heap$_{719,1;731,8}$.p1))

$\rightarrow$ *[from term 36.26, $heap$_{719,1;731,8}$ is equal to $heap$_{funcstart_719,1}$._**replace**(p1 $\rightarrow$ ((-2 * div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1, 177).quot) + (171 * div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1, 177).rem)))._**replace**(p2 $\rightarrow$ ((-35 * div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p2, 176).quot) + (172 * div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p2, 176).rem)))._**replace**(p3 $\rightarrow$ (-63 * div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p3, 178).quot) + (170 * div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p3, 178).rem))]*

[1.11] -32768 $\leq$ ((30269 * **asType**<**int**>(**static_cast**<**integer**>(**asType**<**int**>($heap$_{funcstart_719,1}$._**replace**(p1 $\rightarrow$ ((-2 * div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1, 177).quot) + (171 * div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1, 177).rem)))._**replace**(p2 $\rightarrow$ ((-35 * div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p2, 176).quot) + (172 * div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p2, 176).rem)))._**replace**(p3 $\rightarrow$ ((-63 * div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p3, 178).quot) + (170 * div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p3, 178).rem))).p1) < (**int**)0))) + **asType**<**int**>($heap$_{719,1;731,8}$.p1))

$\rightarrow$ *[simplify]*

[1.23] -32768 $\leq$ ((30269 * **asType**<**int**>(([0 < ((-171 * div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1, 177).rem) + (2 * div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1, 177).quot))]: 1, []: 0))) + **asType**<**int**>($heap$_{719,1;731,8}$.p1))

$\rightarrow$ *[explicitly assert falsehood of skipped guards in subsequent guards]*

[1.24] -32768 $\leq$ ((30269 * **asType**<**int**>(([0 < ((-171 * div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1, 177).rem) + (2 * div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1, 177).quot))]: 1, [!(0 < ((-171 * div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1, 177).rem) + (2 * div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1, 177).quot)))]: 0))) + **asType**<**int**>($heap$_{719,1;731,8}$.p1))

$\rightarrow$ *[simplify]*

[1.30] -32768 ≤ ((30269 * ([0 < ((-171 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).rem) + (2 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot))]: 1, [-1 < ((-2 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).rem))]: 0)) + **asType**<**int**>($\$heap_{719,1;731,8}$.p1))

→ *[move guard outside expression]*

[1.31] -32768 ≤ (([0 < ((-171 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).rem) + (2 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot))]: 1 * 30269, [-1 < ((-2 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).rem))]: 0 * 30269) + **asType**<**int**>($\$heap_{719,1;731,8}$.p1))

→ *[simplify]*

[1.33] -32768 ≤ (([0 < ((-171 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).rem) + (2 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot))]: 30269, [-1 < ((-2 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).rem))]: 0) + **asType**<**int**>($\$heap_{719,1;731,8}$.p1))

→ *[from term 36.26, $\$heap_{719,1;731,8}$ is equal to $\$heap_{funcstart\_719,1}$.__replace(p1 → ((-2 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).rem))).__replace(p2 → ((-35 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).quot) + (172 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).rem))).__replace(p3 → (-63 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p3, 178).quot) + (170 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p3, 178).rem)))]*

[1.34] -32768 ≤ (([0 < ((-171 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).rem) + (2 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot))]: 30269, [-1 < ((-2 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).rem))]: 0) + **asType**<**int**>($\$heap_{funcstart\_719,1}$.__replace(p1 → ((-2 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).rem))).__replace(p2 → ((-35 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).quot) + (172 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).rem))).__replace(p3 → ((-63 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p3, 178).quot) + (170 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p3, 178).rem))).p1))

→ *[simplify]*

[1.39] -32768 ≤ ((-2 * div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p1, 177).rem) + ([0 < ((-171 * div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p1, 177).rem) + (2 * div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p1, 177).quot))]: 30269, [-1 < ((-2 * div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p1, 177).rem))]: 0))

→ *[move guard outside expression]*

[1.40] -32768 ≤ ([0 < ((-171 * div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p1, 177).rem) + (2 * div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p1, 177).quot))]: 30269 + (-2 * div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p1, 177).rem), [-1 < ((-2 * div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p1, 177).rem))]: 0 + (-2 * div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p1, 177).rem))

→ *[simplify]*

[1.43] -32769 < ([0 < ((-171 * div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p1, 177).rem) + (2 * div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p1, 177).quot))]: 30269 + (-2 * div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p1, 177).rem), [-1 < ((-2 * div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p1, 177).rem))]: (-2 * div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p1, 177).rem))

→ *[move guard outside expression]*

[1.44] ([0 < ((-171 * div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p1, 177).rem) + (2 * div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p1, 177).quot))]: -32769 < (30269 + (-2 * div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p1, 177).rem)), [-1 < ((-2 * div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p1, 177).rem))]: -32769 < ((-2 * div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p1, 177).rem)))

→ *[simplify]*

[1.46] ([0 < ((-171 * div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p1, 177).rem) + (2 * div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p1, 177).quot))]: -63038 < ((-2 * div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs** $heap_{funcstart\_719,1}$,

$\$heap_{funcstart\_719,1}$.p1, 177).rem)), [-1 < ((-2 * div(**heapIs**
$\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs**
$\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).rem))]: -32769 < ((-2 *
div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).rem)))

→ *[from guard, literala < ((-2 * div(**heapIs** $\$heap_{funcstart\_719,1}$,*
*$\$heap_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_719,1}$,*
$\$heap_{funcstart\_719,1}$.p1, 177).rem)) is true whenever (-1 + literala) < -1]

Proof of rule precondition:

[1.46.0] (-32769 + -1) < -1

→ *[simplify]*

[1.46.2] **true**

[1.47] ([0 < ((-171 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1,
177).rem) + (2 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1,
177).quot))]: -63038 < ((-2 * div(**heapIs** $\$heap_{funcstart\_719,1}$,
$\$heap_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_719,1}$,
$\$heap_{funcstart\_719,1}$.p1, 177).rem)), [-1 < ((-2 * div(**heapIs**
$\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs**
$\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).rem))]: **true**)

→ *[negate goal and search for contradiction]*

[1.48] !([0 < ((-171 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1,
177).rem) + (2 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1,
177).quot))]: -63038 < ((-2 * div(**heapIs** $\$heap_{funcstart\_719,1}$,
$\$heap_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_719,1}$,
$\$heap_{funcstart\_719,1}$.p1, 177).rem)), [-1 < ((-2 * div(**heapIs**
$\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs**
$\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).rem))]: **true**)

→ *[move guard outside expression]*

[1.49] ([0 < ((-171 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1,
177).rem) + (2 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1,
177).quot))]: !(-63038 < ((-2 * div(**heapIs** $\$heap_{funcstart\_719,1}$,
$\$heap_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_719,1}$,
$\$heap_{funcstart\_719,1}$.p1, 177).rem))), [-1 < ((-2 * div(**heapIs**
$\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs**
$\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).rem))]: !**true**)

→ *[simplify]*

[1.57] (0 < ((-171 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1,
177).rem) + (2 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1,
177).quot))) ∧ (63037 < ((-171 * div(**heapIs** $\$heap_{funcstart\_719,1}$,
$\$heap_{funcstart\_719,1}$.p1, 177).rem) + (2 * div(**heapIs** $\$heap_{funcstart\_719,1}$,
$\$heap_{funcstart\_719,1}$.p1, 177).quot)))

[Work on sub-term 2 of conjunction in term 1.57]

[41.0] 63037 < ((-171 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).rem) + (2 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot))

[Branch on disjunction or conditional in term 10.21]

[42.0] (0 == ((−$\$heap_{funcstart\_719,1}$.p1 / 177) + div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot)) ∨ (0 == (−($\$heap_{funcstart\_719,1}$.p1 / 177) + div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot)) ∨ (-1 < $\$heap_{funcstart\_719,1}$.p1)

[Branch on disjunction or conditional in term 10.21]

[43.0] (0 < −$\$heap_{funcstart\_719,1}$.p1) ∨ (0 == (−($\$heap_{funcstart\_719,1}$.p1 / 177) + div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot)) ∨ (-1 < $\$heap_{funcstart\_719,1}$.p1)

[Copy term 11.40]

[44.0] ([0 < −$\$heap_{funcstart\_719,1}$.p1]: ([0 == ($\$heap_{funcstart\_719,1}$.p1 % 177)]: 0 == div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).rem, [!(0 == ($\$heap_{funcstart\_719,1}$.p1 % 177))]: 177 == (−div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).rem + ($\$heap_{funcstart\_719,1}$.p1 % 177))), [-1 < $\$heap_{funcstart\_719,1}$.p1]: 0 == (−($\$heap_{funcstart\_719,1}$.p1 % 177) + div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).rem)) ∨ (0 == (−($\$heap_{funcstart\_719,1}$.p1 / 177) + div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot)) ∨ (-1 < $\$heap_{funcstart\_719,1}$.p1)

→ *[from term 43.0, literala < −$\$heap_{funcstart\_719,1}$.p1 is true whenever (-1 + literala) < 0]*

Proof of rule precondition:

[44.0.0] (-1 + 0) < 0

→ *[simplify]*

[44.0.2] **true**

[44.1] ([**true**]: ([0 == ($\$heap_{funcstart\_719,1}$.p1 % 177)]: 0 == div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).rem, [!(0 == ($\$heap_{funcstart\_719,1}$.p1 % 177))]: 177 == (−div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).rem + ($\$heap_{funcstart\_719,1}$.p1 % 177))), [-1 < $\$heap_{funcstart\_719,1}$.p1]: 0 == (−($\$heap_{funcstart\_719,1}$.p1 % 177) + div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).rem)) ∨ ...

→ *[simplify]*

[44.3] ([0 == ($\$heap_{funcstart\_719,1}$.p1 % 177)]: 0 == div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).rem, [!(0 == ($\$heap_{funcstart\_719,1}$.p1 % 177))]: 177 == (−div(**heapIs** $\$heap_{funcstart\_719,1}$,

$heap_{funcstart\_719,1}.p1, 177).rem + ($heap_{funcstart_719,1}.p1 \% 177))) \lor ...$

[Branch on disjunction or conditional in term 44.3]

[45.0] $(0 == div(\textbf{heapIs } \$heap_{funcstart\_719,1}, \$heap_{funcstart\_719,1}.p1, 177).rem) \lor (0 == (-(\$heap_{funcstart\_719,1}.p1 / 177) + div(\textbf{heapIs } \$heap_{funcstart\_719,1}, \$heap_{funcstart\_719,1}.p1, 177).quot)) \lor (-1 < \$heap_{funcstart\_719,1}.p1) \lor (177 == (-div(\textbf{heapIs } \$heap_{funcstart\_719,1}, \$heap_{funcstart\_719,1}.p1, 177).rem + (\$heap_{funcstart\_719,1}.p1 \% 177))) \lor !(0 == (\$heap_{funcstart\_719,1}.p1 \% 177))$

[Copy term 41.0]

[50.0] $(63037 < ((-171 * div(\textbf{heapIs } \$heap_{funcstart\_719,1}, \$heap_{funcstart\_719,1}.p1, 177).rem) + (2 * div(\textbf{heapIs } \$heap_{funcstart\_719,1}, \$heap_{funcstart\_719,1}.p1, 177).quot))) \lor (0 == (-(\$heap_{funcstart\_719,1}.p1 / 177) + div(\textbf{heapIs } \$heap_{funcstart\_719,1}, \$heap_{funcstart\_719,1}.p1, 177).quot)) \lor (-1 < \$heap_{funcstart\_719,1}.p1) \lor (177 == (-div(\textbf{heapIs } \$heap_{funcstart\_719,1}, \$heap_{funcstart\_719,1}.p1, 177).rem + (\$heap_{funcstart\_719,1}.p1 \% 177))) \lor !(0 == (\$heap_{funcstart\_719,1}.p1 \% 177))$

$\rightarrow$ *[from term 45.0, div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}.p1$, 177).rem is equal to 0]*

[50.1] $(63037 < ((-171 * 0) + (2 * div(\textbf{heapIs } \$heap_{funcstart\_719,1}, \$heap_{funcstart\_719,1}.p1, 177).quot))) \lor ...$

$\rightarrow$ *[simplify]*

[50.3] $(63037 < (2 * div(\textbf{heapIs } \$heap_{funcstart\_719,1}, \$heap_{funcstart\_719,1}.p1, 177).quot)) \lor ...$

$\rightarrow$ *[literal comparison of product]*

[50.4] $([2 < 0]: (63037 / -2) < -div(\textbf{heapIs } \$heap_{funcstart\_719,1}, \$heap_{funcstart\_719,1}.p1, 177).quot, [0 < 2]: (63037 / 2) < div(\textbf{heapIs } \$heap_{funcstart\_719,1}, \$heap_{funcstart\_719,1}.p1, 177).quot, [0 == 2]: 63037 < 0) \lor ...$

$\rightarrow$ *[explicitly assert falsehood of skipped guards in subsequent guards]*

[50.5] $([2 < 0]: (63037 / -2) < -div(\textbf{heapIs } \$heap_{funcstart\_719,1}, \$heap_{funcstart\_719,1}.p1, 177).quot, [(0 < 2) \land !(2 < 0)]: (63037 / 2) < div(\textbf{heapIs } \$heap_{funcstart\_719,1}, \$heap_{funcstart\_719,1}.p1, 177).quot, [(0 == 2) \land !(0 < 2) \land !(2 < 0)]: 63037 < 0) \lor ...$

$\rightarrow$ *[simplify]*

[50.13] $(31518 < div(\textbf{heapIs } \$heap_{funcstart\_719,1}, \$heap_{funcstart\_719,1}.p1, 177).quot) \lor ...$

[Create new term from terms 50.13, 42.0 using rule: transitivity 15]

[69.0] $((0 + 31518) < -(-\$heap_{funcstart\_719,1}.p1 / 177)) \lor (0 == (-(\$heap_{funcstart\_719,1}.p1 / 177) + div(\textbf{heapIs } \$heap_{funcstart\_719,1}, \$heap_{funcstart\_719,1}.p1, 177).quot)) \lor (-1 < \$heap_{funcstart\_719,1}.p1) \lor (177 ==$

$(-\text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_719,1}, \$\text{heap}_{funcstart\_719,1}.\text{p1}, 177).\text{rem} + (\$\text{heap}_{funcstart\_719,1}.\text{p1} \% 177))) \vee !(0 == (\$\text{heap}_{funcstart\_719,1}.\text{p1} \% 177))$

$\rightarrow$ *[simplify]*

[69.8] $(5578686 < \$\text{heap}_{funcstart\_719,1}.\text{p1}) \vee \dots$

$\rightarrow$ *[from term 43.0, literala $< \$heap_{funcstart\_719,1}.p1$ is false whenever -2 $< (0$ + literala)]*

Proof of rule precondition:

[69.8.0] $-2 < (0 + 5578686)$

$\rightarrow$ *[simplify]*

[69.8.2] **true**

[69.9] **false** $\vee \dots$

[Remove 'false' term 69.9 and fetch new term from containing clause]

[70.0] $(177 == (-\text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_719,1}, \$\text{heap}_{funcstart\_719,1}.\text{p1}, 177).\text{rem} + (\$\text{heap}_{funcstart\_719,1}.\text{p1} \% 177))) \vee (0 == (-(\$\text{heap}_{funcstart\_719,1}.\text{p1} / 177) + \text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_719,1}, \$\text{heap}_{funcstart\_719,1}.\text{p1}, 177).\text{quot})) \vee (-1 < \$\text{heap}_{funcstart\_719,1}.\text{p1})$

[Create new term from terms 41.0, 28.9 using rule: transitivity 5r]

[72.0] $63037 < ((-171 * \text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_719,1}, \$\text{heap}_{funcstart\_719,1}.\text{p1}, 177).\text{rem}) + (2 * -(-32768 + 1)))$

$\rightarrow$ *[simplify]*

[72.5] $-2497 < (-171 * \text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_719,1}, \$\text{heap}_{funcstart\_719,1}.\text{p1}, 177).\text{rem})$

$\rightarrow$ *[literal comparison of product]*

[72.6] $([-171 < 0]: (-2497 / 171) < -\text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_719,1}, \$\text{heap}_{funcstart\_719,1}.\text{p1}, 177).\text{rem}, [0 < -171]: (-2497 / -171) < \text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_719,1}, \$\text{heap}_{funcstart\_719,1}.\text{p1}, 177).\text{rem}, [-171 == 0]: -2497 < 0)$

$\rightarrow$ *[explicitly assert falsehood of skipped guards in subsequent guards]*

[72.7] $([-171 < 0]: (-2497 / 171) < -\text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_719,1}, \$\text{heap}_{funcstart\_719,1}.\text{p1}, 177).\text{rem}, [(0 < -171) \wedge !(-171 < 0)]: (-2497 / -171) < \text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_719,1}, \$\text{heap}_{funcstart\_719,1}.\text{p1}, 177).\text{rem}, [(-171 == 0) \wedge !(-171 < 0) \wedge !(0 < -171)]: -2497 < 0)$

$\rightarrow$ *[simplify]*

[72.11] $-15 < -\text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_719,1}, \$\text{heap}_{funcstart\_719,1}.\text{p1}, 177).\text{rem}$

[Copy term 41.0]

[73.0] $(63037 < ((-171 * \text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_719,1},$

$\text{heap}_{funcstart\_719,1}.\text{p1}, 177).\text{rem}) + (2 * \text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_719,1},$
$\$\text{heap}_{funcstart\_719,1}.\text{p1}, 177).\text{quot}))) \lor (0 == (-(\$\text{heap}_{funcstart\_719,1}.\text{p1} / 177)$
$+ \text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_719,1}, \$\text{heap}_{funcstart\_719,1}.\text{p1}, 177).\text{quot})) \lor (-1 <$
$\$\text{heap}_{funcstart\_719,1}.\text{p1})$

$\rightarrow$ *[from term 70.0, div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}.p1$, 177).rem is equal to -177 + ($\$heap_{funcstart\_719,1}.p1$ % 177)]*

[73.1] $(63037 < ((-171 * (-177 + (\$\text{heap}_{funcstart\_719,1}.\text{p1} \% 177))) + (2 *$
$\text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_719,1}, \$\text{heap}_{funcstart\_719,1}.\text{p1}, 177).\text{quot}))) \lor ...$

$\rightarrow$ *[simplify]*

[73.6] $(32770 < ((-171 * (\$\text{heap}_{funcstart\_719,1}.\text{p1} \% 177)) + (2 * \text{div}(\textbf{heapIs }$
$\$\text{heap}_{funcstart\_719,1}, \$\text{heap}_{funcstart\_719,1}.\text{p1}, 177).\text{quot}))) \lor ...$

[Create new term from term 42.0 using rule: condition for equality of division]

[81.0] $((-\$\text{heap}_{funcstart\_719,1}.\text{p1} < (177 * (0 + 1 + -\text{div}(\textbf{heapIs }$
$\$\text{heap}_{funcstart\_719,1}, \$\text{heap}_{funcstart\_719,1}.\text{p1}, 177).\text{quot}))) \land ((177 * (0 +$
$-\text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_719,1}, \$\text{heap}_{funcstart\_719,1}.\text{p1}, 177).\text{quot})) < (1 +$
$-\$\text{heap}_{funcstart\_719,1}.\text{p1}))) \lor (0 == (-(\$\text{heap}_{funcstart\_719,1}.\text{p1} / 177) +$
$\text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_719,1}, \$\text{heap}_{funcstart\_719,1}.\text{p1}, 177).\text{quot})) \lor (-1 <$
$\$\text{heap}_{funcstart\_719,1}.\text{p1})$

$\rightarrow$ *[simplify]*

[81.18] $((-177 < ((-177 * \text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_719,1},$
$\$\text{heap}_{funcstart\_719,1}.\text{p1}, 177).\text{quot}) + \$\text{heap}_{funcstart\_719,1}.\text{p1})) \land (-1 <$
$(-\$\text{heap}_{funcstart\_719,1}.\text{p1} + (177 * \text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_719,1},$
$\$\text{heap}_{funcstart\_719,1}.\text{p1}, 177).\text{quot})))) \lor ...$

$\rightarrow$ *[separate conjunction and work on first sub-term]*

[81.19] $(-177 < ((-177 * \text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_719,1},$
$\$\text{heap}_{funcstart\_719,1}.\text{p1}, 177).\text{quot}) + \$\text{heap}_{funcstart\_719,1}.\text{p1})) \lor ...$

[Create new term from terms 81.19, 43.0 using rule: transitivity 2]

[84.0] $((-177 + 0 + 1) < (-177 * \text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_719,1},$
$\$\text{heap}_{funcstart\_719,1}.\text{p1}, 177).\text{quot})) \lor (0 == (-(\$\text{heap}_{funcstart\_719,1}.\text{p1} / 177)$
$+ \text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_719,1}, \$\text{heap}_{funcstart\_719,1}.\text{p1}, 177).\text{quot})) \lor (-1 <$
$\$\text{heap}_{funcstart\_719,1}.\text{p1})$

$\rightarrow$ *[simplify]*

[84.1] $(-176 < (-177 * \text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_719,1}, \$\text{heap}_{funcstart\_719,1}.\text{p1},$
$177).\text{quot})) \lor ...$

$\rightarrow$ *[literal comparison of product]*

[84.2] $([-177 < 0]: (-176 / 177) < -\text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_719,1},$
$\$\text{heap}_{funcstart\_719,1}.\text{p1}, 177).\text{quot}, [0 < -177]: (-176 / -177) < \text{div}(\textbf{heapIs }$
$\$\text{heap}_{funcstart\_719,1}, \$\text{heap}_{funcstart\_719,1}.\text{p1}, 177).\text{quot}, [-177 == 0]: -176 < 0)$
$\lor ...$

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

[84.3] ([-177 < 0]: (-176 / 177) < $-$div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot, [(0 < -177) $\wedge$!(-177 < 0)]: (-176 / -177) < div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot, [(-177 == 0) $\wedge$!(-177 < 0) $\wedge$!(0 < -177)]: -176 < 0) $\vee$ ...

→ *[simplify]*

[84.7] (-1 < $-$div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot) $\vee$ ...

[Create new term from terms 84.7, 73.6 using rule: transitivity 5]

[93.0] (32770 < ((-171 * ($\$heap_{funcstart\_719,1}$.p1 % 177)) + (2 * $-$(-1 + 1)))) $\vee$ (0 == ($-$($\$heap_{funcstart\_719,1}$.p1 / 177) + div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot)) $\vee$ (-1 < $\$heap_{funcstart\_719,1}$.p1)

→ *[simplify]*

[93.4] (32770 < (-171 * ($\$heap_{funcstart\_719,1}$.p1 % 177))) $\vee$ ...

→ *[literal comparison of product]*

[93.5] ([-171 < 0]: (32770 / 171) < $-$($\$heap_{funcstart\_719,1}$.p1 % 177), [0 < -171]: (32770 / -171) < ($\$heap_{funcstart\_719,1}$.p1 % 177), [-171 == 0]: 32770 < 0) $\vee$ ...

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

[93.6] ([-171 < 0]: (32770 / 171) < $-$($\$heap_{funcstart\_719,1}$.p1 % 177), [(0 < -171) $\wedge$!(-171 < 0)]: (32770 / -171) < ($\$heap_{funcstart\_719,1}$.p1 % 177), [(-171 == 0) $\wedge$!(-171 < 0) $\wedge$!(0 < -171)]: 32770 < 0) $\vee$ ...

→ *[simplify]*

[93.11] **false** $\vee$ ...

[Remove 'false' term 93.11 and fetch new term from containing clause]

[95.0] 0 == ($-$($\$heap_{funcstart\_719,1}$.p1 / 177) + div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot)

[Remove 'false' term 93.11 and fetch new term from containing clause]

[96.0] -1 < $\$heap_{funcstart\_719,1}$.p1

[Assume known post-assertion, class invariant or type constraint for term 5.6]

[11.40] ([0 < $-\$heap_{funcstart\_719,1}$.p1]: ([0 == ($\$heap_{funcstart\_719,1}$.p1 % 177)]: 0 == div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).rem, [!(0 == ($\$heap_{funcstart\_719,1}$.p1 % 177))]: 177 == (($\$heap_{funcstart\_719,1}$.p1 % 177) + $-$div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).rem)), [-1 < $\$heap_{funcstart\_719,1}$.p1]: 0 == ($-$($\$heap_{funcstart\_719,1}$.p1 % 177) + div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).rem))

→ *[from term 96.0, literala < $-\$heap_{funcstart\_719,1}$.p1 is false whenever -2 <*

(-1 + literala)]

> **Proof of rule precondition:**
>
> *[11.40.0] -2 < (-1 + 0)*
>
> → *[simplify]*
>
> *[11.40.2]* **true**

[11.41] ([**false**]: ([0 == ($heap$_{funcstart_719,1}$.p1 % 177)]: 0 == div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1, 177).rem, [!(0 == ($heap$_{funcstart\_719,1}$.p1 % 177))]: 177 == (−div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1, 177).rem + ($heap$_{funcstart\_719,1}$.p1 % 177))), [-1 < $heap$_{funcstart_719,1}$.p1]: 0 == (−($heap$_{funcstart\_719,1}$.p1 % 177) + div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1, 177).rem))

→ *[from term 96.0, literala < $heap$_{funcstart_719,1}$.p1 is true whenever (-1 + literala) < -1]*

> **Proof of rule precondition:**
>
> *[11.41.0] (-1 + -1) < -1*
>
> → *[simplify]*
>
> *[11.41.2]* **true**

[11.42] ([**false**]: ([0 == ($heap$_{funcstart_719,1}$.p1 % 177)]: 0 == div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1, 177).rem, [!(0 == ($heap$_{funcstart\_719,1}$.p1 % 177))]: 177 == (−div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1, 177).rem + ($heap$_{funcstart\_719,1}$.p1 % 177))), [**true**]: 0 == (−($heap$_{funcstart_719,1}$.p1 % 177) + div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1, 177).rem))

→ *[simplify]*

[11.44] 0 == (−($heap$_{funcstart_719,1}$.p1 % 177) + div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1, 177).rem)

[Create new term from terms 11.44, 72.11 using rule: transitivity 16r]

[97.0] (-15 + 0) < −($heap$_{funcstart_719,1}$.p1 % 177)

→ *[simplify]*

[97.2] ([15 < 177]: ∃ **integer** n • (-1 < ($heap$_{funcstart_719,1}$.p1 + (177 * n))) ∧ (($heap$_{funcstart\_719,1}$.p1 + (177 * n)) < 15), []: **true**)

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

[97.3] ([15 < 177]: ∃ **integer** n • (-1 < ($heap$_{funcstart_719,1}$.p1 + (177 * n))) ∧ (($heap$_{funcstart\_719,1}$.p1 + (177 * n)) < 15), [!(15 < 177)]: **true**)

→ *[simplify]*

[97.12] ∃ **integer** n • (-15 < (−$heap$_{funcstart_719,1}$.p1 + (-177 * n))) ∧ (-1 < ((177 * n) + $heap$_{funcstart_719,1}$.p1))

$\rightarrow$ *[introduce skolem term and eliminate 'exists']*

[97.13] (-15 < ($-\$\text{heap}_{funcstart\_719,1}.\text{p1} + (\text{-177} * \$\text{b\_n}))) \land$ (-1 < ((177 * $\$\text{b\_n}) + \$\text{heap}_{funcstart\_719,1}.\text{p1}))$

$\rightarrow$ *[separate conjunction and work on first sub-term]*

[97.14] -15 < ($-\$\text{heap}_{funcstart\_719,1}.\text{p1} + (\text{-177} * \$\text{b\_n}))$

[Work on sub-term 2 of conjunction in term 97.13]

[98.0] -1 < ((177 * $\$\text{b\_n}) + \$\text{heap}_{funcstart\_719,1}.\text{p1})$

[Copy term 41.0]

[100.0] 63037 < ((-171 * div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}.\text{p1}, 177).\text{rem}) + (2 * \text{div}(\textbf{heapIs} \ \$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}.\text{p1}, 177).\text{quot}))$

$\rightarrow$ *[from term 11.44, div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}.p1$, 177).rem is equal to $\$heap_{funcstart\_719,1}.p1$ % 177]*

[100.1] 63037 < ((-171 * ($\$\text{heap}_{funcstart\_719,1}.\text{p1}$ % 177)) + (2 * div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}.\text{p1}, 177).\text{quot}))$

[Create new term from term 95.0 using rule: condition for equality of division]

[119.0] (0 < (1 + (177 * (0 + $-$div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}.\text{p1}, 177).\text{quot})) + \$\text{heap}_{funcstart\_719,1}.\text{p1})) \land$ ($\$\text{heap}_{funcstart\_719,1}.\text{p1} < (177 * (0 + 1 + \text{div}(\textbf{heapIs} \ \$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}.\text{p1}, 177).\text{quot})))$

$\rightarrow$ *[simplify]*

[119.12] (-1 < ((-177 * div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}.\text{p1}$, 177).quot) + $\$\text{heap}_{funcstart\_719,1}.\text{p1})) \land$ (-177 < ($-\$\text{heap}_{funcstart\_719,1}.\text{p1} +$ (177 * div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}.\text{p1}, 177).\text{quot})))$

$\rightarrow$ *[separate conjunction and work on first sub-term]*

[119.13] -177 < ($-\$\text{heap}_{funcstart\_719,1}.\text{p1} +$ (177 * div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}.\text{p1}, 177).\text{quot}))$

[Work on sub-term 2 of conjunction in term 119.12]

[120.0] -1 < ((-177 * div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}.\text{p1}$, 177).quot) + $\$\text{heap}_{funcstart\_719,1}.\text{p1})$

[Create new term from terms 119.13, 98.0 using rule: transitivity 1]

[121.0] (-177 + -1 + 1) < ((177 * div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}.\text{p1}, 177).\text{quot}) + (177 * \$\text{b\_n}))$

$\rightarrow$ *[simplify]*

[121.1] -177 < ((177 * div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}.\text{p1}$, 177).quot) + (177 * $\$\text{b\_n}))$

$\rightarrow$ *[cancel common factor]*

Proof of rule precondition 1:

[121.1.0.0] $!(0 == 177)$

$\rightarrow$ *[simplify]*

[121.1.0.2] **true**

Proof of rule precondition 2:

[121.1.1.0] $1 < \$\text{gcf}(177, 177)$

$\rightarrow$ *[simplify]*

[121.1.1.2] **true**

[121.2] $(-177 / \$\text{gcf}(177, 177)) < (((177 / \$\text{gcf}(177, 177)) * \text{div}(\textbf{heapIs}$ $\$\text{heap}_{funcstart\_719,1}, \$\text{heap}_{funcstart\_719,1}.\text{p1}, 177).\text{quot}) + ((177 / \$\text{gcf}(177, 177)) * \$\text{b\_n}))$

$\rightarrow$ *[simplify]*

[121.10] $-1 < (\text{div}(\textbf{heapIs}\ \$\text{heap}_{funcstart\_719,1}, \$\text{heap}_{funcstart\_719,1}.\text{p1}, 177).\text{quot} + \$\text{b\_n})$

[Create new term from terms 120.0, 97.14 using rule: transitivity 1]

[123.0] $(-15 + -1 + 1) < ((-177 * \text{div}(\textbf{heapIs}\ \$\text{heap}_{funcstart\_719,1}, \$\text{heap}_{funcstart\_719,1}.\text{p1}, 177).\text{quot}) + (-177 * \$\text{b\_n}))$

$\rightarrow$ *[simplify]*

[123.1] $-15 < ((-177 * \text{div}(\textbf{heapIs}\ \$\text{heap}_{funcstart\_719,1}, \$\text{heap}_{funcstart\_719,1}.\text{p1}, 177).\text{quot}) + (-177 * \$\text{b\_n}))$

$\rightarrow$ *[cancel common factor]*

Proof of rule precondition 1:

[123.1.0.0] $!(-177 == 0)$

$\rightarrow$ *[simplify]*

[123.1.0.2] **true**

Proof of rule precondition 2:

[123.1.1.0] $1 < \$\text{gcf}(-177, -177)$

$\rightarrow$ *[simplify]*

[123.1.1.2] **true**

[123.2] $(-15 / \$\text{gcf}(-177, -177)) < (((-177 / \$\text{gcf}(-177, -177)) * \text{div}(\textbf{heapIs}$ $\$\text{heap}_{funcstart\_719,1}, \$\text{heap}_{funcstart\_719,1}.\text{p1}, 177).\text{quot}) + ((-177 / \$\text{gcf}(-177, -177)) * \$\text{b\_n}))$

$\rightarrow$ *[simplify]*

[123.10] -1 < (−div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot + −$\$b\_n$)

→ *[from term 121.10, -1 < (−div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot + −$\$b\_n$) is true if and only if 0 == (div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot + $\$b\_n$)]*

[123.11] 0 == (div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot + $\$b\_n$)

[Create new term from terms 98.0, 9.9 using rule: transitivity 2]

[118.0] (-32768 + -1 + 1) < (177 * $\$b\_n$)

→ *[simplify]*

[118.1] -32768 < (177 * $\$b\_n$)

→ *[literal comparison of product]*

[118.2] ([177 < 0]: (-32768 / -177) < −$\$b\_n$, [0 < 177]: (-32768 / 177) < $\$b\_n$, [0 == 177]: -32768 < 0)

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

[118.3] ([177 < 0]: (-32768 / -177) < −$\$b\_n$, [(0 < 177) ∧ !(177 < 0)]: (-32768 / 177) < $\$b\_n$, [(0 == 177) ∧ !(0 < 177) ∧ !(177 < 0)]: -32768 < 0)

→ *[simplify]*

[118.11] -186 < $\$b\_n$

→ *[from term 123.11, $\$b\_n$ is equal to −div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot]*

[118.12] -186 < −div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot

[Create new term from terms 118.12, 100.1 using rule: transitivity 5]

[126.0] 63037 < ((-171 * ($\$heap_{funcstart\_719,1}$.p1 % 177)) + (2 * −(-186 + 1)))

→ *[simplify]*

[126.5] 62667 < (-171 * ($\$heap_{funcstart\_719,1}$.p1 % 177))

→ *[literal comparison of product]*

[126.6] ([-171 < 0]: (62667 / 171) < −($\$heap_{funcstart\_719,1}$.p1 % 177), [0 < -171]: (62667 / -171) < ($\$heap_{funcstart\_719,1}$.p1 % 177), [-171 == 0]: 62667 < 0)

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

[126.7] ([-171 < 0]: (62667 / 171) < −($\$heap_{funcstart\_719,1}$.p1 % 177), [(0 < -171) ∧ !(-171 < 0)]: (62667 / -171) < ($\$heap_{funcstart\_719,1}$.p1 % 177), [(-171 == 0) ∧ !(-171 < 0) ∧ !(0 < -171)]: 62667 < 0)

→ *[simplify]*

[126.12] **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 (51,8)

Condition defined at:

To prove: $((\textbf{asType}\textbf{<int>}(\$\text{heap}_{719,1;731,8}.\text{M1}) \ * \ \textbf{asType}\textbf{<int>}(\textbf{static\_cast}\textbf{<integer>}(\textbf{asType}\textbf{<int>}(\$\text{heap}_{719,1;731,8}.\text{p1}) < (\textbf{int})0))) + \textbf{asType}\textbf{<int>}(\$\text{heap}_{719,1;731,8}.\text{p1})) \leq \textbf{maxof}(\textbf{short int})$

Given:

$\$\text{heap}_{init}.\text{LIMIT} == (\textbf{int})80$

$\$\text{heap}_{init}.\text{M1} == \textbf{asType}\textbf{<short int>}((\textbf{int})30269)$

$\$\text{heap}_{init}.\text{r1} == \textbf{asType}\textbf{<short int>}((\textbf{int})171)$

$\$\text{heap}_{init}.\text{a1} == \textbf{asType}\textbf{<short int>}((\textbf{int})177)$

$\$\text{heap}_{init}.\text{b1} == \textbf{asType}\textbf{<short int>}((\textbf{int})2)$

$\$\text{heap}_{init}.\text{M2} == \textbf{asType}\textbf{<short int>}((\textbf{int})30307)$

$\$\text{heap}_{init}.\text{r2} == \textbf{asType}\textbf{<short int>}((\textbf{int})172)$

$\$\text{heap}_{init}.\text{a2} == \textbf{asType}\textbf{<short int>}((\textbf{int})176)$

$\$\text{heap}_{init}.\text{b2} == \textbf{asType}\textbf{<short int>}((\textbf{int})35)$

$\$\text{heap}_{init}.\text{M3} == \textbf{asType}\textbf{<short int>}((\textbf{int})30323)$

$\$\text{heap}_{init}.\text{r3} == \textbf{asType}\textbf{<short int>}((\textbf{int})170)$

$\$\text{heap}_{init}.\text{a3} == \textbf{asType}\textbf{<short int>}((\textbf{int})178)$

$\$\text{heap}_{init}.\text{b3} == \textbf{asType}\textbf{<short int>}((\textbf{int})63)$

$\$\text{heap}_{init}.\text{p1} == \textbf{asType}\textbf{<short int>}((\textbf{int})1)$

$\$\text{heap}_{init}.\text{p2} == \textbf{asType}\textbf{<short int>}((\textbf{int})2)$

$\$\text{heap}_{init}.\text{p3} == \textbf{asType}\textbf{<short int>}((\textbf{int})3)$

$\text{div1} == \text{div}(\textbf{heapIs} \ \$\text{heap}_{funcstart\_719,1}, \textbf{asType}\textbf{<int>}(\$\text{heap}_{funcstart\_719,1}.\text{p1}), \textbf{asType}\textbf{<int>}(\$\text{heap}_{funcstart\_719,1}.\text{a1}))$

$(\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<int>}(\$\text{heap}_{funcstart\_719,1}.\text{p1})) \ / \ \textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<int>}(\$\text{heap}_{funcstart\_719,1}.\text{a1}))) == \textbf{asType}\textbf{<integer>}(\text{div1.quot})$

$(\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<int>}(\$\text{heap}_{funcstart\_719,1}.\text{p1})) \ \% \ \textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<int>}(\$\text{heap}_{funcstart\_719,1}.\text{a1}))) == \textbf{asType}\textbf{<integer>}(\text{div1.rem})$

div2 == div(**heapIs** $\$\mathrm{heap}_{funcstart\_719,1}$,
asType\<int\>($\$\mathrm{heap}_{funcstart\_719,1}$.p2),
asType\<int\>($\$\mathrm{heap}_{funcstart\_719,1}$.a2))

(**asType\<integer\>**(**asType\<int\>**($\$\mathrm{heap}_{funcstart\_719,1}$.p2)) /
asType\<integer\>(**asType\<int\>**($\$\mathrm{heap}_{funcstart\_719,1}$.a2))) ==
asType\<integer\>(div2.quot)

(**asType\<integer\>**(**asType\<int\>**($\$\mathrm{heap}_{funcstart\_719,1}$.p2)) %
asType\<integer\>(**asType\<int\>**($\$\mathrm{heap}_{funcstart\_719,1}$.a2))) ==
asType\<integer\>(div2.rem)

div3 == div(**heapIs** $\$\mathrm{heap}_{funcstart\_719,1}$,
asType\<int\>($\$\mathrm{heap}_{funcstart\_719,1}$.p3),
asType\<int\>($\$\mathrm{heap}_{funcstart\_719,1}$.a3))

(**asType\<integer\>**(**asType\<int\>**($\$\mathrm{heap}_{funcstart\_719,1}$.p3)) /
asType\<integer\>(**asType\<int\>**($\$\mathrm{heap}_{funcstart\_719,1}$.a3))) ==
asType\<integer\>(div3.quot)

(**asType\<integer\>**(**asType\<int\>**($\$\mathrm{heap}_{funcstart\_719,1}$.p3)) %
asType\<integer\>(**asType\<int\>**($\$\mathrm{heap}_{funcstart\_719,1}$.a3))) ==
asType\<integer\>(div3.rem)

$\$\mathrm{heap}_{719,1;729,8}$ == $\$\mathrm{heap}_{funcstart\_719,1}$.**replace**(p1 → **asType\<short
int\>**((**asType\<int\>**(**asType\<short int\>**(div1.rem)) *
asType\<int\>($\$\mathrm{heap}_{funcstart\_719,1}$.r1)) − (**asType\<int\>**(**asType\<short
int\>**(div1.quot)) * **asType\<int\>**($\$\mathrm{heap}_{funcstart\_719,1}$.b1))))

$\$\mathrm{heap}_{719,1;730,8}$ == $\$\mathrm{heap}_{719,1;729,8}$.**replace**(p2 → **asType\<short
int\>**((**asType\<int\>**(**asType\<short int\>**(div2.rem)) *
asType\<int\>($\$\mathrm{heap}_{719,1;729,8}$.r2)) − (**asType\<int\>**(**asType\<short
int\>**(div2.quot)) * **asType\<int\>**($\$\mathrm{heap}_{719,1;729,8}$.b2))))

$\$\mathrm{heap}_{719,1;731,8}$ == $\$\mathrm{heap}_{719,1;730,8}$.**replace**(p3 → **asType\<short
int\>**((**asType\<int\>**(**asType\<short int\>**(div3.rem)) *
asType\<int\>($\$\mathrm{heap}_{719,1;730,8}$.r3)) − (**asType\<int\>**(**asType\<short
int\>**(div3.quot)) * **asType\<int\>**($\$\mathrm{heap}_{719,1;730,8}$.b3))))

Proof:

[Take given term]

[5.0] div1 == div(**heapIs** $\$\mathrm{heap}_{funcstart\_719,1}$,
asType\<int\>($\$\mathrm{heap}_{funcstart\_719,1}$.p1),
asType\<int\>($\$\mathrm{heap}_{funcstart\_719,1}$.a1))

→ *[simplify]*

[5.1] div1 == div(**heapIs** $\$\mathrm{heap}_{funcstart\_719,1}$, $\$\mathrm{heap}_{funcstart\_719,1}$.p1,
asType\<int\>($\$\mathrm{heap}_{funcstart\_719,1}$.a1))

→ *[const static or extern object]*

[5.2] div1 == div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1,
asType<int>($\$heap_{init}$.a1))

→ *[expand definition of constant 'a1' at prang.c (16,20)]*

[5.3] div1 == div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1,
asType<int>(**asType<short int>**((**int**)177)))

→ *[simplify]*

[5.6] div1 == div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177)

[Assume known post-assertion, class invariant or type constraint for term 5.6]

[8.0] **minof(short int)** ≤ $\$heap_{funcstart\_719,1}$.p1

→ *[simplify]*

[8.3] -32769 < $\$heap_{funcstart\_719,1}$.p1

[Assume known post-assertion, class invariant or type constraint for term 5.6]

[10.0] (**asType<integer>**($\$heap_{funcstart\_719,1}$.p1) /
asType<integer>(177)) == **asType<integer>**(div(**heapIs**
$\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot)

→ *[simplify]*

[10.2] ($\$heap_{funcstart\_719,1}$.p1 / 177) == **asType<integer>**(div(**heapIs**
$\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot)

→ *[expand definition of operator './' in class 'int' at built in declaration]*

[10.3] ([**asType<integer>**($\$heap_{funcstart\_719,1}$.p1) < 0]:
−(−**asType<integer>**($\$heap_{funcstart\_719,1}$.p1) / 177), []:
asType<integer>($\$heap_{funcstart\_719,1}$.p1) / 177) ==
asType<integer>(div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1,
177).quot)

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

[10.4] ([**asType<integer>**($\$heap_{funcstart\_719,1}$.p1) < 0]:
−(−**asType<integer>**($\$heap_{funcstart\_719,1}$.p1) / 177),
[!(**asType<integer>**($\$heap_{funcstart\_719,1}$.p1) < 0)]:
asType<integer>($\$heap_{funcstart\_719,1}$.p1) / 177) ==
asType<integer>(div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1,
177).quot)

→ *[simplify]*

[10.17] 0 == (−([0 < −$\$heap_{funcstart\_719,1}$.p1]: −(−$\$heap_{funcstart\_719,1}$.p1 /
177), [-1 < $\$heap_{funcstart\_719,1}$.p1]: $\$heap_{funcstart\_719,1}$.p1 / 177) +
div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot)

→ *[move guard outside expression]*

[10.18] 0 == (((0 < −$\$heap_{funcstart\_719,1}$.p1]: −(−(−$\$heap_{funcstart\_719,1}$.p1 /

177)), [-1 < \$heap$_{funcstart\_719,1}$.p1]: $-$(\$heap$_{funcstart\_719,1}$.p1 / 177)) + div(**heapIs** \$heap$_{funcstart\_719,1}$, \$heap$_{funcstart\_719,1}$.p1, 177).quot)

$\rightarrow$ *[simplify]*

[10.19] 0 == ((([0 < $-$\$heap$_{funcstart\_719,1}$.p1]: $-$\$heap$_{funcstart\_719,1}$.p1 / 177, [-1 < \$heap$_{funcstart\_719,1}$.p1]: $-$(\$heap$_{funcstart\_719,1}$.p1 / 177)) + div(**heapIs** \$heap$_{funcstart\_719,1}$, \$heap$_{funcstart\_719,1}$.p1, 177).quot)

$\rightarrow$ *[move guard outside expression]*

[10.21] ([0 < $-$\$heap$_{funcstart\_719,1}$.p1]: 0 == (($-$\$heap$_{funcstart\_719,1}$.p1 / 177) + div(**heapIs** \$heap$_{funcstart\_719,1}$, \$heap$_{funcstart\_719,1}$.p1, 177).quot), [-1 < \$heap$_{funcstart\_719,1}$.p1]: 0 == ($-$(\$heap$_{funcstart\_719,1}$.p1 / 177) + div(**heapIs** \$heap$_{funcstart\_719,1}$, \$heap$_{funcstart\_719,1}$.p1, 177).quot))

[Assume known post-assertion, class invariant or type constraint for term 5.6]

[11.0] (**asType**<**integer**>(\$heap$_{funcstart\_719,1}$.p1) % **asType**<**integer**>(177)) == **asType**<**integer**>(div(**heapIs** \$heap$_{funcstart\_719,1}$, \$heap$_{funcstart\_719,1}$.p1, 177).rem)

$\rightarrow$ *[simplify]*

[11.2] (\$heap$_{funcstart\_719,1}$.p1 % 177) == **asType**<**integer**>(div(**heapIs** \$heap$_{funcstart\_719,1}$, \$heap$_{funcstart\_719,1}$.p1, 177).rem)

$\rightarrow$ *[expand definition of operator '.%' in class 'int' at built in declaration]*

[11.3] ([**asType**<**integer**>(\$heap$_{funcstart\_719,1}$.p1) < 0]: $-$($-$**asType**<**integer**>(\$heap$_{funcstart\_719,1}$.p1) % 177), []: **asType**<**integer**>(\$heap$_{funcstart\_719,1}$.p1) % 177) == **asType**<**integer**>(div(**heapIs** \$heap$_{funcstart\_719,1}$, \$heap$_{funcstart\_719,1}$.p1, 177).rem)

$\rightarrow$ *[explicitly assert falsehood of skipped guards in subsequent guards]*

[11.4] ([**asType**<**integer**>(\$heap$_{funcstart\_719,1}$.p1) < 0]: $-$($-$**asType**<**integer**>(\$heap$_{funcstart\_719,1}$.p1) % 177), [!(**asType**<**integer**>(\$heap$_{funcstart\_719,1}$.p1) < 0)]: **asType**<**integer**>(\$heap$_{funcstart\_719,1}$.p1) % 177) == **asType**<**integer**>(div(**heapIs** \$heap$_{funcstart\_719,1}$, \$heap$_{funcstart\_719,1}$.p1, 177).rem)

$\rightarrow$ *[simplify]*

[11.14] ([0 < $-$\$heap$_{funcstart\_719,1}$.p1]: $-$($-$\$heap$_{funcstart\_719,1}$.p1 % 177), [-1 < \$heap$_{funcstart\_719,1}$.p1]: **asType**<**integer**>(\$heap$_{funcstart\_719,1}$.p1) % 177) == **asType**<**integer**>(div(**heapIs** \$heap$_{funcstart\_719,1}$, \$heap$_{funcstart\_719,1}$.p1, 177).rem)

$\rightarrow$ *[remainder of negation]*

[11.15] ([0 < $-$\$heap$_{funcstart\_719,1}$.p1]: $-$([0 == (\$heap$_{funcstart\_719,1}$.p1 % 177)]: 0, []: 177 + $-$(\$heap$_{funcstart\_719,1}$.p1 % 177)), [-1 <

$heap_{funcstart\_719,1}.p1$]: **asType\<integer\>**($heap_{funcstart\_719,1}.p1$) % 177)
== **asType\<integer\>**(div(**heapIs** $heap_{funcstart\_719,1}$,
$heap_{funcstart\_719,1}.p1$, 177).rem)

$\rightarrow$ *[explicitly assert falsehood of skipped guards in subsequent guards]*

[11.16] ([0 < $-$heap_{funcstart_719,1}.p1$]: $-$([0 == ($heap_{funcstart\_719,1}.p1$ %
177)]: 0, [!(0 == ($heap_{funcstart\_719,1}.p1$ % 177))]: 177 +
$-$($heap_{funcstart\_719,1}.p1$ % 177)), [-1 < $heap_{funcstart\_719,1}.p1$]:
asType\<integer\>($heap_{funcstart\_719,1}.p1$) % 177) ==
asType\<integer\>(div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}.p1$,
177).rem)

$\rightarrow$ *[move guard outside expression]*

[11.17] ([0 < $-$heap_{funcstart_719,1}.p1$]: ([0 == ($heap_{funcstart_719,1}.p1$ %
177)]: $-$0, [!(0 == ($heap_{funcstart_719,1}.p1$ % 177))]: $-$(177 +
$-$($heap_{funcstart\_719,1}.p1$ % 177))), [-1 < $heap_{funcstart\_719,1}.p1$]:
asType\<integer\>($heap_{funcstart\_719,1}.p1$) % 177) ==
asType\<integer\>(div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}.p1$,
177).rem)

$\rightarrow$ *[simplify]*

[11.24] 0 == ($-$([0 < $-$heap_{funcstart_719,1}.p1$]: ([0 ==
($heap_{funcstart\_719,1}.p1$ % 177)]: 0, [!(0 == ($heap_{funcstart\_719,1}.p1$ % 177))]:
-177 + ($heap_{funcstart\_719,1}.p1$ % 177)), [-1 < $heap_{funcstart\_719,1}.p1$]:
$heap_{funcstart\_719,1}.p1$ % 177) + div(**heapIs** $heap_{funcstart\_719,1}$,
$heap_{funcstart\_719,1}.p1$, 177).rem)

$\rightarrow$ *[move guard outside expression]*

[11.26] 0 == (([0 < $-$heap_{funcstart_719,1}.p1$]: ([0 == ($heap_{funcstart_719,1}.p1$
% 177)]: $-$0, [!(0 == ($heap_{funcstart_719,1}.p1$ % 177))]: $-$(-177 +
($heap_{funcstart\_719,1}.p1$ % 177))), [-1 < $heap_{funcstart\_719,1}.p1$]:
$-$($heap_{funcstart\_719,1}.p1$ % 177)) + div(**heapIs** $heap_{funcstart\_719,1}$,
$heap_{funcstart\_719,1}.p1$, 177).rem)

$\rightarrow$ *[simplify]*

[11.29] 0 == (([0 < $-$heap_{funcstart_719,1}.p1$]: ([0 == ($heap_{funcstart_719,1}.p1$
% 177)]: 0, [!(0 == ($heap_{funcstart\_719,1}.p1$ % 177))]: 177 +
$-$($heap_{funcstart\_719,1}.p1$ % 177)), [-1 < $heap_{funcstart\_719,1}.p1$]:
$-$($heap_{funcstart\_719,1}.p1$ % 177)) + div(**heapIs** $heap_{funcstart\_719,1}$,
$heap_{funcstart\_719,1}.p1$, 177).rem)

$\rightarrow$ *[move guard outside expression]*

[11.31] 0 == ([0 < $-$heap_{funcstart_719,1}.p1$]: ([0 == ($heap_{funcstart_719,1}.p1$ %
177)]: 0 + div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}.p1$, 177).rem,
[!(0 == ($heap_{funcstart\_719,1}.p1$ % 177))]: (177 + $-$($heap_{funcstart\_719,1}.p1$ %
177)) + div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}.p1$, 177).rem), [-1
< $heap_{funcstart\_719,1}.p1$]: $-$($heap_{funcstart\_719,1}.p1$ % 177) + div(**heapIs**

$\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p1, 177).rem)

$\rightarrow$ *[simplify]*

[11.33] 0 == ([0 < $-\text{\$heap}_{funcstart\_719,1}$.p1]: ([0 == ($\text{\$heap}_{funcstart\_719,1}$.p1 % 177)]: div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p1, 177).rem, [!(0 == ($\text{\$heap}_{funcstart\_719,1}$.p1 % 177))]: 177 + $-$($\text{\$heap}_{funcstart\_719,1}$.p1 % 177) + div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p1, 177).rem), [-1 < $\text{\$heap}_{funcstart\_719,1}$.p1]: $-$($\text{\$heap}_{funcstart\_719,1}$.p1 % 177) + div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p1, 177).rem)

$\rightarrow$ *[move guard outside expression]*

[11.35] ([0 < $-\text{\$heap}_{funcstart\_719,1}$.p1]: ([0 == ($\text{\$heap}_{funcstart\_719,1}$.p1 % 177)]: 0 == div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p1, 177).rem, [!(0 == ($\text{\$heap}_{funcstart\_719,1}$.p1 % 177))]: 0 == (177 + $-$($\text{\$heap}_{funcstart\_719,1}$.p1 % 177) + div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p1, 177).rem)), [-1 < $\text{\$heap}_{funcstart\_719,1}$.p1]: 0 == ($-$($\text{\$heap}_{funcstart\_719,1}$.p1 % 177) + div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p1, 177).rem))

$\rightarrow$ *[simplify]*

[11.40] ([0 < $-\text{\$heap}_{funcstart\_719,1}$.p1]: ([0 == ($\text{\$heap}_{funcstart\_719,1}$.p1 % 177)]: 0 == div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p1, 177).rem, [!(0 == ($\text{\$heap}_{funcstart\_719,1}$.p1 % 177))]: 177 == (($\text{\$heap}_{funcstart\_719,1}$.p1 % 177) + $-$div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p1, 177).rem)), [-1 < $\text{\$heap}_{funcstart\_719,1}$.p1]: 0 == ($-$($\text{\$heap}_{funcstart\_719,1}$.p1 % 177) + div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p1, 177).rem))

[Take given term]

[12.0] div2 == div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, **asType**<**int**>($\text{\$heap}_{funcstart\_719,1}$.p2), **asType**<**int**>($\text{\$heap}_{funcstart\_719,1}$.a2))

$\rightarrow$ *[simplify]*

[12.1] div2 == div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p2, **asType**<**int**>($\text{\$heap}_{funcstart\_719,1}$.a2))

$\rightarrow$ *[const static or extern object]*

[12.2] div2 == div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p2, **asType**<**int**>($\text{\$heap}_{init}$.a2))

$\rightarrow$ *[expand definition of constant 'a2' at prang.c (21,20)]*

[12.3] div2 == div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p2, **asType**<**int**>(**asType**<**short int**>((**int**)176)))

$\rightarrow$ *[simplify]*

[12.6] div2 == div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p2, 176)

[Take given term]

[19.0] div3 == div(**heapIs** $\$heap_{funcstart\_719,1}$,
asType\<int\>($\$heap_{funcstart\_719,1}$.p3),
asType\<int\>($\$heap_{funcstart\_719,1}$.a3))

→ *[simplify]*

[19.1] div3 == div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p3,
asType\<int\>($\$heap_{funcstart\_719,1}$.a3))

→ *[const static or extern object]*

[19.2] div3 == div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p3,
asType\<int\>($\$heap_{init}$.a3))

→ *[expand definition of constant 'a3' at prang.c (26,20)]*

[19.3] div3 == div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p3,
asType\<int\>(**asType\<short int\>**((**int**)178)))

→ *[simplify]*

[19.6] div3 == div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p3, 178)

[Take given term]

[26.0] $\$heap_{719,1;729,8}$ == $\$heap_{funcstart\_719,1}$.**replace**(p1 → **asType\<short
int\>**((**asType\<int\>**(**asType\<short int\>**(div1.rem)) *
asType\<int\>($\$heap_{funcstart\_719,1}$.r1)) − (**asType\<int\>**(**asType\<short
int\>**(div1.quot)) * **asType\<int\>**($\$heap_{funcstart\_719,1}$.b1)))))

→ *[from term 5.6, div1 is equal to div(**heapIs** $\$heap_{funcstart\_719,1}$,
$\$heap_{funcstart\_719,1}$.p1, 177)]*

[26.1] $\$heap_{719,1;729,8}$ == $\$heap_{funcstart\_719,1}$.**replace**(p1 → **asType\<short
int\>**((**asType\<int\>**(**asType\<short int\>**(div(**heapIs** $\$heap_{funcstart\_719,1}$,
$\$heap_{funcstart\_719,1}$.p1, 177).rem)) * **asType\<int\>**($\$heap_{funcstart\_719,1}$.r1)) −
(**asType\<int\>**(**asType\<short int\>**(div1.quot)) *
asType\<int\>($\$heap_{funcstart\_719,1}$.b1)))))

→ *[simplify]*

[26.3] $\$heap_{719,1;729,8}$ == $\$heap_{funcstart\_719,1}$.**replace**(p1 → **asType\<short
int\>**((div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).rem *
asType\<int\>($\$heap_{funcstart\_719,1}$.r1)) − (**asType\<int\>**(**asType\<short
int\>**(div1.quot)) * **asType\<int\>**($\$heap_{funcstart\_719,1}$.b1)))))

→ *[const static or extern object]*

[26.4] $\$heap_{719,1;729,8}$ == $\$heap_{funcstart\_719,1}$.**replace**(p1 → **asType\<short
int\>**((div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).rem *
asType\<int\>($\$heap_{init}$.r1)) − (**asType\<int\>**(**asType\<short
int\>**(div1.quot)) * **asType\<int\>**($\$heap_{funcstart\_719,1}$.b1)))))

→ *[expand definition of constant 'r1' at prang.c (15,20)]*

[26.5] $\$heap_{719,1;729,8}$ == $\$heap_{funcstart\_719,1}$.**replace**(p1 → **asType\<short

int>((div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).rem *
asType<**int**>(**asType**<**short int**>((**int**)171))) −
(**asType**<**int**>(**asType**<**short int**>(div1.quot)) *
asType<**int**>($\$heap_{funcstart\_719,1}$.b1))))

→ *[simplify]*

[26.8] $\$heap_{719,1;729,8}$ == $\$heap_{funcstart\_719,1}$.**replace**(p1 → **asType**<**short
int**>((div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).rem * 171)
− (**asType**<**int**>(**asType**<**short int**>(div1.quot)) *
asType<**int**>($\$heap_{funcstart\_719,1}$.b1))))

→ *[from term 5.6, div1 is equal to div(**heapIs** $\$heap_{funcstart\_719,1}$,
$\$heap_{funcstart\_719,1}$.p1, 177)]*

[26.9] $\$heap_{719,1;729,8}$ == $\$heap_{funcstart\_719,1}$.**replace**(p1 → **asType**<**short
int**>((171 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).rem)
− (**asType**<**int**>(**asType**<**short int**>(div(**heapIs** $\$heap_{funcstart\_719,1}$,
$\$heap_{funcstart\_719,1}$.p1, 177).quot)) *
asType<**int**>($\$heap_{funcstart\_719,1}$.b1))))

→ *[simplify]*

[26.11] $\$heap_{719,1;729,8}$ == $\$heap_{funcstart\_719,1}$.**replace**(p1 → **asType**<**short
int**>((171 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).rem)
− (div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot *
asType<**int**>($\$heap_{funcstart\_719,1}$.b1))))

→ *[const static or extern object]*

[26.12] $\$heap_{719,1;729,8}$ == $\$heap_{funcstart\_719,1}$.**replace**(p1 → **asType**<**short
int**>((171 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).rem)
− (div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot *
asType<**int**>($\$heap_{init}$.b1))))

→ *[expand definition of constant 'b1' at prang.c (17,20)]*

[26.13] $\$heap_{719,1;729,8}$ == $\$heap_{funcstart\_719,1}$.**replace**(p1 → **asType**<**short
int**>((171 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).rem)
− (div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot *
asType<**int**>(**asType**<**short int**>((**int**)2)))))

→ *[simplify]*

[26.19] $\$heap_{719,1;729,8}$ == $\$heap_{funcstart\_719,1}$.**replace**(p1 → ((-2 *
div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).rem)))

[Take given term]

[31.0] $\$heap_{719,1;730,8}$ == $\$heap_{719,1;729,8}$.**replace**(p2 → **asType**<**short
int**>((**asType**<**int**>(**asType**<**short int**>(div2.rem)) *
asType<**int**>($\$heap_{719,1;729,8}$.r2)) − (**asType**<**int**>(**asType**<**short
int**>(div2.quot)) * **asType**<**int**>($\$heap_{719,1;729,8}$.b2))))

$\rightarrow$ *[from term 26.19, $\$heap_{719,1;729,8}$ is equal to $\$heap_{funcstart\_719,1}$.__replace*$(p1 \rightarrow$ *(-2 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).rem))]*

[31.1] $\$heap_{719,1;730,8}$ == $\$heap_{funcstart\_719,1}$.__**replace**(p1 $\rightarrow$ ((-2 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).rem))).__**replace**(p2 $\rightarrow$ **asType<short int>**((**asType<int>**(**asType<short int>**(div2.rem)) * **asType<int>**($\$heap_{719,1;729,8}$.r2)) $-$ (**asType<int>**(**asType<short int>**(div2.quot)) * **asType<int>**($\$heap_{719,1;729,8}$.b2))))

$\rightarrow$ *[from term 12.6, div2 is equal to div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176)]*

[31.2] $\$heap_{719,1;730,8}$ == $\$heap_{funcstart\_719,1}$.__**replace**(p1 $\rightarrow$ ((-2 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).rem))).__**replace**(p2 $\rightarrow$ **asType<short int>**((**asType<int>**(**asType<short int>**(div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).rem)) * **asType<int>**($\$heap_{719,1;729,8}$.r2)) $-$ (**asType<int>**(**asType<short int>**(div2.quot)) * **asType<int>**($\$heap_{719,1;729,8}$.b2))))

$\rightarrow$ *[simplify]*

[31.4] $\$heap_{719,1;730,8}$ == $\$heap_{funcstart\_719,1}$.__**replace**(p1 $\rightarrow$ ((-2 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).rem))).__**replace**(p2 $\rightarrow$ **asType<short int>**((div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).rem * **asType<int>**($\$heap_{719,1;729,8}$.r2)) $-$ (**asType<int>**(**asType<short int>**(div2.quot)) * **asType<int>**($\$heap_{719,1;729,8}$.b2))))

$\rightarrow$ *[from term 26.19, $\$heap_{719,1;729,8}$ is equal to $\$heap_{funcstart\_719,1}$.__replace*$(p1 \rightarrow$ *(-2 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).rem))]*

[31.5] $\$heap_{719,1;730,8}$ == $\$heap_{funcstart\_719,1}$.__**replace**(p1 $\rightarrow$ ((-2 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).rem))).__**replace**(p2 $\rightarrow$ **asType<short int>**((div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).rem * **asType<int>**($\$heap_{funcstart\_719,1}$.__**replace**(p1 $\rightarrow$ ((-2 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).rem))).r2)) $-$ (**asType<int>**(**asType<short int>**(div2.quot)) * **asType<int>**($\$heap_{719,1;729,8}$.b2))))

$\rightarrow$ *[const member of object with modified fields]*

[31.6] $\$\text{heap}_{719,1;730,8}$ == $\$\text{heap}_{funcstart\_719,1}.\textbf{replace}(\text{p1} \rightarrow ((\text{-2} *$
div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}.\text{p1}$, 177).quot) + (171 *
div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}.\text{p1}$,
177).rem))).$\textbf{replace}(\text{p2} \rightarrow \textbf{asType}<\textbf{short int}>((\text{div}(\textbf{heapIs}$
$\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}.\text{p2}$, 176).rem *
asType<**int**>($\$\text{heap}_{funcstart\_719,1}.\text{r2}$)) − (**asType**<**int**>(**asType**<**short
int**>(div2.quot)) * **asType**<**int**>($\$\text{heap}_{719,1;729,8}.\text{b2}$))))

$\rightarrow$ *[const static or extern object]*

[31.7] $\$\text{heap}_{719,1;730,8}$ == $\$\text{heap}_{funcstart\_719,1}.\textbf{replace}(\text{p1} \rightarrow ((\text{-2} *$
div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}.\text{p1}$, 177).quot) + (171 *
div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}.\text{p1}$,
177).rem))).$\textbf{replace}(\text{p2} \rightarrow \textbf{asType}<\textbf{short int}>((\text{div}(\textbf{heapIs}$
$\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}.\text{p2}$, 176).rem *
asType<**int**>($\$\text{heap}_{init}.\text{r2}$)) − (**asType**<**int**>(**asType**<**short
int**>(div2.quot)) * **asType**<**int**>($\$\text{heap}_{719,1;729,8}.\text{b2}$))))

$\rightarrow$ *[expand definition of constant 'r2' at prang.c (20,20)]*

[31.8] $\$\text{heap}_{719,1;730,8}$ == $\$\text{heap}_{funcstart\_719,1}.\textbf{replace}(\text{p1} \rightarrow ((\text{-2} *$
div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}.\text{p1}$, 177).quot) + (171 *
div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}.\text{p1}$,
177).rem))).$\textbf{replace}(\text{p2} \rightarrow \textbf{asType}<\textbf{short int}>((\text{div}(\textbf{heapIs}$
$\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}.\text{p2}$, 176).rem *
asType<**int**>(**asType**<**short int**>((**int**)172))) −
(**asType**<**int**>(**asType**<**short int**>(div2.quot)) *
asType<**int**>($\$\text{heap}_{719,1;729,8}.\text{b2}$))))

$\rightarrow$ *[simplify]*

[31.11] $\$\text{heap}_{719,1;730,8}$ == $\$\text{heap}_{funcstart\_719,1}.\textbf{replace}(\text{p1} \rightarrow ((\text{-2} *$
div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}.\text{p1}$, 177).quot) + (171 *
div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}.\text{p1}$,
177).rem))).$\textbf{replace}(\text{p2} \rightarrow \textbf{asType}<\textbf{short int}>((\text{div}(\textbf{heapIs}$
$\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}.\text{p2}$, 176).rem * 172) −
(**asType**<**int**>(**asType**<**short int**>(div2.quot)) *
asType<**int**>($\$\text{heap}_{719,1;729,8}.\text{b2}$))))

$\rightarrow$ *[from term 12.6, div2 is equal to div(**heapIs** $\$heap_{funcstart\_719,1}$,
$\$heap_{funcstart\_719,1}.p2$, 176)]*

[31.12] $\$\text{heap}_{719,1;730,8}$ == $\$\text{heap}_{funcstart\_719,1}.\textbf{replace}(\text{p1} \rightarrow ((\text{-2} *$
div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}.\text{p1}$, 177).quot) + (171 *
div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}.\text{p1}$,
177).rem))).$\textbf{replace}(\text{p2} \rightarrow \textbf{asType}<\textbf{short int}>((172 * \text{div}(\textbf{heapIs}$
$\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}.\text{p2}$, 176).rem) −
(**asType**<**int**>(**asType**<**short int**>(div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$,
$\$\text{heap}_{funcstart\_719,1}.\text{p2}$, 176).quot)) * **asType**<**int**>($\$\text{heap}_{719,1;729,8}.\text{b2}$))))

→ *[simplify]*

[31.14] $\$heap_{719,1;730,8}$ == $\$heap_{funcstart\_719,1}$._**replace**(p1 → ((-2 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).rem)))._**replace**(p2 → **asType**<**short int**>((172 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).rem) − (div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).quot * **asType**<**int**>($\$heap_{719,1;729,8}$.b2))))

→ *[from term 26.19, $\$heap_{719,1;729,8}$ is equal to $\$heap_{funcstart\_719,1}$._**replace**(p1 → (-2 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).rem))]*

[31.15] $\$heap_{719,1;730,8}$ == $\$heap_{funcstart\_719,1}$._**replace**(p1 → ((-2 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).rem)))._**replace**(p2 → **asType**<**short int**>((172 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).rem) − (div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).quot * **asType**<**int**>($\$heap_{funcstart\_719,1}$._**replace**(p1 → ((-2 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).rem))).b2))))

→ *[const member of object with modified fields]*

[31.16] $\$heap_{719,1;730,8}$ == $\$heap_{funcstart\_719,1}$._**replace**(p1 → ((-2 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).rem)))._**replace**(p2 → **asType**<**short int**>((172 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).rem) − (div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).quot * **asType**<**int**>($\$heap_{funcstart\_719,1}$.b2))))

→ *[const static or extern object]*

[31.17] $\$heap_{719,1;730,8}$ == $\$heap_{funcstart\_719,1}$._**replace**(p1 → ((-2 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).rem)))._**replace**(p2 → **asType**<**short int**>((172 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).rem) − (div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).quot * **asType**<**int**>($\$heap_{init}$.b2))))

→ *[expand definition of constant 'b2' at prang.c (22,20)]*

[31.18] $\$heap_{719,1;730,8}$ == $\$heap_{funcstart\_719,1}$._**replace**(p1 → ((-2 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).rem)))._**replace**(p2 → **asType**<**short int**>((172 * div(**heapIs**

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$\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p2, 176).rem) $-$ (div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p2, 176).quot *
asType<int>(asType<short int>((int)35)))))

$\rightarrow$ *[simplify]*

[31.24] $\text{\$heap}_{719,1;730,8}$ == $\text{\$heap}_{funcstart\_719,1}$.**replace**(p1 $\rightarrow$ ((-2 *
div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p1,
177).rem))).**replace**(p2 $\rightarrow$ ((-35 * div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$,
$\text{\$heap}_{funcstart\_719,1}$.p2, 176).quot) + (172 * div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$,
$\text{\$heap}_{funcstart\_719,1}$.p2, 176).rem)))

[Take given term]

[36.0] $\text{\$heap}_{719,1;731,8}$ == $\text{\$heap}_{719,1;730,8}$.**replace**(p3 $\rightarrow$ **asType<short
int>((asType<int>(asType<short int>(div3.rem)) *
asType<int>($\text{\$heap}_{719,1;730,8}$.r3)) $-$ (asType<int>(asType<short
int>(div3.quot)) * asType<int>($\text{\$heap}_{719,1;730,8}$.b3))))**

$\rightarrow$ *[from term 31.24, $\text{\$heap}_{719,1;730,8}$ is equal to*
*$\text{\$heap}_{funcstart\_719,1}$.**replace**(p1 $\rightarrow$ ((-2 * div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$,*
*$\text{\$heap}_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$,*
*$\text{\$heap}_{funcstart\_719,1}$.p1, 177).rem))).**replace**(p2 $\rightarrow$ (-35 * div(**heapIs***
*$\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p2, 176).quot) + (172 * div(**heapIs***
$\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p2, 176).rem))]

[36.1] $\text{\$heap}_{719,1;731,8}$ == $\text{\$heap}_{funcstart\_719,1}$.**replace**(p1 $\rightarrow$ ((-2 *
div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p1,
177).rem))).**replace**(p2 $\rightarrow$ ((-35 * div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$,
$\text{\$heap}_{funcstart\_719,1}$.p2, 176).quot) + (172 * div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$,
$\text{\$heap}_{funcstart\_719,1}$.p2, 176).rem))).**replace**(p3 $\rightarrow$ **asType<short
int>((asType<int>(asType<short int>(div3.rem)) *
asType<int>($\text{\$heap}_{719,1;730,8}$.r3)) $-$ (asType<int>(asType<short
int>(div3.quot)) * asType<int>($\text{\$heap}_{719,1;730,8}$.b3))))**

$\rightarrow$ *[from term 19.6, div3 is equal to div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$,*
$\text{\$heap}_{funcstart\_719,1}$.p3, 178)]

[36.2] $\text{\$heap}_{719,1;731,8}$ == $\text{\$heap}_{funcstart\_719,1}$.**replace**(p1 $\rightarrow$ ((-2 *
div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p1,
177).rem))).**replace**(p2 $\rightarrow$ ((-35 * div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$,
$\text{\$heap}_{funcstart\_719,1}$.p2, 176).quot) + (172 * div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$,
$\text{\$heap}_{funcstart\_719,1}$.p2, 176).rem))).**replace**(p3 $\rightarrow$ **asType<short
int>((asType<int>(asType<short int>(div(heapIs** $\text{\$heap}_{funcstart\_719,1}$,
$\text{\$heap}_{funcstart\_719,1}$.p3, 178).rem)) * **asType<int>**($\text{\$heap}_{719,1;730,8}$.r3)) $-$
(**asType<int>(asType<short int>(div3.quot))** *
asType<int>($\text{\$heap}_{719,1;730,8}$.b3))))

$\rightarrow$ *[simplify]*

[36.4] $\text{\$heap}_{719,1;731,8}$ == $\text{\$heap}_{funcstart\_719,1}.\textbf{replace}(\text{p1} \rightarrow ((\text{-2} *$ div($\textbf{heapIs}$ $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}.\text{p1}$, 177).quot) + (171 * div($\textbf{heapIs}$ $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}.\text{p1}$, 177).rem)))$.\textbf{replace}(\text{p2} \rightarrow ((\text{-35} *$ div($\textbf{heapIs}$ $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}.\text{p2}$, 176).quot) + (172 * div($\textbf{heapIs}$ $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}.\text{p2}$, 176).rem)))$.\textbf{replace}(\text{p3} \rightarrow \textbf{asType}\langle\textbf{short int}\rangle$((div($\textbf{heapIs}$ $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}.\text{p3}$, 178).rem * $\textbf{asType}\langle\textbf{int}\rangle$($\text{\$heap}_{719,1;730,8}.\text{r3}$)) $-$ ($\textbf{asType}\langle\textbf{int}\rangle$($\textbf{asType}\langle\textbf{short int}\rangle$(div3.quot)) * $\textbf{asType}\langle\textbf{int}\rangle$($\text{\$heap}_{719,1;730,8}.\text{b3}$)))))

$\rightarrow$ *[from term 31.24, $\text{\$heap}_{719,1;730,8}$ is equal to $\text{\$heap}_{funcstart\_719,1}.\textbf{replace}(\text{p1} \rightarrow ((\text{-2} *$ div($\textbf{heapIs}$ $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}.\text{p1}$, 177).quot) + (171 * div($\textbf{heapIs}$ $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}.\text{p1}$, 177).rem)))$.\textbf{replace}(\text{p2} \rightarrow (\text{-35} *$ div($\textbf{heapIs}$ $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}.\text{p2}$, 176).quot) + (172 * div($\textbf{heapIs}$ $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}.\text{p2}$, 176).rem))]*

[36.5] $\text{\$heap}_{719,1;731,8}$ == $\text{\$heap}_{funcstart\_719,1}.\textbf{replace}(\text{p1} \rightarrow ((\text{-2} *$ div($\textbf{heapIs}$ $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}.\text{p1}$, 177).quot) + (171 * div($\textbf{heapIs}$ $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}.\text{p1}$, 177).rem)))$.\textbf{replace}(\text{p2} \rightarrow ((\text{-35} *$ div($\textbf{heapIs}$ $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}.\text{p2}$, 176).quot) + (172 * div($\textbf{heapIs}$ $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}.\text{p2}$, 176).rem)))$.\textbf{replace}(\text{p3} \rightarrow \textbf{asType}\langle\textbf{short int}\rangle$((div($\textbf{heapIs}$ $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}.\text{p3}$, 178).rem * $\textbf{asType}\langle\textbf{int}\rangle$($\text{\$heap}_{funcstart\_719,1}.\textbf{replace}(\text{p1} \rightarrow ((\text{-2} *$ div($\textbf{heapIs}$ $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}.\text{p1}$, 177).quot) + (171 * div($\textbf{heapIs}$ $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}.\text{p1}$, 177).rem)))$.\textbf{replace}(\text{p2} \rightarrow ((\text{-35} *$ div($\textbf{heapIs}$ $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}.\text{p2}$, 176).quot) + (172 * div($\textbf{heapIs}$ $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}.\text{p2}$, 176).rem))).r3$)) $-$ ($\textbf{asType}\langle\textbf{int}\rangle$($\textbf{asType}\langle\textbf{short int}\rangle$(div3.quot)) * $\textbf{asType}\langle\textbf{int}\rangle$($\text{\$heap}_{719,1;730,8}.\text{b3}$)))))

$\rightarrow$ *[const member of object with modified fields]*

[36.7] $\text{\$heap}_{719,1;731,8}$ == $\text{\$heap}_{funcstart\_719,1}.\textbf{replace}(\text{p1} \rightarrow ((\text{-2} *$ div($\textbf{heapIs}$ $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}.\text{p1}$, 177).quot) + (171 * div($\textbf{heapIs}$ $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}.\text{p1}$, 177).rem)))$.\textbf{replace}(\text{p2} \rightarrow ((\text{-35} *$ div($\textbf{heapIs}$ $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}.\text{p2}$, 176).quot) + (172 * div($\textbf{heapIs}$ $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}.\text{p2}$, 176).rem)))$.\textbf{replace}(\text{p3} \rightarrow \textbf{asType}\langle\textbf{short int}\rangle$((div($\textbf{heapIs}$ $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}.\text{p3}$, 178).rem * $\textbf{asType}\langle\textbf{int}\rangle$($\text{\$heap}_{funcstart\_719,1}.\text{r3}$)) $-$ ($\textbf{asType}\langle\textbf{int}\rangle$($\textbf{asType}\langle\textbf{short int}\rangle$(div3.quot)) * $\textbf{asType}\langle\textbf{int}\rangle$($\text{\$heap}_{719,1;730,8}.\text{b3}$)))))

$\rightarrow$ *[const static or extern object]*

[36.8] $\text{\$heap}_{719,1;731,8}$ == $\text{\$heap}_{funcstart\_719,1}.\textbf{replace}(\text{p1} \rightarrow ((\text{-2} *$ div($\textbf{heapIs}$ $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}.\text{p1}$, 177).quot) + (171 *

div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1,
177).rem))). **replace**(p2 → ((-35 * div(**heapIs** $\$heap_{funcstart\_719,1}$,
$\$heap_{funcstart\_719,1}$.p2, 176).quot) + (172 * div(**heapIs** $\$heap_{funcstart\_719,1}$,
$\$heap_{funcstart\_719,1}$.p2, 176).rem))). **replace**(p3 → **asType**<**short
int**>((div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p3, 178).rem *
asType<**int**>($\$heap_{init}$.r3)) − (**asType**<**int**>(**asType**<**short
int**>(div3.quot)) * **asType**<**int**>($\$heap_{719,1;730,8}$.b3)))))

→ *[expand definition of constant 'r3' at prang.c (25,20)]*

[36.9] $\$heap_{719,1;731,8}$ == $\$heap_{funcstart\_719,1}$. **replace**(p1 → ((-2 *
div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1,
177).rem))). **replace**(p2 → ((-35 * div(**heapIs** $\$heap_{funcstart\_719,1}$,
$\$heap_{funcstart\_719,1}$.p2, 176).quot) + (172 * div(**heapIs** $\$heap_{funcstart\_719,1}$,
$\$heap_{funcstart\_719,1}$.p2, 176).rem))). **replace**(p3 → **asType**<**short
int**>((div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p3, 178).rem *
asType<**int**>(**asType**<**short int**>((**int**)170))) −
(**asType**<**int**>(**asType**<**short int**>(div3.quot)) *
asType<**int**>($\$heap_{719,1;730,8}$.b3)))))

→ *[simplify]*

[36.12] $\$heap_{719,1;731,8}$ == $\$heap_{funcstart\_719,1}$. **replace**(p1 → ((-2 *
div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1,
177).rem))). **replace**(p2 → ((-35 * div(**heapIs** $\$heap_{funcstart\_719,1}$,
$\$heap_{funcstart\_719,1}$.p2, 176).quot) + (172 * div(**heapIs** $\$heap_{funcstart\_719,1}$,
$\$heap_{funcstart\_719,1}$.p2, 176).rem))). **replace**(p3 → **asType**<**short
int**>((div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p3, 178).rem * 170)
− (**asType**<**int**>(**asType**<**short int**>(div3.quot)) *
asType<**int**>($\$heap_{719,1;730,8}$.b3)))))

→ *[from term 19.6, div3 is equal to div(**heapIs** $\$heap_{funcstart\_719,1}$,
$\$heap_{funcstart\_719,1}$.p3, 178)]*

[36.13] $\$heap_{719,1;731,8}$ == $\$heap_{funcstart\_719,1}$. **replace**(p1 → ((-2 *
div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1,
177).rem))). **replace**(p2 → ((-35 * div(**heapIs** $\$heap_{funcstart\_719,1}$,
$\$heap_{funcstart\_719,1}$.p2, 176).quot) + (172 * div(**heapIs** $\$heap_{funcstart\_719,1}$,
$\$heap_{funcstart\_719,1}$.p2, 176).rem))). **replace**(p3 → **asType**<**short int**>((170
* div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p3, 178).rem) −
(**asType**<**int**>(**asType**<**short int**>(div(**heapIs** $\$heap_{funcstart\_719,1}$,
$\$heap_{funcstart\_719,1}$.p3, 178).quot)) * **asType**<**int**>($\$heap_{719,1;730,8}$.b3)))))

→ *[simplify]*

[36.15] $\$heap_{719,1;731,8}$ == $\$heap_{funcstart\_719,1}$. **replace**(p1 → ((-2 *
div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot) + (171 *

div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1,
177).rem))). **_replace**(p2 → ((-35 * div(**heapIs** $\$heap_{funcstart\_719,1}$,
$\$heap_{funcstart\_719,1}$.p2, 176).quot) + (172 * div(**heapIs** $\$heap_{funcstart\_719,1}$,
$\$heap_{funcstart\_719,1}$.p2, 176).rem))). **_replace**(p3 → **asType**<**short int**>((170
* div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p3, 178).rem) −
(div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p3, 178).quot *
asType<**int**>($\$heap_{719,1;730,8}$.b3))))

→ *[from term 31.24, $\$heap_{719,1;730,8}$ is equal to*
$\$heap_{funcstart\_719,1}$. **_replace***(p1 → ((-2 * div(**heapIs** $\$heap_{funcstart\_719,1}$,*
$\$heap_{funcstart\_719,1}$.*p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_719,1}$,*
$\$heap_{funcstart\_719,1}$.*p1, 177).rem))). **_replace***(p2 → (-35 * div(**heapIs***
$\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.*p2, 176).quot) + (172 * div(**heapIs***
$\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.*p2, 176).rem))]*

[36.16] $\$heap_{719,1;731,8}$ == $\$heap_{funcstart\_719,1}$. **_replace**(p1 → ((-2 *
div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1,
177).rem))). **_replace**(p2 → ((-35 * div(**heapIs** $\$heap_{funcstart\_719,1}$,
$\$heap_{funcstart\_719,1}$.p2, 176).quot) + (172 * div(**heapIs** $\$heap_{funcstart\_719,1}$,
$\$heap_{funcstart\_719,1}$.p2, 176).rem))). **_replace**(p3 → **asType**<**short int**>((170
* div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p3, 178).rem) −
(div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p3, 178).quot *
asType<**int**>($\$heap_{funcstart\_719,1}$. **_replace**(p1 → ((-2 * div(**heapIs**
$\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs**
$\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).rem))). **_replace**(p2 → ((-35
* div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).quot) + (172 *
div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).rem))).b3))))

→ *[const member of object with modified fields]*

[36.18] $\$heap_{719,1;731,8}$ == $\$heap_{funcstart\_719,1}$. **_replace**(p1 → ((-2 *
div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1,
177).rem))). **_replace**(p2 → ((-35 * div(**heapIs** $\$heap_{funcstart\_719,1}$,
$\$heap_{funcstart\_719,1}$.p2, 176).quot) + (172 * div(**heapIs** $\$heap_{funcstart\_719,1}$,
$\$heap_{funcstart\_719,1}$.p2, 176).rem))). **_replace**(p3 → **asType**<**short int**>((170
* div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p3, 178).rem) −
(div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p3, 178).quot *
asType<**int**>($\$heap_{funcstart\_719,1}$.b3))))

→ *[const static or extern object]*

[36.19] $\$heap_{719,1;731,8}$ == $\$heap_{funcstart\_719,1}$. **_replace**(p1 → ((-2 *
div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1,
177).rem))). **_replace**(p2 → ((-35 * div(**heapIs** $\$heap_{funcstart\_719,1}$,
$\$heap_{funcstart\_719,1}$.p2, 176).quot) + (172 * div(**heapIs** $\$heap_{funcstart\_719,1}$,
$\$heap_{funcstart\_719,1}$.p2, 176).rem))). **_replace**(p3 → **asType**<**short int**>((170

577

* div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p3, 178).rem) $-$
(div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p3, 178).quot *
asType$<$int$>$($\$heap_{init}$.b3))))

$\rightarrow$ *[expand definition of constant 'b3' at prang.c (27,20)]*

[36.20] $\$heap_{719,1;731,8}$ == $\$heap_{funcstart\_719,1}$.**replace**(p1 $\rightarrow$ ((-2 *
div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1,
177).rem))).**replace**(p2 $\rightarrow$ ((-35 * div(**heapIs** $\$heap_{funcstart\_719,1}$,
$\$heap_{funcstart\_719,1}$.p2, 176).quot) + (172 * div(**heapIs** $\$heap_{funcstart\_719,1}$,
$\$heap_{funcstart\_719,1}$.p2, 176).rem))).**replace**(p3 $\rightarrow$ **asType$<$short int$>$**((170
* div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p3, 178).rem) $-$
(div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p3, 178).quot *
asType$<$int$>$(asType$<$short int$>$((int)63)))))

$\rightarrow$ *[simplify]*

[36.26] $\$heap_{719,1;731,8}$ == $\$heap_{funcstart\_719,1}$.**replace**(p1 $\rightarrow$ ((-2 *
div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot) + (171 *
div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1,
177).rem))).**replace**(p2 $\rightarrow$ ((-35 * div(**heapIs** $\$heap_{funcstart\_719,1}$,
$\$heap_{funcstart\_719,1}$.p2, 176).quot) + (172 * div(**heapIs** $\$heap_{funcstart\_719,1}$,
$\$heap_{funcstart\_719,1}$.p2, 176).rem))).**replace**(p3 $\rightarrow$ ((-63 * div(**heapIs**
$\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p3, 178).quot) + (170 * div(**heapIs**
$\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p3, 178).rem)))

[Take goal term]

[1.0] ((**asType$<$int$>$**($\$heap_{719,1;731,8}$.M1) *
asType$<$int$>$(static_cast$<$integer$>$(asType$<$int$>$($\$heap_{719,1;731,8}$.p1) $<$
(int)0))) + asType$<$int$>$($\$heap_{719,1;731,8}$.p1)) $\leq$ **maxof(short int)**

$\rightarrow$ *[from term 36.26, $\$heap_{719,1;731,8}$ is equal to*
*$\$heap_{funcstart\_719,1}$.**replace**(p1 $\rightarrow$ ((-2 * div(**heapIs** $\$heap_{funcstart\_719,1}$,*
*$\$heap_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_719,1}$,*
*$\$heap_{funcstart\_719,1}$.p1, 177).rem))).**replace**(p2 $\rightarrow$ ((-35 * div(**heapIs***
*$\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).quot) + (172 * div(**heapIs***
*$\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).rem))).**replace**(p3 $\rightarrow$ (-63 **
*div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p3, 178).quot) + (170 **
*div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p3, 178).rem))]*

[1.1] ((**asType$<$int$>$**($\$heap_{funcstart\_719,1}$.**replace**(p1 $\rightarrow$ ((-2 * div(**heapIs**
$\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs**
$\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).rem))).**replace**(p2 $\rightarrow$ ((-35
* div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2, 176).quot) + (172 *
div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p2,
176).rem))).**replace**(p3 $\rightarrow$ ((-63 * div(**heapIs** $\$heap_{funcstart\_719,1}$,
$\$heap_{funcstart\_719,1}$.p3, 178).quot) + (170 * div(**heapIs** $\$heap_{funcstart\_719,1}$,
$\$heap_{funcstart\_719,1}$.p3, 178).rem))).M1) *

asType\<int\>(static_cast\<integer\>(asType\<int\>($heap$_{719,1;731,8}$.p1) < (int)0))) + asType\<int\>($heap$_{719,1;731,8}$.p1)) ≤ maxof(short int)

→ *[const member of object with modified fields]*

[1.4] **((asType\<int\>($heap$_{funcstart_719,1}$.M1) * asType\<int\>(static_cast\<integer\>(asType\<int\>($heap$_{719,1;731,8}$.p1) < (int)0))) + asType\<int\>($heap$_{719,1;731,8}$.p1)) ≤ maxof(short int)**

→ *[const static or extern object]*

[1.5] **((asType\<int\>($heap$_{init}$.M1) * asType\<int\>(static_cast\<integer\>(asType\<int\>($heap$_{719,1;731,8}$.p1) < (int)0))) + asType\<int\>($heap$_{719,1;731,8}$.p1)) ≤ maxof(short int)**

→ *[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\>($heap$_{719,1;731,8}$.p1) < (int)0))) + asType\<int\>($heap$_{719,1;731,8}$.p1)) ≤ maxof(short int)**

→ *[simplify]*

[1.9] **((30269 * asType\<int\>(static_cast\<integer\>(asType\<int\>($heap$_{719,1;731,8}$.p1) < (int)0))) + asType\<int\>($heap$_{719,1;731,8}$.p1)) ≤ maxof(short int)**

→ *[from term 36.26, $heap$_{719,1;731,8}$ is equal to
$heap$_{funcstart_719,1}$._**replace**(p1 → ((-2 * div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1, 177).quot) + (171 * div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1, 177).rem)))._**replace**(p2 → ((-35 * div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p2, 176).quot) + (172 * div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p2, 176).rem)))._**replace**(p3 → (-63 * div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p3, 178).quot) + (170 * div(**heapIs** $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p3, 178).rem))]*

[1.10] **((30269 * asType\<int\>(static_cast\<integer\>(asType\<int\>($heap$_{funcstart_719,1}$._replace(p1 → ((-2 * div(heapIs $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1, 177).quot) + (171 * div(heapIs $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1, 177).rem)))._replace(p2 → ((-35 * div(heapIs $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p2, 176).quot) + (172 * div(heapIs $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p2, 176).rem)))._replace(p3 → ((-63 * div(heapIs $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p3, 178).quot) + (170 * div(heapIs $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p3, 178).rem))).p1) < (int)0))) + asType\<int\>($heap$_{719,1;731,8}$.p1)) ≤ maxof(short int)**

→ *[simplify]*

[1.22] **((30269 * asType\<int\>(([0 < ((-171 * div(heapIs $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1, 177).rem) + (2 * div(heapIs $heap$_{funcstart_719,1}$, $heap$_{funcstart_719,1}$.p1, 177).quot))]: 1, []: 0))) + asType\<int\>($heap$_{719,1;731,8}$.p1)) ≤ maxof(short int)**

$\rightarrow$ *[explicitly assert falsehood of skipped guards in subsequent guards]*

[1.23] ((30269 * **asType<int>**(([0 < ((-171 * div(**heapIs** \$heap$_{funcstart\_719,1}$, \$heap$_{funcstart\_719,1}$.p1, 177).rem) + (2 * div(**heapIs** \$heap$_{funcstart\_719,1}$, \$heap$_{funcstart\_719,1}$.p1, 177).quot))]: 1, [!(0 < ((-171 * div(**heapIs** \$heap$_{funcstart\_719,1}$, \$heap$_{funcstart\_719,1}$.p1, 177).rem) + (2 * div(**heapIs** \$heap$_{funcstart\_719,1}$, \$heap$_{funcstart\_719,1}$.p1, 177).quot)))]: 0))) + **asType<int>**(\$heap$_{719,1;731,8}$.p1)) $\leq$ **maxof(short int)**

$\rightarrow$ *[simplify]*

[1.29] ((30269 * ([0 < ((-171 * div(**heapIs** \$heap$_{funcstart\_719,1}$, \$heap$_{funcstart\_719,1}$.p1, 177).rem) + (2 * div(**heapIs** \$heap$_{funcstart\_719,1}$, \$heap$_{funcstart\_719,1}$.p1, 177).quot))]: 1, [-1 < ((-2 * div(**heapIs** \$heap$_{funcstart\_719,1}$, \$heap$_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs** \$heap$_{funcstart\_719,1}$, \$heap$_{funcstart\_719,1}$.p1, 177).rem))]: 0)) + **asType<int>**(\$heap$_{719,1;731,8}$.p1)) $\leq$ **maxof(short int)**

$\rightarrow$ *[move guard outside expression]*

[1.30] (([0 < ((-171 * div(**heapIs** \$heap$_{funcstart\_719,1}$, \$heap$_{funcstart\_719,1}$.p1, 177).rem) + (2 * div(**heapIs** \$heap$_{funcstart\_719,1}$, \$heap$_{funcstart\_719,1}$.p1, 177).quot))]: 1 * 30269, [-1 < ((-2 * div(**heapIs** \$heap$_{funcstart\_719,1}$, \$heap$_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs** \$heap$_{funcstart\_719,1}$, \$heap$_{funcstart\_719,1}$.p1, 177).rem))]: 0 * 30269) + **asType<int>**(\$heap$_{719,1;731,8}$.p1)) $\leq$ **maxof(short int)**

$\rightarrow$ *[simplify]*

[1.32] (([0 < ((-171 * div(**heapIs** \$heap$_{funcstart\_719,1}$, \$heap$_{funcstart\_719,1}$.p1, 177).rem) + (2 * div(**heapIs** \$heap$_{funcstart\_719,1}$, \$heap$_{funcstart\_719,1}$.p1, 177).quot))]: 30269, [-1 < ((-2 * div(**heapIs** \$heap$_{funcstart\_719,1}$, \$heap$_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs** \$heap$_{funcstart\_719,1}$, \$heap$_{funcstart\_719,1}$.p1, 177).rem))]: 0) + **asType<int>**(\$heap$_{719,1;731,8}$.p1)) $\leq$ **maxof(short int)**

$\rightarrow$ *[from term 36.26, \$heap$_{719,1;731,8}$ is equal to \$heap$_{funcstart\_719,1}$._**replace**(p1 $\rightarrow$ ((-2 * div(**heapIs** \$heap$_{funcstart\_719,1}$, \$heap$_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs** \$heap$_{funcstart\_719,1}$, \$heap$_{funcstart\_719,1}$.p1, 177).rem)))._**replace**(p2 $\rightarrow$ ((-35 * div(**heapIs** \$heap$_{funcstart\_719,1}$, \$heap$_{funcstart\_719,1}$.p2, 176).quot) + (172 * div(**heapIs** \$heap$_{funcstart\_719,1}$, \$heap$_{funcstart\_719,1}$.p2, 176).rem)))._**replace**(p3 $\rightarrow$ (-63 * div(**heapIs** \$heap$_{funcstart\_719,1}$, \$heap$_{funcstart\_719,1}$.p3, 178).quot) + (170 * div(**heapIs** \$heap$_{funcstart\_719,1}$, \$heap$_{funcstart\_719,1}$.p3, 178).rem))]*

[1.33] (([0 < ((-171 * div(**heapIs** \$heap$_{funcstart\_719,1}$, \$heap$_{funcstart\_719,1}$.p1, 177).rem) + (2 * div(**heapIs** \$heap$_{funcstart\_719,1}$, \$heap$_{funcstart\_719,1}$.p1, 177).quot))]: 30269, [-1 < ((-2 * div(**heapIs** \$heap$_{funcstart\_719,1}$, \$heap$_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs** \$heap$_{funcstart\_719,1}$, \$heap$_{funcstart\_719,1}$.p1, 177).rem))]: 0) + **asType<int>**(\$heap$_{funcstart\_719,1}$._**replace**(p1 $\rightarrow$ ((-2 * div(**heapIs**

$heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p1, 177).rem))). **replace**(p2 → ((-35 * div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p2, 176).quot) + (172 * div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p2, 176).rem))). **replace**(p3 → ((-63 * div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p3, 178).quot) + (170 * div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p3, 178).rem))).p1)) ≤ **maxof(short int)**

→ *[simplify]*

[1.38] ((-2 * div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p1, 177).rem) + ([0 < ((-171 * div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p1, 177).rem) + (2 * div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p1, 177).quot))]: 30269, [-1 < ((-2 * div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p1, 177).rem))]: 0)) ≤ **maxof(short int)**

→ *[move guard outside expression]*

[1.39] ([0 < ((-171 * div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p1, 177).rem) + (2 * div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p1, 177).quot))]: 30269 + (-2 * div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p1, 177).rem), [-1 < ((-2 * div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p1, 177).rem))]: 0 + (-2 * div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p1, 177).rem)) ≤ **maxof(short int)**

→ *[simplify]*

[1.42] (-1 + ([0 < ((-171 * div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p1, 177).rem) + (2 * div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p1, 177).quot))]: 30269 + (-2 * div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p1, 177).rem), [-1 < ((-2 * div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p1, 177).rem))]: (-2 * div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p1, 177).rem))) < 32767

→ *[move guard outside expression]*

[1.43] ([0 < ((-171 * div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p1, 177).rem) + (2 * div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p1, 177).quot))]: -1 + (30269 + (-2 * div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p1, 177).rem)), [-1 < ((-2 * div(**heapIs** $heap_{funcstart\_719,1}$, $heap_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs**

$\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}.\text{p1}$, 177).rem))]: -1 + ((-2 * div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}.\text{p1}$, 177).quot) + (171 * div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}.\text{p1}$, 177).rem))) < 32767

$\rightarrow$ *[simplify]*

[1.47] 0 < (32767 + −([0 < ((-171 * div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}.\text{p1}$, 177).rem) + (2 * div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}.\text{p1}$, 177).quot))]: 30268 + (-2 * div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}.\text{p1}$, 177).quot) + (171 * div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}.\text{p1}$, 177).rem), [-1 < ((-2 * div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}.\text{p1}$, 177).quot) + (171 * div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}.\text{p1}$, 177).rem))]: -1 + (-2 * div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}.\text{p1}$, 177).quot) + (171 * div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}.\text{p1}$, 177).rem)))

$\rightarrow$ *[move guard outside expression]*

[1.48] 0 < (32767 + ([0 < ((-171 * div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}.\text{p1}$, 177).rem) + (2 * div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}.\text{p1}$, 177).quot))]: −(30268 + (-2 * div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}.\text{p1}$, 177).quot) + (171 * div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}.\text{p1}$, 177).rem)), [-1 < ((-2 * div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}.\text{p1}$, 177).quot) + (171 * div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}.\text{p1}$, 177).rem))]: −(-1 + (-2 * div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}.\text{p1}$, 177).quot) + (171 * div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}.\text{p1}$, 177).rem))))

$\rightarrow$ *[simplify]*

[1.60] 0 < (32767 + ([0 < ((-171 * div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}.\text{p1}$, 177).rem) + (2 * div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}.\text{p1}$, 177).quot))]: -30268 + (-171 * div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}.\text{p1}$, 177).rem) + (2 * div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}.\text{p1}$, 177).quot), [-1 < ((-2 * div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}.\text{p1}$, 177).quot) + (171 * div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}.\text{p1}$, 177).rem))]: 1 + (-171 * div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}.\text{p1}$, 177).rem) + (2 * div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}.\text{p1}$, 177).quot)))

$\rightarrow$ *[move guard outside expression]*

[1.61] 0 < ([0 < ((-171 * div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}.\text{p1}$, 177).rem) + (2 * div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}.\text{p1}$, 177).quot))]: 32767 + (-30268 + (-171 * div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}.\text{p1}$, 177).rem) + (2 * div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}.\text{p1}$, 177).quot)), [-1 < ((-2 * div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}.\text{p1}$, 177).quot) + (171 * div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}.\text{p1}$, 177).rem))]: 32767 + (1 + (-171 * div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$, $\$\text{heap}_{funcstart\_719,1}.\text{p1}$, 177).rem)

+ (2 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot)))

→ *[simplify]*

[1.65] 0 < ([0 < ((-171 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).rem) + (2 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot))]: 2499 + (-171 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).rem) + (2 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot), [-1 < ((-2 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).rem))]: 32768 + (-171 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).rem) + (2 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot))

→ *[move guard outside expression]*

[1.66] ([0 < ((-171 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).rem) + (2 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot))]: 0 < (2499 + (-171 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).rem) + (2 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot)), [-1 < ((-2 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).rem))]: 0 < (32768 + (-171 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).rem) + (2 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot)))

→ *[simplify]*

[1.68] ([0 < ((-171 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).rem) + (2 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot))]: -2499 < ((-171 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).rem) + (2 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot)), [-1 < ((-2 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).rem))]: 0 < (32768 + (-171 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).rem) + (2 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot)))

→ *[from guard, literala < ((-171 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).rem) + (2 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot)) is true whenever (-1 + literala) < 0]*

Proof of rule precondition:

[1.68.0] (-2499 + -1) < 0

→ *[simplify]*

[1.68.2] **true**

[1.69] ([0 < ((-171 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).rem) + (2 * div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot))]: **true**, [-1 < ((-2 * div(**heapIs** $\$heap_{funcstart\_719,1}$,

$\text{heap}_{funcstart\_719,1}.\text{p1}, 177).\text{quot}) + (171 * \text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_719,1},$ $\$\text{heap}_{funcstart\_719,1}.\text{p1}, 177).\text{rem}))]: 0 < (32768 + (-171 * \text{div}(\textbf{heapIs }$ $\$\text{heap}_{funcstart\_719,1}, \$\text{heap}_{funcstart\_719,1}.\text{p1}, 177).\text{rem}) + (2 * \text{div}(\textbf{heapIs }$ $\$\text{heap}_{funcstart\_719,1}, \$\text{heap}_{funcstart\_719,1}.\text{p1}, 177).\text{quot})))$

$\rightarrow$ *[simplify]*

[1.71] $([0 < ((-171 * \text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_719,1}, \$\text{heap}_{funcstart\_719,1}.\text{p1},$ $177).\text{rem}) + (2 * \text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_719,1}, \$\text{heap}_{funcstart\_719,1}.\text{p1},$ $177).\text{quot}))]: \textbf{true}, [-1 < ((-2 * \text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_719,1},$ $\$\text{heap}_{funcstart\_719,1}.\text{p1}, 177).\text{quot}) + (171 * \text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_719,1},$ $\$\text{heap}_{funcstart\_719,1}.\text{p1}, 177).\text{rem}))]: -32768 < ((-171 * \text{div}(\textbf{heapIs }$ $\$\text{heap}_{funcstart\_719,1}, \$\text{heap}_{funcstart\_719,1}.\text{p1}, 177).\text{rem}) + (2 * \text{div}(\textbf{heapIs }$ $\$\text{heap}_{funcstart\_719,1}, \$\text{heap}_{funcstart\_719,1}.\text{p1}, 177).\text{quot})))$

$\rightarrow$ *[negate goal and search for contradiction]*

[1.72] $!([0 < ((-171 * \text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_719,1}, \$\text{heap}_{funcstart\_719,1}.\text{p1},$ $177).\text{rem}) + (2 * \text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_719,1}, \$\text{heap}_{funcstart\_719,1}.\text{p1},$ $177).\text{quot}))]: \textbf{true}, [-1 < ((-2 * \text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_719,1},$ $\$\text{heap}_{funcstart\_719,1}.\text{p1}, 177).\text{quot}) + (171 * \text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_719,1},$ $\$\text{heap}_{funcstart\_719,1}.\text{p1}, 177).\text{rem}))]: -32768 < ((-171 * \text{div}(\textbf{heapIs }$ $\$\text{heap}_{funcstart\_719,1}, \$\text{heap}_{funcstart\_719,1}.\text{p1}, 177).\text{rem}) + (2 * \text{div}(\textbf{heapIs }$ $\$\text{heap}_{funcstart\_719,1}, \$\text{heap}_{funcstart\_719,1}.\text{p1}, 177).\text{quot})))$

$\rightarrow$ *[move guard outside expression]*

[1.73] $([0 < ((-171 * \text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_719,1}, \$\text{heap}_{funcstart\_719,1}.\text{p1},$ $177).\text{rem}) + (2 * \text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_719,1}, \$\text{heap}_{funcstart\_719,1}.\text{p1},$ $177).\text{quot}))]: !\textbf{true}, [-1 < ((-2 * \text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_719,1},$ $\$\text{heap}_{funcstart\_719,1}.\text{p1}, 177).\text{quot}) + (171 * \text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_719,1},$ $\$\text{heap}_{funcstart\_719,1}.\text{p1}, 177).\text{rem}))]: !(-32768 < ((-171 * \text{div}(\textbf{heapIs }$ $\$\text{heap}_{funcstart\_719,1}, \$\text{heap}_{funcstart\_719,1}.\text{p1}, 177).\text{rem}) + (2 * \text{div}(\textbf{heapIs }$ $\$\text{heap}_{funcstart\_719,1}, \$\text{heap}_{funcstart\_719,1}.\text{p1}, 177).\text{quot}))))$

$\rightarrow$ *[simplify]*

[1.81] $(-1 < ((-2 * \text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_719,1}, \$\text{heap}_{funcstart\_719,1}.\text{p1},$ $177).\text{quot}) + (171 * \text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_719,1}, \$\text{heap}_{funcstart\_719,1}.\text{p1},$ $177).\text{rem}))) \wedge (32767 < ((-2 * \text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_719,1},$ $\$\text{heap}_{funcstart\_719,1}.\text{p1}, 177).\text{quot}) + (171 * \text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_719,1},$ $\$\text{heap}_{funcstart\_719,1}.\text{p1}, 177).\text{rem})))$

[Work on sub-term 2 of conjunction in term 1.81]

[41.0] $32767 < ((-2 * \text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_719,1}, \$\text{heap}_{funcstart\_719,1}.\text{p1},$ $177).\text{quot}) + (171 * \text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_719,1}, \$\text{heap}_{funcstart\_719,1}.\text{p1},$ $177).\text{rem}))$

[Branch on disjunction or conditional in term 10.21]

[42.0] $(0 == ((-\$\text{heap}_{funcstart\_719,1}.\text{p1} \; / \; 177) + \text{div}(\textbf{heapIs }$ $\$\text{heap}_{funcstart\_719,1}, \$\text{heap}_{funcstart\_719,1}.\text{p1}, 177).\text{quot})) \vee (0 ==$

$(-(\$\text{heap}_{funcstart\_719,1}.p1 \ / \ 177) + \text{div}(\textbf{heapIs} \ \$\text{heap}_{funcstart\_719,1},$
$\$\text{heap}_{funcstart\_719,1}.p1, 177).\text{quot})) \lor (\text{-}1 < \$\text{heap}_{funcstart\_719,1}.p1)$

[Branch on disjunction or conditional in term 10.21]

[43.0] $(0 < -\$\text{heap}_{funcstart\_719,1}.p1) \lor (0 == (-(\$\text{heap}_{funcstart\_719,1}.p1 \ /$
$177) + \text{div}(\textbf{heapIs} \ \$\text{heap}_{funcstart\_719,1}, \$\text{heap}_{funcstart\_719,1}.p1, 177).\text{quot})) \lor$
$(\text{-}1 < \$\text{heap}_{funcstart\_719,1}.p1)$

[Copy term 11.40]

[44.0] $([0 < -\$\text{heap}_{funcstart\_719,1}.p1]: ([0 == (\$\text{heap}_{funcstart\_719,1}.p1 \ \% \ 177)]:$
$0 == \text{div}(\textbf{heapIs} \ \$\text{heap}_{funcstart\_719,1}, \$\text{heap}_{funcstart\_719,1}.p1, 177).\text{rem}, [!(0$
$== (\$\text{heap}_{funcstart\_719,1}.p1 \ \% \ 177))]: 177 == (-\text{div}(\textbf{heapIs}$
$\$\text{heap}_{funcstart\_719,1}, \$\text{heap}_{funcstart\_719,1}.p1, 177).\text{rem} +$
$(\$\text{heap}_{funcstart\_719,1}.p1 \ \% \ 177))), [\text{-}1 < \$\text{heap}_{funcstart\_719,1}.p1]: 0 ==$
$(-(\$\text{heap}_{funcstart\_719,1}.p1 \ \% \ 177) + \text{div}(\textbf{heapIs} \ \$\text{heap}_{funcstart\_719,1},$
$\$\text{heap}_{funcstart\_719,1}.p1, 177).\text{rem})) \lor (0 == (-(\$\text{heap}_{funcstart\_719,1}.p1 \ / \ 177)$
$+ \text{div}(\textbf{heapIs} \ \$\text{heap}_{funcstart\_719,1}, \$\text{heap}_{funcstart\_719,1}.p1, 177).\text{quot})) \lor (\text{-}1 <$
$\$\text{heap}_{funcstart\_719,1}.p1)$

$\rightarrow$ *[from term 43.0, literala $< -\$heap_{funcstart\_719,1}.p1$ is true whenever (-1 +*
literala) < 0]

Proof of rule precondition:

[44.0.0] $(\text{-}1 + 0) < 0$

$\rightarrow$ *[simplify]*

[44.0.2] **true**

[44.1] $([\textbf{true}]: ([0 == (\$\text{heap}_{funcstart\_719,1}.p1 \ \% \ 177)]: 0 == \text{div}(\textbf{heapIs}$
$\$\text{heap}_{funcstart\_719,1}, \$\text{heap}_{funcstart\_719,1}.p1, 177).\text{rem}, [!(0 ==$
$(\$\text{heap}_{funcstart\_719,1}.p1 \ \% \ 177))]: 177 == (-\text{div}(\textbf{heapIs} \ \$\text{heap}_{funcstart\_719,1},$
$\$\text{heap}_{funcstart\_719,1}.p1, 177).\text{rem} + (\$\text{heap}_{funcstart\_719,1}.p1 \ \% \ 177))), [\text{-}1 <$
$\$\text{heap}_{funcstart\_719,1}.p1]: 0 == (-(\$\text{heap}_{funcstart\_719,1}.p1 \ \% \ 177) + \text{div}(\textbf{heapIs}$
$\$\text{heap}_{funcstart\_719,1}, \$\text{heap}_{funcstart\_719,1}.p1, 177).\text{rem})) \lor ...$

$\rightarrow$ *[simplify]*

[44.3] $([0 == (\$\text{heap}_{funcstart\_719,1}.p1 \ \% \ 177)]: 0 == \text{div}(\textbf{heapIs}$
$\$\text{heap}_{funcstart\_719,1}, \$\text{heap}_{funcstart\_719,1}.p1, 177).\text{rem}, [!(0 ==$
$(\$\text{heap}_{funcstart\_719,1}.p1 \ \% \ 177))]: 177 == (-\text{div}(\textbf{heapIs} \ \$\text{heap}_{funcstart\_719,1},$
$\$\text{heap}_{funcstart\_719,1}.p1, 177).\text{rem} + (\$\text{heap}_{funcstart\_719,1}.p1 \ \% \ 177))) \lor ...$

[Branch on disjunction or conditional in term 44.3]

[45.0] $(0 == \text{div}(\textbf{heapIs} \ \$\text{heap}_{funcstart\_719,1}, \$\text{heap}_{funcstart\_719,1}.p1, 177).\text{rem})$
$\lor (0 == (-(\$\text{heap}_{funcstart\_719,1}.p1 \ / \ 177) + \text{div}(\textbf{heapIs} \ \$\text{heap}_{funcstart\_719,1},$
$\$\text{heap}_{funcstart\_719,1}.p1, 177).\text{quot})) \lor (\text{-}1 < \$\text{heap}_{funcstart\_719,1}.p1) \lor (177 ==$
$(-\text{div}(\textbf{heapIs} \ \$\text{heap}_{funcstart\_719,1}, \$\text{heap}_{funcstart\_719,1}.p1, 177).\text{rem} +$
$(\$\text{heap}_{funcstart\_719,1}.p1 \ \% \ 177))) \lor !(0 == (\$\text{heap}_{funcstart\_719,1}.p1 \ \% \ 177))$

[Copy term 41.0]

[50.0] $(32767 < ((-2 * \text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_719,1}, \$\text{heap}_{funcstart\_719,1}.\text{p1},$
$177).\text{quot}) + (171 * \text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_719,1}, \$\text{heap}_{funcstart\_719,1}.\text{p1},$
$177).\text{rem}))) \lor (0 == (-(\$\text{heap}_{funcstart\_719,1}.\text{p1} / 177) + \text{div}(\textbf{heapIs}$
$\$\text{heap}_{funcstart\_719,1}, \$\text{heap}_{funcstart\_719,1}.\text{p1}, 177).\text{quot})) \lor (-1 <$
$\$\text{heap}_{funcstart\_719,1}.\text{p1}) \lor (177 == (-\text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_719,1},$
$\$\text{heap}_{funcstart\_719,1}.\text{p1}, 177).\text{rem} + (\$\text{heap}_{funcstart\_719,1}.\text{p1} \% 177))) \lor !(0 ==$
$(\$\text{heap}_{funcstart\_719,1}.\text{p1} \% 177))$

$\rightarrow$ *[from term 45.0, div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1,*
177).rem is equal to 0]

[50.1] $(32767 < ((-2 * \text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_719,1}, \$\text{heap}_{funcstart\_719,1}.\text{p1},$
$177).\text{quot}) + (171 * 0))) \lor ...$

$\rightarrow$ *[simplify]*

[50.3] $(32767 < (-2 * \text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_719,1}, \$\text{heap}_{funcstart\_719,1}.\text{p1},$
$177).\text{quot})) \lor ...$

$\rightarrow$ *[literal comparison of product]*

[50.4] $([-2 < 0]: (32767 / 2) < -\text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_719,1},$
$\$\text{heap}_{funcstart\_719,1}.\text{p1}, 177).\text{quot}, [0 < -2]: (32767 / -2) < \text{div}(\textbf{heapIs}$
$\$\text{heap}_{funcstart\_719,1}, \$\text{heap}_{funcstart\_719,1}.\text{p1}, 177).\text{quot}, [-2 == 0]: 32767 < 0)$
$\lor ...$

$\rightarrow$ *[explicitly assert falsehood of skipped guards in subsequent guards]*

[50.5] $([-2 < 0]: (32767 / 2) < -\text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_719,1},$
$\$\text{heap}_{funcstart\_719,1}.\text{p1}, 177).\text{quot}, [(0 < -2) \land !(-2 < 0)]: (32767 / -2) <$
$\text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_719,1}, \$\text{heap}_{funcstart\_719,1}.\text{p1}, 177).\text{quot}, [(-2 == 0)$
$\land !(-2 < 0) \land !(0 < -2)]: 32767 < 0) \lor ...$

$\rightarrow$ *[simplify]*

[50.9] $(16383 < -\text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_719,1}, \$\text{heap}_{funcstart\_719,1}.\text{p1},$
$177).\text{quot}) \lor ...$

[Create new term from terms 50.9, 42.0 using rule: transitivity 16]

[69.0] $((0 + 16383) < (-\$\text{heap}_{funcstart\_719,1}.\text{p1} / 177)) \lor (0 ==$
$(-(\$\text{heap}_{funcstart\_719,1}.\text{p1} / 177) + \text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_719,1},$
$\$\text{heap}_{funcstart\_719,1}.\text{p1}, 177).\text{quot})) \lor (-1 < \$\text{heap}_{funcstart\_719,1}.\text{p1}) \lor (177 ==$
$(-\text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_719,1}, \$\text{heap}_{funcstart\_719,1}.\text{p1}, 177).\text{rem} +$
$(\$\text{heap}_{funcstart\_719,1}.\text{p1} \% 177))) \lor !(0 == (\$\text{heap}_{funcstart\_719,1}.\text{p1} \% 177))$

$\rightarrow$ *[simplify]*

[69.8] $(2899967 < -\$\text{heap}_{funcstart\_719,1}.\text{p1}) \lor ...$

$\rightarrow$ *[from term 8.3, literala $< -\$heap_{funcstart\_719,1}$.p1 is false whenever -2 <*
(-32769 + literala)]

Proof of rule precondition:

[69.8.0] -2 < (-32769 + 2899967)

→ *[simplify]*

[69.8.2] **true**

[69.9] **false** ∨ ...

[Remove 'false' term 69.9 and fetch new term from containing clause]

[70.0] (177 == (−div(**heapIs** \$heap$_{funcstart\_719,1}$, \$heap$_{funcstart\_719,1}$.p1, 177).rem + (\$heap$_{funcstart\_719,1}$.p1 % 177))) ∨ (0 == (−(\$heap$_{funcstart\_719,1}$.p1 / 177) + div(**heapIs** \$heap$_{funcstart\_719,1}$, \$heap$_{funcstart\_719,1}$.p1, 177).quot)) ∨ (-1 < \$heap$_{funcstart\_719,1}$.p1)

[Remove 'false' term 69.9 and fetch new term from containing clause]

[71.0] !(0 == (\$heap$_{funcstart\_719,1}$.p1 % 177)) ∨ (0 == (−(\$heap$_{funcstart\_719,1}$.p1 / 177) + div(**heapIs** \$heap$_{funcstart\_719,1}$, \$heap$_{funcstart\_719,1}$.p1, 177).quot)) ∨ (-1 < \$heap$_{funcstart\_719,1}$.p1)

[Copy term 41.0]

[73.0] (32767 < ((-2 * div(**heapIs** \$heap$_{funcstart\_719,1}$, \$heap$_{funcstart\_719,1}$.p1, 177).quot) + (171 * div(**heapIs** \$heap$_{funcstart\_719,1}$, \$heap$_{funcstart\_719,1}$.p1, 177).rem))) ∨ (0 == (−(\$heap$_{funcstart\_719,1}$.p1 / 177) + div(**heapIs** \$heap$_{funcstart\_719,1}$, \$heap$_{funcstart\_719,1}$.p1, 177).quot)) ∨ (-1 < \$heap$_{funcstart\_719,1}$.p1)

→ *[from term 70.0, div(**heapIs** \$heap$_{funcstart\_719,1}$, \$heap$_{funcstart\_719,1}$.p1, 177).rem is equal to -177 + (\$heap$_{funcstart\_719,1}$.p1 % 177)]*

[73.1] (32767 < ((-2 * div(**heapIs** \$heap$_{funcstart\_719,1}$, \$heap$_{funcstart\_719,1}$.p1, 177).quot) + (171 * (-177 + (\$heap$_{funcstart\_719,1}$.p1 % 177))))) ∨ ...

→ *[simplify]*

[73.6] (63034 < ((-2 * div(**heapIs** \$heap$_{funcstart\_719,1}$, \$heap$_{funcstart\_719,1}$.p1, 177).quot) + (171 * (\$heap$_{funcstart\_719,1}$.p1 % 177)))) ∨ ...

[Create new term from term 71.0 using rule: try to prove equality by contradiction]

[77.0] ((0 < (\$heap$_{funcstart\_719,1}$.p1 % 177)) ∨ ((\$heap$_{funcstart\_719,1}$.p1 % 177) < 0)) ∨ (0 == (−(\$heap$_{funcstart\_719,1}$.p1 / 177) + div(**heapIs** \$heap$_{funcstart\_719,1}$, \$heap$_{funcstart\_719,1}$.p1, 177).quot)) ∨ (-1 < \$heap$_{funcstart\_719,1}$.p1)

→ *[simplify]*

[77.1] ((([-1 < 0]: ∃ **integer** n • (0 < (\$heap$_{funcstart\_719,1}$.p1 + (177 * n))) ∧ ((\$heap$_{funcstart\_719,1}$.p1 + (177 * n)) < 177), []: **true**) ∨ ((\$heap$_{funcstart\_719,1}$.p1 % 177) < 0)) ∨ ...

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

[77.2] $(([-1 < 0]: \exists$ **integer** $n \bullet (0 < (\$heap_{funcstart\_719,1}.\text{p1} + (177 * n))) \wedge$ $((\$heap_{funcstart\_719,1}.\text{p1} + (177 * n)) < 177), [!(-1 < 0)]:$ **true**$) \vee$ $((\$heap_{funcstart\_719,1}.\text{p1} \% 177) < 0)) \vee ...$

$\rightarrow$ *[simplify]*

[77.15] $(\exists$ **integer** $n \bullet (-177 < (-\$heap_{funcstart\_719,1}.\text{p1} + (-177 * n))) \wedge (0 <$ $((177 * n) + \$heap_{funcstart\_719,1}.\text{p1}))) \vee ...$

$\rightarrow$ *[introduce skolem term and eliminate 'exists']*

[77.16] $((-177 < (-\$heap_{funcstart\_719,1}.\text{p1} + (-177 * \$a\_n))) \wedge (0 < ((177 *$ $\$a\_n) + \$heap_{funcstart\_719,1}.\text{p1}))) \vee ...$

$\rightarrow$ *[separate conjunction and work on first sub-term]*

[77.17] $(-177 < (-\$heap_{funcstart\_719,1}.\text{p1} + (-177 * \$a\_n))) \vee ...$

[Work on sub-term 2 of conjunction in term 77.16]

[78.0] $(0 < ((177 * \$a\_n) + \$heap_{funcstart\_719,1}.\text{p1})) \vee (0 ==$ $(-(\$heap_{funcstart\_719,1}.\text{p1} / 177) + \text{div}(\textbf{heapIs } \$heap_{funcstart\_719,1},$ $\$heap_{funcstart\_719,1}.\text{p1}, 177).\text{quot})) \vee (-1 < \$heap_{funcstart\_719,1}.\text{p1})$

[Create new term from term 42.0 using rule: condition for equality of division]

[81.0] $((-\$heap_{funcstart\_719,1}.\text{p1} < (177 * (0 + 1 + -\text{div}(\textbf{heapIs}$ $\$heap_{funcstart\_719,1}, \$heap_{funcstart\_719,1}.\text{p1}, 177).\text{quot}))) \wedge ((177 * (0 +$ $-\text{div}(\textbf{heapIs } \$heap_{funcstart\_719,1}, \$heap_{funcstart\_719,1}.\text{p1}, 177).\text{quot})) < (1 +$ $-\$heap_{funcstart\_719,1}.\text{p1}))) \vee (0 == (-(\$heap_{funcstart\_719,1}.\text{p1} / 177) +$ $\text{div}(\textbf{heapIs } \$heap_{funcstart\_719,1}, \$heap_{funcstart\_719,1}.\text{p1}, 177).\text{quot})) \vee (-1 <$ $\$heap_{funcstart\_719,1}.\text{p1})$

$\rightarrow$ *[simplify]*

[81.18] $((-177 < ((-177 * \text{div}(\textbf{heapIs } \$heap_{funcstart\_719,1},$ $\$heap_{funcstart\_719,1}.\text{p1}, 177).\text{quot}) + \$heap_{funcstart\_719,1}.\text{p1})) \wedge (-1 <$ $(-\$heap_{funcstart\_719,1}.\text{p1} + (177 * \text{div}(\textbf{heapIs } \$heap_{funcstart\_719,1},$ $\$heap_{funcstart\_719,1}.\text{p1}, 177).\text{quot})))) \vee ...$

$\rightarrow$ *[separate conjunction and work on first sub-term]*

[81.19] $(-177 < ((-177 * \text{div}(\textbf{heapIs } \$heap_{funcstart\_719,1},$ $\$heap_{funcstart\_719,1}.\text{p1}, 177).\text{quot}) + \$heap_{funcstart\_719,1}.\text{p1})) \vee ...$

[Work on sub-term 2 of conjunction in term 81.18]

[82.0] $(-1 < (-\$heap_{funcstart\_719,1}.\text{p1} + (177 * \text{div}(\textbf{heapIs}$ $\$heap_{funcstart\_719,1}, \$heap_{funcstart\_719,1}.\text{p1}, 177).\text{quot}))) \vee (0 ==$ $(-(\$heap_{funcstart\_719,1}.\text{p1} / 177) + \text{div}(\textbf{heapIs } \$heap_{funcstart\_719,1},$ $\$heap_{funcstart\_719,1}.\text{p1}, 177).\text{quot})) \vee (-1 < \$heap_{funcstart\_719,1}.\text{p1})$

[Create new term from terms 81.19, 77.17 using rule: transitivity 1]

[83.0] $((-177 + -177 + 1) < ((-177 * \text{div}(\textbf{heapIs } \$heap_{funcstart\_719,1},$ $\$heap_{funcstart\_719,1}.\text{p1}, 177).\text{quot}) + (-177 * \$a\_n))) \vee (0 ==$

$(-(\$heap_{funcstart\_719,1}.p1 \; / \; 177) + div(\textbf{heapIs} \; \$heap_{funcstart\_719,1}, \$heap_{funcstart\_719,1}.p1, 177).quot)) \vee (\text{-}1 < \$heap_{funcstart\_719,1}.p1)$

$\rightarrow$ *[simplify]*

[83.1] $(\text{-}353 < ((\text{-}177 * div(\textbf{heapIs} \; \$heap_{funcstart\_719,1}, \$heap_{funcstart\_719,1}.p1, 177).quot) + (\text{-}177 * \$a\_n))) \vee ...$

$\rightarrow$ *[cancel common factor]*

Proof of rule precondition 1:

[83.1.0.0] $!(\text{-}177 == 0)$

$\rightarrow$ *[simplify]*

[83.1.0.2] **true**

Proof of rule precondition 2:

[83.1.1.0] $1 < \$gcf(\text{-}177, \text{-}177)$

$\rightarrow$ *[simplify]*

[83.1.1.2] **true**

[83.2] $((\text{-}353 \; / \; \$gcf(\text{-}177, \text{-}177)) < (((\text{-}177 \; / \; \$gcf(\text{-}177, \text{-}177)) * div(\textbf{heapIs} \; \$heap_{funcstart\_719,1}, \$heap_{funcstart\_719,1}.p1, 177).quot) + ((\text{-}177 \; / \; \$gcf(\text{-}177, \text{-}177)) * \$a\_n))) \vee ...$

$\rightarrow$ *[simplify]*

[83.10] $(\text{-}2 < (-div(\textbf{heapIs} \; \$heap_{funcstart\_719,1}, \$heap_{funcstart\_719,1}.p1, 177).quot + -\$a\_n)) \vee ...$

[Create new term from terms 82.0, 78.0 using rule: transitivity 1]

[87.0] $((\text{-}1 + 0 + 1) < ((177 * div(\textbf{heapIs} \; \$heap_{funcstart\_719,1}, \$heap_{funcstart\_719,1}.p1, 177).quot) + (177 * \$a\_n))) \vee (0 == (-(\$heap_{funcstart\_719,1}.p1 \; / \; 177) + div(\textbf{heapIs} \; \$heap_{funcstart\_719,1}, \$heap_{funcstart\_719,1}.p1, 177).quot)) \vee (\text{-}1 < \$heap_{funcstart\_719,1}.p1)$

$\rightarrow$ *[simplify]*

[87.1] $(0 < ((177 * div(\textbf{heapIs} \; \$heap_{funcstart\_719,1}, \$heap_{funcstart\_719,1}.p1, 177).quot) + (177 * \$a\_n))) \vee ...$

$\rightarrow$ *[cancel common factor]*

Proof of rule precondition 1:

[87.1.0.0] $!(0 == 177)$

$\rightarrow$ *[simplify]*

[87.1.0.2] **true**

Proof of rule precondition 2:

[87.1.1.0] $1 < \$gcf(177, 177)$

$\rightarrow$ *[simplify]*

[87.1.1.2] **true**

[87.2] $((0 \,/\, \$\mathrm{gcf}(177, 177)) < (((177 \,/\, \$\mathrm{gcf}(177, 177)) * \mathrm{div}(\textbf{heapIs}$ $\$\mathrm{heap}_{funcstart\_719,1}, \$\mathrm{heap}_{funcstart\_719,1}.\mathrm{p1}, 177).\mathrm{quot}) + ((177 \,/\, \$\mathrm{gcf}(177, 177)) * \$\mathrm{a\_n}))) \lor ...$

$\rightarrow$ *[simplify]*

[87.10] $(0 < (\mathrm{div}(\textbf{heapIs}\ \$\mathrm{heap}_{funcstart\_719,1}, \$\mathrm{heap}_{funcstart\_719,1}.\mathrm{p1}, 177).\mathrm{quot} + \$\mathrm{a\_n})) \lor ...$

$\rightarrow$ *[from term 83.10, $0 < (div(\textbf{heapIs}\ \$heap_{funcstart\_719,1}, \$heap_{funcstart\_719,1}.p1, 177).quot + \$a\_n)$ is true if and only if $-1 ==$ $(-div(\textbf{heapIs}\ \$heap_{funcstart\_719,1}, \$heap_{funcstart\_719,1}.p1, 177).quot + -\$a\_n)]$*

[87.11] $(\text{-}1 == (-\mathrm{div}(\textbf{heapIs}\ \$\mathrm{heap}_{funcstart\_719,1}, \$\mathrm{heap}_{funcstart\_719,1}.\mathrm{p1}, 177).\mathrm{quot} + -\$\mathrm{a\_n})) \lor ...$

$\rightarrow$ *[simplify]*

[87.15] $(1 == (\mathrm{div}(\textbf{heapIs}\ \$\mathrm{heap}_{funcstart\_719,1}, \$\mathrm{heap}_{funcstart\_719,1}.\mathrm{p1}, 177).\mathrm{quot} + \$\mathrm{a\_n})) \lor ...$

[Create new term from terms 77.17, 8.3 using rule: transitivity 2]

[79.0] $((\text{-}32769 + \text{-}177 + 1) < (\text{-}177 * \$\mathrm{a\_n})) \lor (0 == (-(\$\mathrm{heap}_{funcstart\_719,1}.\mathrm{p1} \,/\, 177) + \mathrm{div}(\textbf{heapIs}\ \$\mathrm{heap}_{funcstart\_719,1}, \$\mathrm{heap}_{funcstart\_719,1}.\mathrm{p1}, 177).\mathrm{quot})) \lor (\text{-}1 < \$\mathrm{heap}_{funcstart\_719,1}.\mathrm{p1})$

$\rightarrow$ *[simplify]*

[79.1] $(\text{-}32945 < (\text{-}177 * \$\mathrm{a\_n})) \lor ...$

$\rightarrow$ *[literal comparison of product]*

[79.2] $([\text{-}177 < 0]: (\text{-}32945 \,/\, 177) < -\$\mathrm{a\_n}, [0 < \text{-}177]: (\text{-}32945 \,/\, \text{-}177) < \$\mathrm{a\_n}, [\text{-}177 == 0]: \text{-}32945 < 0) \lor ...$

$\rightarrow$ *[explicitly assert falsehood of skipped guards in subsequent guards]*

[79.3] $([\text{-}177 < 0]: (\text{-}32945 \,/\, 177) < -\$\mathrm{a\_n}, [(0 < \text{-}177) \land !(\text{-}177 < 0)]: (\text{-}32945 \,/\, \text{-}177) < \$\mathrm{a\_n}, [(\text{-}177 == 0) \land !(\text{-}177 < 0) \land !(0 < \text{-}177)]: \text{-}32945 < 0) \lor ...$

$\rightarrow$ *[simplify]*

[79.7] $(\text{-}187 < -\$\mathrm{a\_n}) \lor ...$

$\rightarrow$ *[from term 87.15, $\$a\_n$ is equal to $1 + -div(\textbf{heapIs}\ \$heap_{funcstart\_719,1}, \$heap_{funcstart\_719,1}.p1, 177).quot]$*

[79.8] $(\text{-}187 < -(1 + -\mathrm{div}(\textbf{heapIs}\ \$\mathrm{heap}_{funcstart\_719,1}, \$\mathrm{heap}_{funcstart\_719,1}.\mathrm{p1}, 177).\mathrm{quot})) \lor ...$

$\rightarrow$ *[simplify]*

[79.13] (-186 < div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot) ∨ ...

[Create new term from terms 79.13, 73.6 using rule: transitivity 11]

[91.0] ((1 + 63034 + (-186 * 2)) < (171 * ($\$heap_{funcstart\_719,1}$.p1 % 177))) ∨ (0 == (−($\$heap_{funcstart\_719,1}$.p1 / 177) + div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot)) ∨ (-1 < $\$heap_{funcstart\_719,1}$.p1)

→ *[simplify]*

[91.2] (62663 < (171 * ($\$heap_{funcstart\_719,1}$.p1 % 177))) ∨ ...

→ *[literal comparison of product]*

[91.3] ([171 < 0]: (62663 / -171) < −($\$heap_{funcstart\_719,1}$.p1 % 177), [0 < 171]: (62663 / 171) < ($\$heap_{funcstart\_719,1}$.p1 % 177), [0 == 171]: 62663 < 0) ∨ ...

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

[91.4] ([171 < 0]: (62663 / -171) < −($\$heap_{funcstart\_719,1}$.p1 % 177), [(0 < 171) ∧ !(171 < 0)]: (62663 / 171) < ($\$heap_{funcstart\_719,1}$.p1 % 177), [(0 == 171) ∧ !(0 < 171) ∧ !(171 < 0)]: 62663 < 0) ∨ ...

→ *[simplify]*

[91.13] **false** ∨ ...

[Remove 'false' term 91.13 and fetch new term from containing clause]

[92.0] 0 == (−($\$heap_{funcstart\_719,1}$.p1 / 177) + div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).quot)

[Remove 'false' term 91.13 and fetch new term from containing clause]

[93.0] -1 < $\$heap_{funcstart\_719,1}$.p1

[Assume known post-assertion, class invariant or type constraint for term 5.6]

[11.40] ([0 < −$\$heap_{funcstart\_719,1}$.p1]: ([0 == ($\$heap_{funcstart\_719,1}$.p1 % 177)]: 0 == div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).rem, [!(0 == ($\$heap_{funcstart\_719,1}$.p1 % 177))]: 177 == (($\$heap_{funcstart\_719,1}$.p1 % 177) + −div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).rem)), [-1 < $\$heap_{funcstart\_719,1}$.p1]: 0 == (−($\$heap_{funcstart\_719,1}$.p1 % 177) + div(**heapIs** $\$heap_{funcstart\_719,1}$, $\$heap_{funcstart\_719,1}$.p1, 177).rem))

→ *[from term 93.0, literala < −$heap_{funcstart\_719,1}$.p1 is false whenever -2 < (-1 + literala)]*

Proof of rule precondition:

[11.40.0] -2 < (-1 + 0)

→ *[simplify]*

[11.40.2] **true**

[11.41] ([**false**]: ([0 == ($\$heap_{funcstart\_719,1}$.p1 % 177)]: 0 == div(**heapIs**

$\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p1, 177).rem, [!(0 ==
($\text{\$heap}_{funcstart\_719,1}$.p1 % 177))]: 177 == ($-$div($\textbf{heapIs}$ $\text{\$heap}_{funcstart\_719,1}$,
$\text{\$heap}_{funcstart\_719,1}$.p1, 177).rem + ($\text{\$heap}_{funcstart\_719,1}$.p1 % 177))), [-1 <
$\text{\$heap}_{funcstart\_719,1}$.p1]: 0 == ($-$($\text{\$heap}_{funcstart\_719,1}$.p1 % 177) + div($\textbf{heapIs}$
$\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p1, 177).rem))

$\rightarrow$ *[from term 93.0, literala < $\text{\$heap}_{funcstart\_719,1}$.p1 is true whenever (-1 +
literala) < -1]*

Proof of rule precondition:

[11.41.0] (-1 + -1) < -1

$\rightarrow$ *[simplify]*

[11.41.2] **true**

[11.42] ([**false**]: ([0 == ($\text{\$heap}_{funcstart\_719,1}$.p1 % 177)]: 0 == div($\textbf{heapIs}$
$\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p1, 177).rem, [!(0 ==
($\text{\$heap}_{funcstart\_719,1}$.p1 % 177))]: 177 == ($-$div($\textbf{heapIs}$ $\text{\$heap}_{funcstart\_719,1}$,
$\text{\$heap}_{funcstart\_719,1}$.p1, 177).rem + ($\text{\$heap}_{funcstart\_719,1}$.p1 % 177))), [**true**]: 0
== ($-$($\text{\$heap}_{funcstart\_719,1}$.p1 % 177) + div($\textbf{heapIs}$ $\text{\$heap}_{funcstart\_719,1}$,
$\text{\$heap}_{funcstart\_719,1}$.p1, 177).rem))

$\rightarrow$ *[simplify]*

[11.44] 0 == ($-$($\text{\$heap}_{funcstart\_719,1}$.p1 % 177) + div($\textbf{heapIs}$
$\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p1, 177).rem)

[Copy term 41.0]

[95.0] 32767 < (($-$2 * div($\textbf{heapIs}$ $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p1,
177).quot) + (171 * div($\textbf{heapIs}$ $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p1,
177).rem))

$\rightarrow$ *[from term 11.44, div($\textbf{heapIs}$ $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p1,
177).rem is equal to $\text{\$heap}_{funcstart\_719,1}$.p1 % 177]*

[95.1] 32767 < (($-$2 * div($\textbf{heapIs}$ $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p1,
177).quot) + (171 * ($\text{\$heap}_{funcstart\_719,1}$.p1 % 177)))

[Create new term from term 92.0 using rule: condition for equality of division]

[103.0] (0 < (1 + (177 * (0 + $-$div($\textbf{heapIs}$ $\text{\$heap}_{funcstart\_719,1}$,
$\text{\$heap}_{funcstart\_719,1}$.p1, 177).quot)) + $\text{\$heap}_{funcstart\_719,1}$.p1)) $\wedge$
($\text{\$heap}_{funcstart\_719,1}$.p1 < (177 * (0 + 1 + div($\textbf{heapIs}$ $\text{\$heap}_{funcstart\_719,1}$,
$\text{\$heap}_{funcstart\_719,1}$.p1, 177).quot)))

$\rightarrow$ *[simplify]*

[103.12] (-1 < (($-$177 * div($\textbf{heapIs}$ $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p1,
177).quot) + $\text{\$heap}_{funcstart\_719,1}$.p1)) $\wedge$ (-177 < ($-\text{\$heap}_{funcstart\_719,1}$.p1 +
(177 * div($\textbf{heapIs}$ $\text{\$heap}_{funcstart\_719,1}$, $\text{\$heap}_{funcstart\_719,1}$.p1, 177).quot)))

$\rightarrow$ *[separate conjunction and work on first sub-term]*

[103.13] -177 < ($-$\$heap$_{funcstart\_719,1}$.p1 + (177 * div(**heapIs**
\$heap$_{funcstart\_719,1}$, \$heap$_{funcstart\_719,1}$.p1, 177).quot))

[Create new term from terms 103.13, 93.0 using rule: transitivity 2]

[105.0] (-177 + -1 + 1) < (177 * div(**heapIs** \$heap$_{funcstart\_719,1}$,
\$heap$_{funcstart\_719,1}$.p1, 177).quot)

$\rightarrow$ *[simplify]*

[105.1] -177 < (177 * div(**heapIs** \$heap$_{funcstart\_719,1}$, \$heap$_{funcstart\_719,1}$.p1,
177).quot)

$\rightarrow$ *[literal comparison of product]*

[105.2] ([177 < 0]: (-177 / -177) < $-$div(**heapIs** \$heap$_{funcstart\_719,1}$,
\$heap$_{funcstart\_719,1}$.p1, 177).quot, [0 < 177]: (-177 / 177) < div(**heapIs**
\$heap$_{funcstart\_719,1}$, \$heap$_{funcstart\_719,1}$.p1, 177).quot, [0 == 177]: -177 < 0)

$\rightarrow$ *[explicitly assert falsehood of skipped guards in subsequent guards]*

[105.3] ([177 < 0]: (-177 / -177) < $-$div(**heapIs** \$heap$_{funcstart\_719,1}$,
\$heap$_{funcstart\_719,1}$.p1, 177).quot, [(0 < 177) $\wedge$!(177 < 0)]: (-177 / 177) <
div(**heapIs** \$heap$_{funcstart\_719,1}$, \$heap$_{funcstart\_719,1}$.p1, 177).quot, [(0 ==
177) $\wedge$!(0 < 177) $\wedge$!(177 < 0)]: -177 < 0)

$\rightarrow$ *[simplify]*

[105.11] -1 < div(**heapIs** \$heap$_{funcstart\_719,1}$, \$heap$_{funcstart\_719,1}$.p1,
177).quot

[Create new term from terms 105.11, 95.1 using rule: transitivity 11]

[108.0] (1 + 32767 + (-1 * 2)) < (171 * (\$heap$_{funcstart\_719,1}$.p1 % 177))

$\rightarrow$ *[simplify]*

[108.2] 32766 < (171 * (\$heap$_{funcstart\_719,1}$.p1 % 177))

$\rightarrow$ *[literal comparison of product]*

[108.3] ([171 < 0]: (32766 / -171) < $-$(\$heap$_{funcstart\_719,1}$.p1 % 177), [0 <
171]: (32766 / 171) < (\$heap$_{funcstart\_719,1}$.p1 % 177), [0 == 171]: 32766 < 0)

$\rightarrow$ *[explicitly assert falsehood of skipped guards in subsequent guards]*

[108.4] ([171 < 0]: (32766 / -171) < $-$(\$heap$_{funcstart\_719,1}$.p1 % 177), [(0 <
171) $\wedge$!(171 < 0)]: (32766 / 171) < (\$heap$_{funcstart\_719,1}$.p1 % 177), [(0 ==
171) $\wedge$!(0 < 171) $\wedge$!(171 < 0)]: 32766 < 0)

$\rightarrow$ *[simplify]*

[108.13] **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 (52,27)

Condition defined at:

To prove: minof(int) $\leq$ **$heap$_{719,1;733,8}$.M2**

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)

$heap_{init}$.M2 == **asType<short int>((int)**30307)

$heap_{init}$.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)

$heap_{init}$.r3 == **asType<short int>((int)**170)

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

$heap_{init}$.b3 == **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)

div1 == div(**heapIs** $heap_{funcstart\_719,1}$,
**asType<int>($heap$_{funcstart_719,1}$.p1),
**asType<int>($heap$_{funcstart_719,1}$.a1))

(**asType<integer>(asType<int>($heap$_{funcstart_719,1}$.p1)) /
**asType<integer>(asType<int>($heap$_{funcstart_719,1}$.a1))) ==
asType<integer>(div1.quot)

(**asType<integer>(asType<int>($heap$_{funcstart_719,1}$.p1)) %
**asType<integer>(asType<int>($heap$_{funcstart_719,1}$.a1))) ==
asType<integer>(div1.rem)

div2 == div(**heapIs** $heap_{funcstart\_719,1}$,
**asType<int>($heap$_{funcstart_719,1}$.p2),
**asType<int>($heap$_{funcstart_719,1}$.a2))

(**asType<integer>(asType<int>($heap$_{funcstart_719,1}$.p2)) /
**asType<integer>(asType<int>($heap$_{funcstart_719,1}$.a2))) ==
asType<integer>(div2.quot)

(**asType<integer>**(**asType<int>**($heap$_{funcstart_719,1}$.p2)) %
asType<integer>(**asType<int>**($heap$_{funcstart_719,1}$.a2))) ==
asType<integer>(div2.rem)

div3 == div(**heapIs** $heap$_{funcstart_719,1}$,
asType<int>($heap$_{funcstart_719,1}$.p3),
asType<int>($heap$_{funcstart_719,1}$.a3))

(**asType<integer>**(**asType<int>**($heap$_{funcstart_719,1}$.p3)) /
asType<integer>(**asType<int>**($heap$_{funcstart_719,1}$.a3))) ==
asType<integer>(div3.quot)

(**asType<integer>**(**asType<int>**($heap$_{funcstart_719,1}$.p3)) %
asType<integer>(**asType<int>**($heap$_{funcstart_719,1}$.a3))) ==
asType<integer>(div3.rem)

$heap$_{719,1;729,8}$ == $heap$_{funcstart_719,1}$.**replace**(p1 → **asType<short
int>**((**asType<int>**(**asType<short int>**(div1.rem)) *
asType<int>($heap$_{funcstart_719,1}$.r1)) − (**asType<int>**(**asType<short
int>**(div1.quot)) * **asType<int>**($heap$_{funcstart_719,1}$.b1)))))

$heap$_{719,1;730,8}$ == $heap$_{719,1;729,8}$.**replace**(p2 → **asType<short
int>**((**asType<int>**(**asType<short int>**(div2.rem)) *
asType<int>($heap$_{719,1;729,8}$.r2)) − (**asType<int>**(**asType<short
int>**(div2.quot)) * **asType<int>**($heap$_{719,1;729,8}$.b2)))))

$heap$_{719,1;731,8}$ == $heap$_{719,1;730,8}$.**replace**(p3 → **asType<short
int>**((**asType<int>**(**asType<short int>**(div3.rem)) *
asType<int>($heap$_{719,1;730,8}$.r3)) − (**asType<int>**(**asType<short
int>**(div3.quot)) * **asType<int>**($heap$_{719,1;730,8}$.b3)))))

$heap$_{719,1;733,8}$ == $heap$_{719,1;731,8}$.**replace**(p1 → **asType<short
int>**((**asType<int>**($heap$_{719,1;731,8}$.M1) *
asType<int>(**static_cast<integer>**(**asType<int>**($heap$_{719,1;731,8}$.p1) <
(**int**)0))) + **asType<int>**($heap$_{719,1;731,8}$.p1)))

Proof:

[Take goal term]

[1.0] **minof(int)** ≤ $heap$_{719,1;733,8}$.M2

→ *[simplify]*

[1.1] -32768 ≤ $heap$_{719,1;733,8}$.M2

→ *[const static or extern object]*

[1.2] -32768 ≤ $heap$_{init}$.M2

→ *[expand definition of constant 'M2' at prang.c (19,20)]*

[1.3] -32768 ≤ **asType<short int>**((**int**)30307)

→ *[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 (52,27)

Condition defined at:

To prove: $\text{\$heap}_{719,1;733,8}.\text{M2} \leq \textbf{maxof}(\textbf{int})$

Given:

$\text{\$heap}_{init}.\text{LIMIT} == (\textbf{int})80$

$\text{\$heap}_{init}.\text{M1} == \textbf{asType}\langle\textbf{short int}\rangle((\textbf{int})30269)$

$\text{\$heap}_{init}.\text{r1} == \textbf{asType}\langle\textbf{short int}\rangle((\textbf{int})171)$

$\text{\$heap}_{init}.\text{a1} == \textbf{asType}\langle\textbf{short int}\rangle((\textbf{int})177)$

$\text{\$heap}_{init}.\text{b1} == \textbf{asType}\langle\textbf{short int}\rangle((\textbf{int})2)$

$\text{\$heap}_{init}.\text{M2} == \textbf{asType}\langle\textbf{short int}\rangle((\textbf{int})30307)$

$\text{\$heap}_{init}.\text{r2} == \textbf{asType}\langle\textbf{short int}\rangle((\textbf{int})172)$

$\text{\$heap}_{init}.\text{a2} == \textbf{asType}\langle\textbf{short int}\rangle((\textbf{int})176)$

$\text{\$heap}_{init}.\text{b2} == \textbf{asType}\langle\textbf{short int}\rangle((\textbf{int})35)$

$\text{\$heap}_{init}.\text{M3} == \textbf{asType}\langle\textbf{short int}\rangle((\textbf{int})30323)$

$\text{\$heap}_{init}.\text{r3} == \textbf{asType}\langle\textbf{short int}\rangle((\textbf{int})170)$

$\text{\$heap}_{init}.\text{a3} == \textbf{asType}\langle\textbf{short int}\rangle((\textbf{int})178)$

$\text{\$heap}_{init}.\text{b3} == \textbf{asType}\langle\textbf{short int}\rangle((\textbf{int})63)$

$\text{\$heap}_{init}.\text{p1} == \textbf{asType}\langle\textbf{short int}\rangle((\textbf{int})1)$

$\text{\$heap}_{init}.\text{p2} == \textbf{asType}\langle\textbf{short int}\rangle((\textbf{int})2)$

$\text{\$heap}_{init}.\text{p3} == \textbf{asType}\langle\textbf{short int}\rangle((\textbf{int})3)$

$\text{div1} == \text{div}(\textbf{heapIs } \text{\$heap}_{funcstart\_719,1},$
$\textbf{asType}\langle\textbf{int}\rangle(\text{\$heap}_{funcstart\_719,1}.\text{p1}),$
$\textbf{asType}\langle\textbf{int}\rangle(\text{\$heap}_{funcstart\_719,1}.\text{a1}))$

$(\textbf{asType}\langle\textbf{integer}\rangle(\textbf{asType}\langle\textbf{int}\rangle(\text{\$heap}_{funcstart\_719,1}.\text{p1})) /$
$\textbf{asType}\langle\textbf{integer}\rangle(\textbf{asType}\langle\textbf{int}\rangle(\text{\$heap}_{funcstart\_719,1}.\text{a1}))) ==$
$\textbf{asType}\langle\textbf{integer}\rangle(\text{div1.quot})$

$(\textbf{asType}\langle\textbf{integer}\rangle(\textbf{asType}\langle\textbf{int}\rangle(\text{\$heap}_{funcstart\_719,1}.\text{p1})) \%$
$\textbf{asType}\langle\textbf{integer}\rangle(\textbf{asType}\langle\textbf{int}\rangle(\text{\$heap}_{funcstart\_719,1}.\text{a1}))) ==$
$\textbf{asType}\langle\textbf{integer}\rangle(\text{div1.rem})$

$\text{div2} == \text{div}(\textbf{heapIs } \text{\$heap}_{funcstart\_719,1},$
$\textbf{asType}\langle\textbf{int}\rangle(\text{\$heap}_{funcstart\_719,1}.\text{p2}),$

asType$<$int$>$($\$\text{heap}_{funcstart\_719,1}$.a2))

(**asType$<$integer$>$**(**asType$<$int$>$**($\$\text{heap}_{funcstart\_719,1}$.p2)) /
asType$<$integer$>$(**asType$<$int$>$**($\$\text{heap}_{funcstart\_719,1}$.a2))) ==
asType$<$integer$>$(div2.quot)

(**asType$<$integer$>$**(**asType$<$int$>$**($\$\text{heap}_{funcstart\_719,1}$.p2)) %
asType$<$integer$>$(**asType$<$int$>$**($\$\text{heap}_{funcstart\_719,1}$.a2))) ==
asType$<$integer$>$(div2.rem)

div3 == div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$,
asType$<$int$>$($\$\text{heap}_{funcstart\_719,1}$.p3),
asType$<$int$>$($\$\text{heap}_{funcstart\_719,1}$.a3))

(**asType$<$integer$>$**(**asType$<$int$>$**($\$\text{heap}_{funcstart\_719,1}$.p3)) /
asType$<$integer$>$(**asType$<$int$>$**($\$\text{heap}_{funcstart\_719,1}$.a3))) ==
asType$<$integer$>$(div3.quot)

(**asType$<$integer$>$**(**asType$<$int$>$**($\$\text{heap}_{funcstart\_719,1}$.p3)) %
asType$<$integer$>$(**asType$<$int$>$**($\$\text{heap}_{funcstart\_719,1}$.a3))) ==
asType$<$integer$>$(div3.rem)

$\$\text{heap}_{719,1;729,8}$ == $\$\text{heap}_{funcstart\_719,1}$.**replace**(p1 $\to$ **asType$<$short
int$>$**((**asType$<$int$>$**(**asType$<$short int$>$**(div1.rem)) *
asType$<$int$>$($\$\text{heap}_{funcstart\_719,1}$.r1)) $-$ (**asType$<$int$>$**(**asType$<$short
int$>$**(div1.quot)) * **asType$<$int$>$**($\$\text{heap}_{funcstart\_719,1}$.b1)))))

$\$\text{heap}_{719,1;730,8}$ == $\$\text{heap}_{719,1;729,8}$.**replace**(p2 $\to$ **asType$<$short
int$>$**((**asType$<$int$>$**(**asType$<$short int$>$**(div2.rem)) *
asType$<$int$>$($\$\text{heap}_{719,1;729,8}$.r2)) $-$ (**asType$<$int$>$**(**asType$<$short
int$>$**(div2.quot)) * **asType$<$int$>$**($\$\text{heap}_{719,1;729,8}$.b2)))))

$\$\text{heap}_{719,1;731,8}$ == $\$\text{heap}_{719,1;730,8}$.**replace**(p3 $\to$ **asType$<$short
int$>$**((**asType$<$int$>$**(**asType$<$short int$>$**(div3.rem)) *
asType$<$int$>$($\$\text{heap}_{719,1;730,8}$.r3)) $-$ (**asType$<$int$>$**(**asType$<$short
int$>$**(div3.quot)) * **asType$<$int$>$**($\$\text{heap}_{719,1;730,8}$.b3)))))

$\$\text{heap}_{719,1;733,8}$ == $\$\text{heap}_{719,1;731,8}$.**replace**(p1 $\to$ **asType$<$short
int$>$**((**asType$<$int$>$**($\$\text{heap}_{719,1;731,8}$.M1) *
asType$<$int$>$(**static_cast$<$integer$>$**(**asType$<$int$>$**($\$\text{heap}_{719,1;731,8}$.p1) $<$
(**int**)0))) + **asType$<$int$>$**($\$\text{heap}_{719,1;731,8}$.p1)))

Proof:

[Take goal term]

[1.0] $\$\text{heap}_{719,1;733,8}$.M2 $\leq$ **maxof**(**int**)

$\to$ *[const static or extern object]*

[1.1] $\$\text{heap}_{init}$.M2 $\leq$ **maxof**(**int**)

$\to$ *[expand definition of constant 'M2' at prang.c (19,20)]*

[1.2] **asType$<$short int$>$**((**int**)30307) $\leq$ **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 (52,17)

Condition defined at:

To prove: minof(int) $\leq$ \$heap$_{719,1;733,8}$.p2

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)

\$heap$_{init}$.M2 == **asType<short int>**((**int**)30307)

\$heap$_{init}$.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)

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

\$heap$_{init}$.a3 == **asType<short int>**((**int**)178)

\$heap$_{init}$.b3 == **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)

div1 == div(**heapIs** \$heap$_{funcstart\_719,1}$,
asType<int>(\$heap$_{funcstart\_719,1}$.p1),
asType<int>(\$heap$_{funcstart\_719,1}$.a1))

(**asType<integer>**(**asType<int>**(\$heap$_{funcstart\_719,1}$.p1)) /
asType<integer>(**asType<int>**(\$heap$_{funcstart\_719,1}$.a1))) ==
asType<integer>(div1.quot)

(**asType<integer>**(**asType<int>**(\$heap$_{funcstart\_719,1}$.p1)) %
asType<integer>(**asType<int>**(\$heap$_{funcstart\_719,1}$.a1))) ==
asType<integer>(div1.rem)

div2 == div(**heapIs** \$heap$_{funcstart\_719,1}$,

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asType<int>($heap$_{funcstart_719,1}$.p2),
asType<int>($heap$_{funcstart_719,1}$.a2))

(**asType<integer>**(**asType<int>**($heap$_{funcstart_719,1}$.p2)) /
asType<integer>(**asType<int>**($heap$_{funcstart_719,1}$.a2))) ==
asType<integer>(div2.quot)

(**asType<integer>**(**asType<int>**($heap$_{funcstart_719,1}$.p2)) %
asType<integer>(**asType<int>**($heap$_{funcstart_719,1}$.a2))) ==
asType<integer>(div2.rem)

div3 == div(**heapIs** $heap$_{funcstart_719,1}$,
asType<int>($heap$_{funcstart_719,1}$.p3),
asType<int>($heap$_{funcstart_719,1}$.a3))

(**asType<integer>**(**asType<int>**($heap$_{funcstart_719,1}$.p3)) /
asType<integer>(**asType<int>**($heap$_{funcstart_719,1}$.a3))) ==
asType<integer>(div3.quot)

(**asType<integer>**(**asType<int>**($heap$_{funcstart_719,1}$.p3)) %
asType<integer>(**asType<int>**($heap$_{funcstart_719,1}$.a3))) ==
asType<integer>(div3.rem)

$heap$_{719,1;729,8}$ == $heap$_{funcstart_719,1}$.**replace**(p1 → **asType<short int>**((**asType<int>**(**asType<short int>**(div1.rem)) *
asType<int>($heap$_{funcstart_719,1}$.r1)) − (**asType<int>**(**asType<short int>**(div1.quot)) * **asType<int>**($heap$_{funcstart\_719,1}$.b1)))))

$heap$_{719,1;730,8}$ == $heap$_{719,1;729,8}$.**replace**(p2 → **asType<short int>**((**asType<int>**(**asType<short int>**(div2.rem)) *
asType<int>($heap$_{719,1;729,8}$.r2)) − (**asType<int>**(**asType<short int>**(div2.quot)) * **asType<int>**($heap$_{719,1;729,8}$.b2)))))

$heap$_{719,1;731,8}$ == $heap$_{719,1;730,8}$.**replace**(p3 → **asType<short int>**((**asType<int>**(**asType<short int>**(div3.rem)) *
asType<int>($heap$_{719,1;730,8}$.r3)) − (**asType<int>**(**asType<short int>**(div3.quot)) * **asType<int>**($heap$_{719,1;730,8}$.b3)))))

$heap$_{719,1;733,8}$ == $heap$_{719,1;731,8}$.**replace**(p1 → **asType<short int>**((**asType<int>**($heap$_{719,1;731,8}$.M1) *
asType<int>(**static_cast<integer>**(**asType<int>**($heap$_{719,1;731,8}$.p1) <
(**int**)0))) + **asType<int>**($heap$_{719,1;731,8}$.p1)))

Proof:

[Take goal term]

[1.0] **minof(int)** $\leq$ $heap$_{719,1;733,8}$.p2

$\rightarrow$ *[simplify]*

[1.3] -32769 $<$ $heap$_{719,1;733,8}$.p2

$\rightarrow$ *[negate goal and search for contradiction]*

[1.4] !(-32769 < $heap_{719,1;733,8}$.p2)

→ *[simplify]*

[1.6] 32768 < −$heap_{719,1;733,8}$.p2

[Assume known post-assertion, class invariant or type constraint for term 1.6]

[42.0] **minof(short int)** ≤ $heap_{719,1;733,8}$.p2

→ *[simplify]*

[42.3] -32769 < $heap_{719,1;733,8}$.p2

→ *[from term 1.6, literala < $heap_{719,1;733,8}$.p2 is false whenever -2 < (32768 + literala)]*

> **Proof of rule precondition:**
>
> *[42.3.0]* -2 < (-32769 + 32768)
>
> → *[simplify]*
>
> *[42.3.2]* **true**

[42.4] **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 (52,17)

Condition defined at:

To prove: $heap_{719,1;733,8}$.p2 ≤ **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)

$heap_{init}$.b1 == **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)

$heap_{init}$.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)

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

$\$heap_{init}.p1 == \textbf{asType}\textbf{<short int>}((\textbf{int})1)$

$\$heap_{init}.p2 == \textbf{asType}\textbf{<short int>}((\textbf{int})2)$

$\$heap_{init}.p3 == \textbf{asType}\textbf{<short int>}((\textbf{int})3)$

$\mathrm{div1} == \mathrm{div}(\textbf{heapIs } \$heap_{funcstart\_719,1},$
$\textbf{asType}\textbf{<int>}(\$heap_{funcstart\_719,1}.p1),$
$\textbf{asType}\textbf{<int>}(\$heap_{funcstart\_719,1}.a1))$

$(\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<int>}(\$heap_{funcstart\_719,1}.p1))\ /$
$\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<int>}(\$heap_{funcstart\_719,1}.a1))) ==$
$\textbf{asType}\textbf{<integer>}(\mathrm{div1.quot})$

$(\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<int>}(\$heap_{funcstart\_719,1}.p1))\ \%$
$\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<int>}(\$heap_{funcstart\_719,1}.a1))) ==$
$\textbf{asType}\textbf{<integer>}(\mathrm{div1.rem})$

$\mathrm{div2} == \mathrm{div}(\textbf{heapIs } \$heap_{funcstart\_719,1},$
$\textbf{asType}\textbf{<int>}(\$heap_{funcstart\_719,1}.p2),$
$\textbf{asType}\textbf{<int>}(\$heap_{funcstart\_719,1}.a2))$

$(\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<int>}(\$heap_{funcstart\_719,1}.p2))\ /$
$\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<int>}(\$heap_{funcstart\_719,1}.a2))) ==$
$\textbf{asType}\textbf{<integer>}(\mathrm{div2.quot})$

$(\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<int>}(\$heap_{funcstart\_719,1}.p2))\ \%$
$\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<int>}(\$heap_{funcstart\_719,1}.a2))) ==$
$\textbf{asType}\textbf{<integer>}(\mathrm{div2.rem})$

$\mathrm{div3} == \mathrm{div}(\textbf{heapIs } \$heap_{funcstart\_719,1},$
$\textbf{asType}\textbf{<int>}(\$heap_{funcstart\_719,1}.p3),$
$\textbf{asType}\textbf{<int>}(\$heap_{funcstart\_719,1}.a3))$

$(\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<int>}(\$heap_{funcstart\_719,1}.p3))\ /$
$\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<int>}(\$heap_{funcstart\_719,1}.a3))) ==$
$\textbf{asType}\textbf{<integer>}(\mathrm{div3.quot})$

$(\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<int>}(\$heap_{funcstart\_719,1}.p3))\ \%$
$\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<int>}(\$heap_{funcstart\_719,1}.a3))) ==$
$\textbf{asType}\textbf{<integer>}(\mathrm{div3.rem})$

$\$heap_{719,1;729,8} == \$heap_{funcstart\_719,1}.\textbf{replace}(\mathrm{p1} \to \textbf{asType}\textbf{<short}$
$\textbf{int>}((\textbf{asType}\textbf{<int>}(\textbf{asType}\textbf{<short int>}(\mathrm{div1.rem}))\ *$
$\textbf{asType}\textbf{<int>}(\$heap_{funcstart\_719,1}.r1)) - (\textbf{asType}\textbf{<int>}(\textbf{asType}\textbf{<short}$
$\textbf{int>}(\mathrm{div1.quot}))\ * \textbf{asType}\textbf{<int>}(\$heap_{funcstart\_719,1}.b1))))$

$\$heap_{719,1;730,8} == \$heap_{719,1;729,8}.\textbf{replace}(\mathrm{p2} \to \textbf{asType}\textbf{<short}$
$\textbf{int>}((\textbf{asType}\textbf{<int>}(\textbf{asType}\textbf{<short int>}(\mathrm{div2.rem}))\ *$
$\textbf{asType}\textbf{<int>}(\$heap_{719,1;729,8}.r2)) - (\textbf{asType}\textbf{<int>}(\textbf{asType}\textbf{<short}$
$\textbf{int>}(\mathrm{div2.quot}))\ * \textbf{asType}\textbf{<int>}(\$heap_{719,1;729,8}.b2))))$

$\text{\$heap}_{719,1;731,8} == \text{\$heap}_{719,1;730,8}.\textbf{\_replace}(p3 \rightarrow \textbf{asType}<\textbf{short int}>((\textbf{asType}<\textbf{int}>(\textbf{asType}<\textbf{short int}>(\text{div3.rem})) * \textbf{asType}<\textbf{int}>(\text{\$heap}_{719,1;730,8}.r3)) - (\textbf{asType}<\textbf{int}>(\textbf{asType}<\textbf{short int}>(\text{div3.quot})) * \textbf{asType}<\textbf{int}>(\text{\$heap}_{719,1;730,8}.b3))))$

$\text{\$heap}_{719,1;733,8} == \text{\$heap}_{719,1;731,8}.\textbf{\_replace}(p1 \rightarrow \textbf{asType}<\textbf{short int}>((\textbf{asType}<\textbf{int}>(\text{\$heap}_{719,1;731,8}.M1) * \textbf{asType}<\textbf{int}>(\textbf{static\_cast}<\textbf{integer}>(\textbf{asType}<\textbf{int}>(\text{\$heap}_{719,1;731,8}.p1) < (\textbf{int})0))) + \textbf{asType}<\textbf{int}>(\text{\$heap}_{719,1;731,8}.p1)))$

Proof:

[Take goal term]

[1.0] $\text{\$heap}_{719,1;733,8}.p2 \leq \textbf{maxof}(\textbf{int})$

$\rightarrow$ *[simplify]*

[1.9] -32768 $< -\text{\$heap}_{719,1;733,8}.p2$

$\rightarrow$ *[negate goal and search for contradiction]*

[1.10] !(-32768 $< -\text{\$heap}_{719,1;733,8}.p2$)

$\rightarrow$ *[simplify]*

[1.13] 32767 $< \text{\$heap}_{719,1;733,8}.p2$

[Assume known post-assertion, class invariant or type constraint for term 1.13]

[42.0] $\text{\$heap}_{719,1;733,8}.p2 \leq \textbf{maxof}(\textbf{short int})$

$\rightarrow$ *[simplify]*

[42.9] -32768 $< -\text{\$heap}_{719,1;733,8}.p2$

$\rightarrow$ *[from term 1.13, literala $< -\$heap_{719,1;733,8}.p2$ is false whenever -2 $<$ (32767 + literala)]*

> **Proof of rule precondition:**
>
> *[42.9.0]* -2 $<$ (-32768 + 32767)
>
> $\rightarrow$ *[simplify]*
>
> *[42.9.2]* **true**

[42.10] **false**

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

Condition generated at: C:\Escher\Customers\prang\prang.c (52,11)

Condition defined at:

To prove: minof(int) $\leq$
static_cast$<$**integer**$>$(**asType**$<$**int**$>$($\text{\$heap}_{719,1;733,8}.p2$) $<$ (**int**)0)

Given:

$\$\text{heap}_{init}.\text{LIMIT} == (\textbf{int})80$

$\$\text{heap}_{init}.\text{M1} == \textbf{asType}\textbf{<short int>}((\textbf{int})30269)$

$\$\text{heap}_{init}.\text{r1} == \textbf{asType}\textbf{<short int>}((\textbf{int})171)$

$\$\text{heap}_{init}.\text{a1} == \textbf{asType}\textbf{<short int>}((\textbf{int})177)$

$\$\text{heap}_{init}.\text{b1} == \textbf{asType}\textbf{<short int>}((\textbf{int})2)$

$\$\text{heap}_{init}.\text{M2} == \textbf{asType}\textbf{<short int>}((\textbf{int})30307)$

$\$\text{heap}_{init}.\text{r2} == \textbf{asType}\textbf{<short int>}((\textbf{int})172)$

$\$\text{heap}_{init}.\text{a2} == \textbf{asType}\textbf{<short int>}((\textbf{int})176)$

$\$\text{heap}_{init}.\text{b2} == \textbf{asType}\textbf{<short int>}((\textbf{int})35)$

$\$\text{heap}_{init}.\text{M3} == \textbf{asType}\textbf{<short int>}((\textbf{int})30323)$

$\$\text{heap}_{init}.\text{r3} == \textbf{asType}\textbf{<short int>}((\textbf{int})170)$

$\$\text{heap}_{init}.\text{a3} == \textbf{asType}\textbf{<short int>}((\textbf{int})178)$

$\$\text{heap}_{init}.\text{b3} == \textbf{asType}\textbf{<short int>}((\textbf{int})63)$

$\$\text{heap}_{init}.\text{p1} == \textbf{asType}\textbf{<short int>}((\textbf{int})1)$

$\$\text{heap}_{init}.\text{p2} == \textbf{asType}\textbf{<short int>}((\textbf{int})2)$

$\$\text{heap}_{init}.\text{p3} == \textbf{asType}\textbf{<short int>}((\textbf{int})3)$

div1 == div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$,
asType<int>$(\$\text{heap}_{funcstart\_719,1}.\text{p1})$,
asType<int>$(\$\text{heap}_{funcstart\_719,1}.\text{a1}))$

$(\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<int>}(\$\text{heap}_{funcstart\_719,1}.\text{p1}))$ /
$\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<int>}(\$\text{heap}_{funcstart\_719,1}.\text{a1}))) ==$
$\textbf{asType}\textbf{<integer>}(\text{div1.quot})$

$(\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<int>}(\$\text{heap}_{funcstart\_719,1}.\text{p1}))$ %
$\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<int>}(\$\text{heap}_{funcstart\_719,1}.\text{a1}))) ==$
$\textbf{asType}\textbf{<integer>}(\text{div1.rem})$

div2 == div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$,
asType<int>$(\$\text{heap}_{funcstart\_719,1}.\text{p2})$,
asType<int>$(\$\text{heap}_{funcstart\_719,1}.\text{a2}))$

$(\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<int>}(\$\text{heap}_{funcstart\_719,1}.\text{p2}))$ /
$\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<int>}(\$\text{heap}_{funcstart\_719,1}.\text{a2}))) ==$
$\textbf{asType}\textbf{<integer>}(\text{div2.quot})$

$(\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<int>}(\$\text{heap}_{funcstart\_719,1}.\text{p2}))$ %
$\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<int>}(\$\text{heap}_{funcstart\_719,1}.\text{a2}))) ==$
$\textbf{asType}\textbf{<integer>}(\text{div2.rem})$

div3 == div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$,

asType<int>($heap$_{funcstart_719,1}$.p3),
asType<int>($heap$_{funcstart_719,1}$.a3))

(**asType<integer>**(**asType<int>**($heap$_{funcstart_719,1}$.p3)) /
asType<integer>(**asType<int>**($heap$_{funcstart_719,1}$.a3))) ==
asType<integer>(div3.quot)

(**asType<integer>**(**asType<int>**($heap$_{funcstart_719,1}$.p3)) %
asType<integer>(**asType<int>**($heap$_{funcstart_719,1}$.a3))) ==
asType<integer>(div3.rem)

$heap$_{719,1;729,8}$ == $heap$_{funcstart_719,1}$.**replace**(p1 → **asType<short
int>**((**asType<int>**(**asType<short int>**(div1.rem)) *
asType<int>($heap$_{funcstart_719,1}$.r1)) − (**asType<int>**(**asType<short
int>**(div1.quot)) * **asType<int>**($heap$_{funcstart_719,1}$.b1))))

$heap$_{719,1;730,8}$ == $heap$_{719,1;729,8}$.**replace**(p2 → **asType<short
int>**((**asType<int>**(**asType<short int>**(div2.rem)) *
asType<int>($heap$_{719,1;729,8}$.r2)) − (**asType<int>**(**asType<short
int>**(div2.quot)) * **asType<int>**($heap$_{719,1;729,8}$.b2))))

$heap$_{719,1;731,8}$ == $heap$_{719,1;730,8}$.**replace**(p3 → **asType<short
int>**((**asType<int>**(**asType<short int>**(div3.rem)) *
asType<int>($heap$_{719,1;730,8}$.r3)) − (**asType<int>**(**asType<short
int>**(div3.quot)) * **asType<int>**($heap$_{719,1;730,8}$.b3))))

$heap$_{719,1;733,8}$ == $heap$_{719,1;731,8}$.**replace**(p1 → **asType<short
int>**((**asType<int>**($heap$_{719,1;731,8}$.M1) *
asType<int>(**static_cast<integer>**(**asType<int>**($heap$_{719,1;731,8}$.p1) <
(**int**)0))) + **asType<int>**($heap$_{719,1;731,8}$.p1)))

Proof:

[Take goal term]

[1.0] **minof(int)** ≤ **static_cast<integer>**(**asType<int>**($heap$_{719,1;733,8}$.p2)
< (**int**)0)

→ *[simplify]*

[1.6] -32768 ≤ ([0 < −$heap$_{719,1;733,8}$.p2]: 1, []: 0)

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

[1.7] -32768 ≤ ([0 < −$heap$_{719,1;733,8}$.p2]: 1, [!(0 < −$heap$_{719,1;733,8}$.p2)]: 0)

→ *[simplify]*

[1.12] -32769 < ([0 < −$heap$_{719,1;733,8}$.p2]: 1, [-1 < $heap$_{719,1;733,8}$.p2]: 0)

→ *[move guard outside expression]*

[1.13] ([0 < −$heap$_{719,1;733,8}$.p2]: -32769 < 1, [-1 < $heap$_{719,1;733,8}$.p2]: -32769
< 0)

→ *[simplify]*

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[1.15] ($[0 < -\$heap_{719,1;733,8}.p2]$: **true**, $[-1 < \$heap_{719,1;733,8}.p2]$: **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 (52,11)

Condition defined at:

To prove: static_cast<integer>(asType<int>($heap$_{719,1;733,8}$.p2) < (int)0) $\leq$ 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)

$\$heap_{init}$.b1 == **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)

$\$heap_{init}$.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)

$\$heap_{init}$.b3 == **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)

div1 == div(**heapIs** $\$heap_{funcstart\_719,1}$,
asType<int>($\$heap_{funcstart\_719,1}$.p1),
asType<int>($\$heap_{funcstart\_719,1}$.a1))

(**asType<integer>**(**asType<int>**($\$heap_{funcstart\_719,1}$.p1)) /
asType<integer>(**asType<int>**($\$heap_{funcstart\_719,1}$.a1))) ==
asType<integer>(div1.quot)

(**asType<integer>**(**asType<int>**($\$heap_{funcstart\_719,1}$.p1)) %
asType<integer>(**asType<int>**($\$heap_{funcstart\_719,1}$.a1))) ==

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asType\<integer\>(div1.rem)

div2 == div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$,
asType\<int\>($\$\text{heap}_{funcstart\_719,1}$.p2),
asType\<int\>($\$\text{heap}_{funcstart\_719,1}$.a2))

(**asType\<integer\>**(**asType\<int\>**($\$\text{heap}_{funcstart\_719,1}$.p2)) /
asType\<integer\>(**asType\<int\>**($\$\text{heap}_{funcstart\_719,1}$.a2))) ==
asType\<integer\>(div2.quot)

(**asType\<integer\>**(**asType\<int\>**($\$\text{heap}_{funcstart\_719,1}$.p2)) %
asType\<integer\>(**asType\<int\>**($\$\text{heap}_{funcstart\_719,1}$.a2))) ==
asType\<integer\>(div2.rem)

div3 == div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$,
asType\<int\>($\$\text{heap}_{funcstart\_719,1}$.p3),
asType\<int\>($\$\text{heap}_{funcstart\_719,1}$.a3))

(**asType\<integer\>**(**asType\<int\>**($\$\text{heap}_{funcstart\_719,1}$.p3)) /
asType\<integer\>(**asType\<int\>**($\$\text{heap}_{funcstart\_719,1}$.a3))) ==
asType\<integer\>(div3.quot)

(**asType\<integer\>**(**asType\<int\>**($\$\text{heap}_{funcstart\_719,1}$.p3)) %
asType\<integer\>(**asType\<int\>**($\$\text{heap}_{funcstart\_719,1}$.a3))) ==
asType\<integer\>(div3.rem)

$\$\text{heap}_{719,1;729,8}$ == $\$\text{heap}_{funcstart\_719,1}$.**replace**(p1 → **asType\<short
int\>**((**asType\<int\>**(**asType\<short int\>**(div1.rem)) *
asType\<int\>($\$\text{heap}_{funcstart\_719,1}$.r1)) − (**asType\<int\>**(**asType\<short
int\>**(div1.quot)) * **asType\<int\>**($\$\text{heap}_{funcstart\_719,1}$.b1))))

$\$\text{heap}_{719,1;730,8}$ == $\$\text{heap}_{719,1;729,8}$.**replace**(p2 → **asType\<short
int\>**((**asType\<int\>**(**asType\<short int\>**(div2.rem)) *
asType\<int\>($\$\text{heap}_{719,1;729,8}$.r2)) − (**asType\<int\>**(**asType\<short
int\>**(div2.quot)) * **asType\<int\>**($\$\text{heap}_{719,1;729,8}$.b2))))

$\$\text{heap}_{719,1;731,8}$ == $\$\text{heap}_{719,1;730,8}$.**replace**(p3 → **asType\<short
int\>**((**asType\<int\>**(**asType\<short int\>**(div3.rem)) *
asType\<int\>($\$\text{heap}_{719,1;730,8}$.r3)) − (**asType\<int\>**(**asType\<short
int\>**(div3.quot)) * **asType\<int\>**($\$\text{heap}_{719,1;730,8}$.b3))))

$\$\text{heap}_{719,1;733,8}$ == $\$\text{heap}_{719,1;731,8}$.**replace**(p1 → **asType\<short
int\>**((**asType\<int\>**($\$\text{heap}_{719,1;731,8}$.M1) *
asType\<int\>(**static_cast\<integer\>**(**asType\<int\>**($\$\text{heap}_{719,1;731,8}$.p1) <
(**int**)0))) + **asType\<int\>**($\$\text{heap}_{719,1;731,8}$.p1)))

Proof:

[Take goal term]

[1.0] **static_cast\<integer\>**(**asType\<int\>**($\$\text{heap}_{719,1;733,8}$.p2) < (**int**)0) ≤
maxof(**int**)

→ *[simplify]*

[1.5] $([0 < -\$heap_{719,1;733,8}.p2]: 1, []: 0) \leq \mathbf{maxof(int)}$

$\rightarrow$ *[explicitly assert falsehood of skipped guards in subsequent guards]*

[1.6] $([0 < -\$heap_{719,1;733,8}.p2]: 1, [!(0 < -\$heap_{719,1;733,8}.p2)]: 0) \leq$ $\mathbf{maxof(int)}$

$\rightarrow$ *[simplify]*

[1.11] $(-1 + ([0 < -\$heap_{719,1;733,8}.p2]: 1, [-1 < \$heap_{719,1;733,8}.p2]: 0)) <$ 32767

$\rightarrow$ *[move guard outside expression]*

[1.12] $([0 < -\$heap_{719,1;733,8}.p2]: -1 + 1, [-1 < \$heap_{719,1;733,8}.p2]: -1 + 0) <$ 32767

$\rightarrow$ *[simplify]*

[1.15] $0 < (32767 + -([0 < -\$heap_{719,1;733,8}.p2]: 0, [-1 < \$heap_{719,1;733,8}.p2]:$ $-1))$

$\rightarrow$ *[move guard outside expression]*

[1.16] $0 < (32767 + ([0 < -\$heap_{719,1;733,8}.p2]: -0, [-1 < \$heap_{719,1;733,8}.p2]:$ $--1))$

$\rightarrow$ *[simplify]*

[1.18] $0 < (32767 + ([0 < -\$heap_{719,1;733,8}.p2]: 0, [-1 < \$heap_{719,1;733,8}.p2]:$ $1))$

$\rightarrow$ *[move guard outside expression]*

[1.19] $0 < ([0 < -\$heap_{719,1;733,8}.p2]: 0 + 32767, [-1 < \$heap_{719,1;733,8}.p2]: 1$ $+ 32767)$

$\rightarrow$ *[simplify]*

[1.21] $0 < ([0 < -\$heap_{719,1;733,8}.p2]: 32767, [-1 < \$heap_{719,1;733,8}.p2]: 32768)$

$\rightarrow$ *[move guard outside expression]*

[1.22] $([0 < -\$heap_{719,1;733,8}.p2]: 0 < 32767, [-1 < \$heap_{719,1;733,8}.p2]: 0 <$ $32768)$

$\rightarrow$ *[simplify]*

[1.24] $([0 < -\$heap_{719,1;733,8}.p2]: \mathbf{true}, [-1 < \$heap_{719,1;733,8}.p2]: \mathbf{true})$

$\rightarrow$ *[all guards have equal guarded terms]*

[1.25] $\mathbf{true}$

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

Condition generated at: C:\Escher\Customers\prang\prang.c (52,25)

Condition defined at:

To prove: minof(int) $\leq$ (**asType**<**int**>($\text{\$heap}_{719,1;733,8}$.M2) * **asType**<**int**>(**static_cast**<**integer**>(**asType**<**int**>($\text{\$heap}_{719,1;733,8}$.p2) < (**int**)0)))

Given:

$\text{\$heap}_{init}$.LIMIT == (**int**)80

$\text{\$heap}_{init}$.M1 == **asType**<**short int**>(((**int**)30269)

$\text{\$heap}_{init}$.r1 == **asType**<**short int**>(((**int**)171)

$\text{\$heap}_{init}$.a1 == **asType**<**short int**>(((**int**)177)

$\text{\$heap}_{init}$.b1 == **asType**<**short int**>(((**int**)2)

$\text{\$heap}_{init}$.M2 == **asType**<**short int**>(((**int**)30307)

$\text{\$heap}_{init}$.r2 == **asType**<**short int**>(((**int**)172)

$\text{\$heap}_{init}$.a2 == **asType**<**short int**>(((**int**)176)

$\text{\$heap}_{init}$.b2 == **asType**<**short int**>(((**int**)35)

$\text{\$heap}_{init}$.M3 == **asType**<**short int**>(((**int**)30323)

$\text{\$heap}_{init}$.r3 == **asType**<**short int**>(((**int**)170)

$\text{\$heap}_{init}$.a3 == **asType**<**short int**>(((**int**)178)

$\text{\$heap}_{init}$.b3 == **asType**<**short int**>(((**int**)63)

$\text{\$heap}_{init}$.p1 == **asType**<**short int**>(((**int**)1)

$\text{\$heap}_{init}$.p2 == **asType**<**short int**>(((**int**)2)

$\text{\$heap}_{init}$.p3 == **asType**<**short int**>(((**int**)3)

div1 == div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, **asType**<**int**>($\text{\$heap}_{funcstart\_719,1}$.p1), **asType**<**int**>($\text{\$heap}_{funcstart\_719,1}$.a1))

(**asType**<**integer**>(**asType**<**int**>($\text{\$heap}_{funcstart\_719,1}$.p1)) / **asType**<**integer**>(**asType**<**int**>($\text{\$heap}_{funcstart\_719,1}$.a1))) == **asType**<**integer**>(div1.quot)

(**asType**<**integer**>(**asType**<**int**>($\text{\$heap}_{funcstart\_719,1}$.p1)) % **asType**<**integer**>(**asType**<**int**>($\text{\$heap}_{funcstart\_719,1}$.a1))) == **asType**<**integer**>(div1.rem)

div2 == div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, **asType**<**int**>($\text{\$heap}_{funcstart\_719,1}$.p2), **asType**<**int**>($\text{\$heap}_{funcstart\_719,1}$.a2))

(**asType**<**integer**>(**asType**<**int**>($\text{\$heap}_{funcstart\_719,1}$.p2)) / **asType**<**integer**>(**asType**<**int**>($\text{\$heap}_{funcstart\_719,1}$.a2))) == **asType**<**integer**>(div2.quot)

($\mathbf{asType{<}integer{>}}(\mathbf{asType{<}int{>}}(\$\mathrm{heap}_{funcstart\_719,1}.\mathrm{p2}))$ % $\mathbf{asType{<}integer{>}}(\mathbf{asType{<}int{>}}(\$\mathrm{heap}_{funcstart\_719,1}.\mathrm{a2}))) ==$ $\mathbf{asType{<}integer{>}}(\mathrm{div2.rem})$

$\mathrm{div3} ==$ div($\mathbf{heapIs}$ $\$\mathrm{heap}_{funcstart\_719,1}$, $\mathbf{asType{<}int{>}}(\$\mathrm{heap}_{funcstart\_719,1}.\mathrm{p3})$, $\mathbf{asType{<}int{>}}(\$\mathrm{heap}_{funcstart\_719,1}.\mathrm{a3}))$

($\mathbf{asType{<}integer{>}}(\mathbf{asType{<}int{>}}(\$\mathrm{heap}_{funcstart\_719,1}.\mathrm{p3}))$ / $\mathbf{asType{<}integer{>}}(\mathbf{asType{<}int{>}}(\$\mathrm{heap}_{funcstart\_719,1}.\mathrm{a3}))) ==$ $\mathbf{asType{<}integer{>}}(\mathrm{div3.quot})$

($\mathbf{asType{<}integer{>}}(\mathbf{asType{<}int{>}}(\$\mathrm{heap}_{funcstart\_719,1}.\mathrm{p3}))$ % $\mathbf{asType{<}integer{>}}(\mathbf{asType{<}int{>}}(\$\mathrm{heap}_{funcstart\_719,1}.\mathrm{a3}))) ==$ $\mathbf{asType{<}integer{>}}(\mathrm{div3.rem})$

$\$\mathrm{heap}_{719,1;729,8} ==$ $\$\mathrm{heap}_{funcstart\_719,1}.\mathbf{\_replace}(\mathrm{p1} \rightarrow \mathbf{asType{<}short\ int{>}}((\mathbf{asType{<}int{>}}(\mathbf{asType{<}short\ int{>}}(\mathrm{div1.rem}))$ * $\mathbf{asType{<}int{>}}(\$\mathrm{heap}_{funcstart\_719,1}.\mathrm{r1})) - (\mathbf{asType{<}int{>}}(\mathbf{asType{<}short\ int{>}}(\mathrm{div1.quot}))$ * $\mathbf{asType{<}int{>}}(\$\mathrm{heap}_{funcstart\_719,1}.\mathrm{b1}))))$

$\$\mathrm{heap}_{719,1;730,8} ==$ $\$\mathrm{heap}_{719,1;729,8}.\mathbf{\_replace}(\mathrm{p2} \rightarrow \mathbf{asType{<}short\ int{>}}((\mathbf{asType{<}int{>}}(\mathbf{asType{<}short\ int{>}}(\mathrm{div2.rem}))$ * $\mathbf{asType{<}int{>}}(\$\mathrm{heap}_{719,1;729,8}.\mathrm{r2})) - (\mathbf{asType{<}int{>}}(\mathbf{asType{<}short\ int{>}}(\mathrm{div2.quot}))$ * $\mathbf{asType{<}int{>}}(\$\mathrm{heap}_{719,1;729,8}.\mathrm{b2}))))$

$\$\mathrm{heap}_{719,1;731,8} ==$ $\$\mathrm{heap}_{719,1;730,8}.\mathbf{\_replace}(\mathrm{p3} \rightarrow \mathbf{asType{<}short\ int{>}}((\mathbf{asType{<}int{>}}(\mathbf{asType{<}short\ int{>}}(\mathrm{div3.rem}))$ * $\mathbf{asType{<}int{>}}(\$\mathrm{heap}_{719,1;730,8}.\mathrm{r3})) - (\mathbf{asType{<}int{>}}(\mathbf{asType{<}short\ int{>}}(\mathrm{div3.quot}))$ * $\mathbf{asType{<}int{>}}(\$\mathrm{heap}_{719,1;730,8}.\mathrm{b3}))))$

$\$\mathrm{heap}_{719,1;733,8} ==$ $\$\mathrm{heap}_{719,1;731,8}.\mathbf{\_replace}(\mathrm{p1} \rightarrow \mathbf{asType{<}short\ int{>}}((\mathbf{asType{<}int{>}}(\$\mathrm{heap}_{719,1;731,8}.\mathrm{M1})$ * $\mathbf{asType{<}int{>}}(\mathbf{static\_cast{<}integer{>}}(\mathbf{asType{<}int{>}}(\$\mathrm{heap}_{719,1;731,8}.\mathrm{p1}) < (\mathbf{int})0))) + \mathbf{asType{<}int{>}}(\$\mathrm{heap}_{719,1;731,8}.\mathrm{p1})))$

Proof:

[Take goal term]

[1.0] $\mathbf{minof}(\mathbf{int}) \leq (\mathbf{asType{<}int{>}}(\$\mathrm{heap}_{719,1;733,8}.\mathrm{M2})$ * $\mathbf{asType{<}int{>}}(\mathbf{static\_cast{<}integer{>}}(\mathbf{asType{<}int{>}}(\$\mathrm{heap}_{719,1;733,8}.\mathrm{p2}) < (\mathbf{int})0)))$

$\rightarrow$ *[simplify]*

[1.1] -32768 $\leq (\mathbf{asType{<}int{>}}(\$\mathrm{heap}_{719,1;733,8}.\mathrm{M2})$ * $\mathbf{asType{<}int{>}}(\mathbf{static\_cast{<}integer{>}}(\mathbf{asType{<}int{>}}(\$\mathrm{heap}_{719,1;733,8}.\mathrm{p2}) < (\mathbf{int})0)))$

$\rightarrow$ *[const static or extern object]*

[1.2] -32768 $\leq (\mathbf{asType{<}int{>}}(\$\mathrm{heap}_{init}.\mathrm{M2})$ * $\mathbf{asType{<}int{>}}(\mathbf{static\_cast{<}integer{>}}(\mathbf{asType{<}int{>}}(\$\mathrm{heap}_{719,1;733,8}.\mathrm{p2}) <$

(**int**)0)))

→ *[expand definition of constant 'M2' at prang.c (19,20)]*

[1.3] -32768 ≤ (**asType**<**int**>(**asType**<**short int**>((**int**)30307)) *
asType<**int**>(**static_cast**<**integer**>(**asType**<**int**>($heap$_{719,1;733,8}$.p2) <
(**int**)0)))

→ *[simplify]*

[1.11] -32768 ≤ (30307 * **asType**<**int**>(([0 < −$heap$_{719,1;733,8}$.p2]: 1, []: 0)))

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

[1.12] -32768 ≤ (30307 * **asType**<**int**>(([0 < −$heap$_{719,1;733,8}$.p2]: 1, [!(0 <
−$heap$_{719,1;733,8}$.p2)]: 0)))

→ *[simplify]*

[1.16] -32768 ≤ (30307 * ([0 < −$heap$_{719,1;733,8}$.p2]: 1, [-1 <
$heap$_{719,1;733,8}$.p2]: 0))

→ *[move guard outside expression]*

[1.17] -32768 ≤ ([0 < −$heap$_{719,1;733,8}$.p2]: 1 * 30307, [-1 <
$heap$_{719,1;733,8}$.p2]: 0 * 30307)

→ *[simplify]*

[1.21] -32769 < ([0 < −$heap$_{719,1;733,8}$.p2]: 30307, [-1 < $heap$_{719,1;733,8}$.p2]: 0)

→ *[move guard outside expression]*

[1.22] ([0 < −$heap$_{719,1;733,8}$.p2]: -32769 < 30307, [-1 < $heap$_{719,1;733,8}$.p2]:
-32769 < 0)

→ *[simplify]*

[1.24] ([0 < −$heap$_{719,1;733,8}$.p2]: **true**, [-1 < $heap$_{719,1;733,8}$.p2]: **true**)

→ *[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 (52,25)

Condition defined at:

To prove: (**asType**<**int**>($heap$_{719,1;733,8}$.M2) *
asType<**int**>(**static_cast**<**integer**>(**asType**<**int**>($heap$_{719,1;733,8}$.p2) <
(**int**)0))) ≤ **maxof**(**int**)

Given:

$heap$_{init}$.LIMIT == (**int**)80

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$\$heap_{init}.M1 == \textbf{asType}\textbf{<short int>}((\textbf{int})30269)$

$\$heap_{init}.r1 == \textbf{asType}\textbf{<short int>}((\textbf{int})171)$

$\$heap_{init}.a1 == \textbf{asType}\textbf{<short int>}((\textbf{int})177)$

$\$heap_{init}.b1 == \textbf{asType}\textbf{<short int>}((\textbf{int})2)$

$\$heap_{init}.M2 == \textbf{asType}\textbf{<short int>}((\textbf{int})30307)$

$\$heap_{init}.r2 == \textbf{asType}\textbf{<short int>}((\textbf{int})172)$

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

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

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

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

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

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

$\$heap_{init}.p1 == \textbf{asType}\textbf{<short int>}((\textbf{int})1)$

$\$heap_{init}.p2 == \textbf{asType}\textbf{<short int>}((\textbf{int})2)$

$\$heap_{init}.p3 == \textbf{asType}\textbf{<short int>}((\textbf{int})3)$

div1 == div(**heapIs** $\$heap_{funcstart\_719,1}$,
asType<int>($\$heap_{funcstart\_719,1}$.p1),
asType<int>($\$heap_{funcstart\_719,1}$.a1))

(**asType<integer>**(**asType<int>**($\$heap_{funcstart\_719,1}$.p1)) /
asType<integer>(**asType<int>**($\$heap_{funcstart\_719,1}$.a1))) ==
asType<integer>(div1.quot)

(**asType<integer>**(**asType<int>**($\$heap_{funcstart\_719,1}$.p1)) %
asType<integer>(**asType<int>**($\$heap_{funcstart\_719,1}$.a1))) ==
asType<integer>(div1.rem)

div2 == div(**heapIs** $\$heap_{funcstart\_719,1}$,
asType<int>($\$heap_{funcstart\_719,1}$.p2),
asType<int>($\$heap_{funcstart\_719,1}$.a2))

(**asType<integer>**(**asType<int>**($\$heap_{funcstart\_719,1}$.p2)) /
asType<integer>(**asType<int>**($\$heap_{funcstart\_719,1}$.a2))) ==
asType<integer>(div2.quot)

(**asType<integer>**(**asType<int>**($\$heap_{funcstart\_719,1}$.p2)) %
asType<integer>(**asType<int>**($\$heap_{funcstart\_719,1}$.a2))) ==
asType<integer>(div2.rem)

div3 == div(**heapIs** $\$heap_{funcstart\_719,1}$,
asType<int>($\$heap_{funcstart\_719,1}$.p3),
asType<int>($\$heap_{funcstart\_719,1}$.a3))

(**asType\<integer\>**(**asType\<int\>**($\text{heap}_{funcstart\_719,1}$.p3)) /
asType\<integer\>(**asType\<int\>**($\text{heap}_{funcstart\_719,1}$.a3))) ==
asType\<integer\>(div3.quot)

(**asType\<integer\>**(**asType\<int\>**($\text{heap}_{funcstart\_719,1}$.p3)) %
asType\<integer\>(**asType\<int\>**($\text{heap}_{funcstart\_719,1}$.a3))) ==
asType\<integer\>(div3.rem)

$\text{heap}_{719,1;729,8}$ == $\text{heap}_{funcstart\_719,1}$.**replace**(p1 → **asType\<short
int\>**((**asType\<int\>**(**asType\<short int\>**(div1.rem)) *
asType\<int\>($\text{heap}_{funcstart\_719,1}$.r1)) − (**asType\<int\>**(**asType\<short
int\>**(div1.quot)) * **asType\<int\>**($\text{heap}_{funcstart\_719,1}$.b1)))))

$\text{heap}_{719,1;730,8}$ == $\text{heap}_{719,1;729,8}$.**replace**(p2 → **asType\<short
int\>**((**asType\<int\>**(**asType\<short int\>**(div2.rem)) *
asType\<int\>($\text{heap}_{719,1;729,8}$.r2)) − (**asType\<int\>**(**asType\<short
int\>**(div2.quot)) * **asType\<int\>**($\text{heap}_{719,1;729,8}$.b2)))))

$\text{heap}_{719,1;731,8}$ == $\text{heap}_{719,1;730,8}$.**replace**(p3 → **asType\<short
int\>**((**asType\<int\>**(**asType\<short int\>**(div3.rem)) *
asType\<int\>($\text{heap}_{719,1;730,8}$.r3)) − (**asType\<int\>**(**asType\<short
int\>**(div3.quot)) * **asType\<int\>**($\text{heap}_{719,1;730,8}$.b3)))))

$\text{heap}_{719,1;733,8}$ == $\text{heap}_{719,1;731,8}$.**replace**(p1 → **asType\<short
int\>**((**asType\<int\>**($\text{heap}_{719,1;731,8}$.M1) *
asType\<int\>(**static_cast\<integer\>**(**asType\<int\>**($\text{heap}_{719,1;731,8}$.p1) <
(**int**)0))) + **asType\<int\>**($\text{heap}_{719,1;731,8}$.p1)))

Proof:

[Take goal term]

[1.0] (**asType\<int\>**($\text{heap}_{719,1;733,8}$.M2) *
asType\<int\>(**static_cast\<integer\>**(**asType\<int\>**($\text{heap}_{719,1;733,8}$.p2) <
(**int**)0))) ≤ **maxof**(**int**)

→ *[const static or extern object]*

[1.1] (**asType\<int\>**(heap_{init}.M2) *
asType\<int\>(**static_cast\<integer\>**(**asType\<int\>**($\text{heap}_{719,1;733,8}$.p2) <
(**int**)0))) ≤ **maxof**(**int**)

→ *[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\>**($\text{heap}_{719,1;733,8}$.p2) <
(**int**)0))) ≤ **maxof**(**int**)

→ *[simplify]*

[1.10] (30307 * **asType\<int\>**(((0 < −$\text{heap}_{719,1;733,8}$.p2]: 1, []: 0))) ≤
maxof(**int**)

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

[1.11] $(30307 *$ **asType$<$int$>$**$(([0 < -\$heap_{719,1;733,8}.p2]$: 1, $[!(0 <$ $-\$heap_{719,1;733,8}.p2)]$: 0$))) \leq$ **maxof(int)**

$\rightarrow$ *[simplify]*

[1.15] $(30307 * ([0 < -\$heap_{719,1;733,8}.p2]$: 1, $[-1 < \$heap_{719,1;733,8}.p2]$: 0$)) \leq$ **maxof(int)**

$\rightarrow$ *[move guard outside expression]*

[1.16] $([0 < -\$heap_{719,1;733,8}.p2]$: 1 * 30307, $[-1 < \$heap_{719,1;733,8}.p2]$: 0 * 30307$) \leq$ **maxof(int)**

$\rightarrow$ *[simplify]*

[1.20] $(-1 + ([0 < -\$heap_{719,1;733,8}.p2]$: 30307, $[-1 < \$heap_{719,1;733,8}.p2]$: 0$)) <$ 32767

$\rightarrow$ *[move guard outside expression]*

[1.21] $([0 < -\$heap_{719,1;733,8}.p2]$: -1 + 30307, $[-1 < \$heap_{719,1;733,8}.p2]$: -1 + 0$) <$ 32767

$\rightarrow$ *[simplify]*

[1.24] $0 < (32767 + -([0 < -\$heap_{719,1;733,8}.p2]$: 30306, $[-1 < \$heap_{719,1;733,8}.p2]$: -1$))$

$\rightarrow$ *[move guard outside expression]*

[1.25] $0 < (32767 + ([0 < -\$heap_{719,1;733,8}.p2]$: -30306, $[-1 < \$heap_{719,1;733,8}.p2]$: $--1$$))$

$\rightarrow$ *[simplify]*

[1.27] $0 < (32767 + ([0 < -\$heap_{719,1;733,8}.p2]$: -30306, $[-1 < \$heap_{719,1;733,8}.p2]$: 1$))$

$\rightarrow$ *[move guard outside expression]*

[1.28] $0 < ([0 < -\$heap_{719,1;733,8}.p2]$: -30306 + 32767, $[-1 < \$heap_{719,1;733,8}.p2]$: 1 + 32767$)$

$\rightarrow$ *[simplify]*

[1.30] $0 < ([0 < -\$heap_{719,1;733,8}.p2]$: 2461, $[-1 < \$heap_{719,1;733,8}.p2]$: 32768$)$

$\rightarrow$ *[move guard outside expression]*

[1.31] $([0 < -\$heap_{719,1;733,8}.p2]$: 0 < 2461, $[-1 < \$heap_{719,1;733,8}.p2]$: 0 < 32768$)$

$\rightarrow$ *[simplify]*

[1.33] $([0 < -\$heap_{719,1;733,8}.p2]$: **true**, $[-1 < \$heap_{719,1;733,8}.p2]$: **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 (52,5)

Condition defined at:

To prove: minof(int) $\leq$ $\text{\$heap}_{719,1;733,8}.\text{p2}$

Given:

$\text{\$heap}_{init}.\text{LIMIT} == (\textbf{int})80$

$\text{\$heap}_{init}.\text{M1} == \textbf{asType}<\textbf{short int}>((\textbf{int})30269)$

$\text{\$heap}_{init}.\text{r1} == \textbf{asType}<\textbf{short int}>((\textbf{int})171)$

$\text{\$heap}_{init}.\text{a1} == \textbf{asType}<\textbf{short int}>((\textbf{int})177)$

$\text{\$heap}_{init}.\text{b1} == \textbf{asType}<\textbf{short int}>((\textbf{int})2)$

$\text{\$heap}_{init}.\text{M2} == \textbf{asType}<\textbf{short int}>((\textbf{int})30307)$

$\text{\$heap}_{init}.\text{r2} == \textbf{asType}<\textbf{short int}>((\textbf{int})172)$

$\text{\$heap}_{init}.\text{a2} == \textbf{asType}<\textbf{short int}>((\textbf{int})176)$

$\text{\$heap}_{init}.\text{b2} == \textbf{asType}<\textbf{short int}>((\textbf{int})35)$

$\text{\$heap}_{init}.\text{M3} == \textbf{asType}<\textbf{short int}>((\textbf{int})30323)$

$\text{\$heap}_{init}.\text{r3} == \textbf{asType}<\textbf{short int}>((\textbf{int})170)$

$\text{\$heap}_{init}.\text{a3} == \textbf{asType}<\textbf{short int}>((\textbf{int})178)$

$\text{\$heap}_{init}.\text{b3} == \textbf{asType}<\textbf{short int}>((\textbf{int})63)$

$\text{\$heap}_{init}.\text{p1} == \textbf{asType}<\textbf{short int}>((\textbf{int})1)$

$\text{\$heap}_{init}.\text{p2} == \textbf{asType}<\textbf{short int}>((\textbf{int})2)$

$\text{\$heap}_{init}.\text{p3} == \textbf{asType}<\textbf{short int}>((\textbf{int})3)$

div1 == div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, **asType**<**int**>($\text{\$heap}_{funcstart\_719,1}.\text{p1}$), **asType**<**int**>($\text{\$heap}_{funcstart\_719,1}.\text{a1}$))

(**asType**<**integer**>(**asType**<**int**>($\text{\$heap}_{funcstart\_719,1}.\text{p1}$)) / **asType**<**integer**>(**asType**<**int**>($\text{\$heap}_{funcstart\_719,1}.\text{a1}$))) == **asType**<**integer**>(div1.quot)

(**asType**<**integer**>(**asType**<**int**>($\text{\$heap}_{funcstart\_719,1}.\text{p1}$)) % **asType**<**integer**>(**asType**<**int**>($\text{\$heap}_{funcstart\_719,1}.\text{a1}$))) == **asType**<**integer**>(div1.rem)

div2 == div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$, **asType**<**int**>($\text{\$heap}_{funcstart\_719,1}.\text{p2}$), **asType**<**int**>($\text{\$heap}_{funcstart\_719,1}.\text{a2}$))

(**asType**<**integer**>(**asType**<**int**>($\text{\$heap}_{funcstart\_719,1}.\text{p2}$)) /

asType\<integer\>(**asType\<int\>**($\text{heap}_{funcstart\_719,1}$.a2))) ==
asType\<integer\>(div2.quot)

(**asType\<integer\>**(**asType\<int\>**($\text{heap}_{funcstart\_719,1}$.p2)) %
asType\<integer\>(**asType\<int\>**($\text{heap}_{funcstart\_719,1}$.a2))) ==
asType\<integer\>(div2.rem)

div3 == div(**heapIs** $\text{heap}_{funcstart\_719,1}$,
asType\<int\>($\text{heap}_{funcstart\_719,1}$.p3),
asType\<int\>($\text{heap}_{funcstart\_719,1}$.a3))

(**asType\<integer\>**(**asType\<int\>**($\text{heap}_{funcstart\_719,1}$.p3)) /
asType\<integer\>(**asType\<int\>**($\text{heap}_{funcstart\_719,1}$.a3))) ==
asType\<integer\>(div3.quot)

(**asType\<integer\>**(**asType\<int\>**($\text{heap}_{funcstart\_719,1}$.p3)) %
asType\<integer\>(**asType\<int\>**($\text{heap}_{funcstart\_719,1}$.a3))) ==
asType\<integer\>(div3.rem)

$\text{heap}_{719,1;729,8}$ == $\text{heap}_{funcstart\_719,1}$.**replace**(p1 → **asType\<short int\>**((**asType\<int\>**(**asType\<short int\>**(div1.rem)) *
asType\<int\>($\text{heap}_{funcstart\_719,1}$.r1)) − (**asType\<int\>**(**asType\<short int\>**(div1.quot)) * **asType\<int\>**($\text{heap}_{funcstart\_719,1}$.b1))))

$\text{heap}_{719,1;730,8}$ == $\text{heap}_{719,1;729,8}$.**replace**(p2 → **asType\<short int\>**((**asType\<int\>**(**asType\<short int\>**(div2.rem)) *
asType\<int\>($\text{heap}_{719,1;729,8}$.r2)) − (**asType\<int\>**(**asType\<short int\>**(div2.quot)) * **asType\<int\>**($\text{heap}_{719,1;729,8}$.b2))))

$\text{heap}_{719,1;731,8}$ == $\text{heap}_{719,1;730,8}$.**replace**(p3 → **asType\<short int\>**((**asType\<int\>**(**asType\<short int\>**(div3.rem)) *
asType\<int\>($\text{heap}_{719,1;730,8}$.r3)) − (**asType\<int\>**(**asType\<short int\>**(div3.quot)) * **asType\<int\>**($\text{heap}_{719,1;730,8}$.b3))))

$\text{heap}_{719,1;733,8}$ == $\text{heap}_{719,1;731,8}$.**replace**(p1 → **asType\<short int\>**((**asType\<int\>**($\text{heap}_{719,1;731,8}$.M1) *
asType\<int\>(**static_cast\<integer\>**(**asType\<int\>**($\text{heap}_{719,1;731,8}$.p1) <
(**int**)0))) + **asType\<int\>**($\text{heap}_{719,1;731,8}$.p1)))

Proof:

[Take goal term]

[1.0] **minof(int)** $\leq$ $\text{heap}_{719,1;733,8}$.p2

$\to$ *[simplify]*

[1.3] -32769 < $\text{heap}_{719,1;733,8}$.p2

$\to$ *[negate goal and search for contradiction]*

[1.4] !(-32769 < $\text{heap}_{719,1;733,8}$.p2)

$\to$ *[simplify]*

[1.6] $32768 < -\$\text{heap}_{719,1;733,8}.\text{p2}$

[Assume known post-assertion, class invariant or type constraint for term 1.6]

[42.0] $\textbf{minof}(\textbf{short int}) \leq \$\text{heap}_{719,1;733,8}.\text{p2}$

$\rightarrow$ *[simplify]*

[42.3] $\text{-}32769 < \$\text{heap}_{719,1;733,8}.\text{p2}$

$\rightarrow$ *[from term 1.6, literala $< \$heap_{719,1;733,8}.p2$ is false whenever -2 < (32768 + literala)]*

> **Proof of rule precondition:**
>
> *[42.3.0]* $\text{-}2 < (\text{-}32769 + 32768)$
>
> $\rightarrow$ *[simplify]*
>
> *[42.3.2]* **true**

[42.4] **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 (52,5)

Condition defined at:

To prove: $\$\text{heap}_{719,1;733,8}.\text{p2} \leq \textbf{maxof}(\textbf{int})$

Given:

$\$\text{heap}_{init}.\text{LIMIT} == (\textbf{int})80$

$\$\text{heap}_{init}.\text{M1} == \textbf{asType}\langle\textbf{short int}\rangle((\textbf{int})30269)$

$\$\text{heap}_{init}.\text{r1} == \textbf{asType}\langle\textbf{short int}\rangle((\textbf{int})171)$

$\$\text{heap}_{init}.\text{a1} == \textbf{asType}\langle\textbf{short int}\rangle((\textbf{int})177)$

$\$\text{heap}_{init}.\text{b1} == \textbf{asType}\langle\textbf{short int}\rangle((\textbf{int})2)$

$\$\text{heap}_{init}.\text{M2} == \textbf{asType}\langle\textbf{short int}\rangle((\textbf{int})30307)$

$\$\text{heap}_{init}.\text{r2} == \textbf{asType}\langle\textbf{short int}\rangle((\textbf{int})172)$

$\$\text{heap}_{init}.\text{a2} == \textbf{asType}\langle\textbf{short int}\rangle((\textbf{int})176)$

$\$\text{heap}_{init}.\text{b2} == \textbf{asType}\langle\textbf{short int}\rangle((\textbf{int})35)$

$\$\text{heap}_{init}.\text{M3} == \textbf{asType}\langle\textbf{short int}\rangle((\textbf{int})30323)$

$\$\text{heap}_{init}.\text{r3} == \textbf{asType}\langle\textbf{short int}\rangle((\textbf{int})170)$

$\$\text{heap}_{init}.\text{a3} == \textbf{asType}\langle\textbf{short int}\rangle((\textbf{int})178)$

$\$\text{heap}_{init}.\text{b3} == \textbf{asType}\langle\textbf{short int}\rangle((\textbf{int})63)$

$\$\text{heap}_{init}.\text{p1} == \textbf{asType}\langle\textbf{short int}\rangle((\textbf{int})1)$

$\text{\$heap}_{init}.\text{p2} == \textbf{asType}\textbf{<short int>}((\textbf{int})2)$

$\text{\$heap}_{init}.\text{p3} == \textbf{asType}\textbf{<short int>}((\textbf{int})3)$

$\text{div1} == \text{div}(\textbf{heapIs } \text{\$heap}_{funcstart\_719,1},$
$\textbf{asType<int>}(\text{\$heap}_{funcstart\_719,1}.\text{p1}),$
$\textbf{asType<int>}(\text{\$heap}_{funcstart\_719,1}.\text{a1}))$

$(\textbf{asType<integer>}(\textbf{asType<int>}(\text{\$heap}_{funcstart\_719,1}.\text{p1}))\ /$
$\textbf{asType<integer>}(\textbf{asType<int>}(\text{\$heap}_{funcstart\_719,1}.\text{a1}))) ==$
$\textbf{asType<integer>}(\text{div1.quot})$

$(\textbf{asType<integer>}(\textbf{asType<int>}(\text{\$heap}_{funcstart\_719,1}.\text{p1}))\ \%$
$\textbf{asType<integer>}(\textbf{asType<int>}(\text{\$heap}_{funcstart\_719,1}.\text{a1}))) ==$
$\textbf{asType<integer>}(\text{div1.rem})$

$\text{div2} == \text{div}(\textbf{heapIs } \text{\$heap}_{funcstart\_719,1},$
$\textbf{asType<int>}(\text{\$heap}_{funcstart\_719,1}.\text{p2}),$
$\textbf{asType<int>}(\text{\$heap}_{funcstart\_719,1}.\text{a2}))$

$(\textbf{asType<integer>}(\textbf{asType<int>}(\text{\$heap}_{funcstart\_719,1}.\text{p2}))\ /$
$\textbf{asType<integer>}(\textbf{asType<int>}(\text{\$heap}_{funcstart\_719,1}.\text{a2}))) ==$
$\textbf{asType<integer>}(\text{div2.quot})$

$(\textbf{asType<integer>}(\textbf{asType<int>}(\text{\$heap}_{funcstart\_719,1}.\text{p2}))\ \%$
$\textbf{asType<integer>}(\textbf{asType<int>}(\text{\$heap}_{funcstart\_719,1}.\text{a2}))) ==$
$\textbf{asType<integer>}(\text{div2.rem})$

$\text{div3} == \text{div}(\textbf{heapIs } \text{\$heap}_{funcstart\_719,1},$
$\textbf{asType<int>}(\text{\$heap}_{funcstart\_719,1}.\text{p3}),$
$\textbf{asType<int>}(\text{\$heap}_{funcstart\_719,1}.\text{a3}))$

$(\textbf{asType<integer>}(\textbf{asType<int>}(\text{\$heap}_{funcstart\_719,1}.\text{p3}))\ /$
$\textbf{asType<integer>}(\textbf{asType<int>}(\text{\$heap}_{funcstart\_719,1}.\text{a3}))) ==$
$\textbf{asType<integer>}(\text{div3.quot})$

$(\textbf{asType<integer>}(\textbf{asType<int>}(\text{\$heap}_{funcstart\_719,1}.\text{p3}))\ \%$
$\textbf{asType<integer>}(\textbf{asType<int>}(\text{\$heap}_{funcstart\_719,1}.\text{a3}))) ==$
$\textbf{asType<integer>}(\text{div3.rem})$

$\text{\$heap}_{719,1;729,8} == \text{\$heap}_{funcstart\_719,1}.\underline{\ }\textbf{replace}(\text{p1} \rightarrow \textbf{asType<short}$
$\textbf{int>}((\textbf{asType<int>}(\textbf{asType<short int>}(\text{div1.rem}))\ *$
$\textbf{asType<int>}(\text{\$heap}_{funcstart\_719,1}.\text{r1})) - (\textbf{asType<int>}(\textbf{asType<short}$
$\textbf{int>}(\text{div1.quot})\ *\ \textbf{asType<int>}(\text{\$heap}_{funcstart\_719,1}.\text{b1}))))$

$\text{\$heap}_{719,1;730,8} == \text{\$heap}_{719,1;729,8}.\underline{\ }\textbf{replace}(\text{p2} \rightarrow \textbf{asType<short}$
$\textbf{int>}((\textbf{asType<int>}(\textbf{asType<short int>}(\text{div2.rem}))\ *$
$\textbf{asType<int>}(\text{\$heap}_{719,1;729,8}.\text{r2})) - (\textbf{asType<int>}(\textbf{asType<short}$
$\textbf{int>}(\text{div2.quot})\ *\ \textbf{asType<int>}(\text{\$heap}_{719,1;729,8}.\text{b2}))))$

$\text{\$heap}_{719,1;731,8} == \text{\$heap}_{719,1;730,8}.\underline{\ }\textbf{replace}(\text{p3} \rightarrow \textbf{asType<short}$
$\textbf{int>}((\textbf{asType<int>}(\textbf{asType<short int>}(\text{div3.rem}))\ *$
$\textbf{asType<int>}(\text{\$heap}_{719,1;730,8}.\text{r3})) - (\textbf{asType<int>}(\textbf{asType<short}$

int>(div3.quot)) * **asType**<**int**>($heap$_{719,1;730,8}$.b3))))

$heap$_{719,1;733,8}$ == $heap$_{719,1;731,8}$._**replace**(p1 → **asType**<**short int**>((**asType**<**int**>($heap$_{719,1;731,8}$.M1) * **asType**<**int**>(**static_cast**<**integer**>(**asType**<**int**>($heap$_{719,1;731,8}$.p1) < (**int**)0))) + **asType**<**int**>($heap$_{719,1;731,8}$.p1)))

Proof:

[Take goal term]

[1.0] $heap$_{719,1;733,8}$.p2 ≤ **maxof**(**int**)

→ *[simplify]*

[1.9] -32768 < −$heap$_{719,1;733,8}$.p2

→ *[negate goal and search for contradiction]*

[1.10] !(-32768 < −$heap$_{719,1;733,8}$.p2)

→ *[simplify]*

[1.13] 32767 < $heap$_{719,1;733,8}$.p2

[Assume known post-assertion, class invariant or type constraint for term 1.13]

[42.0] $heap$_{719,1;733,8}$.p2 ≤ **maxof**(**short int**)

→ *[simplify]*

[42.9] -32768 < −$heap$_{719,1;733,8}$.p2

→ *[from term 1.13, literala < −$heap$_{719,1;733,8}$.p2 is false whenever -2 < (32767 + literala)]*

    Proof of rule precondition:

    [42.9.0] -2 < (-32768 + 32767)

    → *[simplify]*

    [42.9.2] **true**

[42.10] **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 (52,8)

Condition defined at:

To prove: minof(**short int**) ≤ ((**asType**<**int**>($heap$_{719,1;733,8}$.M2) * **asType**<**int**>(**static_cast**<**integer**>(**asType**<**int**>($heap$_{719,1;733,8}$.p2) < (**int**)0))) + **asType**<**int**>($heap$_{719,1;733,8}$.p2))

Given:

$heap$_{init}$.LIMIT == (**int**)80

$\$\text{heap}_{init}.\text{M1} == \textbf{asType}<\textbf{short int}>((\textbf{int})30269)$

$\$\text{heap}_{init}.\text{r1} == \textbf{asType}<\textbf{short int}>((\textbf{int})171)$

$\$\text{heap}_{init}.\text{a1} == \textbf{asType}<\textbf{short int}>((\textbf{int})177)$

$\$\text{heap}_{init}.\text{b1} == \textbf{asType}<\textbf{short int}>((\textbf{int})2)$

$\$\text{heap}_{init}.\text{M2} == \textbf{asType}<\textbf{short int}>((\textbf{int})30307)$

$\$\text{heap}_{init}.\text{r2} == \textbf{asType}<\textbf{short int}>((\textbf{int})172)$

$\$\text{heap}_{init}.\text{a2} == \textbf{asType}<\textbf{short int}>((\textbf{int})176)$

$\$\text{heap}_{init}.\text{b2} == \textbf{asType}<\textbf{short int}>((\textbf{int})35)$

$\$\text{heap}_{init}.\text{M3} == \textbf{asType}<\textbf{short int}>((\textbf{int})30323)$

$\$\text{heap}_{init}.\text{r3} == \textbf{asType}<\textbf{short int}>((\textbf{int})170)$

$\$\text{heap}_{init}.\text{a3} == \textbf{asType}<\textbf{short int}>((\textbf{int})178)$

$\$\text{heap}_{init}.\text{b3} == \textbf{asType}<\textbf{short int}>((\textbf{int})63)$

$\$\text{heap}_{init}.\text{p1} == \textbf{asType}<\textbf{short int}>((\textbf{int})1)$

$\$\text{heap}_{init}.\text{p2} == \textbf{asType}<\textbf{short int}>((\textbf{int})2)$

$\$\text{heap}_{init}.\text{p3} == \textbf{asType}<\textbf{short int}>((\textbf{int})3)$

$\text{div1} == \text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_719,1},$
$\textbf{asType}<\textbf{int}>(\$\text{heap}_{funcstart\_719,1}.\text{p1}),$
$\textbf{asType}<\textbf{int}>(\$\text{heap}_{funcstart\_719,1}.\text{a1}))$

$(\textbf{asType}<\textbf{integer}>(\textbf{asType}<\textbf{int}>(\$\text{heap}_{funcstart\_719,1}.\text{p1}))\ /$
$\textbf{asType}<\textbf{integer}>(\textbf{asType}<\textbf{int}>(\$\text{heap}_{funcstart\_719,1}.\text{a1}))) ==$
$\textbf{asType}<\textbf{integer}>(\text{div1.quot})$

$(\textbf{asType}<\textbf{integer}>(\textbf{asType}<\textbf{int}>(\$\text{heap}_{funcstart\_719,1}.\text{p1}))\ \%$
$\textbf{asType}<\textbf{integer}>(\textbf{asType}<\textbf{int}>(\$\text{heap}_{funcstart\_719,1}.\text{a1}))) ==$
$\textbf{asType}<\textbf{integer}>(\text{div1.rem})$

$\text{div2} == \text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_719,1},$
$\textbf{asType}<\textbf{int}>(\$\text{heap}_{funcstart\_719,1}.\text{p2}),$
$\textbf{asType}<\textbf{int}>(\$\text{heap}_{funcstart\_719,1}.\text{a2}))$

$(\textbf{asType}<\textbf{integer}>(\textbf{asType}<\textbf{int}>(\$\text{heap}_{funcstart\_719,1}.\text{p2}))\ /$
$\textbf{asType}<\textbf{integer}>(\textbf{asType}<\textbf{int}>(\$\text{heap}_{funcstart\_719,1}.\text{a2}))) ==$
$\textbf{asType}<\textbf{integer}>(\text{div2.quot})$

$(\textbf{asType}<\textbf{integer}>(\textbf{asType}<\textbf{int}>(\$\text{heap}_{funcstart\_719,1}.\text{p2}))\ \%$
$\textbf{asType}<\textbf{integer}>(\textbf{asType}<\textbf{int}>(\$\text{heap}_{funcstart\_719,1}.\text{a2}))) ==$
$\textbf{asType}<\textbf{integer}>(\text{div2.rem})$

$\text{div3} == \text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_719,1},$
$\textbf{asType}<\textbf{int}>(\$\text{heap}_{funcstart\_719,1}.\text{p3}),$
$\textbf{asType}<\textbf{int}>(\$\text{heap}_{funcstart\_719,1}.\text{a3}))$

(**asType<integer>**(**asType<int>**($heap$_{funcstart_719,1}$.p3)) /
asType<integer>(**asType<int>**($heap$_{funcstart_719,1}$.a3))) ==
asType<integer>(div3.quot)

(**asType<integer>**(**asType<int>**($heap$_{funcstart_719,1}$.p3)) %
asType<integer>(**asType<int>**($heap$_{funcstart_719,1}$.a3))) ==
asType<integer>(div3.rem)

$heap$_{719,1;729,8}$ == $heap$_{funcstart_719,1}$.**replace**(p1 → **asType<short
int>**((**asType<int>**(**asType<short int>**(div1.rem)) *
asType<int>($heap$_{funcstart_719,1}$.r1)) − (**asType<int>**(**asType<short
int>**(div1.quot)) * **asType<int>**($heap$_{funcstart_719,1}$.b1)))))

$heap$_{719,1;730,8}$ == $heap$_{719,1;729,8}$.**replace**(p2 → **asType<short
int>**((**asType<int>**(**asType<short int>**(div2.rem)) *
asType<int>($heap$_{719,1;729,8}$.r2)) − (**asType<int>**(**asType<short
int>**(div2.quot)) * **asType<int>**($heap$_{719,1;729,8}$.b2)))))

$heap$_{719,1;731,8}$ == $heap$_{719,1;730,8}$.**replace**(p3 → **asType<short
int>**((**asType<int>**(**asType<short int>**(div3.rem)) *
asType<int>($heap$_{719,1;730,8}$.r3)) − (**asType<int>**(**asType<short
int>**(div3.quot)) * **asType<int>**($heap$_{719,1;730,8}$.b3)))))

$heap$_{719,1;733,8}$ == $heap$_{719,1;731,8}$.**replace**(p1 → **asType<short
int>**((**asType<int>**($heap$_{719,1;731,8}$.M1) *
asType<int>(**static_cast<integer>**(**asType<int>**($heap$_{719,1;731,8}$.p1) <
(**int**)0))) + **asType<int>**($heap$_{719,1;731,8}$.p1)))

Proof:

[Take goal term]

[1.0] **minof(short int)** ≤ ((**asType<int>**($heap$_{719,1;733,8}$.M2) *
asType<int>(**static_cast<integer>**(**asType<int>**($heap$_{719,1;733,8}$.p2) <
(**int**)0))) + **asType<int>**($heap$_{719,1;733,8}$.p2))

→ *[simplify]*

[1.1] -32768 ≤ ((**asType<int>**($heap$_{719,1;733,8}$.M2) *
asType<int>(**static_cast<integer>**(**asType<int>**($heap$_{719,1;733,8}$.p2) <
(**int**)0))) + **asType<int>**($heap$_{719,1;733,8}$.p2))

→ *[const static or extern object]*

[1.2] -32768 ≤ ((**asType<int>**($heap$_{init}$.M2) *
asType<int>(**static_cast<integer>**(**asType<int>**($heap$_{719,1;733,8}$.p2) <
(**int**)0))) + **asType<int>**($heap$_{719,1;733,8}$.p2))

→ *[expand definition of constant 'M2' at prang.c (19,20)]*

[1.3] -32768 ≤ ((**asType<int>**(**asType<short int>**((**int**)30307)) *
asType<int>(**static_cast<integer>**(**asType<int>**($heap$_{719,1;733,8}$.p2) <
(**int**)0))) + **asType<int>**($heap$_{719,1;733,8}$.p2))

$\rightarrow$ *[simplify]*

[1.11] -32768 $\leq$ ((30307 * **asType\<int\>**(([0 < $-\$heap_{719,1;733,8}$.p2]: 1, []: 0))) + **asType\<int\>**($\$heap_{719,1;733,8}$.p2))

$\rightarrow$ *[explicitly assert falsehood of skipped guards in subsequent guards]*

[1.12] -32768 $\leq$ ((30307 * **asType\<int\>**(([0 < $-\$heap_{719,1;733,8}$.p2]: 1, [!(0 < $-\$heap_{719,1;733,8}$.p2)]: 0))) + **asType\<int\>**($\$heap_{719,1;733,8}$.p2))

$\rightarrow$ *[simplify]*

[1.16] -32768 $\leq$ ((30307 * ([0 < $-\$heap_{719,1;733,8}$.p2]: 1, [-1 < $\$heap_{719,1;733,8}$.p2]: 0)) + **asType\<int\>**($\$heap_{719,1;733,8}$.p2))

$\rightarrow$ *[move guard outside expression]*

[1.17] -32768 $\leq$ (([0 < $-\$heap_{719,1;733,8}$.p2]: 1 * 30307, [-1 < $\$heap_{719,1;733,8}$.p2]: 0 * 30307) + **asType\<int\>**($\$heap_{719,1;733,8}$.p2))

$\rightarrow$ *[simplify]*

[1.20] -32768 $\leq$ (([0 < $-\$heap_{719,1;733,8}$.p2]: 30307, [-1 < $\$heap_{719,1;733,8}$.p2]: 0) + $\$heap_{719,1;733,8}$.p2)

$\rightarrow$ *[move guard outside expression]*

[1.21] -32768 $\leq$ ([0 < $-\$heap_{719,1;733,8}$.p2]: 30307 + $\$heap_{719,1;733,8}$.p2, [-1 < $\$heap_{719,1;733,8}$.p2]: 0 + $\$heap_{719,1;733,8}$.p2)

$\rightarrow$ *[simplify]*

[1.24] -32769 < ([0 < $-\$heap_{719,1;733,8}$.p2]: 30307 + $\$heap_{719,1;733,8}$.p2, [-1 < $\$heap_{719,1;733,8}$.p2]: $\$heap_{719,1;733,8}$.p2)

$\rightarrow$ *[move guard outside expression]*

[1.25] ([0 < $-\$heap_{719,1;733,8}$.p2]: -32769 < (30307 + $\$heap_{719,1;733,8}$.p2), [-1 < $\$heap_{719,1;733,8}$.p2]: -32769 < $\$heap_{719,1;733,8}$.p2)

$\rightarrow$ *[simplify]*

[1.27] ([0 < $-\$heap_{719,1;733,8}$.p2]: -63076 < $\$heap_{719,1;733,8}$.p2, [-1 < $\$heap_{719,1;733,8}$.p2]: -32769 < $\$heap_{719,1;733,8}$.p2)

$\rightarrow$ *[from guard, literala < $\$heap_{719,1;733,8}$.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 < $-\$heap_{719,1;733,8}$.p2]: -63076 < $\$heap_{719,1;733,8}$.p2, [-1 < $\$heap_{719,1;733,8}$.p2]: **true**)

$\rightarrow$ *[negate goal and search for contradiction]*

[1.29] !([0 < −$\text{\$heap}_{719,1;733,8}$.p2]: -63076 < $\text{\$heap}_{719,1;733,8}$.p2, [-1 < $\text{\$heap}_{719,1;733,8}$.p2]: **true**)

→ *[move guard outside expression]*

[1.30] ([0 < −$\text{\$heap}_{719,1;733,8}$.p2]: !(-63076 < $\text{\$heap}_{719,1;733,8}$.p2), [-1 < $\text{\$heap}_{719,1;733,8}$.p2]: !**true**)

→ *[simplify]*

[1.35] (0 < −$\text{\$heap}_{719,1;733,8}$.p2) ∧ (63075 < −$\text{\$heap}_{719,1;733,8}$.p2)

[Work on sub-term 2 of conjunction in term 1.35]

[42.0] 63075 < −$\text{\$heap}_{719,1;733,8}$.p2

[Assume known post-assertion, class invariant or type constraint for term 1.35]

[43.0] **minof(short int)** ≤ $\text{\$heap}_{719,1;733,8}$.p2

→ *[simplify]*

[43.3] -32769 < $\text{\$heap}_{719,1;733,8}$.p2

→ *[from term 42.0, literala < $\text{\$heap}_{719,1;733,8}$.p2 is false whenever -2 < (63075 + literala)]*

> **Proof of rule precondition:**
>
> *[43.3.0]* -2 < (-32769 + 63075)
>
> → *[simplify]*
>
> *[43.3.2]* **true**

[43.4] **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 (52,8)

Condition defined at:

To prove: ((**asType<int>**($\text{\$heap}_{719,1;733,8}$.M2) * **asType<int>**(**static_cast<integer>**(**asType<int>**($\text{\$heap}_{719,1;733,8}$.p2) < (**int**)0))) + **asType<int>**($\text{\$heap}_{719,1;733,8}$.p2)) ≤ **maxof(short int)**

Given:

$\text{\$heap}_{init}$.LIMIT == (**int**)80

$\text{\$heap}_{init}$.M1 == **asType<short int>**((**int**)30269)

$\text{\$heap}_{init}$.r1 == **asType<short int>**((**int**)171)

$\text{\$heap}_{init}$.a1 == **asType<short int>**((**int**)177)

$\text{\$heap}_{init}$.b1 == **asType<short int>**((**int**)2)

$\text{\$heap}_{init}.\text{M2} == \textbf{asType}\mathbf{<}\textbf{short int}\mathbf{>}((\textbf{int})30307)$

$\text{\$heap}_{init}.\text{r2} == \textbf{asType}\mathbf{<}\textbf{short int}\mathbf{>}((\textbf{int})172)$

$\text{\$heap}_{init}.\text{a2} == \textbf{asType}\mathbf{<}\textbf{short int}\mathbf{>}((\textbf{int})176)$

$\text{\$heap}_{init}.\text{b2} == \textbf{asType}\mathbf{<}\textbf{short int}\mathbf{>}((\textbf{int})35)$

$\text{\$heap}_{init}.\text{M3} == \textbf{asType}\mathbf{<}\textbf{short int}\mathbf{>}((\textbf{int})30323)$

$\text{\$heap}_{init}.\text{r3} == \textbf{asType}\mathbf{<}\textbf{short int}\mathbf{>}((\textbf{int})170)$

$\text{\$heap}_{init}.\text{a3} == \textbf{asType}\mathbf{<}\textbf{short int}\mathbf{>}((\textbf{int})178)$

$\text{\$heap}_{init}.\text{b3} == \textbf{asType}\mathbf{<}\textbf{short int}\mathbf{>}((\textbf{int})63)$

$\text{\$heap}_{init}.\text{p1} == \textbf{asType}\mathbf{<}\textbf{short int}\mathbf{>}((\textbf{int})1)$

$\text{\$heap}_{init}.\text{p2} == \textbf{asType}\mathbf{<}\textbf{short int}\mathbf{>}((\textbf{int})2)$

$\text{\$heap}_{init}.\text{p3} == \textbf{asType}\mathbf{<}\textbf{short int}\mathbf{>}((\textbf{int})3)$

div1 == div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$,
asType<int>$(\text{\$heap}_{funcstart\_719,1}.\text{p1})$,
asType<int>$(\text{\$heap}_{funcstart\_719,1}.\text{a1}))$

$(\textbf{asType}\mathbf{<}\textbf{integer}\mathbf{>}(\textbf{asType}\mathbf{<}\textbf{int}\mathbf{>}(\text{\$heap}_{funcstart\_719,1}.\text{p1}))\ /$
$\textbf{asType}\mathbf{<}\textbf{integer}\mathbf{>}(\textbf{asType}\mathbf{<}\textbf{int}\mathbf{>}(\text{\$heap}_{funcstart\_719,1}.\text{a1}))) ==$
$\textbf{asType}\mathbf{<}\textbf{integer}\mathbf{>}(\text{div1.quot})$

$(\textbf{asType}\mathbf{<}\textbf{integer}\mathbf{>}(\textbf{asType}\mathbf{<}\textbf{int}\mathbf{>}(\text{\$heap}_{funcstart\_719,1}.\text{p1}))\ \%$
$\textbf{asType}\mathbf{<}\textbf{integer}\mathbf{>}(\textbf{asType}\mathbf{<}\textbf{int}\mathbf{>}(\text{\$heap}_{funcstart\_719,1}.\text{a1}))) ==$
$\textbf{asType}\mathbf{<}\textbf{integer}\mathbf{>}(\text{div1.rem})$

div2 == div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$,
asType<int>$(\text{\$heap}_{funcstart\_719,1}.\text{p2})$,
asType<int>$(\text{\$heap}_{funcstart\_719,1}.\text{a2}))$

$(\textbf{asType}\mathbf{<}\textbf{integer}\mathbf{>}(\textbf{asType}\mathbf{<}\textbf{int}\mathbf{>}(\text{\$heap}_{funcstart\_719,1}.\text{p2}))\ /$
$\textbf{asType}\mathbf{<}\textbf{integer}\mathbf{>}(\textbf{asType}\mathbf{<}\textbf{int}\mathbf{>}(\text{\$heap}_{funcstart\_719,1}.\text{a2}))) ==$
$\textbf{asType}\mathbf{<}\textbf{integer}\mathbf{>}(\text{div2.quot})$

$(\textbf{asType}\mathbf{<}\textbf{integer}\mathbf{>}(\textbf{asType}\mathbf{<}\textbf{int}\mathbf{>}(\text{\$heap}_{funcstart\_719,1}.\text{p2}))\ \%$
$\textbf{asType}\mathbf{<}\textbf{integer}\mathbf{>}(\textbf{asType}\mathbf{<}\textbf{int}\mathbf{>}(\text{\$heap}_{funcstart\_719,1}.\text{a2}))) ==$
$\textbf{asType}\mathbf{<}\textbf{integer}\mathbf{>}(\text{div2.rem})$

div3 == div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$,
asType<int>$(\text{\$heap}_{funcstart\_719,1}.\text{p3})$,
asType<int>$(\text{\$heap}_{funcstart\_719,1}.\text{a3}))$

$(\textbf{asType}\mathbf{<}\textbf{integer}\mathbf{>}(\textbf{asType}\mathbf{<}\textbf{int}\mathbf{>}(\text{\$heap}_{funcstart\_719,1}.\text{p3}))\ /$
$\textbf{asType}\mathbf{<}\textbf{integer}\mathbf{>}(\textbf{asType}\mathbf{<}\textbf{int}\mathbf{>}(\text{\$heap}_{funcstart\_719,1}.\text{a3}))) ==$
$\textbf{asType}\mathbf{<}\textbf{integer}\mathbf{>}(\text{div3.quot})$

$(\textbf{asType}\mathbf{<}\textbf{integer}\mathbf{>}(\textbf{asType}\mathbf{<}\textbf{int}\mathbf{>}(\text{\$heap}_{funcstart\_719,1}.\text{p3}))\ \%$
$\textbf{asType}\mathbf{<}\textbf{integer}\mathbf{>}(\textbf{asType}\mathbf{<}\textbf{int}\mathbf{>}(\text{\$heap}_{funcstart\_719,1}.\text{a3}))) ==$
$\textbf{asType}\mathbf{<}\textbf{integer}\mathbf{>}(\text{div3.rem})$

$\text{\$heap}_{719,1;729,8} == \text{\$heap}_{funcstart\_719,1}.\textbf{replace}(\text{p1} \rightarrow \textbf{asType}\textbf{<short int>}((\textbf{asType}\textbf{<int>}(\textbf{asType}\textbf{<short int>}(\text{div1.rem})) * \textbf{asType}\textbf{<int>}(\text{\$heap}_{funcstart\_719,1}.\text{r1})) - (\textbf{asType}\textbf{<int>}(\textbf{asType}\textbf{<short int>}(\text{div1.quot})) * \textbf{asType}\textbf{<int>}(\text{\$heap}_{funcstart\_719,1}.\text{b1}))))$

$\text{\$heap}_{719,1;730,8} == \text{\$heap}_{719,1;729,8}.\textbf{replace}(\text{p2} \rightarrow \textbf{asType}\textbf{<short int>}((\textbf{asType}\textbf{<int>}(\textbf{asType}\textbf{<short int>}(\text{div2.rem})) * \textbf{asType}\textbf{<int>}(\text{\$heap}_{719,1;729,8}.\text{r2})) - (\textbf{asType}\textbf{<int>}(\textbf{asType}\textbf{<short int>}(\text{div2.quot})) * \textbf{asType}\textbf{<int>}(\text{\$heap}_{719,1;729,8}.\text{b2}))))$

$\text{\$heap}_{719,1;731,8} == \text{\$heap}_{719,1;730,8}.\textbf{replace}(\text{p3} \rightarrow \textbf{asType}\textbf{<short int>}((\textbf{asType}\textbf{<int>}(\textbf{asType}\textbf{<short int>}(\text{div3.rem})) * \textbf{asType}\textbf{<int>}(\text{\$heap}_{719,1;730,8}.\text{r3})) - (\textbf{asType}\textbf{<int>}(\textbf{asType}\textbf{<short int>}(\text{div3.quot})) * \textbf{asType}\textbf{<int>}(\text{\$heap}_{719,1;730,8}.\text{b3}))))$

$\text{\$heap}_{719,1;733,8} == \text{\$heap}_{719,1;731,8}.\textbf{replace}(\text{p1} \rightarrow \textbf{asType}\textbf{<short int>}((\textbf{asType}\textbf{<int>}(\text{\$heap}_{719,1;731,8}.\text{M1}) * \textbf{asType}\textbf{<int>}(\textbf{static\_cast}\textbf{<integer>}(\textbf{asType}\textbf{<int>}(\text{\$heap}_{719,1;731,8}.\text{p1}) < (\textbf{int})0))) + \textbf{asType}\textbf{<int>}(\text{\$heap}_{719,1;731,8}.\text{p1})))$

Proof:

[Take goal term]

[1.0] $((\textbf{asType}\textbf{<int>}(\text{\$heap}_{719,1;733,8}.\text{M2}) * \textbf{asType}\textbf{<int>}(\textbf{static\_cast}\textbf{<integer>}(\textbf{asType}\textbf{<int>}(\text{\$heap}_{719,1;733,8}.\text{p2}) < (\textbf{int})0))) + \textbf{asType}\textbf{<int>}(\text{\$heap}_{719,1;733,8}.\text{p2})) \leq \textbf{maxof}(\textbf{short int})$

$\rightarrow$ *[const static or extern object]*

[1.1] $((\textbf{asType}\textbf{<int>}(\text{\$heap}_{init}.\text{M2}) * \textbf{asType}\textbf{<int>}(\textbf{static\_cast}\textbf{<integer>}(\textbf{asType}\textbf{<int>}(\text{\$heap}_{719,1;733,8}.\text{p2}) < (\textbf{int})0))) + \textbf{asType}\textbf{<int>}(\text{\$heap}_{719,1;733,8}.\text{p2})) \leq \textbf{maxof}(\textbf{short int})$

$\rightarrow$ *[expand definition of constant 'M2' at prang.c (19,20)]*

[1.2] $((\textbf{asType}\textbf{<int>}(\textbf{asType}\textbf{<short int>}((\textbf{int})30307)) * \textbf{asType}\textbf{<int>}(\textbf{static\_cast}\textbf{<integer>}(\textbf{asType}\textbf{<int>}(\text{\$heap}_{719,1;733,8}.\text{p2}) < (\textbf{int})0))) + \textbf{asType}\textbf{<int>}(\text{\$heap}_{719,1;733,8}.\text{p2})) \leq \textbf{maxof}(\textbf{short int})$

$\rightarrow$ *[simplify]*

[1.10] $((30307 * \textbf{asType}\textbf{<int>}(([0 < -\text{\$heap}_{719,1;733,8}.\text{p2}]: 1, []: 0))) + \textbf{asType}\textbf{<int>}(\text{\$heap}_{719,1;733,8}.\text{p2})) \leq \textbf{maxof}(\textbf{short int})$

$\rightarrow$ *[explicitly assert falsehood of skipped guards in subsequent guards]*

[1.11] $((30307 * \textbf{asType}\textbf{<int>}(([0 < -\text{\$heap}_{719,1;733,8}.\text{p2}]: 1, [!(0 < -\text{\$heap}_{719,1;733,8}.\text{p2})]: 0))) + \textbf{asType}\textbf{<int>}(\text{\$heap}_{719,1;733,8}.\text{p2})) \leq \textbf{maxof}(\textbf{short int})$

$\rightarrow$ *[simplify]*

[1.15] $((30307 * ([0 < -\text{\$heap}_{719,1;733,8}.\text{p2}]: 1, [\text{-}1 < \text{\$heap}_{719,1;733,8}.\text{p2}]: 0)) + \textbf{asType}\textbf{<int>}(\text{\$heap}_{719,1;733,8}.\text{p2})) \leq \textbf{maxof}(\textbf{short int})$

$\rightarrow$ *[move guard outside expression]*

[1.16] $((([0 < -\$heap_{719,1;733,8}.p2]:\ 1 * 30307,\ [-1 < \$heap_{719,1;733,8}.p2]:\ 0 * 30307) + \textbf{asType}\textbf{<int>}(\$heap_{719,1;733,8}.p2)) \leq \textbf{maxof}(\textbf{short int})$

$\rightarrow$ *[simplify]*

[1.19] $((([0 < -\$heap_{719,1;733,8}.p2]:\ 30307,\ [-1 < \$heap_{719,1;733,8}.p2]:\ 0) + \$heap_{719,1;733,8}.p2) \leq \textbf{maxof}(\textbf{short int})$

$\rightarrow$ *[move guard outside expression]*

[1.20] $([0 < -\$heap_{719,1;733,8}.p2]:\ 30307 + \$heap_{719,1;733,8}.p2,\ [-1 < \$heap_{719,1;733,8}.p2]:\ 0 + \$heap_{719,1;733,8}.p2) \leq \textbf{maxof}(\textbf{short int})$

$\rightarrow$ *[simplify]*

[1.23] $(-1 + ([0 < -\$heap_{719,1;733,8}.p2]:\ 30307 + \$heap_{719,1;733,8}.p2,\ [-1 < \$heap_{719,1;733,8}.p2]:\ \$heap_{719,1;733,8}.p2)) < 32767$

$\rightarrow$ *[move guard outside expression]*

[1.24] $([0 < -\$heap_{719,1;733,8}.p2]:\ -1 + (30307 + \$heap_{719,1;733,8}.p2),\ [-1 < \$heap_{719,1;733,8}.p2]:\ -1 + \$heap_{719,1;733,8}.p2) < 32767$

$\rightarrow$ *[simplify]*

[1.27] $0 < (32767 + -([0 < -\$heap_{719,1;733,8}.p2]:\ 30306 + \$heap_{719,1;733,8}.p2,\ [-1 < \$heap_{719,1;733,8}.p2]:\ -1 + \$heap_{719,1;733,8}.p2))$

$\rightarrow$ *[move guard outside expression]*

[1.28] $0 < (32767 + ([0 < -\$heap_{719,1;733,8}.p2]:\ -(30306 + \$heap_{719,1;733,8}.p2),\ [-1 < \$heap_{719,1;733,8}.p2]:\ -(-1 + \$heap_{719,1;733,8}.p2)))$

$\rightarrow$ *[simplify]*

[1.32] $0 < (32767 + ([0 < -\$heap_{719,1;733,8}.p2]:\ -30306 + -\$heap_{719,1;733,8}.p2,\ [-1 < \$heap_{719,1;733,8}.p2]:\ 1 + -\$heap_{719,1;733,8}.p2))$

$\rightarrow$ *[move guard outside expression]*

[1.33] $0 < ([0 < -\$heap_{719,1;733,8}.p2]:\ 32767 + (-30306 + -\$heap_{719,1;733,8}.p2),\ [-1 < \$heap_{719,1;733,8}.p2]:\ 32767 + (1 + -\$heap_{719,1;733,8}.p2))$

$\rightarrow$ *[simplify]*

[1.37] $0 < ([0 < -\$heap_{719,1;733,8}.p2]:\ 2461 + -\$heap_{719,1;733,8}.p2,\ [-1 < \$heap_{719,1;733,8}.p2]:\ 32768 + -\$heap_{719,1;733,8}.p2)$

$\rightarrow$ *[move guard outside expression]*

[1.38] $([0 < -\$heap_{719,1;733,8}.p2]:\ 0 < (2461 + -\$heap_{719,1;733,8}.p2),\ [-1 < \$heap_{719,1;733,8}.p2]:\ 0 < (32768 + -\$heap_{719,1;733,8}.p2))$

$\rightarrow$ *[simplify]*

[1.40] $([0 < -\$heap_{719,1;733,8}.p2]:\ -2461 < -\$heap_{719,1;733,8}.p2,\ [-1 < \$heap_{719,1;733,8}.p2]:\ 0 < (32768 + -\$heap_{719,1;733,8}.p2))$

→ *[from guard, literala < −$heap$_{719,1;733,8}$.p2 is true whenever (-1 + literala) < 0]*

Proof of rule precondition:

[1.40.0] (-2461 + -1) < 0

→ *[simplify]*

[1.40.2] **true**

[1.41] ([0 < −$heap$_{719,1;733,8}$.p2]: **true**, [-1 < $heap$_{719,1;733,8}$.p2]: 0 < (32768 + −$heap$_{719,1;733,8}$.p2))

→ *[simplify]*

[1.43] ([0 < −$heap$_{719,1;733,8}$.p2]: **true**, [-1 < $heap$_{719,1;733,8}$.p2]: -32768 < −$heap$_{719,1;733,8}$.p2)

→ *[negate goal and search for contradiction]*

[1.44] !([0 < −$heap$_{719,1;733,8}$.p2]: **true**, [-1 < $heap$_{719,1;733,8}$.p2]: -32768 < −$heap$_{719,1;733,8}$.p2)

→ *[move guard outside expression]*

[1.45] ([0 < −$heap$_{719,1;733,8}$.p2]: !**true**, [-1 < $heap$_{719,1;733,8}$.p2]: !(-32768 < −$heap$_{719,1;733,8}$.p2))

→ *[simplify]*

[1.51] (-1 < $heap$_{719,1;733,8}$.p2) ∧ (32767 < $heap$_{719,1;733,8}$.p2)

[Work on sub-term 2 of conjunction in term 1.51]

[42.0] 32767 < $heap$_{719,1;733,8}$.p2

[Assume known post-assertion, class invariant or type constraint for term 1.51]

[43.0] $heap$_{719,1;733,8}$.p2 ≤ **maxof**(**short int**)

→ *[simplify]*

[43.9] -32768 < −$heap$_{719,1;733,8}$.p2

→ *[from term 42.0, literala < −$heap$_{719,1;733,8}$.p2 is false whenever -2 < (32767 + literala)]*

Proof of rule precondition:

[43.9.0] -2 < (-32768 + 32767)

→ *[simplify]*

[43.9.2] **true**

[43.10] **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 (53,27)

Condition defined at:

To prove: minof(int) $\leq$ **$\$$heap$_{719,1;734,8}$.M3**

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)

$\$$heap$_{init}$.M2 == **asType<short int>**((**int**)30307)

$\$$heap$_{init}$.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)

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

$\$$heap$_{init}$.a3 == **asType<short int>**((**int**)178)

$\$$heap$_{init}$.b3 == **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)

div1 == div(**heapIs** $\$$heap$_{funcstart\_719,1}$,
asType<int>($\$$heap$_{funcstart\_719,1}$.p1),
asType<int>($\$$heap$_{funcstart\_719,1}$.a1))

(**asType<integer>**(**asType<int>**($\$$heap$_{funcstart\_719,1}$.p1)) /
asType<integer>(**asType<int>**($\$$heap$_{funcstart\_719,1}$.a1))) ==
asType<integer>(div1.quot)

(**asType<integer>**(**asType<int>**($\$$heap$_{funcstart\_719,1}$.p1)) %
asType<integer>(**asType<int>**($\$$heap$_{funcstart\_719,1}$.a1))) ==
asType<integer>(div1.rem)

div2 == div(**heapIs** $\$$heap$_{funcstart\_719,1}$,
asType<int>($\$$heap$_{funcstart\_719,1}$.p2),
asType<int>($\$$heap$_{funcstart\_719,1}$.a2))

(**asType<integer>**(**asType<int>**($\$$heap$_{funcstart\_719,1}$.p2)) /
asType<integer>(**asType<int>**($\$$heap$_{funcstart\_719,1}$.a2))) ==
asType<integer>(div2.quot)

$(\mathbf{asType{<}integer{>}}(\mathbf{asType{<}int{>}}(\$\text{heap}_{funcstart\_719,1}.\text{p2}))\ \%$
$\mathbf{asType{<}integer{>}}(\mathbf{asType{<}int{>}}(\$\text{heap}_{funcstart\_719,1}.\text{a2}))) ==$
$\mathbf{asType{<}integer{>}}(\text{div2.rem})$

$\text{div3} == \text{div}(\mathbf{heapIs}\ \$\text{heap}_{funcstart\_719,1},$
$\mathbf{asType{<}int{>}}(\$\text{heap}_{funcstart\_719,1}.\text{p3}),$
$\mathbf{asType{<}int{>}}(\$\text{heap}_{funcstart\_719,1}.\text{a3}))$

$(\mathbf{asType{<}integer{>}}(\mathbf{asType{<}int{>}}(\$\text{heap}_{funcstart\_719,1}.\text{p3}))\ /$
$\mathbf{asType{<}integer{>}}(\mathbf{asType{<}int{>}}(\$\text{heap}_{funcstart\_719,1}.\text{a3}))) ==$
$\mathbf{asType{<}integer{>}}(\text{div3.quot})$

$(\mathbf{asType{<}integer{>}}(\mathbf{asType{<}int{>}}(\$\text{heap}_{funcstart\_719,1}.\text{p3}))\ \%$
$\mathbf{asType{<}integer{>}}(\mathbf{asType{<}int{>}}(\$\text{heap}_{funcstart\_719,1}.\text{a3}))) ==$
$\mathbf{asType{<}integer{>}}(\text{div3.rem})$

$\$\text{heap}_{719,1;729,8} == \$\text{heap}_{funcstart\_719,1}.\mathbf{\_replace}(\text{p1} \rightarrow \mathbf{asType{<}short}$
$\mathbf{int{>}}((\mathbf{asType{<}int{>}}(\mathbf{asType{<}short\ int{>}}(\text{div1.rem}))\ *$
$\mathbf{asType{<}int{>}}(\$\text{heap}_{funcstart\_719,1}.\text{r1})) - (\mathbf{asType{<}int{>}}(\mathbf{asType{<}short}$
$\mathbf{int{>}}(\text{div1.quot}))\ *\ \mathbf{asType{<}int{>}}(\$\text{heap}_{funcstart\_719,1}.\text{b1}))))$

$\$\text{heap}_{719,1;730,8} == \$\text{heap}_{719,1;729,8}.\mathbf{\_replace}(\text{p2} \rightarrow \mathbf{asType{<}short}$
$\mathbf{int{>}}((\mathbf{asType{<}int{>}}(\mathbf{asType{<}short\ int{>}}(\text{div2.rem}))\ *$
$\mathbf{asType{<}int{>}}(\$\text{heap}_{719,1;729,8}.\text{r2})) - (\mathbf{asType{<}int{>}}(\mathbf{asType{<}short}$
$\mathbf{int{>}}(\text{div2.quot}))\ *\ \mathbf{asType{<}int{>}}(\$\text{heap}_{719,1;729,8}.\text{b2}))))$

$\$\text{heap}_{719,1;731,8} == \$\text{heap}_{719,1;730,8}.\mathbf{\_replace}(\text{p3} \rightarrow \mathbf{asType{<}short}$
$\mathbf{int{>}}((\mathbf{asType{<}int{>}}(\mathbf{asType{<}short\ int{>}}(\text{div3.rem}))\ *$
$\mathbf{asType{<}int{>}}(\$\text{heap}_{719,1;730,8}.\text{r3})) - (\mathbf{asType{<}int{>}}(\mathbf{asType{<}short}$
$\mathbf{int{>}}(\text{div3.quot}))\ *\ \mathbf{asType{<}int{>}}(\$\text{heap}_{719,1;730,8}.\text{b3}))))$

$\$\text{heap}_{719,1;733,8} == \$\text{heap}_{719,1;731,8}.\mathbf{\_replace}(\text{p1} \rightarrow \mathbf{asType{<}short}$
$\mathbf{int{>}}((\mathbf{asType{<}int{>}}(\$\text{heap}_{719,1;731,8}.\text{M1})\ *$
$\mathbf{asType{<}int{>}}(\mathbf{static\_cast{<}integer{>}}(\mathbf{asType{<}int{>}}(\$\text{heap}_{719,1;731,8}.\text{p1}) <$
$(\mathbf{int})0))) + \mathbf{asType{<}int{>}}(\$\text{heap}_{719,1;731,8}.\text{p1})))$

$\$\text{heap}_{719,1;734,8} == \$\text{heap}_{719,1;733,8}.\mathbf{\_replace}(\text{p2} \rightarrow \mathbf{asType{<}short}$
$\mathbf{int{>}}((\mathbf{asType{<}int{>}}(\$\text{heap}_{719,1;733,8}.\text{M2})\ *$
$\mathbf{asType{<}int{>}}(\mathbf{static\_cast{<}integer{>}}(\mathbf{asType{<}int{>}}(\$\text{heap}_{719,1;733,8}.\text{p2}) <$
$(\mathbf{int})0))) + \mathbf{asType{<}int{>}}(\$\text{heap}_{719,1;733,8}.\text{p2})))$

Proof:

[Take goal term]

[1.0] $\mathbf{minof(int)} \leq \$\text{heap}_{719,1;734,8}.\text{M3}$

$\rightarrow$ *[simplify]*

[1.1] $\text{-32768} \leq \$\text{heap}_{719,1;734,8}.\text{M3}$

$\rightarrow$ *[const static or extern object]*

[1.2] $\text{-32768} \leq \$\text{heap}_{init}.\text{M3}$

$\rightarrow$ *[expand definition of constant 'M3' at prang.c (24,20)]*

[1.3] -32768 $\leq$ **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 (53,27)

Condition defined at:

To prove: $\$\text{heap}_{719,1;734,8}$.M3 $\leq$ **maxof**(**int**)

Given:

$\$\text{heap}_{init}$.LIMIT == (**int**)80

$\$\text{heap}_{init}$.M1 == **asType**<**short int**>((**int**)30269)

$\$\text{heap}_{init}$.r1 == **asType**<**short int**>((**int**)171)

$\$\text{heap}_{init}$.a1 == **asType**<**short int**>((**int**)177)

$\$\text{heap}_{init}$.b1 == **asType**<**short int**>((**int**)2)

$\$\text{heap}_{init}$.M2 == **asType**<**short int**>((**int**)30307)

$\$\text{heap}_{init}$.r2 == **asType**<**short int**>((**int**)172)

$\$\text{heap}_{init}$.a2 == **asType**<**short int**>((**int**)176)

$\$\text{heap}_{init}$.b2 == **asType**<**short int**>((**int**)35)

$\$\text{heap}_{init}$.M3 == **asType**<**short int**>((**int**)30323)

$\$\text{heap}_{init}$.r3 == **asType**<**short int**>((**int**)170)

$\$\text{heap}_{init}$.a3 == **asType**<**short int**>((**int**)178)

$\$\text{heap}_{init}$.b3 == **asType**<**short int**>((**int**)63)

$\$\text{heap}_{init}$.p1 == **asType**<**short int**>((**int**)1)

$\$\text{heap}_{init}$.p2 == **asType**<**short int**>((**int**)2)

$\$\text{heap}_{init}$.p3 == **asType**<**short int**>((**int**)3)

div1 == div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$,
asType<**int**>($\$\text{heap}_{funcstart\_719,1}$.p1),
asType<**int**>($\$\text{heap}_{funcstart\_719,1}$.a1))

(**asType**<**integer**>(**asType**<**int**>($\$\text{heap}_{funcstart\_719,1}$.p1)) /
asType<**integer**>(**asType**<**int**>($\$\text{heap}_{funcstart\_719,1}$.a1))) ==
asType<**integer**>(div1.quot)

(**asType**<**integer**>(**asType**<**int**>($\$\text{heap}_{funcstart\_719,1}$.p1)) %

asType<integer>(**asType<int>**($heap$_{funcstart_719,1}$.a1))) ==
asType<integer>(div1.rem)

div2 == div(**heapIs** $heap$_{funcstart_719,1}$,
asType<int>($heap$_{funcstart_719,1}$.p2),
asType<int>($heap$_{funcstart_719,1}$.a2))

(**asType<integer>**(**asType<int>**($heap$_{funcstart_719,1}$.p2)) /
asType<integer>(**asType<int>**($heap$_{funcstart_719,1}$.a2))) ==
asType<integer>(div2.quot)

(**asType<integer>**(**asType<int>**($heap$_{funcstart_719,1}$.p2)) %
asType<integer>(**asType<int>**($heap$_{funcstart_719,1}$.a2))) ==
asType<integer>(div2.rem)

div3 == div(**heapIs** $heap$_{funcstart_719,1}$,
asType<int>($heap$_{funcstart_719,1}$.p3),
asType<int>($heap$_{funcstart_719,1}$.a3))

(**asType<integer>**(**asType<int>**($heap$_{funcstart_719,1}$.p3)) /
asType<integer>(**asType<int>**($heap$_{funcstart_719,1}$.a3))) ==
asType<integer>(div3.quot)

(**asType<integer>**(**asType<int>**($heap$_{funcstart_719,1}$.p3)) %
asType<integer>(**asType<int>**($heap$_{funcstart_719,1}$.a3))) ==
asType<integer>(div3.rem)

$heap$_{719,1;729,8}$ == $heap$_{funcstart_719,1}$.**replace**(p1 → **asType<short
int>**((**asType<int>**(**asType<short int>**(div1.rem)) *
asType<int>($heap$_{funcstart_719,1}$.r1)) − (**asType<int>**(**asType<short
int>**(div1.quot)) * **asType<int>**($heap$_{funcstart_719,1}$.b1))))

$heap$_{719,1;730,8}$ == $heap$_{719,1;729,8}$.**replace**(p2 → **asType<short
int>**((**asType<int>**(**asType<short int>**(div2.rem)) *
asType<int>($heap$_{719,1;729,8}$.r2)) − (**asType<int>**(**asType<short
int>**(div2.quot)) * **asType<int>**($heap$_{719,1;729,8}$.b2))))

$heap$_{719,1;731,8}$ == $heap$_{719,1;730,8}$.**replace**(p3 → **asType<short
int>**((**asType<int>**(**asType<short int>**(div3.rem)) *
asType<int>($heap$_{719,1;730,8}$.r3)) − (**asType<int>**(**asType<short
int>**(div3.quot)) * **asType<int>**($heap$_{719,1;730,8}$.b3))))

$heap$_{719,1;733,8}$ == $heap$_{719,1;731,8}$.**replace**(p1 → **asType<short
int>**((**asType<int>**($heap$_{719,1;731,8}$.M1) *
asType<int>(**static_cast<integer>**(**asType<int>**($heap$_{719,1;731,8}$.p1) <
(**int**)0))) + **asType<int>**($heap$_{719,1;731,8}$.p1)))

$heap$_{719,1;734,8}$ == $heap$_{719,1;733,8}$.**replace**(p2 → **asType<short
int>**((**asType<int>**($heap$_{719,1;733,8}$.M2) *
asType<int>(**static_cast<integer>**(**asType<int>**($heap$_{719,1;733,8}$.p2) <
(**int**)0))) + **asType<int>**($heap$_{719,1;733,8}$.p2)))

Proof:

[Take goal term]

[1.0] $\$heap_{719,1;734,8}.M3 \leq$ **maxof(int)**

$\rightarrow$ *[const static or extern object]*

[1.1] $\$heap_{init}.M3 \leq$ **maxof(int)**

$\rightarrow$ *[expand definition of constant 'M3' at prang.c (24,20)]*

[1.2] **asType<short int>((int)**30323$) \leq$ **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 (53,17)

Condition defined at:

To prove: minof(int) $\leq \$heap_{719,1;734,8}.p3$

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)

$\$heap_{init}.M2 ==$ **asType<short int>((int)**30307)

$\$heap_{init}.r2 ==$ **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)

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

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

$\$heap_{init}.b3 ==$ **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)

div1 $==$ div(**heapIs** $\$heap_{funcstart\_719,1}$,
asType<int>($\$heap_{funcstart\_719,1}.p1$),

asType<int>($heap$_{funcstart_719,1}$.a1))

(**asType<integer>**(**asType<int>**($heap$_{funcstart_719,1}$.p1)) /
asType<integer>(**asType<int>**($heap$_{funcstart_719,1}$.a1))) ==
asType<integer>(div1.quot)

(**asType<integer>**(**asType<int>**($heap$_{funcstart_719,1}$.p1)) %
asType<integer>(**asType<int>**($heap$_{funcstart_719,1}$.a1))) ==
asType<integer>(div1.rem)

div2 == div(**heapIs** $heap$_{funcstart_719,1}$,
asType<int>($heap$_{funcstart_719,1}$.p2),
asType<int>($heap$_{funcstart_719,1}$.a2))

(**asType<integer>**(**asType<int>**($heap$_{funcstart_719,1}$.p2)) /
asType<integer>(**asType<int>**($heap$_{funcstart_719,1}$.a2))) ==
asType<integer>(div2.quot)

(**asType<integer>**(**asType<int>**($heap$_{funcstart_719,1}$.p2)) %
asType<integer>(**asType<int>**($heap$_{funcstart_719,1}$.a2))) ==
asType<integer>(div2.rem)

div3 == div(**heapIs** $heap$_{funcstart_719,1}$,
asType<int>($heap$_{funcstart_719,1}$.p3),
asType<int>($heap$_{funcstart_719,1}$.a3))

(**asType<integer>**(**asType<int>**($heap$_{funcstart_719,1}$.p3)) /
asType<integer>(**asType<int>**($heap$_{funcstart_719,1}$.a3))) ==
asType<integer>(div3.quot)

(**asType<integer>**(**asType<int>**($heap$_{funcstart_719,1}$.p3)) %
asType<integer>(**asType<int>**($heap$_{funcstart_719,1}$.a3))) ==
asType<integer>(div3.rem)

$heap$_{719,1;729,8}$ == $heap$_{funcstart_719,1}$.**replace**(p1 → **asType<short
int>**((**asType<int>**(**asType<short int>**(div1.rem)) *
asType<int>($heap$_{funcstart_719,1}$.r1)) − (**asType<int>**(**asType<short
int>**(div1.quot)) * **asType<int>**($heap$_{funcstart_719,1}$.b1)))))

$heap$_{719,1;730,8}$ == $heap$_{719,1;729,8}$.**replace**(p2 → **asType<short
int>**((**asType<int>**(**asType<short int>**(div2.rem)) *
asType<int>($heap$_{719,1;729,8}$.r2)) − (**asType<int>**(**asType<short
int>**(div2.quot)) * **asType<int>**($heap$_{719,1;729,8}$.b2)))))

$heap$_{719,1;731,8}$ == $heap$_{719,1;730,8}$.**replace**(p3 → **asType<short
int>**((**asType<int>**(**asType<short int>**(div3.rem)) *
asType<int>($heap$_{719,1;730,8}$.r3)) − (**asType<int>**(**asType<short
int>**(div3.quot)) * **asType<int>**($heap$_{719,1;730,8}$.b3)))))

$heap$_{719,1;733,8}$ == $heap$_{719,1;731,8}$.**replace**(p1 → **asType<short
int>**((**asType<int>**($heap$_{719,1;731,8}$.M1) *
asType<int>(**static_cast<integer>**(**asType<int>**($heap$_{719,1;731,8}$.p1) <
(**int**)0))) + **asType<int>**($heap$_{719,1;731,8}$.p1)))

$\text{\$heap}_{719,1;734,8}$ == $\text{\$heap}_{719,1;733,8}$.**replace**(p2 $\rightarrow$ **asType**$<$**short int**$>$((**asType**$<$**int**$>$($\text{\$heap}_{719,1;733,8}$.M2) *
asType$<$**int**$>$(**static_cast**$<$**integer**$>$(**asType**$<$**int**$>$($\text{\$heap}_{719,1;733,8}$.p2) $<$
(**int**)0))) + **asType**$<$**int**$>$($\text{\$heap}_{719,1;733,8}$.p2)))

Proof:

[Take goal term]

[1.0] **minof**(**int**) $\leq$ $\text{\$heap}_{719,1;734,8}$.p3

$\rightarrow$ *[simplify]*

[1.3] -32769 $<$ $\text{\$heap}_{719,1;734,8}$.p3

$\rightarrow$ *[negate goal and search for contradiction]*

[1.4] !(-32769 $<$ $\text{\$heap}_{719,1;734,8}$.p3)

$\rightarrow$ *[simplify]*

[1.6] 32768 $<$ $-\text{\$heap}_{719,1;734,8}$.p3

[Assume known post-assertion, class invariant or type constraint for term 1.6]

[45.0] **minof**(**short int**) $\leq$ $\text{\$heap}_{719,1;734,8}$.p3

$\rightarrow$ *[simplify]*

[45.3] -32769 $<$ $\text{\$heap}_{719,1;734,8}$.p3

$\rightarrow$ *[from term 1.6, literala $<$ $\text{\$heap}_{719,1;734,8}$.p3 is false whenever -2 $<$ (32768 + literala)]*

> **Proof of rule precondition:**
>
> *[45.3.0]* -2 $<$ (-32769 + 32768)
>
> $\rightarrow$ *[simplify]*
>
> *[45.3.2]* **true**

[45.4] **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 (53,17)

Condition defined at:

To prove: $\text{\$heap}_{719,1;734,8}$.p3 $\leq$ **maxof**(**int**)

Given:

$\text{\$heap}_{init}$.LIMIT == (**int**)80

$\text{\$heap}_{init}$.M1 == **asType**$<$**short int**$>$((**int**)30269)

$\text{\$heap}_{init}$.r1 == **asType**$<$**short int**$>$((**int**)171)

$\$\text{heap}_{init}.\text{a1} == \textbf{asType}<\textbf{short int}>((\textbf{int})177)$

$\$\text{heap}_{init}.\text{b1} == \textbf{asType}<\textbf{short int}>((\textbf{int})2)$

$\$\text{heap}_{init}.\text{M2} == \textbf{asType}<\textbf{short int}>((\textbf{int})30307)$

$\$\text{heap}_{init}.\text{r2} == \textbf{asType}<\textbf{short int}>((\textbf{int})172)$

$\$\text{heap}_{init}.\text{a2} == \textbf{asType}<\textbf{short int}>((\textbf{int})176)$

$\$\text{heap}_{init}.\text{b2} == \textbf{asType}<\textbf{short int}>((\textbf{int})35)$

$\$\text{heap}_{init}.\text{M3} == \textbf{asType}<\textbf{short int}>((\textbf{int})30323)$

$\$\text{heap}_{init}.\text{r3} == \textbf{asType}<\textbf{short int}>((\textbf{int})170)$

$\$\text{heap}_{init}.\text{a3} == \textbf{asType}<\textbf{short int}>((\textbf{int})178)$

$\$\text{heap}_{init}.\text{b3} == \textbf{asType}<\textbf{short int}>((\textbf{int})63)$

$\$\text{heap}_{init}.\text{p1} == \textbf{asType}<\textbf{short int}>((\textbf{int})1)$

$\$\text{heap}_{init}.\text{p2} == \textbf{asType}<\textbf{short int}>((\textbf{int})2)$

$\$\text{heap}_{init}.\text{p3} == \textbf{asType}<\textbf{short int}>((\textbf{int})3)$

div1 == div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$,
asType$<$**int**$>(\$\text{heap}_{funcstart\_719,1}.\text{p1})$,
asType$<$**int**$>(\$\text{heap}_{funcstart\_719,1}.\text{a1}))$

(**asType**$<$**integer**$>$(**asType**$<$**int**$>(\$\text{heap}_{funcstart\_719,1}.\text{p1}))$ /
asType$<$**integer**$>$(**asType**$<$**int**$>(\$\text{heap}_{funcstart\_719,1}.\text{a1}))) ==$
asType$<$**integer**$>$(div1.quot)

(**asType**$<$**integer**$>$(**asType**$<$**int**$>(\$\text{heap}_{funcstart\_719,1}.\text{p1}))$ %
asType$<$**integer**$>$(**asType**$<$**int**$>(\$\text{heap}_{funcstart\_719,1}.\text{a1}))) ==$
asType$<$**integer**$>$(div1.rem)

div2 == div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$,
asType$<$**int**$>(\$\text{heap}_{funcstart\_719,1}.\text{p2})$,
asType$<$**int**$>(\$\text{heap}_{funcstart\_719,1}.\text{a2}))$

(**asType**$<$**integer**$>$(**asType**$<$**int**$>(\$\text{heap}_{funcstart\_719,1}.\text{p2}))$ /
asType$<$**integer**$>$(**asType**$<$**int**$>(\$\text{heap}_{funcstart\_719,1}.\text{a2}))) ==$
asType$<$**integer**$>$(div2.quot)

(**asType**$<$**integer**$>$(**asType**$<$**int**$>(\$\text{heap}_{funcstart\_719,1}.\text{p2}))$ %
asType$<$**integer**$>$(**asType**$<$**int**$>(\$\text{heap}_{funcstart\_719,1}.\text{a2}))) ==$
asType$<$**integer**$>$(div2.rem)

div3 == div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$,
asType$<$**int**$>(\$\text{heap}_{funcstart\_719,1}.\text{p3})$,
asType$<$**int**$>(\$\text{heap}_{funcstart\_719,1}.\text{a3}))$

(**asType**$<$**integer**$>$(**asType**$<$**int**$>(\$\text{heap}_{funcstart\_719,1}.\text{p3}))$ /
asType$<$**integer**$>$(**asType**$<$**int**$>(\$\text{heap}_{funcstart\_719,1}.\text{a3}))) ==$
asType$<$**integer**$>$(div3.quot)

**(asType$<$integer$>$(asType$<$int$>$($\text{\$heap}_{funcstart\_719,1}$.p3)) %
asType$<$integer$>$(asType$<$int$>$($\text{\$heap}_{funcstart\_719,1}$.a3))) ==
asType$<$integer$>$**(div3.rem)

$\text{\$heap}_{719,1;729,8}$ == $\text{\$heap}_{funcstart\_719,1}$.**_replace**(p1 $\to$ **asType$<$short
int$>$((asType$<$int$>$(asType$<$short int$>$**(div1.rem)) *
asType$<$int$>$($\text{\$heap}_{funcstart\_719,1}$.r1)) $-$ **(asType$<$int$>$(asType$<$short
int$>$**(div1.quot)) * **asType$<$int$>$**($\text{\$heap}_{funcstart\_719,1}$.b1))))

$\text{\$heap}_{719,1;730,8}$ == $\text{\$heap}_{719,1;729,8}$.**_replace**(p2 $\to$ **asType$<$short
int$>$((asType$<$int$>$(asType$<$short int$>$**(div2.rem)) *
asType$<$int$>$($\text{\$heap}_{719,1;729,8}$.r2)) $-$ **(asType$<$int$>$(asType$<$short
int$>$**(div2.quot)) * **asType$<$int$>$**($\text{\$heap}_{719,1;729,8}$.b2))))

$\text{\$heap}_{719,1;731,8}$ == $\text{\$heap}_{719,1;730,8}$.**_replace**(p3 $\to$ **asType$<$short
int$>$((asType$<$int$>$(asType$<$short int$>$**(div3.rem)) *
asType$<$int$>$($\text{\$heap}_{719,1;730,8}$.r3)) $-$ **(asType$<$int$>$(asType$<$short
int$>$**(div3.quot)) * **asType$<$int$>$**($\text{\$heap}_{719,1;730,8}$.b3))))

$\text{\$heap}_{719,1;733,8}$ == $\text{\$heap}_{719,1;731,8}$.**_replace**(p1 $\to$ **asType$<$short
int$>$((asType$<$int$>$**($\text{\$heap}_{719,1;731,8}$.M1) *
asType$<$int$>$(static_cast$<$integer$>$(asType$<$int$>$($\text{\$heap}_{719,1;731,8}$.p1) $<$
(int)0))) + **asType$<$int$>$**($\text{\$heap}_{719,1;731,8}$.p1)))

$\text{\$heap}_{719,1;734,8}$ == $\text{\$heap}_{719,1;733,8}$.**_replace**(p2 $\to$ **asType$<$short
int$>$((asType$<$int$>$**($\text{\$heap}_{719,1;733,8}$.M2) *
asType$<$int$>$(static_cast$<$integer$>$(asType$<$int$>$($\text{\$heap}_{719,1;733,8}$.p2) $<$
(int)0))) + **asType$<$int$>$**($\text{\$heap}_{719,1;733,8}$.p2)))

Proof:

[Take goal term]

[1.0] $\text{\$heap}_{719,1;734,8}$.p3 $\leq$ **maxof(int)**

$\to$ *[simplify]*

[1.9] -32768 $<$ $-\text{\$heap}_{719,1;734,8}$.p3

$\to$ *[negate goal and search for contradiction]*

[1.10] !(-32768 $<$ $-\text{\$heap}_{719,1;734,8}$.p3)

$\to$ *[simplify]*

[1.13] 32767 $<$ $\text{\$heap}_{719,1;734,8}$.p3

[Assume known post-assertion, class invariant or type constraint for term 1.13]

[45.0] $\text{\$heap}_{719,1;734,8}$.p3 $\leq$ **maxof(short int)**

$\to$ *[simplify]*

[45.9] -32768 $<$ $-\text{\$heap}_{719,1;734,8}$.p3

$\to$ *[from term 1.13, literala $<$ $-$\$heap$_{719,1;734,8}$.p3 is false whenever -2 $<$
(32767 + literala)]*

Proof of rule precondition:

[45.9.0] -2 < (-32768 + 32767)

→ *[simplify]*

[45.9.2] **true**

[45.10] **false**

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

Condition generated at: C:\Escher\Customers\prang\prang.c (53,11)

Condition defined at:

To prove: minof(int) ≤
static_cast<integer>(asType<int>($heap$_{719,1;734,8}$.p3) < (int)0)

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)

$heap$_{init}$.M2 == **asType<short int>**((**int**)30307)

$heap$_{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)

$heap$_{init}$.r3 == **asType<short int>**((**int**)170)

$heap$_{init}$.a3 == **asType<short int>**((**int**)178)

$heap$_{init}$.b3 == **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)

div1 == div(**heapIs** $heap$_{funcstart_719,1}$,
asType<int>($heap$_{funcstart_719,1}$.p1),
asType<int>($heap$_{funcstart_719,1}$.a1))

(**asType<integer>**(**asType<int>**($heap$_{funcstart_719,1}$.p1)) /
asType<integer>(**asType<int>**($heap$_{funcstart_719,1}$.a1))) ==

asType<integer>(div1.quot)

(**asType<integer>**(**asType<int>**($heap$_{funcstart_719,1}$.p1)) %
asType<integer>(**asType<int>**($heap$_{funcstart_719,1}$.a1))) ==
asType<integer>(div1.rem)

div2 == div(**heapIs** $heap$_{funcstart_719,1}$,
asType<int>($heap$_{funcstart_719,1}$.p2),
asType<int>($heap$_{funcstart_719,1}$.a2))

(**asType<integer>**(**asType<int>**($heap$_{funcstart_719,1}$.p2)) /
asType<integer>(**asType<int>**($heap$_{funcstart_719,1}$.a2))) ==
asType<integer>(div2.quot)

(**asType<integer>**(**asType<int>**($heap$_{funcstart_719,1}$.p2)) %
asType<integer>(**asType<int>**($heap$_{funcstart_719,1}$.a2))) ==
asType<integer>(div2.rem)

div3 == div(**heapIs** $heap$_{funcstart_719,1}$,
asType<int>($heap$_{funcstart_719,1}$.p3),
asType<int>($heap$_{funcstart_719,1}$.a3))

(**asType<integer>**(**asType<int>**($heap$_{funcstart_719,1}$.p3)) /
asType<integer>(**asType<int>**($heap$_{funcstart_719,1}$.a3))) ==
asType<integer>(div3.quot)

(**asType<integer>**(**asType<int>**($heap$_{funcstart_719,1}$.p3)) %
asType<integer>(**asType<int>**($heap$_{funcstart_719,1}$.a3))) ==
asType<integer>(div3.rem)

$heap$_{719,1;729,8}$ == $heap$_{funcstart_719,1}$.**replace**(p1 → **asType<short
int>**((**asType<int>**(**asType<short int>**(div1.rem)) *
asType<int>($heap$_{funcstart_719,1}$.r1)) − (**asType<int>**(**asType<short
int>**(div1.quot)) * **asType<int>**($heap$_{funcstart_719,1}$.b1))))

$heap$_{719,1;730,8}$ == $heap$_{719,1;729,8}$.**replace**(p2 → **asType<short
int>**((**asType<int>**(**asType<short int>**(div2.rem)) *
asType<int>($heap$_{719,1;729,8}$.r2)) − (**asType<int>**(**asType<short
int>**(div2.quot)) * **asType<int>**($heap$_{719,1;729,8}$.b2))))

$heap$_{719,1;731,8}$ == $heap$_{719,1;730,8}$.**replace**(p3 → **asType<short
int>**((**asType<int>**(**asType<short int>**(div3.rem)) *
asType<int>($heap$_{719,1;730,8}$.r3)) − (**asType<int>**(**asType<short
int>**(div3.quot)) * **asType<int>**($heap$_{719,1;730,8}$.b3))))

$heap$_{719,1;733,8}$ == $heap$_{719,1;731,8}$.**replace**(p1 → **asType<short
int>**((**asType<int>**($heap$_{719,1;731,8}$.M1) *
asType<int>(**static_cast<integer>**(**asType<int>**($heap$_{719,1;731,8}$.p1) <
(**int**)0))) + **asType<int>**($heap$_{719,1;731,8}$.p1)))

$heap$_{719,1;734,8}$ == $heap$_{719,1;733,8}$.**replace**(p2 → **asType<short
int>**((**asType<int>**($heap$_{719,1;733,8}$.M2) *
asType<int>(**static_cast<integer>**(**asType<int>**($heap$_{719,1;733,8}$.p2) <

$(\mathbf{int})0))) + \mathbf{asType{<}int{>}}(\$heap_{719,1;733,8}.p2)))$

Proof:

[Take goal term]

[1.0] $\mathbf{minof(int)} \leq \mathbf{static\_cast{<}integer{>}}(\mathbf{asType{<}int{>}}(\$heap_{719,1;734,8}.p3) < (\mathbf{int})0)$

$\rightarrow$ *[simplify]*

[1.6] $\text{-32768} \leq ([0 < -\$heap_{719,1;734,8}.p3]\colon 1, []\colon 0)$

$\rightarrow$ *[explicitly assert falsehood of skipped guards in subsequent guards]*

[1.7] $\text{-32768} \leq ([0 < -\$heap_{719,1;734,8}.p3]\colon 1, [!(0 < -\$heap_{719,1;734,8}.p3)]\colon 0)$

$\rightarrow$ *[simplify]*

[1.12] $\text{-32769} < ([0 < -\$heap_{719,1;734,8}.p3]\colon 1, [\text{-1} < \$heap_{719,1;734,8}.p3]\colon 0)$

$\rightarrow$ *[move guard outside expression]*

[1.13] $([0 < -\$heap_{719,1;734,8}.p3]\colon \text{-32769} < 1, [\text{-1} < \$heap_{719,1;734,8}.p3]\colon \text{-32769} < 0)$

$\rightarrow$ *[simplify]*

[1.15] $([0 < -\$heap_{719,1;734,8}.p3]\colon \mathbf{true}, [\text{-1} < \$heap_{719,1;734,8}.p3]\colon \mathbf{true})$

$\rightarrow$ *[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 (53,11)

Condition defined at:

To prove: $\mathbf{static\_cast{<}integer{>}}(\mathbf{asType{<}int{>}}(\$heap_{719,1;734,8}.p3) < (\mathbf{int})0) \leq \mathbf{maxof(int)}$

Given:

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

$\$heap_{init}.\text{M1} == \mathbf{asType{<}short\ int{>}}((\mathbf{int})30269)$

$\$heap_{init}.\text{r1} == \mathbf{asType{<}short\ int{>}}((\mathbf{int})171)$

$\$heap_{init}.\text{a1} == \mathbf{asType{<}short\ int{>}}((\mathbf{int})177)$

$\$heap_{init}.\text{b1} == \mathbf{asType{<}short\ int{>}}((\mathbf{int})2)$

$\$heap_{init}.\text{M2} == \mathbf{asType{<}short\ int{>}}((\mathbf{int})30307)$

$\$heap_{init}.\text{r2} == \mathbf{asType{<}short\ int{>}}((\mathbf{int})172)$

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

$\$\text{heap}_{init}.\text{b2} == \textbf{asType}\textbf{<short int>}((\textbf{int})35)$

$\$\text{heap}_{init}.\text{M3} == \textbf{asType}\textbf{<short int>}((\textbf{int})30323)$

$\$\text{heap}_{init}.\text{r3} == \textbf{asType}\textbf{<short int>}((\textbf{int})170)$

$\$\text{heap}_{init}.\text{a3} == \textbf{asType}\textbf{<short int>}((\textbf{int})178)$

$\$\text{heap}_{init}.\text{b3} == \textbf{asType}\textbf{<short int>}((\textbf{int})63)$

$\$\text{heap}_{init}.\text{p1} == \textbf{asType}\textbf{<short int>}((\textbf{int})1)$

$\$\text{heap}_{init}.\text{p2} == \textbf{asType}\textbf{<short int>}((\textbf{int})2)$

$\$\text{heap}_{init}.\text{p3} == \textbf{asType}\textbf{<short int>}((\textbf{int})3)$

$\text{div1} == \text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_719,1},$
$\textbf{asType}\textbf{<int>}(\$\text{heap}_{funcstart\_719,1}.\text{p1}),$
$\textbf{asType}\textbf{<int>}(\$\text{heap}_{funcstart\_719,1}.\text{a1}))$

$(\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<int>}(\$\text{heap}_{funcstart\_719,1}.\text{p1}))\ /$
$\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<int>}(\$\text{heap}_{funcstart\_719,1}.\text{a1}))) ==$
$\textbf{asType}\textbf{<integer>}(\text{div1.quot})$

$(\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<int>}(\$\text{heap}_{funcstart\_719,1}.\text{p1}))\ \%$
$\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<int>}(\$\text{heap}_{funcstart\_719,1}.\text{a1}))) ==$
$\textbf{asType}\textbf{<integer>}(\text{div1.rem})$

$\text{div2} == \text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_719,1},$
$\textbf{asType}\textbf{<int>}(\$\text{heap}_{funcstart\_719,1}.\text{p2}),$
$\textbf{asType}\textbf{<int>}(\$\text{heap}_{funcstart\_719,1}.\text{a2}))$

$(\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<int>}(\$\text{heap}_{funcstart\_719,1}.\text{p2}))\ /$
$\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<int>}(\$\text{heap}_{funcstart\_719,1}.\text{a2}))) ==$
$\textbf{asType}\textbf{<integer>}(\text{div2.quot})$

$(\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<int>}(\$\text{heap}_{funcstart\_719,1}.\text{p2}))\ \%$
$\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<int>}(\$\text{heap}_{funcstart\_719,1}.\text{a2}))) ==$
$\textbf{asType}\textbf{<integer>}(\text{div2.rem})$

$\text{div3} == \text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_719,1},$
$\textbf{asType}\textbf{<int>}(\$\text{heap}_{funcstart\_719,1}.\text{p3}),$
$\textbf{asType}\textbf{<int>}(\$\text{heap}_{funcstart\_719,1}.\text{a3}))$

$(\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<int>}(\$\text{heap}_{funcstart\_719,1}.\text{p3}))\ /$
$\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<int>}(\$\text{heap}_{funcstart\_719,1}.\text{a3}))) ==$
$\textbf{asType}\textbf{<integer>}(\text{div3.quot})$

$(\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<int>}(\$\text{heap}_{funcstart\_719,1}.\text{p3}))\ \%$
$\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<int>}(\$\text{heap}_{funcstart\_719,1}.\text{a3}))) ==$
$\textbf{asType}\textbf{<integer>}(\text{div3.rem})$

$\$\text{heap}_{719,1;729,8} == \$\text{heap}_{funcstart\_719,1}.\textbf{\_replace}(\text{p1} \rightarrow \textbf{asType}\textbf{<short}$
$\textbf{int>}((\textbf{asType}\textbf{<int>}(\textbf{asType}\textbf{<short int>}(\text{div1.rem}))\ *$
$\textbf{asType}\textbf{<int>}(\$\text{heap}_{funcstart\_719,1}.\text{r1})) - (\textbf{asType}\textbf{<int>}(\textbf{asType}\textbf{<short}$

int>(div1.quot)) * **asType**<**int**>($\text{heap}_{funcstart\_719,1}$.b1))))

$\text{heap}_{719,1;730,8}$ == $\text{heap}_{719,1;729,8}$.__replace__(p2 → **asType**<**short int**>((**asType**<**int**>(**asType**<**short int**>(div2.rem)) * **asType**<**int**>($\text{heap}_{719,1;729,8}$.r2)) − (**asType**<**int**>(**asType**<**short int**>(div2.quot)) * **asType**<**int**>($\text{heap}_{719,1;729,8}$.b2))))

$\text{heap}_{719,1;731,8}$ == $\text{heap}_{719,1;730,8}$.__replace__(p3 → **asType**<**short int**>((**asType**<**int**>(**asType**<**short int**>(div3.rem)) * **asType**<**int**>($\text{heap}_{719,1;730,8}$.r3)) − (**asType**<**int**>(**asType**<**short int**>(div3.quot)) * **asType**<**int**>($\text{heap}_{719,1;730,8}$.b3))))

$\text{heap}_{719,1;733,8}$ == $\text{heap}_{719,1;731,8}$.__replace__(p1 → **asType**<**short int**>((**asType**<**int**>($\text{heap}_{719,1;731,8}$.M1) * **asType**<**int**>(**static_cast**<**integer**>(**asType**<**int**>($\text{heap}_{719,1;731,8}$.p1) < (**int**)0))) + **asType**<**int**>($\text{heap}_{719,1;731,8}$.p1)))

$\text{heap}_{719,1;734,8}$ == $\text{heap}_{719,1;733,8}$.__replace__(p2 → **asType**<**short int**>((**asType**<**int**>($\text{heap}_{719,1;733,8}$.M2) * **asType**<**int**>(**static_cast**<**integer**>(**asType**<**int**>($\text{heap}_{719,1;733,8}$.p2) < (**int**)0))) + **asType**<**int**>($\text{heap}_{719,1;733,8}$.p2)))

Proof:

[Take goal term]

[1.0] **static_cast**<**integer**>(**asType**<**int**>($\text{heap}_{719,1;734,8}$.p3) < (**int**)0) ≤ **maxof**(**int**)

→ *[simplify]*

[1.5] ($[0 < -\text{heap}_{719,1;734,8}.p3]$: 1, []: 0) ≤ **maxof**(**int**)

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

[1.6] ($[0 < -\text{heap}_{719,1;734,8}.p3]$: 1, $[!(0 < -\text{heap}_{719,1;734,8}.p3)]$: 0) ≤ **maxof**(**int**)

→ *[simplify]*

[1.11] (-1 + ($[0 < -\text{heap}_{719,1;734,8}.p3]$: 1, $[-1 < \text{heap}_{719,1;734,8}.p3]$: 0)) < 32767

→ *[move guard outside expression]*

[1.12] ($[0 < -\text{heap}_{719,1;734,8}.p3]$: -1 + 1, $[-1 < \text{heap}_{719,1;734,8}.p3]$: -1 + 0) < 32767

→ *[simplify]*

[1.15] 0 < (32767 + −($[0 < -\text{heap}_{719,1;734,8}.p3]$: 0, $[-1 < \text{heap}_{719,1;734,8}.p3]$: -1))

→ *[move guard outside expression]*

[1.16] 0 < (32767 + ($[0 < -\text{heap}_{719,1;734,8}.p3]$: −0, $[-1 < \text{heap}_{719,1;734,8}.p3]$: −-1))

→ *[simplify]*

[1.18] $0 < (32767 + ([0 < -\$heap_{719,1;734,8}.p3]: 0, [-1 < \$heap_{719,1;734,8}.p3]: 1))$

→ *[move guard outside expression]*

[1.19] $0 < ([0 < -\$heap_{719,1;734,8}.p3]: 0 + 32767, [-1 < \$heap_{719,1;734,8}.p3]: 1 + 32767)$

→ *[simplify]*

[1.21] $0 < ([0 < -\$heap_{719,1;734,8}.p3]: 32767, [-1 < \$heap_{719,1;734,8}.p3]: 32768)$

→ *[move guard outside expression]*

[1.22] $([0 < -\$heap_{719,1;734,8}.p3]: 0 < 32767, [-1 < \$heap_{719,1;734,8}.p3]: 0 < 32768)$

→ *[simplify]*

[1.24] $([0 < -\$heap_{719,1;734,8}.p3]:$ **true**, $[-1 < \$heap_{719,1;734,8}.p3]:$ **true**$)$

→ *[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 (53,25)

Condition defined at:

To prove: minof(int) $\leq$ **(asType\<int\>**($\$heap_{719,1;734,8}$.M3) * **asType\<int\>(static_cast\<integer\>(asType\<int\>**($\$heap_{719,1;734,8}$.p3) $<$ **(int)0)))**

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$)$

$\$heap_{init}$.M2 $==$ **asType\<short int\>((int)**30307$)$

$\$heap_{init}$.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$)$

$\text{\$heap}_{init}.r3 == \textbf{asType}\textbf{<short int>}((\textbf{int})170)$

$\text{\$heap}_{init}.a3 == \textbf{asType}\textbf{<short int>}((\textbf{int})178)$

$\text{\$heap}_{init}.b3 == \textbf{asType}\textbf{<short int>}((\textbf{int})63)$

$\text{\$heap}_{init}.p1 == \textbf{asType}\textbf{<short int>}((\textbf{int})1)$

$\text{\$heap}_{init}.p2 == \textbf{asType}\textbf{<short int>}((\textbf{int})2)$

$\text{\$heap}_{init}.p3 == \textbf{asType}\textbf{<short int>}((\textbf{int})3)$

div1 == div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$,
asType<int>($\text{\$heap}_{funcstart\_719,1}$.p1),
asType<int>($\text{\$heap}_{funcstart\_719,1}$.a1))

(**asType<integer>**(**asType<int>**($\text{\$heap}_{funcstart\_719,1}$.p1)) /
asType<integer>(**asType<int>**($\text{\$heap}_{funcstart\_719,1}$.a1))) ==
asType<integer>(div1.quot)

(**asType<integer>**(**asType<int>**($\text{\$heap}_{funcstart\_719,1}$.p1)) %
asType<integer>(**asType<int>**($\text{\$heap}_{funcstart\_719,1}$.a1))) ==
asType<integer>(div1.rem)

div2 == div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$,
asType<int>($\text{\$heap}_{funcstart\_719,1}$.p2),
asType<int>($\text{\$heap}_{funcstart\_719,1}$.a2))

(**asType<integer>**(**asType<int>**($\text{\$heap}_{funcstart\_719,1}$.p2)) /
asType<integer>(**asType<int>**($\text{\$heap}_{funcstart\_719,1}$.a2))) ==
asType<integer>(div2.quot)

(**asType<integer>**(**asType<int>**($\text{\$heap}_{funcstart\_719,1}$.p2)) %
asType<integer>(**asType<int>**($\text{\$heap}_{funcstart\_719,1}$.a2))) ==
asType<integer>(div2.rem)

div3 == div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$,
asType<int>($\text{\$heap}_{funcstart\_719,1}$.p3),
asType<int>($\text{\$heap}_{funcstart\_719,1}$.a3))

(**asType<integer>**(**asType<int>**($\text{\$heap}_{funcstart\_719,1}$.p3)) /
asType<integer>(**asType<int>**($\text{\$heap}_{funcstart\_719,1}$.a3))) ==
asType<integer>(div3.quot)

(**asType<integer>**(**asType<int>**($\text{\$heap}_{funcstart\_719,1}$.p3)) %
asType<integer>(**asType<int>**($\text{\$heap}_{funcstart\_719,1}$.a3))) ==
asType<integer>(div3.rem)

$\text{\$heap}_{719,1;729,8} == \text{\$heap}_{funcstart\_719,1}.$_**replace**(p1 → **asType<short
int>**((**asType<int>**(**asType<short int>**(div1.rem)) *
asType<int>($\text{\$heap}_{funcstart\_719,1}$.r1)) − (**asType<int>**(**asType<short
int>**(div1.quot)) * **asType<int>**($\text{\$heap}_{funcstart\_719,1}$.b1))))

$\text{\$heap}_{719,1;730,8} == \text{\$heap}_{719,1;729,8}.$_**replace**(p2 → **asType<short
int>**((**asType<int>**(**asType<short int>**(div2.rem)) *

asType<int>($heap$_{719,1;729,8}$.r2)) − (**asType<int>**(**asType<short int>**(div2.quot)) * **asType<int>**($heap$_{719,1;729,8}$.b2)))))

$heap$_{719,1;731,8}$ == $heap$_{719,1;730,8}$.**_replace**(p3 → **asType<short int>**((**asType<int>**(**asType<short int>**(div3.rem)) * **asType<int>**($heap$_{719,1;730,8}$.r3)) − (**asType<int>**(**asType<short int>**(div3.quot)) * **asType<int>**($heap$_{719,1;730,8}$.b3)))))

$heap$_{719,1;733,8}$ == $heap$_{719,1;731,8}$.**_replace**(p1 → **asType<short int>**((**asType<int>**($heap$_{719,1;731,8}$.M1) * **asType<int>**(**static_cast<integer>**(**asType<int>**($heap$_{719,1;731,8}$.p1) < (**int**)0))) + **asType<int>**($heap$_{719,1;731,8}$.p1)))

$heap$_{719,1;734,8}$ == $heap$_{719,1;733,8}$.**_replace**(p2 → **asType<short int>**((**asType<int>**($heap$_{719,1;733,8}$.M2) * **asType<int>**(**static_cast<integer>**(**asType<int>**($heap$_{719,1;733,8}$.p2) < (**int**)0))) + **asType<int>**($heap$_{719,1;733,8}$.p2)))

Proof:

[Take goal term]

[1.0] **minof(int)** ≤ (**asType<int>**($heap$_{719,1;734,8}$.M3) * **asType<int>**(**static_cast<integer>**(**asType<int>**($heap$_{719,1;734,8}$.p3) < (**int**)0)))

→ *[simplify]*

[1.1] -32768 ≤ (**asType<int>**($heap$_{719,1;734,8}$.M3) * **asType<int>**(**static_cast<integer>**(**asType<int>**($heap$_{719,1;734,8}$.p3) < (**int**)0)))

→ *[const static or extern object]*

[1.2] -32768 ≤ (**asType<int>**($heap$_{init}$.M3) * **asType<int>**(**static_cast<integer>**(**asType<int>**($heap$_{719,1;734,8}$.p3) < (**int**)0)))

→ *[expand definition of constant 'M3' at prang.c (24,20)]*

[1.3] -32768 ≤ (**asType<int>**(**asType<short int>**((**int**)30323)) * **asType<int>**(**static_cast<integer>**(**asType<int>**($heap$_{719,1;734,8}$.p3) < (**int**)0)))

→ *[simplify]*

[1.11] -32768 ≤ (30323 * **asType<int>**(([0 < −$heap$_{719,1;734,8}$.p3]: 1, []: 0)))

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

[1.12] -32768 ≤ (30323 * **asType<int>**(([0 < −$heap$_{719,1;734,8}$.p3]: 1, [!(0 < −$heap$_{719,1;734,8}$.p3)]: 0)))

→ *[simplify]*

[1.16] -32768 ≤ (30323 * ([0 < −$heap$_{719,1;734,8}$.p3]: 1, [-1 <

$heap_{719,1;734,8}$.p3]: 0))

$\rightarrow$ *[move guard outside expression]*

[1.17] -32768 $\leq$ ([0 < $-$$heap_{719,1;734,8}$.p3]: 1 * 30323, [-1 < $heap_{719,1;734,8}$.p3]: 0 * 30323)

$\rightarrow$ *[simplify]*

[1.21] -32769 < ([0 < $-$$heap_{719,1;734,8}$.p3]: 30323, [-1 < $heap_{719,1;734,8}$.p3]: 0)

$\rightarrow$ *[move guard outside expression]*

[1.22] ([0 < $-$$heap_{719,1;734,8}$.p3]: -32769 < 30323, [-1 < $heap_{719,1;734,8}$.p3]: -32769 < 0)

$\rightarrow$ *[simplify]*

[1.24] ([0 < $-$$heap_{719,1;734,8}$.p3]: **true**, [-1 < $heap_{719,1;734,8}$.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 (53,25)

Condition defined at:

To prove: (**asType<int>**($heap_{719,1;734,8}$.M3) * **asType<int>**(**static_cast<integer>**(**asType<int>**($heap_{719,1;734,8}$.p3) < (**int**)0))) $\leq$ **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)

$heap_{init}$.b1 == **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)

$heap_{init}$.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)

$\$\text{heap}_{init}.\text{b3} == \textbf{asType}\textbf{<short int>}((\textbf{int})63)$

$\$\text{heap}_{init}.\text{p1} == \textbf{asType}\textbf{<short int>}((\textbf{int})1)$

$\$\text{heap}_{init}.\text{p2} == \textbf{asType}\textbf{<short int>}((\textbf{int})2)$

$\$\text{heap}_{init}.\text{p3} == \textbf{asType}\textbf{<short int>}((\textbf{int})3)$

$\text{div1} == \text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_719,1},$
$\textbf{asType}\textbf{<int>}(\$\text{heap}_{funcstart\_719,1}.\text{p1}),$
$\textbf{asType}\textbf{<int>}(\$\text{heap}_{funcstart\_719,1}.\text{a1}))$

$(\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<int>}\$\text{heap}_{funcstart\_719,1}.\text{p1})) \;/$
$\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<int>}\$\text{heap}_{funcstart\_719,1}.\text{a1}))) ==$
$\textbf{asType}\textbf{<integer>}(\text{div1.quot})$

$(\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<int>}\$\text{heap}_{funcstart\_719,1}.\text{p1})) \;\%$
$\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<int>}\$\text{heap}_{funcstart\_719,1}.\text{a1}))) ==$
$\textbf{asType}\textbf{<integer>}(\text{div1.rem})$

$\text{div2} == \text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_719,1},$
$\textbf{asType}\textbf{<int>}(\$\text{heap}_{funcstart\_719,1}.\text{p2}),$
$\textbf{asType}\textbf{<int>}(\$\text{heap}_{funcstart\_719,1}.\text{a2}))$

$(\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<int>}\$\text{heap}_{funcstart\_719,1}.\text{p2})) \;/$
$\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<int>}\$\text{heap}_{funcstart\_719,1}.\text{a2}))) ==$
$\textbf{asType}\textbf{<integer>}(\text{div2.quot})$

$(\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<int>}\$\text{heap}_{funcstart\_719,1}.\text{p2})) \;\%$
$\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<int>}\$\text{heap}_{funcstart\_719,1}.\text{a2}))) ==$
$\textbf{asType}\textbf{<integer>}(\text{div2.rem})$

$\text{div3} == \text{div}(\textbf{heapIs } \$\text{heap}_{funcstart\_719,1},$
$\textbf{asType}\textbf{<int>}(\$\text{heap}_{funcstart\_719,1}.\text{p3}),$
$\textbf{asType}\textbf{<int>}(\$\text{heap}_{funcstart\_719,1}.\text{a3}))$

$(\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<int>}\$\text{heap}_{funcstart\_719,1}.\text{p3})) \;/$
$\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<int>}\$\text{heap}_{funcstart\_719,1}.\text{a3}))) ==$
$\textbf{asType}\textbf{<integer>}(\text{div3.quot})$

$(\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<int>}\$\text{heap}_{funcstart\_719,1}.\text{p3})) \;\%$
$\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<int>}\$\text{heap}_{funcstart\_719,1}.\text{a3}))) ==$
$\textbf{asType}\textbf{<integer>}(\text{div3.rem})$

$\$\text{heap}_{719,1;729,8} == \$\text{heap}_{funcstart\_719,1}.\textbf{replace}(\text{p1} \rightarrow \textbf{asType}\textbf{<short}$
$\textbf{int>}((\textbf{asType}\textbf{<int>}(\textbf{asType}\textbf{<short int>}(\text{div1.rem})) *$
$\textbf{asType}\textbf{<int>}(\$\text{heap}_{funcstart\_719,1}.\text{r1})) - (\textbf{asType}\textbf{<int>}(\textbf{asType}\textbf{<short}$
$\textbf{int>}(\text{div1.quot})) * \textbf{asType}\textbf{<int>}(\$\text{heap}_{funcstart\_719,1}.\text{b1}))))$

$\$\text{heap}_{719,1;730,8} == \$\text{heap}_{719,1;729,8}.\textbf{replace}(\text{p2} \rightarrow \textbf{asType}\textbf{<short}$
$\textbf{int>}((\textbf{asType}\textbf{<int>}(\textbf{asType}\textbf{<short int>}(\text{div2.rem})) *$
$\textbf{asType}\textbf{<int>}(\$\text{heap}_{719,1;729,8}.\text{r2})) - (\textbf{asType}\textbf{<int>}(\textbf{asType}\textbf{<short}$
$\textbf{int>}(\text{div2.quot})) * \textbf{asType}\textbf{<int>}(\$\text{heap}_{719,1;729,8}.\text{b2}))))$

$\$heap_{719,1;731,8}$ == $\$heap_{719,1;730,8}$.**replace**(p3 → **asType<short int>**((**asType<int>**(**asType<short int>**(div3.rem)) * **asType<int>**($\$heap_{719,1;730,8}$.r3)) − (**asType<int>**(**asType<short int>**(div3.quot)) * **asType<int>**($\$heap_{719,1;730,8}$.b3))))

$\$heap_{719,1;733,8}$ == $\$heap_{719,1;731,8}$.**replace**(p1 → **asType<short int>**((**asType<int>**($\$heap_{719,1;731,8}$.M1) * **asType<int>**(**static_cast<integer>**(**asType<int>**($\$heap_{719,1;731,8}$.p1) < (**int**)0))) + **asType<int>**($\$heap_{719,1;731,8}$.p1)))

$\$heap_{719,1;734,8}$ == $\$heap_{719,1;733,8}$.**replace**(p2 → **asType<short int>**((**asType<int>**($\$heap_{719,1;733,8}$.M2) * **asType<int>**(**static_cast<integer>**(**asType<int>**($\$heap_{719,1;733,8}$.p2) < (**int**)0))) + **asType<int>**($\$heap_{719,1;733,8}$.p2)))

Proof:

[Take goal term]

[1.0] (**asType<int>**($\$heap_{719,1;734,8}$.M3) * **asType<int>**(**static_cast<integer>**(**asType<int>**($\$heap_{719,1;734,8}$.p3) < (**int**)0))) ≤ **maxof(int)**

→ *[const static or extern object]*

[1.1] (**asType<int>**($\$heap_{init}$.M3) * **asType<int>**(**static_cast<integer>**(**asType<int>**($\$heap_{719,1;734,8}$.p3) < (**int**)0))) ≤ **maxof(int)**

→ *[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>**($\$heap_{719,1;734,8}$.p3) < (**int**)0))) ≤ **maxof(int)**

→ *[simplify]*

[1.10] (30323 * **asType<int>**(([0 < −$\$heap_{719,1;734,8}$.p3]: 1, []: 0))) ≤ **maxof(int)**

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

[1.11] (30323 * **asType<int>**(([0 < −$\$heap_{719,1;734,8}$.p3]: 1, [!(0 < −$\$heap_{719,1;734,8}$.p3)]: 0))) ≤ **maxof(int)**

→ *[simplify]*

[1.15] (30323 * ([0 < −$\$heap_{719,1;734,8}$.p3]: 1, [-1 < $\$heap_{719,1;734,8}$.p3]: 0)) ≤ **maxof(int)**

→ *[move guard outside expression]*

[1.16] ([0 < −$\$heap_{719,1;734,8}$.p3]: 1 * 30323, [-1 < $\$heap_{719,1;734,8}$.p3]: 0 * 30323) ≤ **maxof(int)**

→ *[simplify]*

[1.20] (-1 + ([0 < $-\$heap_{719,1;734,8}.\text{p3}$]: 30323, [-1 < $\$heap_{719,1;734,8}.\text{p3}$]: 0)) < 32767

→ *[move guard outside expression]*

[1.21] ([0 < $-\$heap_{719,1;734,8}.\text{p3}$]: -1 + 30323, [-1 < $\$heap_{719,1;734,8}.\text{p3}$]: -1 + 0) < 32767

→ *[simplify]*

[1.24] 0 < (32767 + −([0 < $-\$heap_{719,1;734,8}.\text{p3}$]: 30322, [-1 < $\$heap_{719,1;734,8}.\text{p3}$]: -1))

→ *[move guard outside expression]*

[1.25] 0 < (32767 + ([0 < $-\$heap_{719,1;734,8}.\text{p3}$]: −30322, [-1 < $\$heap_{719,1;734,8}.\text{p3}$]: −-1))

→ *[simplify]*

[1.27] 0 < (32767 + ([0 < $-\$heap_{719,1;734,8}.\text{p3}$]: -30322, [-1 < $\$heap_{719,1;734,8}.\text{p3}$]: 1))

→ *[move guard outside expression]*

[1.28] 0 < ([0 < $-\$heap_{719,1;734,8}.\text{p3}$]: -30322 + 32767, [-1 < $\$heap_{719,1;734,8}.\text{p3}$]: 1 + 32767)

→ *[simplify]*

[1.30] 0 < ([0 < $-\$heap_{719,1;734,8}.\text{p3}$]: 2445, [-1 < $\$heap_{719,1;734,8}.\text{p3}$]: 32768)

→ *[move guard outside expression]*

[1.31] ([0 < $-\$heap_{719,1;734,8}.\text{p3}$]: 0 < 2445, [-1 < $\$heap_{719,1;734,8}.\text{p3}$]: 0 < 32768)

→ *[simplify]*

[1.33] ([0 < $-\$heap_{719,1;734,8}.\text{p3}$]: **true**, [-1 < $\$heap_{719,1;734,8}.\text{p3}$]: **true**)

→ *[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 (53,5)

Condition defined at:

To prove: minof(int) $\leq \$heap_{719,1;734,8}.\text{p3}$

Given:

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

$\$heap_{init}.\text{M1} == \textbf{asType}<\textbf{short int}>((\textbf{int})30269)$

$\text{\$heap}_{init}.\text{r1} == \textbf{asType}\textbf{<short int>}((\textbf{int})171)$

$\text{\$heap}_{init}.\text{a1} == \textbf{asType}\textbf{<short int>}((\textbf{int})177)$

$\text{\$heap}_{init}.\text{b1} == \textbf{asType}\textbf{<short int>}((\textbf{int})2)$

$\text{\$heap}_{init}.\text{M2} == \textbf{asType}\textbf{<short int>}((\textbf{int})30307)$

$\text{\$heap}_{init}.\text{r2} == \textbf{asType}\textbf{<short int>}((\textbf{int})172)$

$\text{\$heap}_{init}.\text{a2} == \textbf{asType}\textbf{<short int>}((\textbf{int})176)$

$\text{\$heap}_{init}.\text{b2} == \textbf{asType}\textbf{<short int>}((\textbf{int})35)$

$\text{\$heap}_{init}.\text{M3} == \textbf{asType}\textbf{<short int>}((\textbf{int})30323)$

$\text{\$heap}_{init}.\text{r3} == \textbf{asType}\textbf{<short int>}((\textbf{int})170)$

$\text{\$heap}_{init}.\text{a3} == \textbf{asType}\textbf{<short int>}((\textbf{int})178)$

$\text{\$heap}_{init}.\text{b3} == \textbf{asType}\textbf{<short int>}((\textbf{int})63)$

$\text{\$heap}_{init}.\text{p1} == \textbf{asType}\textbf{<short int>}((\textbf{int})1)$

$\text{\$heap}_{init}.\text{p2} == \textbf{asType}\textbf{<short int>}((\textbf{int})2)$

$\text{\$heap}_{init}.\text{p3} == \textbf{asType}\textbf{<short int>}((\textbf{int})3)$

div1 == div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$,
asType<int>($\text{\$heap}_{funcstart\_719,1}.\text{p1}$),
asType<int>($\text{\$heap}_{funcstart\_719,1}.\text{a1}$))

(**asType<integer>**(**asType<int>**($\text{\$heap}_{funcstart\_719,1}.\text{p1}$)) /
asType<integer>(**asType<int>**($\text{\$heap}_{funcstart\_719,1}.\text{a1}$))) ==
asType<integer>(div1.quot)

(**asType<integer>**(**asType<int>**($\text{\$heap}_{funcstart\_719,1}.\text{p1}$)) %
asType<integer>(**asType<int>**($\text{\$heap}_{funcstart\_719,1}.\text{a1}$))) ==
asType<integer>(div1.rem)

div2 == div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$,
asType<int>($\text{\$heap}_{funcstart\_719,1}.\text{p2}$),
asType<int>($\text{\$heap}_{funcstart\_719,1}.\text{a2}$))

(**asType<integer>**(**asType<int>**($\text{\$heap}_{funcstart\_719,1}.\text{p2}$)) /
asType<integer>(**asType<int>**($\text{\$heap}_{funcstart\_719,1}.\text{a2}$))) ==
asType<integer>(div2.quot)

(**asType<integer>**(**asType<int>**($\text{\$heap}_{funcstart\_719,1}.\text{p2}$)) %
asType<integer>(**asType<int>**($\text{\$heap}_{funcstart\_719,1}.\text{a2}$))) ==
asType<integer>(div2.rem)

div3 == div(**heapIs** $\text{\$heap}_{funcstart\_719,1}$,
asType<int>($\text{\$heap}_{funcstart\_719,1}.\text{p3}$),
asType<int>($\text{\$heap}_{funcstart\_719,1}.\text{a3}$))

(**asType<integer>**(**asType<int>**($\text{\$heap}_{funcstart\_719,1}.\text{p3}$)) /
asType<integer>(**asType<int>**($\text{\$heap}_{funcstart\_719,1}.\text{a3}$))) ==

asType<integer>(div3.quot)

(**asType<integer>**(**asType<int>**($heap$_{funcstart_719,1}$.p3)) %
asType<integer>(**asType<int>**($heap$_{funcstart_719,1}$.a3))) ==
asType<integer>(div3.rem)

$heap$_{719,1;729,8}$ == $heap$_{funcstart_719,1}$.**_replace**(p1 → **asType<short
int>**((**asType<int>**(**asType<short int>**(div1.rem)) *
asType<int>($heap$_{funcstart_719,1}$.r1)) − (**asType<int>**(**asType<short
int>**(div1.quot)) * **asType<int>**($heap$_{funcstart_719,1}$.b1))))

$heap$_{719,1;730,8}$ == $heap$_{719,1;729,8}$.**_replace**(p2 → **asType<short
int>**((**asType<int>**(**asType<short int>**(div2.rem)) *
asType<int>($heap$_{719,1;729,8}$.r2)) − (**asType<int>**(**asType<short
int>**(div2.quot)) * **asType<int>**($heap$_{719,1;729,8}$.b2))))

$heap$_{719,1;731,8}$ == $heap$_{719,1;730,8}$.**_replace**(p3 → **asType<short
int>**((**asType<int>**(**asType<short int>**(div3.rem)) *
asType<int>($heap$_{719,1;730,8}$.r3)) − (**asType<int>**(**asType<short
int>**(div3.quot)) * **asType<int>**($heap$_{719,1;730,8}$.b3))))

$heap$_{719,1;733,8}$ == $heap$_{719,1;731,8}$.**_replace**(p1 → **asType<short
int>**((**asType<int>**($heap$_{719,1;731,8}$.M1) *
asType<int>(**static_cast<integer>**(**asType<int>**($heap$_{719,1;731,8}$.p1) <
(**int**)0))) + **asType<int>**($heap$_{719,1;731,8}$.p1)))

$heap$_{719,1;734,8}$ == $heap$_{719,1;733,8}$.**_replace**(p2 → **asType<short
int>**((**asType<int>**($heap$_{719,1;733,8}$.M2) *
asType<int>(**static_cast<integer>**(**asType<int>**($heap$_{719,1;733,8}$.p2) <
(**int**)0))) + **asType<int>**($heap$_{719,1;733,8}$.p2)))

Proof:

[Take goal term]

[1.0] **minof**(**int**) ≤ $heap$_{719,1;734,8}$.p3

→ *[simplify]*

[1.3] -32769 < $heap$_{719,1;734,8}$.p3

→ *[negate goal and search for contradiction]*

[1.4] !(-32769 < $heap$_{719,1;734,8}$.p3)

→ *[simplify]*

[1.6] 32768 < −$heap$_{719,1;734,8}$.p3

[Assume known post-assertion, class invariant or type constraint for term 1.6]

[45.0] **minof**(**short int**) ≤ $heap$_{719,1;734,8}$.p3

→ *[simplify]*

[45.3] -32769 < $heap$_{719,1;734,8}$.p3

$\rightarrow$ *[from term 1.6, literala < \$heap$_{719,1;734,8}$.p3 is false whenever -2 < (32768 + literala)]*

Proof of rule precondition:

[45.3.0] -2 < (-32769 + 32768)

$\rightarrow$ *[simplify]*

[45.3.2] **true**

[45.4] **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 (53,5)

Condition defined at:

To prove: \$heap$_{719,1;734,8}$.p3 $\leq$ **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)

\$heap$_{init}$.b1 == **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)

\$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)

\$heap$_{init}$.b3 == **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)

div1 == div(**heapIs** \$heap$_{funcstart\_719,1}$, **asType<int>**(\$heap$_{funcstart\_719,1}$.p1), **asType<int>**(\$heap$_{funcstart\_719,1}$.a1))

(**asType<integer>**(**asType<int>**(\$heap$_{funcstart\_719,1}$.p1)) /

asType<integer>(**asType<int>**($heap$_{funcstart_719,1}$.a1))) ==
asType<integer>(div1.quot)

(**asType<integer>**(**asType<int>**($heap$_{funcstart_719,1}$.p1)) %
asType<integer>(**asType<int>**($heap$_{funcstart_719,1}$.a1))) ==
asType<integer>(div1.rem)

div2 == div(**heapIs** $heap$_{funcstart_719,1}$,
asType<int>($heap$_{funcstart_719,1}$.p2),
asType<int>($heap$_{funcstart_719,1}$.a2))

(**asType<integer>**(**asType<int>**($heap$_{funcstart_719,1}$.p2)) /
asType<integer>(**asType<int>**($heap$_{funcstart_719,1}$.a2))) ==
asType<integer>(div2.quot)

(**asType<integer>**(**asType<int>**($heap$_{funcstart_719,1}$.p2)) %
asType<integer>(**asType<int>**($heap$_{funcstart_719,1}$.a2))) ==
asType<integer>(div2.rem)

div3 == div(**heapIs** $heap$_{funcstart_719,1}$,
asType<int>($heap$_{funcstart_719,1}$.p3),
asType<int>($heap$_{funcstart_719,1}$.a3))

(**asType<integer>**(**asType<int>**($heap$_{funcstart_719,1}$.p3)) /
asType<integer>(**asType<int>**($heap$_{funcstart_719,1}$.a3))) ==
asType<integer>(div3.quot)

(**asType<integer>**(**asType<int>**($heap$_{funcstart_719,1}$.p3)) %
asType<integer>(**asType<int>**($heap$_{funcstart_719,1}$.a3))) ==
asType<integer>(div3.rem)

$heap$_{719,1;729,8}$ == $heap$_{funcstart_719,1}$.**replace**(p1 → **asType<short
int>**((**asType<int>**(**asType<short int>**(div1.rem)) *
asType<int>($heap$_{funcstart_719,1}$.r1)) − (**asType<int>**(**asType<short
int>**(div1.quot)) * **asType<int>**($heap$_{funcstart_719,1}$.b1)))))

$heap$_{719,1;730,8}$ == $heap$_{719,1;729,8}$.**replace**(p2 → **asType<short
int>**((**asType<int>**(**asType<short int>**(div2.rem)) *
asType<int>($heap$_{719,1;729,8}$.r2)) − (**asType<int>**(**asType<short
int>**(div2.quot)) * **asType<int>**($heap$_{719,1;729,8}$.b2)))))

$heap$_{719,1;731,8}$ == $heap$_{719,1;730,8}$.**replace**(p3 → **asType<short
int>**((**asType<int>**(**asType<short int>**(div3.rem)) *
asType<int>($heap$_{719,1;730,8}$.r3)) − (**asType<int>**(**asType<short
int>**(div3.quot)) * **asType<int>**($heap$_{719,1;730,8}$.b3)))))

$heap$_{719,1;733,8}$ == $heap$_{719,1;731,8}$.**replace**(p1 → **asType<short
int>**((**asType<int>**($heap$_{719,1;731,8}$.M1) *
asType<int>(**static_cast<integer>**(**asType<int>**($heap$_{719,1;731,8}$.p1) <
(**int**)0))) + **asType<int>**($heap$_{719,1;731,8}$.p1)))

$heap$_{719,1;734,8}$ == $heap$_{719,1;733,8}$.**replace**(p2 → **asType<short
int>**((**asType<int>**($heap$_{719,1;733,8}$.M2) *

asType\<int\>(static_cast\<integer\>(asType\<int\>($heap$_{719,1;733,8}$.p2) < (int)0))) + asType\<int\>($heap$_{719,1;733,8}$.p2)))

Proof:

[Take goal term]

[1.0] $heap$_{719,1;734,8}$.p3 $\leq$ **maxof(int)**

$\rightarrow$ *[simplify]*

[1.9] -32768 $< -$$heap$_{719,1;734,8}$.p3

$\rightarrow$ *[negate goal and search for contradiction]*

[1.10] !(-32768 $< -$$heap$_{719,1;734,8}$.p3)

$\rightarrow$ *[simplify]*

[1.13] 32767 $<$ $heap$_{719,1;734,8}$.p3

[Assume known post-assertion, class invariant or type constraint for term 1.13]

[45.0] $heap$_{719,1;734,8}$.p3 $\leq$ **maxof(short int)**

$\rightarrow$ *[simplify]*

[45.9] -32768 $< -$$heap$_{719,1;734,8}$.p3

$\rightarrow$ *[from term 1.13, literala $< -$$heap$_{719,1;734,8}$.p3 is false whenever -2 < (32767 + literala)]*

    Proof of rule precondition:

    [45.9.0] -2 $<$ (-32768 + 32767)

    $\rightarrow$ *[simplify]*

    [45.9.2] **true**

[45.10] **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 (53,8)

Condition defined at:

To prove: minof(short int) $\leq$ ((**asType\<int\>**($heap$_{719,1;734,8}$.M3) * **asType\<int\>(static_cast\<integer\>(asType\<int\>**($heap$_{719,1;734,8}$.p3) < (int)0))) + **asType\<int\>**($heap$_{719,1;734,8}$.p3))

Given:

$heap$_{init}$.LIMIT == (**int**)80

$heap$_{init}$.M1 == **asType\<short int\>**((**int**)30269)

$heap$_{init}$.r1 == **asType\<short int\>**((**int**)171)

$\$\text{heap}_{init}.\text{a1} == \textbf{asType}\textbf{<short int>}((\textbf{int})177)$

$\$\text{heap}_{init}.\text{b1} == \textbf{asType}\textbf{<short int>}((\textbf{int})2)$

$\$\text{heap}_{init}.\text{M2} == \textbf{asType}\textbf{<short int>}((\textbf{int})30307)$

$\$\text{heap}_{init}.\text{r2} == \textbf{asType}\textbf{<short int>}((\textbf{int})172)$

$\$\text{heap}_{init}.\text{a2} == \textbf{asType}\textbf{<short int>}((\textbf{int})176)$

$\$\text{heap}_{init}.\text{b2} == \textbf{asType}\textbf{<short int>}((\textbf{int})35)$

$\$\text{heap}_{init}.\text{M3} == \textbf{asType}\textbf{<short int>}((\textbf{int})30323)$

$\$\text{heap}_{init}.\text{r3} == \textbf{asType}\textbf{<short int>}((\textbf{int})170)$

$\$\text{heap}_{init}.\text{a3} == \textbf{asType}\textbf{<short int>}((\textbf{int})178)$

$\$\text{heap}_{init}.\text{b3} == \textbf{asType}\textbf{<short int>}((\textbf{int})63)$

$\$\text{heap}_{init}.\text{p1} == \textbf{asType}\textbf{<short int>}((\textbf{int})1)$

$\$\text{heap}_{init}.\text{p2} == \textbf{asType}\textbf{<short int>}((\textbf{int})2)$

$\$\text{heap}_{init}.\text{p3} == \textbf{asType}\textbf{<short int>}((\textbf{int})3)$

div1 == div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$,
asType<int>($\$\text{heap}_{funcstart\_719,1}$.p1),
asType<int>($\$\text{heap}_{funcstart\_719,1}$.a1))

(**asType<integer>**(**asType<int>**($\$\text{heap}_{funcstart\_719,1}$.p1)) /
asType<integer>(**asType<int>**($\$\text{heap}_{funcstart\_719,1}$.a1))) ==
asType<integer>(div1.quot)

(**asType<integer>**(**asType<int>**($\$\text{heap}_{funcstart\_719,1}$.p1)) %
asType<integer>(**asType<int>**($\$\text{heap}_{funcstart\_719,1}$.a1))) ==
asType<integer>(div1.rem)

div2 == div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$,
asType<int>($\$\text{heap}_{funcstart\_719,1}$.p2),
asType<int>($\$\text{heap}_{funcstart\_719,1}$.a2))

(**asType<integer>**(**asType<int>**($\$\text{heap}_{funcstart\_719,1}$.p2)) /
asType<integer>(**asType<int>**($\$\text{heap}_{funcstart\_719,1}$.a2))) ==
asType<integer>(div2.quot)

(**asType<integer>**(**asType<int>**($\$\text{heap}_{funcstart\_719,1}$.p2)) %
asType<integer>(**asType<int>**($\$\text{heap}_{funcstart\_719,1}$.a2))) ==
asType<integer>(div2.rem)

div3 == div(**heapIs** $\$\text{heap}_{funcstart\_719,1}$,
asType<int>($\$\text{heap}_{funcstart\_719,1}$.p3),
asType<int>($\$\text{heap}_{funcstart\_719,1}$.a3))

(**asType<integer>**(**asType<int>**($\$\text{heap}_{funcstart\_719,1}$.p3)) /
asType<integer>(**asType<int>**($\$\text{heap}_{funcstart\_719,1}$.a3))) ==
asType<integer>(div3.quot)

(**asType\<integer\>**(**asType\<int\>**($heap_{funcstart\_719,1}$.p3)) %
asType\<integer\>(**asType\<int\>**($heap_{funcstart\_719,1}$.a3))) ==
asType\<integer\>(div3.rem)

$heap_{719,1;729,8}$ == $heap_{funcstart\_719,1}$.**replace**(p1 → **asType\<short
int\>**((**asType\<int\>**(**asType\<short int\>**(div1.rem)) *
asType\<int\>($heap_{funcstart\_719,1}$.r1)) − (**asType\<int\>**(**asType\<short
int\>**(div1.quot)) * **asType\<int\>**($heap_{funcstart\_719,1}$.b1))))

$heap_{719,1;730,8}$ == $heap_{719,1;729,8}$.**replace**(p2 → **asType\<short
int\>**((**asType\<int\>**(**asType\<short int\>**(div2.rem)) *
asType\<int\>($heap_{719,1;729,8}$.r2)) − (**asType\<int\>**(**asType\<short
int\>**(div2.quot)) * **asType\<int\>**($heap_{719,1;729,8}$.b2))))

$heap_{719,1;731,8}$ == $heap_{719,1;730,8}$.**replace**(p3 → **asType\<short
int\>**((**asType\<int\>**(**asType\<short int\>**(div3.rem)) *
asType\<int\>($heap_{719,1;730,8}$.r3)) − (**asType\<int\>**(**asType\<short
int\>**(div3.quot)) * **asType\<int\>**($heap_{719,1;730,8}$.b3))))

$heap_{719,1;733,8}$ == $heap_{719,1;731,8}$.**replace**(p1 → **asType\<short
int\>**((**asType\<int\>**($heap_{719,1;731,8}$.M1) *
asType\<int\>(**static_cast\<integer\>**(**asType\<int\>**($heap_{719,1;731,8}$.p1) <
(**int**)0))) + **asType\<int\>**($heap_{719,1;731,8}$.p1)))

$heap_{719,1;734,8}$ == $heap_{719,1;733,8}$.**replace**(p2 → **asType\<short
int\>**((**asType\<int\>**($heap_{719,1;733,8}$.M2) *
asType\<int\>(**static_cast\<integer\>**(**asType\<int\>**($heap_{719,1;733,8}$.p2) <
(**int**)0))) + **asType\<int\>**($heap_{719,1;733,8}$.p2)))

Proof:

[Take goal term]

[1.0] **minof**(**short int**) ≤ ((**asType\<int\>**($heap_{719,1;734,8}$.M3) *
asType\<int\>(**static_cast\<integer\>**(**asType\<int\>**($heap_{719,1;734,8}$.p3) <
(**int**)0))) + **asType\<int\>**($heap_{719,1;734,8}$.p3))

→ *[simplify]*

[1.1] -32768 ≤ ((**asType\<int\>**($heap_{719,1;734,8}$.M3) *
asType\<int\>(**static_cast\<integer\>**(**asType\<int\>**($heap_{719,1;734,8}$.p3) <
(**int**)0))) + **asType\<int\>**($heap_{719,1;734,8}$.p3))

→ *[const static or extern object]*

[1.2] -32768 ≤ ((**asType\<int\>**($heap_{init}$.M3) *
asType\<int\>(**static_cast\<integer\>**(**asType\<int\>**($heap_{719,1;734,8}$.p3) <
(**int**)0))) + **asType\<int\>**($heap_{719,1;734,8}$.p3))

→ *[expand definition of constant 'M3' at prang.c (24,20)]*

[1.3] -32768 ≤ ((**asType\<int\>**(**asType\<short int\>**((**int**)30323)) *
asType\<int\>(**static_cast\<integer\>**(**asType\<int\>**($heap_{719,1;734,8}$.p3) <
(**int**)0))) + **asType\<int\>**($heap_{719,1;734,8}$.p3))

$\rightarrow$ *[simplify]*

[1.11] -32768 $\leq$ ((30323 * **asType\<int\>**(([0 < $-$\$heap$_{719,1;734,8}$.p3]: 1, []: 0)))
+ **asType\<int\>**(\$heap$_{719,1;734,8}$.p3))

$\rightarrow$ *[explicitly assert falsehood of skipped guards in subsequent guards]*

[1.12] -32768 $\leq$ ((30323 * **asType\<int\>**((([0 < $-$\$heap$_{719,1;734,8}$.p3]: 1, [!(0 <
$-$\$heap$_{719,1;734,8}$.p3)]: 0))) + **asType\<int\>**(\$heap$_{719,1;734,8}$.p3))

$\rightarrow$ *[simplify]*

[1.16] -32768 $\leq$ ((30323 * ([0 < $-$\$heap$_{719,1;734,8}$.p3]: 1, [-1 <
\$heap$_{719,1;734,8}$.p3]: 0)) + **asType\<int\>**(\$heap$_{719,1;734,8}$.p3))

$\rightarrow$ *[move guard outside expression]*

[1.17] -32768 $\leq$ ((([0 < $-$\$heap$_{719,1;734,8}$.p3]: 1 * 30323, [-1 <
\$heap$_{719,1;734,8}$.p3]: 0 * 30323) + **asType\<int\>**(\$heap$_{719,1;734,8}$.p3))

$\rightarrow$ *[simplify]*

[1.20] -32768 $\leq$ ((([0 < $-$\$heap$_{719,1;734,8}$.p3]: 30323, [-1 < \$heap$_{719,1;734,8}$.p3]:
0) + \$heap$_{719,1;734,8}$.p3)

$\rightarrow$ *[move guard outside expression]*

[1.21] -32768 $\leq$ ([0 < $-$\$heap$_{719,1;734,8}$.p3]: 30323 + \$heap$_{719,1;734,8}$.p3, [-1 <
\$heap$_{719,1;734,8}$.p3]: 0 + \$heap$_{719,1;734,8}$.p3)

$\rightarrow$ *[simplify]*

[1.24] -32769 < ([0 < $-$\$heap$_{719,1;734,8}$.p3]: 30323 + \$heap$_{719,1;734,8}$.p3, [-1 <
\$heap$_{719,1;734,8}$.p3]: \$heap$_{719,1;734,8}$.p3)

$\rightarrow$ *[move guard outside expression]*

[1.25] ([0 < $-$\$heap$_{719,1;734,8}$.p3]: -32769 < (30323 + \$heap$_{719,1;734,8}$.p3), [-1 <
\$heap$_{719,1;734,8}$.p3]: -32769 < \$heap$_{719,1;734,8}$.p3)

$\rightarrow$ *[simplify]*

[1.27] ([0 < $-$\$heap$_{719,1;734,8}$.p3]: -63092 < \$heap$_{719,1;734,8}$.p3, [-1 <
\$heap$_{719,1;734,8}$.p3]: -32769 < \$heap$_{719,1;734,8}$.p3)

$\rightarrow$ *[from guard, literala < \$heap$_{719,1;734,8}$.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$_{719,1;734,8}$.p3]: -63092 < \$heap$_{719,1;734,8}$.p3, [-1 <
\$heap$_{719,1;734,8}$.p3]: **true**)

$\rightarrow$ *[negate goal and search for contradiction]*

[1.29] !([0 < −$heap_{719,1;734,8}$.p3]: -63092 < $heap_{719,1;734,8}$.p3, [-1 < $heap_{719,1;734,8}$.p3]: **true**)

→ *[move guard outside expression]*

[1.30] ([0 < −$heap_{719,1;734,8}$.p3]: !(-63092 < $heap_{719,1;734,8}$.p3), [-1 < $heap_{719,1;734,8}$.p3]: !**true**)

→ *[simplify]*

[1.35] (0 < −$heap_{719,1;734,8}$.p3) ∧ (63091 < −$heap_{719,1;734,8}$.p3)

[Work on sub-term 2 of conjunction in term 1.35]

[45.0] 63091 < −$heap_{719,1;734,8}$.p3

[Assume known post-assertion, class invariant or type constraint for term 1.35]

[46.0] **minof**(**short int**) ≤ $heap_{719,1;734,8}$.p3

→ *[simplify]*

[46.3] -32769 < $heap_{719,1;734,8}$.p3

→ *[from term 45.0, literala < $heap_{719,1;734,8}$.p3 is false whenever -2 < (63091 + literala)]*

> **Proof of rule precondition:**
>
> *[46.3.0]* -2 < (-32769 + 63091)
>
> → *[simplify]*
>
> *[46.3.2]* **true**

[46.4] **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 (53,8)

Condition defined at:

To prove: ((**asType**<**int**>($heap_{719,1;734,8}$.M3) * **asType**<**int**>(**static_cast**<**integer**>(**asType**<**int**>($heap_{719,1;734,8}$.p3) < (**int**)0))) + **asType**<**int**>($heap_{719,1;734,8}$.p3)) ≤ **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)

$\text{\$heap}_{init}.\text{M2} == \textbf{asType}\textbf{<short int>}((\textbf{int})30307)$

$\text{\$heap}_{init}.\text{r2} == \textbf{asType}\textbf{<short int>}((\textbf{int})172)$

$\text{\$heap}_{init}.\text{a2} == \textbf{asType}\textbf{<short int>}((\textbf{int})176)$

$\text{\$heap}_{init}.\text{b2} == \textbf{asType}\textbf{<short int>}((\textbf{int})35)$

$\text{\$heap}_{init}.\text{M3} == \textbf{asType}\textbf{<short int>}((\textbf{int})30323)$

$\text{\$heap}_{init}.\text{r3} == \textbf{asType}\textbf{<short int>}((\textbf{int})170)$

$\text{\$heap}_{init}.\text{a3} == \textbf{asType}\textbf{<short int>}((\textbf{int})178)$

$\text{\$heap}_{init}.\text{b3} == \textbf{asType}\textbf{<short int>}((\textbf{int})63)$

$\text{\$heap}_{init}.\text{p1} == \textbf{asType}\textbf{<short int>}((\textbf{int})1)$

$\text{\$heap}_{init}.\text{p2} == \textbf{asType}\textbf{<short int>}((\textbf{int})2)$

$\text{\$heap}_{init}.\text{p3} == \textbf{asType}\textbf{<short int>}((\textbf{int})3)$

$\text{div1} == \text{div}(\textbf{heapIs } \text{\$heap}_{funcstart\_719,1},$
$\textbf{asType}\textbf{<int>}(\text{\$heap}_{funcstart\_719,1}.\text{p1}),$
$\textbf{asType}\textbf{<int>}(\text{\$heap}_{funcstart\_719,1}.\text{a1}))$

$(\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<int>}(\text{\$heap}_{funcstart\_719,1}.\text{p1}))\ /$
$\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<int>}(\text{\$heap}_{funcstart\_719,1}.\text{a1}))) ==$
$\textbf{asType}\textbf{<integer>}(\text{div1.quot})$

$(\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<int>}(\text{\$heap}_{funcstart\_719,1}.\text{p1}))\ \%$
$\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<int>}(\text{\$heap}_{funcstart\_719,1}.\text{a1}))) ==$
$\textbf{asType}\textbf{<integer>}(\text{div1.rem})$

$\text{div2} == \text{div}(\textbf{heapIs } \text{\$heap}_{funcstart\_719,1},$
$\textbf{asType}\textbf{<int>}(\text{\$heap}_{funcstart\_719,1}.\text{p2}),$
$\textbf{asType}\textbf{<int>}(\text{\$heap}_{funcstart\_719,1}.\text{a2}))$

$(\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<int>}(\text{\$heap}_{funcstart\_719,1}.\text{p2}))\ /$
$\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<int>}(\text{\$heap}_{funcstart\_719,1}.\text{a2}))) ==$
$\textbf{asType}\textbf{<integer>}(\text{div2.quot})$

$(\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<int>}(\text{\$heap}_{funcstart\_719,1}.\text{p2}))\ \%$
$\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<int>}(\text{\$heap}_{funcstart\_719,1}.\text{a2}))) ==$
$\textbf{asType}\textbf{<integer>}(\text{div2.rem})$

$\text{div3} == \text{div}(\textbf{heapIs } \text{\$heap}_{funcstart\_719,1},$
$\textbf{asType}\textbf{<int>}(\text{\$heap}_{funcstart\_719,1}.\text{p3}),$
$\textbf{asType}\textbf{<int>}(\text{\$heap}_{funcstart\_719,1}.\text{a3}))$

$(\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<int>}(\text{\$heap}_{funcstart\_719,1}.\text{p3}))\ /$
$\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<int>}(\text{\$heap}_{funcstart\_719,1}.\text{a3}))) ==$
$\textbf{asType}\textbf{<integer>}(\text{div3.quot})$

$(\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<int>}(\text{\$heap}_{funcstart\_719,1}.\text{p3}))\ \%$
$\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<int>}(\text{\$heap}_{funcstart\_719,1}.\text{a3}))) ==$
$\textbf{asType}\textbf{<integer>}(\text{div3.rem})$

$\$\text{heap}_{719,1;729,8} == \$\text{heap}_{funcstart\_719,1}.\textbf{replace}(\text{p1} \to \textbf{asType}<\textbf{short int}>((\textbf{asType}<\textbf{int}>(\textbf{asType}<\textbf{short int}>(\text{div1.rem}))\,*\,\textbf{asType}<\textbf{int}>(\$\text{heap}_{funcstart\_719,1}.\text{r1})) - (\textbf{asType}<\textbf{int}>(\textbf{asType}<\textbf{short int}>(\text{div1.quot}))\,*\,\textbf{asType}<\textbf{int}>(\$\text{heap}_{funcstart\_719,1}.\text{b1}))))$

$\$\text{heap}_{719,1;730,8} == \$\text{heap}_{719,1;729,8}.\textbf{replace}(\text{p2} \to \textbf{asType}<\textbf{short int}>((\textbf{asType}<\textbf{int}>(\textbf{asType}<\textbf{short int}>(\text{div2.rem}))\,*\,\textbf{asType}<\textbf{int}>(\$\text{heap}_{719,1;729,8}.\text{r2})) - (\textbf{asType}<\textbf{int}>(\textbf{asType}<\textbf{short int}>(\text{div2.quot}))\,*\,\textbf{asType}<\textbf{int}>(\$\text{heap}_{719,1;729,8}.\text{b2}))))$

$\$\text{heap}_{719,1;731,8} == \$\text{heap}_{719,1;730,8}.\textbf{replace}(\text{p3} \to \textbf{asType}<\textbf{short int}>((\textbf{asType}<\textbf{int}>(\textbf{asType}<\textbf{short int}>(\text{div3.rem}))\,*\,\textbf{asType}<\textbf{int}>(\$\text{heap}_{719,1;730,8}.\text{r3})) - (\textbf{asType}<\textbf{int}>(\textbf{asType}<\textbf{short int}>(\text{div3.quot}))\,*\,\textbf{asType}<\textbf{int}>(\$\text{heap}_{719,1;730,8}.\text{b3}))))$

$\$\text{heap}_{719,1;733,8} == \$\text{heap}_{719,1;731,8}.\textbf{replace}(\text{p1} \to \textbf{asType}<\textbf{short int}>((\textbf{asType}<\textbf{int}>(\$\text{heap}_{719,1;731,8}.\text{M1})\,*\,\textbf{asType}<\textbf{int}>(\textbf{static\_cast}<\textbf{integer}>(\textbf{asType}<\textbf{int}>(\$\text{heap}_{719,1;731,8}.\text{p1}) < (\textbf{int})0))) + \textbf{asType}<\textbf{int}>(\$\text{heap}_{719,1;731,8}.\text{p1})))$

$\$\text{heap}_{719,1;734,8} == \$\text{heap}_{719,1;733,8}.\textbf{replace}(\text{p2} \to \textbf{asType}<\textbf{short int}>((\textbf{asType}<\textbf{int}>(\$\text{heap}_{719,1;733,8}.\text{M2})\,*\,\textbf{asType}<\textbf{int}>(\textbf{static\_cast}<\textbf{integer}>(\textbf{asType}<\textbf{int}>(\$\text{heap}_{719,1;733,8}.\text{p2}) < (\textbf{int})0))) + \textbf{asType}<\textbf{int}>(\$\text{heap}_{719,1;733,8}.\text{p2})))$

Proof:

[Take goal term]

[1.0] $((\textbf{asType}<\textbf{int}>(\$\text{heap}_{719,1;734,8}.\text{M3})\,*\,\textbf{asType}<\textbf{int}>(\textbf{static\_cast}<\textbf{integer}>(\textbf{asType}<\textbf{int}>(\$\text{heap}_{719,1;734,8}.\text{p3}) < (\textbf{int})0))) + \textbf{asType}<\textbf{int}>(\$\text{heap}_{719,1;734,8}.\text{p3})) \le \textbf{maxof(short int)}$

$\to$ *[const static or extern object]*

[1.1] $((\textbf{asType}<\textbf{int}>(\$\text{heap}_{init}.\text{M3})\,*\,\textbf{asType}<\textbf{int}>(\textbf{static\_cast}<\textbf{integer}>(\textbf{asType}<\textbf{int}>(\$\text{heap}_{719,1;734,8}.\text{p3}) < (\textbf{int})0))) + \textbf{asType}<\textbf{int}>(\$\text{heap}_{719,1;734,8}.\text{p3})) \le \textbf{maxof(short int)}$

$\to$ *[expand definition of constant 'M3' at prang.c (24,20)]*

[1.2] $((\textbf{asType}<\textbf{int}>(\textbf{asType}<\textbf{short int}>((\textbf{int})30323))\,*\,\textbf{asType}<\textbf{int}>(\textbf{static\_cast}<\textbf{integer}>(\textbf{asType}<\textbf{int}>(\$\text{heap}_{719,1;734,8}.\text{p3}) < (\textbf{int})0))) + \textbf{asType}<\textbf{int}>(\$\text{heap}_{719,1;734,8}.\text{p3})) \le \textbf{maxof(short int)}$

$\to$ *[simplify]*

[1.10] $((30323\,*\,\textbf{asType}<\textbf{int}>(([0 < -\$\text{heap}_{719,1;734,8}.\text{p3}]:\,1,\,[]:\,0))) + \textbf{asType}<\textbf{int}>(\$\text{heap}_{719,1;734,8}.\text{p3})) \le \textbf{maxof(short int)}$

$\to$ *[explicitly assert falsehood of skipped guards in subsequent guards]*

[1.11] $((30323\,*\,\textbf{asType}<\textbf{int}>(([0 < -\$\text{heap}_{719,1;734,8}.\text{p3}]:\,1,\,[!(0 < -\$\text{heap}_{719,1;734,8}.\text{p3})]:\,0))) + \textbf{asType}<\textbf{int}>(\$\text{heap}_{719,1;734,8}.\text{p3})) \le$

maxof(short int)

$\rightarrow$ *[simplify]*

[1.15] $((30323 * ([0 < -\$\text{heap}_{719,1;734,8}.\text{p3}]: 1, [-1 < \$\text{heap}_{719,1;734,8}.\text{p3}]: 0)) +$ **asType<int>**$(\$\text{heap}_{719,1;734,8}.\text{p3})) \leq$ **maxof(short int)**

$\rightarrow$ *[move guard outside expression]*

[1.16] $(([0 < -\$\text{heap}_{719,1;734,8}.\text{p3}]: 1 * 30323, [-1 < \$\text{heap}_{719,1;734,8}.\text{p3}]: 0 *$ $30323) +$ **asType<int>**$(\$\text{heap}_{719,1;734,8}.\text{p3})) \leq$ **maxof(short int)**

$\rightarrow$ *[simplify]*

[1.19] $(([0 < -\$\text{heap}_{719,1;734,8}.\text{p3}]: 30323, [-1 < \$\text{heap}_{719,1;734,8}.\text{p3}]: 0) +$ $\$\text{heap}_{719,1;734,8}.\text{p3}) \leq$ **maxof(short int)**

$\rightarrow$ *[move guard outside expression]*

[1.20] $([0 < -\$\text{heap}_{719,1;734,8}.\text{p3}]: 30323 + \$\text{heap}_{719,1;734,8}.\text{p3}, [-1 <$ $\$\text{heap}_{719,1;734,8}.\text{p3}]: 0 + \$\text{heap}_{719,1;734,8}.\text{p3}) \leq$ **maxof(short int)**

$\rightarrow$ *[simplify]*

[1.23] $(-1 + ([0 < -\$\text{heap}_{719,1;734,8}.\text{p3}]: 30323 + \$\text{heap}_{719,1;734,8}.\text{p3}, [-1 <$ $\$\text{heap}_{719,1;734,8}.\text{p3}]: \$\text{heap}_{719,1;734,8}.\text{p3})) < 32767$

$\rightarrow$ *[move guard outside expression]*

[1.24] $([0 < -\$\text{heap}_{719,1;734,8}.\text{p3}]: -1 + (30323 + \$\text{heap}_{719,1;734,8}.\text{p3}), [-1 <$ $\$\text{heap}_{719,1;734,8}.\text{p3}]: -1 + \$\text{heap}_{719,1;734,8}.\text{p3}) < 32767$

$\rightarrow$ *[simplify]*

[1.27] $0 < (32767 + -([0 < -\$\text{heap}_{719,1;734,8}.\text{p3}]: 30322 + \$\text{heap}_{719,1;734,8}.\text{p3},$ $[-1 < \$\text{heap}_{719,1;734,8}.\text{p3}]: -1 + \$\text{heap}_{719,1;734,8}.\text{p3}))$

$\rightarrow$ *[move guard outside expression]*

[1.28] $0 < (32767 + ([0 < -\$\text{heap}_{719,1;734,8}.\text{p3}]: -(30322 +$ $\$\text{heap}_{719,1;734,8}.\text{p3}), [-1 < \$\text{heap}_{719,1;734,8}.\text{p3}]: -(-1 + \$\text{heap}_{719,1;734,8}.\text{p3})))$

$\rightarrow$ *[simplify]*

[1.32] $0 < (32767 + ([0 < -\$\text{heap}_{719,1;734,8}.\text{p3}]: -30322 + -\$\text{heap}_{719,1;734,8}.\text{p3},$ $[-1 < \$\text{heap}_{719,1;734,8}.\text{p3}]: 1 + -\$\text{heap}_{719,1;734,8}.\text{p3}))$

$\rightarrow$ *[move guard outside expression]*

[1.33] $0 < ([0 < -\$\text{heap}_{719,1;734,8}.\text{p3}]: 32767 + (-30322 + -\$\text{heap}_{719,1;734,8}.\text{p3}),$ $[-1 < \$\text{heap}_{719,1;734,8}.\text{p3}]: 32767 + (1 + -\$\text{heap}_{719,1;734,8}.\text{p3}))$

$\rightarrow$ *[simplify]*

[1.37] $0 < ([0 < -\$\text{heap}_{719,1;734,8}.\text{p3}]: 2445 + -\$\text{heap}_{719,1;734,8}.\text{p3}, [-1 <$ $\$\text{heap}_{719,1;734,8}.\text{p3}]: 32768 + -\$\text{heap}_{719,1;734,8}.\text{p3})$

$\rightarrow$ *[move guard outside expression]*

[1.38] $([0 < -\$\text{heap}_{719,1;734,8}.\text{p3}]: 0 < (2445 + -\$\text{heap}_{719,1;734,8}.\text{p3}), [-1 <$

$\text{\$heap}_{719,1;734,8}.\text{p3}]: 0 < (32768 + -\text{\$heap}_{719,1;734,8}.\text{p3}))$

$\rightarrow$ *[simplify]*

[1.40] $([0 < -\text{\$heap}_{719,1;734,8}.\text{p3}]: \text{-2445} < -\text{\$heap}_{719,1;734,8}.\text{p3}, [\text{-1} < \text{\$heap}_{719,1;734,8}.\text{p3}]: 0 < (32768 + -\text{\$heap}_{719,1;734,8}.\text{p3}))$

$\rightarrow$ *[from guard, literala $< -\text{\$heap}_{719,1;734,8}.p3$ is true whenever (-1 + literala) < 0]*

Proof of rule precondition:

[1.40.0] $(\text{-2445} + \text{-1}) < 0$

$\rightarrow$ *[simplify]*

[1.40.2] **true**

[1.41] $([0 < -\text{\$heap}_{719,1;734,8}.\text{p3}]: \textbf{true}, [\text{-1} < \text{\$heap}_{719,1;734,8}.\text{p3}]: 0 < (32768 + -\text{\$heap}_{719,1;734,8}.\text{p3}))$

$\rightarrow$ *[simplify]*

[1.43] $([0 < -\text{\$heap}_{719,1;734,8}.\text{p3}]: \textbf{true}, [\text{-1} < \text{\$heap}_{719,1;734,8}.\text{p3}]: \text{-32768} < -\text{\$heap}_{719,1;734,8}.\text{p3})$

$\rightarrow$ *[negate goal and search for contradiction]*

[1.44] $!([0 < -\text{\$heap}_{719,1;734,8}.\text{p3}]: \textbf{true}, [\text{-1} < \text{\$heap}_{719,1;734,8}.\text{p3}]: \text{-32768} < -\text{\$heap}_{719,1;734,8}.\text{p3})$

$\rightarrow$ *[move guard outside expression]*

[1.45] $([0 < -\text{\$heap}_{719,1;734,8}.\text{p3}]: !\textbf{true}, [\text{-1} < \text{\$heap}_{719,1;734,8}.\text{p3}]: !(\text{-32768} < -\text{\$heap}_{719,1;734,8}.\text{p3}))$

$\rightarrow$ *[simplify]*

[1.51] $(\text{-1} < \text{\$heap}_{719,1;734,8}.\text{p3}) \land (32767 < \text{\$heap}_{719,1;734,8}.\text{p3})$

[Work on sub-term 2 of conjunction in term 1.51]

[45.0] $32767 < \text{\$heap}_{719,1;734,8}.\text{p3}$

[Assume known post-assertion, class invariant or type constraint for term 1.51]

[46.0] $\text{\$heap}_{719,1;734,8}.\text{p3} \leq \textbf{maxof}(\textbf{short int})$

$\rightarrow$ *[simplify]*

[46.9] $\text{-32768} < -\text{\$heap}_{719,1;734,8}.\text{p3}$

$\rightarrow$ *[from term 45.0, literala $< -\text{\$heap}_{719,1;734,8}.p3$ is false whenever -2 $<$ (32767 + literala)]*

Proof of rule precondition:

[46.9.0] $\text{-2} < (\text{-32768} + 32767)$

$\rightarrow$ *[simplify]*

[46.9.2] **true**

[46.10] **false**

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

Condition generated at: C:\Escher\Customers\prang\prang.c (61,34)

Condition defined at: built in declaration

To prove: !(0.0 ==
asType<**double**>(**static_cast**<**real**>($heap$_{funcend_719,1}$.M1)))

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)

$heap$_{init}$.M2 == **asType**<**short int**>((**int**)30307)

$heap$_{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)

$heap$_{init}$.r3 == **asType**<**short int**>((**int**)170)

$heap$_{init}$.a3 == **asType**<**short int**>((**int**)178)

$heap$_{init}$.b3 == **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)

div1 == div(**heapIs** $heap$_{funcstart_719,1}$,
asType<**int**>($heap$_{funcstart_719,1}$.p1),
asType<**int**>($heap$_{funcstart_719,1}$.a1))

(**asType**<**integer**>(**asType**<**int**>($heap$_{funcstart_719,1}$.p1)) /
asType<**integer**>(**asType**<**int**>($heap$_{funcstart_719,1}$.a1))) ==
asType<**integer**>(div1.quot)

(**asType**<**integer**>(**asType**<**int**>($heap$_{funcstart_719,1}$.p1)) %
asType<**integer**>(**asType**<**int**>($heap$_{funcstart_719,1}$.a1))) ==
asType<**integer**>(div1.rem)

div2 == div(**heapIs** $heap$_{funcstart_719,1}$,

$\textbf{asType}\textbf{<int>}(\$\text{heap}_{funcstart\_719,1}.\text{p2}),$
$\textbf{asType}\textbf{<int>}(\$\text{heap}_{funcstart\_719,1}.\text{a2}))$

$(\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<int>}(\$\text{heap}_{funcstart\_719,1}.\text{p2}))\ /$
$\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<int>}(\$\text{heap}_{funcstart\_719,1}.\text{a2}))) ==$
$\textbf{asType}\textbf{<integer>}(\text{div2.quot})$

$(\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<int>}(\$\text{heap}_{funcstart\_719,1}.\text{p2}))\ \%$
$\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<int>}(\$\text{heap}_{funcstart\_719,1}.\text{a2}))) ==$
$\textbf{asType}\textbf{<integer>}(\text{div2.rem})$

$\text{div3} == \text{div}(\textbf{heapIs}\ \$\text{heap}_{funcstart\_719,1},$
$\textbf{asType}\textbf{<int>}(\$\text{heap}_{funcstart\_719,1}.\text{p3}),$
$\textbf{asType}\textbf{<int>}(\$\text{heap}_{funcstart\_719,1}.\text{a3}))$

$(\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<int>}(\$\text{heap}_{funcstart\_719,1}.\text{p3}))\ /$
$\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<int>}(\$\text{heap}_{funcstart\_719,1}.\text{a3}))) ==$
$\textbf{asType}\textbf{<integer>}(\text{div3.quot})$

$(\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<int>}(\$\text{heap}_{funcstart\_719,1}.\text{p3}))\ \%$
$\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<int>}(\$\text{heap}_{funcstart\_719,1}.\text{a3}))) ==$
$\textbf{asType}\textbf{<integer>}(\text{div3.rem})$

$\$\text{heap}_{719,1;729,8} == \$\text{heap}_{funcstart\_719,1}.\_\textbf{replace}(\text{p1} \rightarrow \textbf{asType}\textbf{<short}$
$\textbf{int>}((\textbf{asType}\textbf{<int>}(\textbf{asType}\textbf{<short int>}(\text{div1.rem}))\ *$
$\textbf{asType}\textbf{<int>}(\$\text{heap}_{funcstart\_719,1}.\text{r1})) - (\textbf{asType}\textbf{<int>}(\textbf{asType}\textbf{<short}$
$\textbf{int>}(\text{div1.quot})) * \textbf{asType}\textbf{<int>}(\$\text{heap}_{funcstart\_719,1}.\text{b1}))))$

$\$\text{heap}_{719,1;730,8} == \$\text{heap}_{719,1;729,8}.\_\textbf{replace}(\text{p2} \rightarrow \textbf{asType}\textbf{<short}$
$\textbf{int>}((\textbf{asType}\textbf{<int>}(\textbf{asType}\textbf{<short int>}(\text{div2.rem}))\ *$
$\textbf{asType}\textbf{<int>}(\$\text{heap}_{719,1;729,8}.\text{r2})) - (\textbf{asType}\textbf{<int>}(\textbf{asType}\textbf{<short}$
$\textbf{int>}(\text{div2.quot})) * \textbf{asType}\textbf{<int>}(\$\text{heap}_{719,1;729,8}.\text{b2}))))$

$\$\text{heap}_{719,1;731,8} == \$\text{heap}_{719,1;730,8}.\_\textbf{replace}(\text{p3} \rightarrow \textbf{asType}\textbf{<short}$
$\textbf{int>}((\textbf{asType}\textbf{<int>}(\textbf{asType}\textbf{<short int>}(\text{div3.rem}))\ *$
$\textbf{asType}\textbf{<int>}(\$\text{heap}_{719,1;730,8}.\text{r3})) - (\textbf{asType}\textbf{<int>}(\textbf{asType}\textbf{<short}$
$\textbf{int>}(\text{div3.quot})) * \textbf{asType}\textbf{<int>}(\$\text{heap}_{719,1;730,8}.\text{b3}))))$

$\$\text{heap}_{719,1;733,8} == \$\text{heap}_{719,1;731,8}.\_\textbf{replace}(\text{p1} \rightarrow \textbf{asType}\textbf{<short}$
$\textbf{int>}((\textbf{asType}\textbf{<int>}(\$\text{heap}_{719,1;731,8}.\text{M1})\ *$
$\textbf{asType}\textbf{<int>}(\textbf{static\_cast}\textbf{<integer>}(\textbf{asType}\textbf{<int>}(\$\text{heap}_{719,1;731,8}.\text{p1}) <$
$(\textbf{int})0))) + \textbf{asType}\textbf{<int>}(\$\text{heap}_{719,1;731,8}.\text{p1})))$

$\$\text{heap}_{719,1;734,8} == \$\text{heap}_{719,1;733,8}.\_\textbf{replace}(\text{p2} \rightarrow \textbf{asType}\textbf{<short}$
$\textbf{int>}((\textbf{asType}\textbf{<int>}(\$\text{heap}_{719,1;733,8}.\text{M2})\ *$
$\textbf{asType}\textbf{<int>}(\textbf{static\_cast}\textbf{<integer>}(\textbf{asType}\textbf{<int>}(\$\text{heap}_{719,1;733,8}.\text{p2}) <$
$(\textbf{int})0))) + \textbf{asType}\textbf{<int>}(\$\text{heap}_{719,1;733,8}.\text{p2})))$

$\$\text{heap}_{funcend\_719,1} == \$\text{heap}_{719,1;734,8}.\_\textbf{replace}(\text{p3} \rightarrow \textbf{asType}\textbf{<short}$
$\textbf{int>}((\textbf{asType}\textbf{<int>}(\$\text{heap}_{719,1;734,8}.\text{M3})\ *$
$\textbf{asType}\textbf{<int>}(\textbf{static\_cast}\textbf{<integer>}(\textbf{asType}\textbf{<int>}(\$\text{heap}_{719,1;734,8}.\text{p3}) <$
$(\textbf{int})0))) + \textbf{asType}\textbf{<int>}(\$\text{heap}_{719,1;734,8}.\text{p3})))$

Proof:

[Take goal term]

[1.0] !(0.0 ==
asType<**double**>(**static_cast**<**real**>($heap$_{funcend_719,1}$.M1)))

→ *[const static or extern object]*

[1.1] !(0.0 == **asType**<**double**>(**static_cast**<**real**>($heap$_{init}$.M1)))

→ *[expand definition of constant 'M1' at prang.c (14,20)]*

[1.2] !(0.0 == **asType**<**double**>(**static_cast**<**real**>(**asType**<**short int**>((**int**)30269))))

→ *[simplify]*

[1.9] **true**

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

Condition generated at: C:\Escher\Customers\prang\prang.c (62,34)

Condition defined at: built in declaration

To prove: !(0.0 ==
asType<**double**>(**static_cast**<**real**>($heap$_{funcend_719,1}$.M2)))

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)

$heap$_{init}$.M2 == **asType**<**short int**>((**int**)30307)

$heap$_{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)

$heap$_{init}$.r3 == **asType**<**short int**>((**int**)170)

$heap$_{init}$.a3 == **asType**<**short int**>((**int**)178)

$heap$_{init}$.b3 == **asType**<**short int**>((**int**)63)

$heap$_{init}$.p1 == **asType**<**short int**>((**int**)1)

$heap$_{init}$.p2 == **asType**<**short int**>((**int**)2)

$\text{\$heap}_{init}.p3 == \textbf{asType}\textbf{<short int>}((\textbf{int})3)$

$\text{div1} == \text{div}(\textbf{heapIs } \text{\$heap}_{funcstart\_719,1},$
$\textbf{asType}\textbf{<int>}(\text{\$heap}_{funcstart\_719,1}.p1),$
$\textbf{asType}\textbf{<int>}(\text{\$heap}_{funcstart\_719,1}.a1))$

$(\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<int>}(\text{\$heap}_{funcstart\_719,1}.p1)) \text{ / }$
$\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<int>}(\text{\$heap}_{funcstart\_719,1}.a1))) ==$
$\textbf{asType}\textbf{<integer>}(\text{div1.quot})$

$(\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<int>}(\text{\$heap}_{funcstart\_719,1}.p1)) \text{ \% }$
$\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<int>}(\text{\$heap}_{funcstart\_719,1}.a1))) ==$
$\textbf{asType}\textbf{<integer>}(\text{div1.rem})$

$\text{div2} == \text{div}(\textbf{heapIs } \text{\$heap}_{funcstart\_719,1},$
$\textbf{asType}\textbf{<int>}(\text{\$heap}_{funcstart\_719,1}.p2),$
$\textbf{asType}\textbf{<int>}(\text{\$heap}_{funcstart\_719,1}.a2))$

$(\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<int>}(\text{\$heap}_{funcstart\_719,1}.p2)) \text{ / }$
$\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<int>}(\text{\$heap}_{funcstart\_719,1}.a2))) ==$
$\textbf{asType}\textbf{<integer>}(\text{div2.quot})$

$(\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<int>}(\text{\$heap}_{funcstart\_719,1}.p2)) \text{ \% }$
$\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<int>}(\text{\$heap}_{funcstart\_719,1}.a2))) ==$
$\textbf{asType}\textbf{<integer>}(\text{div2.rem})$

$\text{div3} == \text{div}(\textbf{heapIs } \text{\$heap}_{funcstart\_719,1},$
$\textbf{asType}\textbf{<int>}(\text{\$heap}_{funcstart\_719,1}.p3),$
$\textbf{asType}\textbf{<int>}(\text{\$heap}_{funcstart\_719,1}.a3))$

$(\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<int>}(\text{\$heap}_{funcstart\_719,1}.p3)) \text{ / }$
$\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<int>}(\text{\$heap}_{funcstart\_719,1}.a3))) ==$
$\textbf{asType}\textbf{<integer>}(\text{div3.quot})$

$(\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<int>}(\text{\$heap}_{funcstart\_719,1}.p3)) \text{ \% }$
$\textbf{asType}\textbf{<integer>}(\textbf{asType}\textbf{<int>}(\text{\$heap}_{funcstart\_719,1}.a3))) ==$
$\textbf{asType}\textbf{<integer>}(\text{div3.rem})$

$\text{\$heap}_{719,1;729,8} == \text{\$heap}_{funcstart\_719,1}.\underline{\textbf{replace}}(p1 \rightarrow \textbf{asType}\textbf{<short}$
$\textbf{int>}((\textbf{asType}\textbf{<int>}(\textbf{asType}\textbf{<short int>}(\text{div1.rem})) \text{ * }$
$\textbf{asType}\textbf{<int>}(\text{\$heap}_{funcstart\_719,1}.r1)) - (\textbf{asType}\textbf{<int>}(\textbf{asType}\textbf{<short}$
$\textbf{int>}(\text{div1.quot})) \text{ * } \textbf{asType}\textbf{<int>}(\text{\$heap}_{funcstart\_719,1}.b1))))$

$\text{\$heap}_{719,1;730,8} == \text{\$heap}_{719,1;729,8}.\underline{\textbf{replace}}(p2 \rightarrow \textbf{asType}\textbf{<short}$
$\textbf{int>}((\textbf{asType}\textbf{<int>}(\textbf{asType}\textbf{<short int>}(\text{div2.rem})) \text{ * }$
$\textbf{asType}\textbf{<int>}(\text{\$heap}_{719,1;729,8}.r2)) - (\textbf{asType}\textbf{<int>}(\textbf{asType}\textbf{<short}$
$\textbf{int>}(\text{div2.quot})) \text{ * } \textbf{asType}\textbf{<int>}(\text{\$heap}_{719,1;729,8}.b2))))$

$\text{\$heap}_{719,1;731,8} == \text{\$heap}_{719,1;730,8}.\underline{\textbf{replace}}(p3 \rightarrow \textbf{asType}\textbf{<short}$
$\textbf{int>}((\textbf{asType}\textbf{<int>}(\textbf{asType}\textbf{<short int>}(\text{div3.rem})) \text{ * }$
$\textbf{asType}\textbf{<int>}(\text{\$heap}_{719,1;730,8}.r3)) - (\textbf{asType}\textbf{<int>}(\textbf{asType}\textbf{<short}$
$\textbf{int>}(\text{div3.quot})) \text{ * } \textbf{asType}\textbf{<int>}(\text{\$heap}_{719,1;730,8}.b3))))$

$\$heap_{719,1;733,8} == \$heap_{719,1;731,8}.\_$**replace**$(p1 \rightarrow$ **asType**<**short int**>((**asType**<**int**>($\$heap_{719,1;731,8}$.M1) * **asType**<**int**>(**static_cast**<**integer**>(**asType**<**int**>($\$heap_{719,1;731,8}$.p1) < (**int**)0))) + **asType**<**int**>($\$heap_{719,1;731,8}$.p1)))

$\$heap_{719,1;734,8} == \$heap_{719,1;733,8}.\_$**replace**$(p2 \rightarrow$ **asType**<**short int**>((**asType**<**int**>($\$heap_{719,1;733,8}$.M2) * **asType**<**int**>(**static_cast**<**integer**>(**asType**<**int**>($\$heap_{719,1;733,8}$.p2) < (**int**)0))) + **asType**<**int**>($\$heap_{719,1;733,8}$.p2)))

$\$heap_{funcend\_719,1} == \$heap_{719,1;734,8}.\_$**replace**$(p3 \rightarrow$ **asType**<**short int**>((**asType**<**int**>($\$heap_{719,1;734,8}$.M3) * **asType**<**int**>(**static_cast**<**integer**>(**asType**<**int**>($\$heap_{719,1;734,8}$.p3) < (**int**)0))) + **asType**<**int**>($\$heap_{719,1;734,8}$.p3)))

raux1 == **asType**<**double**>(**static_cast**<**real**>($\$heap_{funcend\_719,1}$.p1)) / **asType**<**double**>(**static_cast**<**real**>($\$heap_{funcend\_719,1}$.M1))

Proof:

[Take goal term]

[1.0] !(0.0 == **asType**<**double**>(**static_cast**<**real**>($\$heap_{funcend\_719,1}$.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 (63,34)

Condition defined at: built in declaration

To prove: !(0.0 == **asType**<**double**>(**static_cast**<**real**>($\$heap_{funcend\_719,1}$.M3)))

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**$>((\textbf{int})2)$

$\$heap_{init}.M2 == $ **asType**$<$**short int**$>((\textbf{int})30307)$

$\$heap_{init}.r2 == $ **asType**$<$**short int**$>((\textbf{int})172)$

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

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

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

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

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

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

$\$heap_{init}.p1 == $ **asType**$<$**short int**$>((\textbf{int})1)$

$\$heap_{init}.p2 == $ **asType**$<$**short int**$>((\textbf{int})2)$

$\$heap_{init}.p3 == $ **asType**$<$**short int**$>((\textbf{int})3)$

$\text{div1} == \text{div}($**heapIs** $\$heap_{funcstart\_719,1},$
asType$<$**int**$>(\$heap_{funcstart\_719,1}.p1),$
asType$<$**int**$>(\$heap_{funcstart\_719,1}.a1))$

(**asType**$<$**integer**$>($**asType**$<$**int**$>(\$heap_{funcstart\_719,1}.p1))$ /
asType$<$**integer**$>($**asType**$<$**int**$>(\$heap_{funcstart\_719,1}.a1))) ==$
asType$<$**integer**$>(\text{div1.quot})$

(**asType**$<$**integer**$>($**asType**$<$**int**$>(\$heap_{funcstart\_719,1}.p1))$ %
asType$<$**integer**$>($**asType**$<$**int**$>(\$heap_{funcstart\_719,1}.a1))) ==$
asType$<$**integer**$>(\text{div1.rem})$

$\text{div2} == \text{div}($**heapIs** $\$heap_{funcstart\_719,1},$
asType$<$**int**$>(\$heap_{funcstart\_719,1}.p2),$
asType$<$**int**$>(\$heap_{funcstart\_719,1}.a2))$

(**asType**$<$**integer**$>($**asType**$<$**int**$>(\$heap_{funcstart\_719,1}.p2))$ /
asType$<$**integer**$>($**asType**$<$**int**$>(\$heap_{funcstart\_719,1}.a2))) ==$
asType$<$**integer**$>(\text{div2.quot})$

(**asType**$<$**integer**$>($**asType**$<$**int**$>(\$heap_{funcstart\_719,1}.p2))$ %
asType$<$**integer**$>($**asType**$<$**int**$>(\$heap_{funcstart\_719,1}.a2))) ==$
asType$<$**integer**$>(\text{div2.rem})$

$\text{div3} == \text{div}($**heapIs** $\$heap_{funcstart\_719,1},$
asType$<$**int**$>(\$heap_{funcstart\_719,1}.p3),$
asType$<$**int**$>(\$heap_{funcstart\_719,1}.a3))$

(**asType**$<$**integer**$>($**asType**$<$**int**$>(\$heap_{funcstart\_719,1}.p3))$ /
asType$<$**integer**$>($**asType**$<$**int**$>(\$heap_{funcstart\_719,1}.a3))) ==$
asType$<$**integer**$>(\text{div3.quot})$

(**asType**$<$**integer**$>($**asType**$<$**int**$>(\$heap_{funcstart\_719,1}.p3))$ %

asType\<integer\>(**asType\<int\>**($\text{heap}_{funcstart\_719,1}$.a3))) ==
asType\<integer\>(div3.rem)

$\text{heap}_{719,1;729,8}$ == $\text{heap}_{funcstart\_719,1}$.**replace**(p1 → **asType\<short int\>**((**asType\<int\>**(**asType\<short int\>**(div1.rem)) *
asType\<int\>($\text{heap}_{funcstart\_719,1}$.r1)) − (**asType\<int\>**(**asType\<short int\>**(div1.quot)) * **asType\<int\>**($\text{heap}_{funcstart\_719,1}$.b1)))))

$\text{heap}_{719,1;730,8}$ == $\text{heap}_{719,1;729,8}$.**replace**(p2 → **asType\<short int\>**((**asType\<int\>**(**asType\<short int\>**(div2.rem)) *
asType\<int\>($\text{heap}_{719,1;729,8}$.r2)) − (**asType\<int\>**(**asType\<short int\>**(div2.quot)) * **asType\<int\>**($\text{heap}_{719,1;729,8}$.b2)))))

$\text{heap}_{719,1;731,8}$ == $\text{heap}_{719,1;730,8}$.**replace**(p3 → **asType\<short int\>**((**asType\<int\>**(**asType\<short int\>**(div3.rem)) *
asType\<int\>($\text{heap}_{719,1;730,8}$.r3)) − (**asType\<int\>**(**asType\<short int\>**(div3.quot)) * **asType\<int\>**($\text{heap}_{719,1;730,8}$.b3)))))

$\text{heap}_{719,1;733,8}$ == $\text{heap}_{719,1;731,8}$.**replace**(p1 → **asType\<short int\>**((**asType\<int\>**($\text{heap}_{719,1;731,8}$.M1) *
asType\<int\>(**static_cast\<integer\>**(**asType\<int\>**($\text{heap}_{719,1;731,8}$.p1) < (**int**)0))) + **asType\<int\>**($\text{heap}_{719,1;731,8}$.p1)))

$\text{heap}_{719,1;734,8}$ == $\text{heap}_{719,1;733,8}$.**replace**(p2 → **asType\<short int\>**((**asType\<int\>**($\text{heap}_{719,1;733,8}$.M2) *
asType\<int\>(**static_cast\<integer\>**(**asType\<int\>**($\text{heap}_{719,1;733,8}$.p2) < (**int**)0))) + **asType\<int\>**($\text{heap}_{719,1;733,8}$.p2)))

$\text{heap}_{funcend\_719,1}$ == $\text{heap}_{719,1;734,8}$.**replace**(p3 → **asType\<short int\>**((**asType\<int\>**($\text{heap}_{719,1;734,8}$.M3) *
asType\<int\>(**static_cast\<integer\>**(**asType\<int\>**($\text{heap}_{719,1;734,8}$.p3) < (**int**)0))) + **asType\<int\>**($\text{heap}_{719,1;734,8}$.p3)))

raux1 == **asType\<double\>**(**static_cast\<real\>**($\text{heap}_{funcend\_719,1}$.p1)) / **asType\<double\>**(**static_cast\<real\>**($\text{heap}_{funcend\_719,1}$.M1))

raux2 == **asType\<double\>**(**static_cast\<real\>**($\text{heap}_{funcend\_719,1}$.p2)) / **asType\<double\>**(**static_cast\<real\>**($\text{heap}_{funcend\_719,1}$.M2))

Proof:

[Take goal term]

[1.0] !(0.0 == **asType\<double\>**(**static_cast\<real\>**($\text{heap}_{funcend\_719,1}$.M3)))

→ *[const static or extern object]*

[1.1] !(0.0 == **asType\<double\>**(**static_cast\<real\>**(heap_{init}.M3)))

→ *[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: Loop initialisation establishes end condition or a valid variant

Condition generated at: C:\Escher\Customers\prang\prang.c (84,5)

Condition defined at: C:\Escher\Customers\prang\prang.c (86,20)

To prove: $0 \le (\textbf{asType}\langle\textbf{integer const}\rangle(\text{limit}) - \textbf{asType}\langle\textbf{integer}\rangle(\text{count}))$

Given:

$\text{\$heap}_{init}.\text{LIMIT} == (\textbf{int})80$

$\text{\$heap}_{init}.\text{M1} == \textbf{asType}\langle\textbf{short int}\rangle((\textbf{int})30269)$

$\text{\$heap}_{init}.\text{r1} == \textbf{asType}\langle\textbf{short int}\rangle((\textbf{int})171)$

$\text{\$heap}_{init}.\text{a1} == \textbf{asType}\langle\textbf{short int}\rangle((\textbf{int})177)$

$\text{\$heap}_{init}.\text{b1} == \textbf{asType}\langle\textbf{short int}\rangle((\textbf{int})2)$

$\text{\$heap}_{init}.\text{M2} == \textbf{asType}\langle\textbf{short int}\rangle((\textbf{int})30307)$

$\text{\$heap}_{init}.\text{r2} == \textbf{asType}\langle\textbf{short int}\rangle((\textbf{int})172)$

$\text{\$heap}_{init}.\text{a2} == \textbf{asType}\langle\textbf{short int}\rangle((\textbf{int})176)$

$\text{\$heap}_{init}.\text{b2} == \textbf{asType}\langle\textbf{short int}\rangle((\textbf{int})35)$

$\text{\$heap}_{init}.\text{M3} == \textbf{asType}\langle\textbf{short int}\rangle((\textbf{int})30323)$

$\text{\$heap}_{init}.\text{r3} == \textbf{asType}\langle\textbf{short int}\rangle((\textbf{int})170)$

$\text{\$heap}_{init}.\text{a3} == \textbf{asType}\langle\textbf{short int}\rangle((\textbf{int})178)$

$\text{\$heap}_{init}.\text{b3} == \textbf{asType}\langle\textbf{short int}\rangle((\textbf{int})63)$

$\text{\$heap}_{init}.\text{p1} == \textbf{asType}\langle\textbf{short int}\rangle((\textbf{int})1)$

$\text{\$heap}_{init}.\text{p2} == \textbf{asType}\langle\textbf{short int}\rangle((\textbf{int})2)$

$\text{\$heap}_{init}.\text{p3} == \textbf{asType}\langle\textbf{short int}\rangle((\textbf{int})3)$

$\text{limit} == \text{\$heap}_{funcstart\_756,1}.\text{LIMIT}$

$\textbf{minof}(\textbf{int const}) \le \text{limit}$

$\text{limit} \le \textbf{maxof}(\textbf{int const})$

$\text{count} == (\textbf{int})0$

$\textbf{minof}(\textbf{int}) \le \text{count}$

$\text{count} \le \textbf{maxof}(\textbf{int})$

$\text{\$heap}_{756,1;761,5} ==$

$\$\text{heap}_{funcstart\_756,1}.\_\mathbf{replace}((\&\$\text{heap}_{funcstart\_756,1}.\_\text{ecv\_files}[1]).\$r \rightarrow \text{writes}\_761\_5)$

count < limit

Proof:

[Take given term]

[5.0] $\$\text{heap}_{funcstart\_756,1}.\text{LIMIT} == \text{limit}$

$\rightarrow$ *[const static or extern object]*

[5.1] $\$\text{heap}_{init}.\text{LIMIT} == \text{limit}$

$\rightarrow$ *[expand definition of constant 'LIMIT' at prang.c (12,18)]*

[5.2] $(\mathbf{int})80 == \text{limit}$

$\rightarrow$ *[simplify]*

[5.3] $80 == \text{limit}$

[Take given term]

[6.0] $(\mathbf{int})0 == \text{count}$

$\rightarrow$ *[simplify]*

[6.1] $0 == \text{count}$

[Take goal term]

[1.0] $0 \le (\mathbf{asType}<\mathbf{integer\ const}>(\text{limit}) - \mathbf{asType}<\mathbf{integer}>(\text{count}))$

$\rightarrow$ *[from term 5.3, limit is equal to 80]*

[1.1] $0 \le (\mathbf{asType}<\mathbf{integer\ const}>(80) - \mathbf{asType}<\mathbf{integer}>(\text{count}))$

$\rightarrow$ *[simplify]*

[1.2] $0 \le (80 - \mathbf{asType}<\mathbf{integer}>(\text{count}))$

$\rightarrow$ *[from term 6.1, count is equal to 0]*

[1.3] $0 \le (80 - \mathbf{asType}<\mathbf{integer}>(0))$

$\rightarrow$ *[simplify]*

[1.6] **true**

Proof of verification condition: Loop body establishes end condition or decreases variant

Condition generated at: C:\Escher\Customers\prang\prang.c (87,5)

Condition defined at: C:\Escher\Customers\prang\prang.c (86,5)

To prove: $(\mathbf{asType}<\mathbf{integer\ const}>(\text{limit}) - \mathbf{asType}<\mathbf{integer}>(\text{count}_{loopend})) < (\mathbf{asType}<\mathbf{integer\ const}>(\text{limit}) - \mathbf{asType}<\mathbf{integer}>(\text{count}_{loopstart\_763,5}))$

Given:

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

$\$heap_{init}.M1 == \textbf{asType}<\textbf{short int}>((\textbf{int})30269)$

$\$heap_{init}.r1 == \textbf{asType}<\textbf{short int}>((\textbf{int})171)$

$\$heap_{init}.a1 == \textbf{asType}<\textbf{short int}>((\textbf{int})177)$

$\$heap_{init}.b1 == \textbf{asType}<\textbf{short int}>((\textbf{int})2)$

$\$heap_{init}.M2 == \textbf{asType}<\textbf{short int}>((\textbf{int})30307)$

$\$heap_{init}.r2 == \textbf{asType}<\textbf{short int}>((\textbf{int})172)$

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

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

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

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

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

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

$\$heap_{init}.p1 == \textbf{asType}<\textbf{short int}>((\textbf{int})1)$

$\$heap_{init}.p2 == \textbf{asType}<\textbf{short int}>((\textbf{int})2)$

$\$heap_{init}.p3 == \textbf{asType}<\textbf{short int}>((\textbf{int})3)$

$limit == \$heap_{funcstart\_756,1}.LIMIT$

$\textbf{minof}(\textbf{int const}) \le limit$

$limit \le \textbf{maxof}(\textbf{int const})$

$count == (\textbf{int})0$

$\textbf{minof}(\textbf{int}) \le count$

$count \le \textbf{maxof}(\textbf{int})$

$\$heap_{756,1;761,5} ==$
$\$heap_{funcstart\_756,1}.\_\textbf{replace}((\&\$heap_{funcstart\_756,1}.\_ecv\_files[1]).\$r \to$
$writes\_761\_5)$

$\$heap_{loopstart\_763,5} == \$heap_{756,1;761,5}.\_\textbf{replace}(p1 \to$
$writes\_764\_12).\_\textbf{replace}(p2 \to writes\_764\_12).\_\textbf{replace}(p3 \to$
$writes\_764\_12).\_\textbf{replace}(\_ecv\_files \to writes\_764\_12)$

$\#writes\_764\_12 == \#\$heap_{756,1;761,5}.\_ecv\_files$

$\textbf{minof}(\textbf{int}) \le count_{loopstart\_763,5}$

$count_{loopstart\_763,5} \le \textbf{maxof}(\textbf{int})$

$count_{loopstart\_763,5} < limit$

$0 \leq (\mathbf{asType}\texttt{<}\mathbf{integer\ const}\texttt{>}(\text{limit}) -$
$\mathbf{asType}\texttt{<}\mathbf{integer}\texttt{>}(\text{count}_{loopstart\_763,5}))$

$(\mathbf{asType}\texttt{<}\mathbf{integer\ const}\texttt{>}(\text{limit}) - \mathbf{asType}\texttt{<}\mathbf{integer}\texttt{>}(\text{count}_{loopstart\_763,5}))$
$\leq (\mathbf{asType}\texttt{<}\mathbf{integer\ const}\texttt{>}(\text{limit}) - \mathbf{asType}\texttt{<}\mathbf{integer}\texttt{>}(\text{count}))$

$(++\text{count}_{loopstart\_763,5} == \text{count}_{loopend}) \wedge (\$\text{heap}_{767,16} ==$
$\$\text{heap}_{loopstart\_763,5}.\_\mathbf{replace}(\text{p1} \rightarrow \text{writes\_767\_25}).\_\mathbf{replace}(\text{p2} \rightarrow$
$\text{writes\_767\_25}).\_\mathbf{replace}(\text{p3} \rightarrow \text{writes\_767\_25})) \wedge (\$\text{heap}_{loopend} ==$
$\$\text{heap}_{767,16}.\_\mathbf{replace}((\&\$\text{heap}_{767,16}.\_\text{ecv\_files}[1]).\$r \rightarrow \text{writes\_767\_9}))$

$\text{count}_{loopend} < \text{limit}$

Proof:

[Take given term]

[5.0] $\$\text{heap}_{funcstart\_756,1}.\text{LIMIT} == \text{limit}$

$\rightarrow$ *[const static or extern object]*

[5.1] $\$\text{heap}_{init}.\text{LIMIT} == \text{limit}$

$\rightarrow$ *[expand definition of constant 'LIMIT' at prang.c (12,18)]*

[5.2] $(\mathbf{int})80 == \text{limit}$

$\rightarrow$ *[simplify]*

[5.3] $80 == \text{limit}$

[Take given term]

[7.0] $\$\text{heap}_{756,1;761,5} ==$
$\$\text{heap}_{funcstart\_756,1}.\_\mathbf{replace}((\&\$\text{heap}_{funcstart\_756,1}.\_\text{ecv\_files}[1]).\$r \rightarrow$
$\text{writes\_761\_5})$

$\rightarrow$ *[simplify]*

[7.1] $\$\text{heap}_{756,1;761,5} == \$\text{heap}_{funcstart\_756,1}.\_\mathbf{replace}((\&\$\text{heap}.\_\text{ecv\_files}[1]).\$r$
$\rightarrow \text{writes\_761\_5})$

$\rightarrow$ *[attribute value is known from postcondition]*

[7.2] $\$\text{heap}_{756,1;761,5} == \$\text{heap}_{funcstart\_756,1}.\_\mathbf{replace}(\&\$\text{heap}.\_\text{ecv\_files}[1] \rightarrow$
$\text{writes\_761\_5})$

[Take given term]

[8.0] $\$\text{heap}_{loopstart\_763,5} == \$\text{heap}_{756,1;761,5}.\_\mathbf{replace}(\text{p1} \rightarrow$
$\text{writes\_764\_12}).\_\mathbf{replace}(\text{p2} \rightarrow \text{writes\_764\_12}).\_\mathbf{replace}(\text{p3} \rightarrow$
$\text{writes\_764\_12}).\_\mathbf{replace}(\_\text{ecv\_files} \rightarrow \text{writes\_764\_12})$

$\rightarrow$ *[from term 7.2, $\$heap_{756,1;761,5}$ is equal to*
$\$heap_{funcstart\_756,1}.\_\mathbf{replace}(\&\$heap.\_ecv\_files[1] \rightarrow writes\_761\_5)]$

[8.1] $\$\text{heap}_{loopstart\_763,5} ==$
$\$\text{heap}_{funcstart\_756,1}.\_\mathbf{replace}((\&\$\text{heap}.\_\text{ecv\_files}[1]) \rightarrow$

writes_761_5)._**replace**(p1 → writes_764_12)._**replace**(p2 →
writes_764_12)._**replace**(p3 → writes_764_12)._**replace**(_ecv_files →
writes_764_12)

[Take given term]

[20.0] (++count$_{loopstart\_763,5}$ == count$_{loopend}$) ∧ ($heap$_{767,16}$ ==
$heap$_{loopstart_763,5}$._**replace**(p1 → writes_767_25)._**replace**(p2 →
writes_767_25)._**replace**(p3 → writes_767_25)) ∧ ($heap$_{loopend}$ ==
$heap$_{767,16}$._**replace**((&$heap$_{767,16}$._ecv_files[1]).$r → writes_767_9))

→ *[simplify]*

[20.8] (1 == (count$_{loopend}$ + −count$_{loopstart\_763,5}$)) ∧ ($heap$_{767,16}$ ==
$heap$_{loopstart_763,5}$._**replace**(p1 → writes_767_25)._**replace**(p2 →
writes_767_25)._**replace**(p3 → writes_767_25)) ∧ ($heap$_{loopend}$ ==
$heap$_{767,16}$._**replace**((&$heap$_{767,16}$._ecv_files[1]).$r → writes_767_9))

→ *[from term 8.1, $heap$_{loopstart_763,5}$ is equal to*
$heap$_{funcstart_756,1}$._**replace**((&$heap._ecv_files[1]) →
*writes_761_5)._**replace**(p1 → writes_764_12)._**replace**(p2 →*
*writes_764_12)._**replace**(p3 → writes_764_12)._**replace**(_ecv_files →*
writes_764_12)]

[20.9] (1 == (−count$_{loopstart\_763,5}$ + count$_{loopend}$)) ∧ ($heap$_{767,16}$ ==
$heap$_{funcstart_756,1}$._**replace**((&$heap._ecv_files[1]) →
writes_761_5)._**replace**(p1 → writes_764_12)._**replace**(p2 →
writes_764_12)._**replace**(p3 → writes_764_12)._**replace**(_ecv_files →
writes_764_12)._**replace**(p1 → writes_767_25)._**replace**(p2 →
writes_767_25)._**replace**(p3 → writes_767_25)) ∧ ($heap$_{loopend}$ ==
$heap$_{767,16}$._**replace**((&$heap$_{767,16}$._ecv_files[1]).$r → writes_767_9))

→ *[simplify]*

[20.10] (1 == (−count$_{loopstart\_763,5}$ + count$_{loopend}$)) ∧ ($heap$_{767,16}$ ==
$heap$_{funcstart_756,1}$._**replace**((&$heap._ecv_files[1]) →
writes_761_5)._**replace**(p1 → writes_764_12)._**replace**(p2 →
writes_764_12)._**replace**(p3 → writes_764_12)._**replace**(_ecv_files →
writes_764_12)._**replace**(p1 → writes_767_25)._**replace**(p2 →
writes_767_25)._**replace**(p3 → writes_767_25)) ∧ ($heap$_{loopend}$ ==
$heap$_{767,16}$._**replace**((&$heap._ecv_files[1]).$r → writes_767_9))

→ *[attribute value is known from postcondition]*

[20.11] (1 == (−count$_{loopstart\_763,5}$ + count$_{loopend}$)) ∧ ($heap$_{767,16}$ ==
$heap$_{funcstart_756,1}$._**replace**((&$heap._ecv_files[1]) →
writes_761_5)._**replace**(p1 → writes_764_12)._**replace**(p2 →
writes_764_12)._**replace**(p3 → writes_764_12)._**replace**(_ecv_files →
writes_764_12)._**replace**(p1 → writes_767_25)._**replace**(p2 →
writes_767_25)._**replace**(p3 → writes_767_25)) ∧ ($heap$_{loopend}$ ==
$heap$_{767,16}$._**replace**(&$heap._ecv_files[1] → writes_767_9))

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$\rightarrow$ *[separate conjunction and work on first sub-term]*

[20.12] $1 == (-\text{count}_{loopstart\_763,5} + \text{count}_{loopend})$

[Take goal term]

[1.0] $(\textbf{asType}\textless\textbf{integer const}\textgreater(\text{limit}) - \textbf{asType}\textless\textbf{integer}\textgreater(\text{count}_{loopend})) <$ $(\textbf{asType}\textless\textbf{integer const}\textgreater(\text{limit}) - \textbf{asType}\textless\textbf{integer}\textgreater(\text{count}_{loopstart\_763,5}))$

$\rightarrow$ *[from term 5.3, limit is equal to 80]*

[1.1] $(\textbf{asType}\textless\textbf{integer const}\textgreater(80) - \textbf{asType}\textless\textbf{integer}\textgreater(\text{count}_{loopend})) <$ $(\textbf{asType}\textless\textbf{integer const}\textgreater(\text{limit}) - \textbf{asType}\textless\textbf{integer}\textgreater(\text{count}_{loopstart\_763,5}))$

$\rightarrow$ *[simplify]*

[1.2] $(80 - \textbf{asType}\textless\textbf{integer}\textgreater(\text{count}_{loopend})) < (\textbf{asType}\textless\textbf{integer}$ $\textbf{const}\textgreater(\text{limit}) - \textbf{asType}\textless\textbf{integer}\textgreater(\text{count}_{loopstart\_763,5}))$

$\rightarrow$ *[from term 20.12, count$_{loopend}$ is equal to 1 + count$_{loopstart\_763,5}$]*

[1.3] $(80 - \textbf{asType}\textless\textbf{integer}\textgreater(1 + \text{count}_{loopstart\_763,5})) < (\textbf{asType}\textless\textbf{integer}$ $\textbf{const}\textgreater(\text{limit}) - \textbf{asType}\textless\textbf{integer}\textgreater(\text{count}_{loopstart\_763,5}))$

$\rightarrow$ *[simplify]*

[1.9] $(79 + -\text{count}_{loopstart\_763,5}) < (\textbf{asType}\textless\textbf{integer const}\textgreater(\text{limit}) -$ $\textbf{asType}\textless\textbf{integer}\textgreater(\text{count}_{loopstart\_763,5}))$

$\rightarrow$ *[from term 5.3, limit is equal to 80]*

[1.10] $(79 + -\text{count}_{loopstart\_763,5}) < (\textbf{asType}\textless\textbf{integer const}\textgreater(80) -$ $\textbf{asType}\textless\textbf{integer}\textgreater(\text{count}_{loopstart\_763,5}))$

$\rightarrow$ *[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 (87,5)

Condition defined at: C:\Escher\Customers\prang\prang.c (86,20)

To prove: $0 \leq (\textbf{asType}\textless\textbf{integer const}\textgreater(\text{limit}) -$ $\textbf{asType}\textless\textbf{integer}\textgreater(\text{count}_{loopend}))$

Given:

$\$\text{heap}_{init}.\text{LIMIT} == (\textbf{int})80$

$\$\text{heap}_{init}.\text{M1} == \textbf{asType}\textless\textbf{short int}\textgreater((\textbf{int})30269)$

$\$\text{heap}_{init}.\text{r1} == \textbf{asType}\textless\textbf{short int}\textgreater((\textbf{int})171)$

$\$\text{heap}_{init}.\text{a1} == \textbf{asType}\textless\textbf{short int}\textgreater((\textbf{int})177)$

$\$\text{heap}_{init}.\text{b1} == \textbf{asType}\textless\textbf{short int}\textgreater((\textbf{int})2)$

$\text{\$heap}_{init}.\text{M2} == \textbf{asType}\textbf{<short int>}((\textbf{int})30307)$

$\text{\$heap}_{init}.\text{r2} == \textbf{asType}\textbf{<short int>}((\textbf{int})172)$

$\text{\$heap}_{init}.\text{a2} == \textbf{asType}\textbf{<short int>}((\textbf{int})176)$

$\text{\$heap}_{init}.\text{b2} == \textbf{asType}\textbf{<short int>}((\textbf{int})35)$

$\text{\$heap}_{init}.\text{M3} == \textbf{asType}\textbf{<short int>}((\textbf{int})30323)$

$\text{\$heap}_{init}.\text{r3} == \textbf{asType}\textbf{<short int>}((\textbf{int})170)$

$\text{\$heap}_{init}.\text{a3} == \textbf{asType}\textbf{<short int>}((\textbf{int})178)$

$\text{\$heap}_{init}.\text{b3} == \textbf{asType}\textbf{<short int>}((\textbf{int})63)$

$\text{\$heap}_{init}.\text{p1} == \textbf{asType}\textbf{<short int>}((\textbf{int})1)$

$\text{\$heap}_{init}.\text{p2} == \textbf{asType}\textbf{<short int>}((\textbf{int})2)$

$\text{\$heap}_{init}.\text{p3} == \textbf{asType}\textbf{<short int>}((\textbf{int})3)$

$\text{limit} == \text{\$heap}_{funcstart\_756,1}.\text{LIMIT}$

$\textbf{minof}(\textbf{int const}) \leq \text{limit}$

$\text{limit} \leq \textbf{maxof}(\textbf{int const})$

$\text{count} == (\textbf{int})0$

$\textbf{minof}(\textbf{int}) \leq \text{count}$

$\text{count} \leq \textbf{maxof}(\textbf{int})$

$\text{\$heap}_{756,1;761,5} ==$
$\text{\$heap}_{funcstart\_756,1}.\textbf{\_replace}((\&\text{\$heap}_{funcstart\_756,1}.\text{\_ecv\_files}[1]).\text{\$r} \rightarrow$
$\text{writes\_761\_5})$

$\text{\$heap}_{loopstart\_763,5} == \text{\$heap}_{756,1;761,5}.\textbf{\_replace}(\text{p1} \rightarrow$
$\text{writes\_764\_12}).\textbf{\_replace}(\text{p2} \rightarrow \text{writes\_764\_12}).\textbf{\_replace}(\text{p3} \rightarrow$
$\text{writes\_764\_12}).\textbf{\_replace}(\text{\_ecv\_files} \rightarrow \text{writes\_764\_12})$

$\#\text{writes\_764\_12} == \#\text{\$heap}_{756,1;761,5}.\text{\_ecv\_files}$

$\textbf{minof}(\textbf{int}) \leq \text{count}_{loopstart\_763,5}$

$\text{count}_{loopstart\_763,5} \leq \textbf{maxof}(\textbf{int})$

$\text{count}_{loopstart\_763,5} < \text{limit}$

$0 \leq (\textbf{asType}\textbf{<integer const>}(\text{limit}) -$
$\textbf{asType}\textbf{<integer>}(\text{count}_{loopstart\_763,5}))$

$(\textbf{asType}\textbf{<integer const>}(\text{limit}) - \textbf{asType}\textbf{<integer>}(\text{count}_{loopstart\_763,5}))$
$\leq (\textbf{asType}\textbf{<integer const>}(\text{limit}) - \textbf{asType}\textbf{<integer>}(\text{count}))$

$(++\text{count}_{loopstart\_763,5} == \text{count}_{loopend}) \wedge (\text{\$heap}_{767,16} ==$
$\text{\$heap}_{loopstart\_763,5}.\textbf{\_replace}(\text{p1} \rightarrow \text{writes\_767\_25}).\textbf{\_replace}(\text{p2} \rightarrow$
$\text{writes\_767\_25}).\textbf{\_replace}(\text{p3} \rightarrow \text{writes\_767\_25})) \wedge (\text{\$heap}_{loopend} ==$
$\text{\$heap}_{767,16}.\textbf{\_replace}((\&\text{\$heap}_{767,16}.\text{\_ecv\_files}[1]).\text{\$r} \rightarrow \text{writes\_767\_9}))$

count$_{loopend}$ < limit

Proof:

[Take given term]

[5.0] $heap$_{funcstart_756,1}$.LIMIT == limit

→ *[const static or extern object]*

[5.1] $heap$_{init}$.LIMIT == limit

→ *[expand definition of constant 'LIMIT' at prang.c (12,18)]*

[5.2] (**int**)80 == limit

→ *[simplify]*

[5.3] 80 == limit

[Take given term]

[7.0] $heap$_{756,1;761,5}$ ==
$heap$_{funcstart_756,1}$.\_**replace**((&$heap$_{funcstart\_756,1}$._ecv_files[1]).$r →
writes_761_5)

→ *[simplify]*

[7.1] $heap$_{756,1;761,5}$ == $heap$_{funcstart_756,1}$.\_**replace**((&$heap._ecv_files[1]).$r
→ writes_761_5)

→ *[attribute value is known from postcondition]*

[7.2] $heap$_{756,1;761,5}$ == $heap$_{funcstart_756,1}$.\_**replace**(&$heap._ecv_files[1] →
writes_761_5)

[Take given term]

[8.0] $heap$_{loopstart_763,5}$ == $heap$_{756,1;761,5}$._**replace**(p1 →
writes_764_12)._**replace**(p2 → writes_764_12)._**replace**(p3 →
writes_764_12)._**replace**(_ecv_files → writes_764_12)

→ *[from term 7.2, $heap$_{756,1;761,5}$ is equal to
$heap$_{funcstart_756,1}$.\_**replace**(&$heap._ecv_files[1] → writes_761_5)]*

[8.1] $heap$_{loopstart_763,5}$ ==
$heap$_{funcstart_756,1}$.\_**replace**((&$heap._ecv_files[1]) →
writes_761_5)._**replace**(p1 → writes_764_12)._**replace**(p2 →
writes_764_12)._**replace**(p3 → writes_764_12)._**replace**(_ecv_files →
writes_764_12)

[Take given term]

[20.0] (++count$_{loopstart\_763,5}$ == count$_{loopend}$) ∧ ($heap$_{767,16}$ ==
$heap$_{loopstart_763,5}$._**replace**(p1 → writes_767_25)._**replace**(p2 →
writes_767_25)._**replace**(p3 → writes_767_25)) ∧ ($heap$_{loopend}$ ==
$heap$_{767,16}$.\_**replace**((&$heap$_{767,16}$._ecv_files[1]).$r → writes_767_9))

→ *[simplify]*

[20.8] $(1 == (\text{count}_{loopend} + -\text{count}_{loopstart\_763,5})) \wedge (\$\text{heap}_{767,16} == \$\text{heap}_{loopstart\_763,5}.\_\mathbf{replace}(\text{p1} \rightarrow \text{writes\_767\_25}).\_\mathbf{replace}(\text{p2} \rightarrow \text{writes\_767\_25}).\_\mathbf{replace}(\text{p3} \rightarrow \text{writes\_767\_25})) \wedge (\$\text{heap}_{loopend} == \$\text{heap}_{767,16}.\_\mathbf{replace}((\&\$\text{heap}_{767,16}.\_\text{ecv\_files}[1]).\$\text{r} \rightarrow \text{writes\_767\_9}))$

→ *[from term 8.1, $\$\text{heap}_{loopstart\_763,5}$ is equal to $\$\text{heap}_{funcstart_756,1}._\mathbf{replace}((\&\$\text{heap}._\text{ecv_files}[1]) \rightarrow \text{writes_761_5})._\mathbf{replace}(\text{p1} \rightarrow \text{writes_764_12})._\mathbf{replace}(\text{p2} \rightarrow \text{writes_764_12})._\mathbf{replace}(\text{p3} \rightarrow \text{writes_764_12})._\mathbf{replace}(_\text{ecv_files} \rightarrow \text{writes_764_12})]*

[20.9] $(1 == (-\text{count}_{loopstart\_763,5} + \text{count}_{loopend})) \wedge (\$\text{heap}_{767,16} == \$\text{heap}_{funcstart\_756,1}.\_\mathbf{replace}((\&\$\text{heap}.\_\text{ecv\_files}[1]) \rightarrow \text{writes\_761\_5}).\_\mathbf{replace}(\text{p1} \rightarrow \text{writes\_764\_12}).\_\mathbf{replace}(\text{p2} \rightarrow \text{writes\_764\_12}).\_\mathbf{replace}(\text{p3} \rightarrow \text{writes\_764\_12}).\_\mathbf{replace}(\_\text{ecv\_files} \rightarrow \text{writes\_764\_12}).\_\mathbf{replace}(\text{p1} \rightarrow \text{writes\_767\_25}).\_\mathbf{replace}(\text{p2} \rightarrow \text{writes\_767\_25}).\_\mathbf{replace}(\text{p3} \rightarrow \text{writes\_767\_25})) \wedge (\$\text{heap}_{loopend} == \$\text{heap}_{767,16}.\_\mathbf{replace}((\&\$\text{heap}_{767,16}.\_\text{ecv\_files}[1]).\$\text{r} \rightarrow \text{writes\_767\_9}))$

→ *[simplify]*

[20.10] $(1 == (-\text{count}_{loopstart\_763,5} + \text{count}_{loopend})) \wedge (\$\text{heap}_{767,16} == \$\text{heap}_{funcstart\_756,1}.\_\mathbf{replace}((\&\$\text{heap}.\_\text{ecv\_files}[1]) \rightarrow \text{writes\_761\_5}).\_\mathbf{replace}(\text{p1} \rightarrow \text{writes\_764\_12}).\_\mathbf{replace}(\text{p2} \rightarrow \text{writes\_764\_12}).\_\mathbf{replace}(\text{p3} \rightarrow \text{writes\_764\_12}).\_\mathbf{replace}(\_\text{ecv\_files} \rightarrow \text{writes\_764\_12}).\_\mathbf{replace}(\text{p1} \rightarrow \text{writes\_767\_25}).\_\mathbf{replace}(\text{p2} \rightarrow \text{writes\_767\_25}).\_\mathbf{replace}(\text{p3} \rightarrow \text{writes\_767\_25})) \wedge (\$\text{heap}_{loopend} == \$\text{heap}_{767,16}.\_\mathbf{replace}((\&\$\text{heap}.\_\text{ecv\_files}[1]).\$\text{r} \rightarrow \text{writes\_767\_9}))$

→ *[attribute value is known from postcondition]*

[20.11] $(1 == (-\text{count}_{loopstart\_763,5} + \text{count}_{loopend})) \wedge (\$\text{heap}_{767,16} == \$\text{heap}_{funcstart\_756,1}.\_\mathbf{replace}((\&\$\text{heap}.\_\text{ecv\_files}[1]) \rightarrow \text{writes\_761\_5}).\_\mathbf{replace}(\text{p1} \rightarrow \text{writes\_764\_12}).\_\mathbf{replace}(\text{p2} \rightarrow \text{writes\_764\_12}).\_\mathbf{replace}(\text{p3} \rightarrow \text{writes\_764\_12}).\_\mathbf{replace}(\_\text{ecv\_files} \rightarrow \text{writes\_764\_12}).\_\mathbf{replace}(\text{p1} \rightarrow \text{writes\_767\_25}).\_\mathbf{replace}(\text{p2} \rightarrow \text{writes\_767\_25}).\_\mathbf{replace}(\text{p3} \rightarrow \text{writes\_767\_25})) \wedge (\$\text{heap}_{loopend} == \$\text{heap}_{767,16}.\_\mathbf{replace}(\&\$\text{heap}.\_\text{ecv\_files}[1] \rightarrow \text{writes\_767\_9}))$

→ *[separate conjunction and work on first sub-term]*

[20.12] $1 == (-\text{count}_{loopstart\_763,5} + \text{count}_{loopend})$

[Take given term]

[31.0] $\text{count}_{loopend} < \text{limit}$

→ *[from term 20.12, $\text{count}_{loopend}$ is equal to $1 + \text{count}_{loopstart\_763,5}$]*

[31.1] $(1 + \text{count}_{loopstart\_763,5}) < \text{limit}$

→ *[from term 5.3, limit is equal to 80]*

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[31.2] $(1 + \mathrm{count}_{loopstart\_763,5}) < 80$

$\rightarrow$ *[simplify]*

[31.9] $-79 < -\mathrm{count}_{loopstart\_763,5}$

[Take goal term]

[1.0] $0 \leq (\textbf{asType}\textbf{<integer const>}(\mathrm{limit}) - \textbf{asType}\textbf{<integer>}(\mathrm{count}_{loopend}))$

$\rightarrow$ *[from term 5.3, limit is equal to 80]*

[1.1] $0 \leq (\textbf{asType}\textbf{<integer const>}(80) - \textbf{asType}\textbf{<integer>}(\mathrm{count}_{loopend}))$

$\rightarrow$ *[simplify]*

[1.2] $0 \leq (80 - \textbf{asType}\textbf{<integer>}(\mathrm{count}_{loopend}))$

$\rightarrow$ *[from term 20.12, $\mathrm{count}_{loopend}$ is equal to $1 + \mathrm{count}_{loopstart\_763,5}$]*

[1.3] $0 \leq (80 - \textbf{asType}\textbf{<integer>}(1 + \mathrm{count}_{loopstart\_763,5}))$

$\rightarrow$ *[simplify]*

[1.13] $-80 < -\mathrm{count}_{loopstart\_763,5}$

$\rightarrow$ *[from term 31.9, $literala < -\mathrm{count}_{loopstart\_763,5}$ 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 (89,9)

Condition defined at:

To prove: minof(int) $\leq$ ++$\mathrm{count}_{loopstart\_763,5}$

Given:

$\$\mathrm{heap}_{init}.\mathrm{LIMIT} == (\textbf{int})80$

$\$\mathrm{heap}_{init}.\mathrm{M1} == \textbf{asType}\textbf{<short int>}((\textbf{int})30269)$

$\$\mathrm{heap}_{init}.\mathrm{r1} == \textbf{asType}\textbf{<short int>}((\textbf{int})171)$

$\$\mathrm{heap}_{init}.\mathrm{a1} == \textbf{asType}\textbf{<short int>}((\textbf{int})177)$

$\$\mathrm{heap}_{init}.\mathrm{b1} == \textbf{asType}\textbf{<short int>}((\textbf{int})2)$

$\$\mathrm{heap}_{init}.\mathrm{M2} == \textbf{asType}\textbf{<short int>}((\textbf{int})30307)$

$\$\mathrm{heap}_{init}.\mathrm{r2} == \textbf{asType}\textbf{<short int>}((\textbf{int})172)$

$\$\mathrm{heap}_{init}.\mathrm{a2} == \textbf{asType}\textbf{<short int>}((\textbf{int})176)$

$\$\mathrm{heap}_{init}.\mathrm{b2} == \textbf{asType}\textbf{<short int>}((\textbf{int})35)$

$\$\mathrm{heap}_{init}.\mathrm{M3} == \textbf{asType}\textbf{<short int>}((\textbf{int})30323)$

$\$\mathrm{heap}_{init}.\mathrm{r3} == \textbf{asType}\textbf{<short int>}((\textbf{int})170)$

$\$\mathrm{heap}_{init}.\mathrm{a3} == \textbf{asType}\textbf{<short int>}((\textbf{int})178)$

$\$\mathrm{heap}_{init}.\mathrm{b3} == \textbf{asType}\textbf{<short int>}((\textbf{int})63)$

$\$\mathrm{heap}_{init}.\mathrm{p1} == \textbf{asType}\textbf{<short int>}((\textbf{int})1)$

$\$\mathrm{heap}_{init}.\mathrm{p2} == \textbf{asType}\textbf{<short int>}((\textbf{int})2)$

$\$\mathrm{heap}_{init}.\mathrm{p3} == \textbf{asType}\textbf{<short int>}((\textbf{int})3)$

$\mathrm{limit} == \$\mathrm{heap}_{funcstart\_756,1}.\mathrm{LIMIT}$

$\textbf{minof}(\textbf{int const}) \leq \mathrm{limit}$

$\mathrm{limit} \leq \textbf{maxof}(\textbf{int const})$

$\mathrm{count} == (\textbf{int})0$

$\textbf{minof}(\textbf{int}) \leq \mathrm{count}$

$\mathrm{count} \leq \textbf{maxof}(\textbf{int})$

$\$\mathrm{heap}_{756,1;761,5} ==$
$\$\mathrm{heap}_{funcstart\_756,1}.\_\textbf{replace}((\&\$\mathrm{heap}_{funcstart\_756,1}.\_\mathrm{ecv\_files}[1]).\$\mathrm{r} \rightarrow$
$\mathrm{writes\_761\_5})$

$\$\mathrm{heap}_{loopstart\_763,5} == \$\mathrm{heap}_{756,1;761,5}.\_\textbf{replace}(\mathrm{p1} \rightarrow$
$\mathrm{writes\_764\_12}).\_\textbf{replace}(\mathrm{p2} \rightarrow \mathrm{writes\_764\_12}).\_\textbf{replace}(\mathrm{p3} \rightarrow$
$\mathrm{writes\_764\_12}).\_\textbf{replace}(\_\mathrm{ecv\_files} \rightarrow \mathrm{writes\_764\_12})$

$\#\mathrm{writes\_764\_12} == \#\$\mathrm{heap}_{756,1;761,5}.\_\mathrm{ecv\_files}$

$\textbf{minof}(\textbf{int}) \leq \mathrm{count}_{loopstart\_763,5}$

$\mathrm{count}_{loopstart\_763,5} \leq \textbf{maxof}(\textbf{int})$

$\mathrm{count}_{loopstart\_763,5} < \mathrm{limit}$

$0 \leq (\textbf{asType}\textbf{<integer const>}(\mathrm{limit}) -$
$\textbf{asType}\textbf{<integer>}(\mathrm{count}_{loopstart\_763,5}))$

$(\textbf{asType}\textbf{<integer const>}(\mathrm{limit}) - \textbf{asType}\textbf{<integer>}(\mathrm{count}_{loopstart\_763,5}))$
$\leq (\textbf{asType}\textbf{<integer const>}(\mathrm{limit}) - \textbf{asType}\textbf{<integer>}(\mathrm{count}))$

$\$\mathrm{heap}_{767,16} == \$\mathrm{heap}_{loopstart\_763,5}.\_\textbf{replace}(\mathrm{p1} \rightarrow \mathrm{writes\_767\_25}).\_\textbf{replace}(\mathrm{p2}$
$\rightarrow \mathrm{writes\_767\_25}).\_\textbf{replace}(\mathrm{p3} \rightarrow \mathrm{writes\_767\_25})$

$\$\mathrm{heap}_{loopend} == \$\mathrm{heap}_{767,16}.\_\textbf{replace}((\&\$\mathrm{heap}_{767,16}.\_\mathrm{ecv\_files}[1]).\$\mathrm{r} \rightarrow$
$\mathrm{writes\_767\_9})$

Proof:

[Take given term]

[5.0] $\text{\$heap}_{funcstart\_756,1}.\text{LIMIT} == \text{limit}$

$\rightarrow$ *[const static or extern object]*

[5.1] $\text{\$heap}_{init}.\text{LIMIT} == \text{limit}$

$\rightarrow$ *[expand definition of constant 'LIMIT' at prang.c (12,18)]*

[5.2] $(\textbf{int})80 == \text{limit}$

$\rightarrow$ *[simplify]*

[5.3] $80 == \text{limit}$

[Take given term]

[6.0] $(\textbf{int})0 == \text{count}$

$\rightarrow$ *[simplify]*

[6.1] $0 == \text{count}$

[Take given term]

[19.0] $(\textbf{asType}\text{<}\textbf{integer const}\text{>}(\text{limit}) - \textbf{asType}\text{<}\textbf{integer}\text{>}(\text{count}_{loopstart\_763,5})) \leq (\textbf{asType}\text{<}\textbf{integer const}\text{>}(\text{limit}) - \textbf{asType}\text{<}\textbf{integer}\text{>}(\text{count}))$

$\rightarrow$ *[from term 5.3, limit is equal to 80]*

[19.1] $(\textbf{asType}\text{<}\textbf{integer const}\text{>}(80) - \textbf{asType}\text{<}\textbf{integer}\text{>}(\text{count}_{loopstart\_763,5})) \leq (\textbf{asType}\text{<}\textbf{integer const}\text{>}(\text{limit}) - \textbf{asType}\text{<}\textbf{integer}\text{>}(\text{count}))$

$\rightarrow$ *[simplify]*

[19.4] $(80 + -\text{count}_{loopstart\_763,5}) \leq (\textbf{asType}\text{<}\textbf{integer const}\text{>}(\text{limit}) - \textbf{asType}\text{<}\textbf{integer}\text{>}(\text{count}))$

$\rightarrow$ *[from term 5.3, limit is equal to 80]*

[19.5] $(80 + -\text{count}_{loopstart\_763,5}) \leq (\textbf{asType}\text{<}\textbf{integer const}\text{>}(80) - \textbf{asType}\text{<}\textbf{integer}\text{>}(\text{count}))$

$\rightarrow$ *[simplify]*

[19.6] $(80 + -\text{count}_{loopstart\_763,5}) \leq (80 - \textbf{asType}\text{<}\textbf{integer}\text{>}(\text{count}))$

$\rightarrow$ *[from term 6.1, count is equal to 0]*

[19.7] $(80 + -\text{count}_{loopstart\_763,5}) \leq (80 - \textbf{asType}\text{<}\textbf{integer}\text{>}(0))$

$\rightarrow$ *[simplify]*

[19.20] $\text{-1} < \text{count}_{loopstart\_763,5}$

[Take goal term]

[1.0] **minof(int)** $\leq$ ++count$_{loopstart\_763,5}$

$\rightarrow$ *[simplify]*

[1.6] -32770 < count$_{loopstart\_763,5}$

$\rightarrow$ *[from term 19.20, literala < count$_{loopstart\_763,5}$ 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 (89,9)

Condition defined at:

To prove: ++count$_{loopstart\_763,5}$ $\leq$ **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)

$heap_{init}$.b1 == **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)

$heap_{init}$.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)

$heap_{init}$.b3 == **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)

limit $==$ \$heap$_{funcstart\_756,1}$.LIMIT

minof(int const) $\leq$ limit

limit $\leq$ **maxof(int const)**

count $==$ **(int)**0

minof(int) $\leq$ count

count $\leq$ **maxof(int)**

\$heap$_{756,1;761,5}$ $==$
\$heap$_{funcstart\_756,1}$._**replace**((&\$heap$_{funcstart\_756,1}$._ecv_files[1]).\$r $\rightarrow$
writes_761_5)

\$heap$_{loopstart\_763,5}$ $==$ \$heap$_{756,1;761,5}$._**replace**(p1 $\rightarrow$
writes_764_12)._**replace**(p2 $\rightarrow$ writes_764_12)._**replace**(p3 $\rightarrow$
writes_764_12)._**replace**(_ecv_files $\rightarrow$ writes_764_12)

#writes_764_12 $==$ #\$heap$_{756,1;761,5}$._ecv_files

minof(int) $\leq$ count$_{loopstart\_763,5}$

count$_{loopstart\_763,5}$ $\leq$ **maxof(int)**

count$_{loopstart\_763,5}$ $<$ limit

$0 \leq$ (**asType$<$integer const$>$**(limit) $-$
asType$<$integer$>$(count$_{loopstart\_763,5}$))

(**asType$<$integer const$>$**(limit) $-$ **asType$<$integer$>$**(count$_{loopstart\_763,5}$))
$\leq$ (**asType$<$integer const$>$**(limit) $-$ **asType$<$integer$>$**(count))

\$heap$_{767,16}$ $==$ \$heap$_{loopstart\_763,5}$._**replace**(p1 $\rightarrow$ writes_767_25)._**replace**(p2
$\rightarrow$ writes_767_25)._**replace**(p3 $\rightarrow$ writes_767_25)

\$heap$_{loopend}$ $==$ \$heap$_{767,16}$._**replace**((&\$heap$_{767,16}$._ecv_files[1]).\$r $\rightarrow$
writes_767_9)

Proof:

[Take given term]

[5.0] \$heap$_{funcstart\_756,1}$.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]

[18.0] count$_{loopstart\_763,5}$ $<$ limit

$\rightarrow$ *[from term 5.3, limit is equal to 80]*

[18.1] count$_{loopstart\_763,5} < 80$

$\rightarrow$ *[simplify]*

[18.4] -80 $< -$count$_{loopstart\_763,5}$

[Take goal term]

[1.0] ++count$_{loopstart\_763,5} \leq$ **maxof(int)**

$\rightarrow$ *[simplify]*

[1.9] -32767 $< -$count$_{loopstart\_763,5}$

$\rightarrow$ *[from term 18.4, literala $< -$count$_{loopstart\_763,5}$ 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**

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: minof(short int) $\leq$ (int)3

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)

\$heap$_{init}$.M2 == **asType**<**short int**>((**int**)30307)

\$heap$_{init}$.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)

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

$\text{\$heap}_{init}.\text{a3} == \textbf{asType}\textbf{<short int>}((\textbf{int})178)$

$\text{\$heap}_{init}.\text{b3} == \textbf{asType}\textbf{<short int>}((\textbf{int})63)$

$\text{\$heap}_{init}.\text{p1} == \textbf{asType}\textbf{<short int>}((\textbf{int})1)$

$\text{\$heap}_{init}.\text{p2} == \textbf{asType}\textbf{<short int>}((\textbf{int})2)$

Proof:

[Take goal term]

[1.0] **minof(short int)** $\leq$ **(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: $(\textbf{int})3 \leq \textbf{maxof(short int)}$

Given:

$\text{\$heap}_{init}.\text{LIMIT} == (\textbf{int})80$

$\text{\$heap}_{init}.\text{M1} == \textbf{asType}\textbf{<short int>}((\textbf{int})30269)$

$\text{\$heap}_{init}.\text{r1} == \textbf{asType}\textbf{<short int>}((\textbf{int})171)$

$\text{\$heap}_{init}.\text{a1} == \textbf{asType}\textbf{<short int>}((\textbf{int})177)$

$\text{\$heap}_{init}.\text{b1} == \textbf{asType}\textbf{<short int>}((\textbf{int})2)$

$\text{\$heap}_{init}.\text{M2} == \textbf{asType}\textbf{<short int>}((\textbf{int})30307)$

$\text{\$heap}_{init}.\text{r2} == \textbf{asType}\textbf{<short int>}((\textbf{int})172)$

$\text{\$heap}_{init}.\text{a2} == \textbf{asType}\textbf{<short int>}((\textbf{int})176)$

$\text{\$heap}_{init}.\text{b2} == \textbf{asType}\textbf{<short int>}((\textbf{int})35)$

$\text{\$heap}_{init}.\text{M3} == \textbf{asType}\textbf{<short int>}((\textbf{int})30323)$

$\text{\$heap}_{init}.\text{r3} == \textbf{asType}\textbf{<short int>}((\textbf{int})170)$

$\text{\$heap}_{init}.\text{a3} == \textbf{asType}\textbf{<short int>}((\textbf{int})178)$

$\text{\$heap}_{init}.\text{b3} == \textbf{asType}\textbf{<short int>}((\textbf{int})63)$

$\text{\$heap}_{init}.\text{p1} == \textbf{asType}\textbf{<short int>}((\textbf{int})1)$

$\text{\$heap}_{init}.\text{p2} == \textbf{asType}\textbf{<short int>}((\textbf{int})2)$

Proof:

[Take goal term]

[1.0] (**int**)3 ≤ **maxof**(**short int**)

→ *[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

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)

heap_{init}.M2 == **asType**<**short int**>((**int**)30307)

heap_{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)

heap_{init}.r3 == **asType**<**short int**>((**int**)170)

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

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

heap_{init}.p1 == **asType**<**short int**>((**int**)1)

Proof:

[Take goal term]

[1.0] **minof**(**short int**) ≤ (**int**)2

→ *[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)

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Condition defined at:

To prove: $(\mathbf{int})2 \leq \mathbf{maxof}(\mathbf{short\ int})$

Given:

$\$\mathrm{heap}_{init}.\mathrm{LIMIT} == (\mathbf{int})80$

$\$\mathrm{heap}_{init}.\mathrm{M1} == \mathbf{asType}{<}\mathbf{short\ int}{>}((\mathbf{int})30269)$

$\$\mathrm{heap}_{init}.\mathrm{r1} == \mathbf{asType}{<}\mathbf{short\ int}{>}((\mathbf{int})171)$

$\$\mathrm{heap}_{init}.\mathrm{a1} == \mathbf{asType}{<}\mathbf{short\ int}{>}((\mathbf{int})177)$

$\$\mathrm{heap}_{init}.\mathrm{b1} == \mathbf{asType}{<}\mathbf{short\ int}{>}((\mathbf{int})2)$

$\$\mathrm{heap}_{init}.\mathrm{M2} == \mathbf{asType}{<}\mathbf{short\ int}{>}((\mathbf{int})30307)$

$\$\mathrm{heap}_{init}.\mathrm{r2} == \mathbf{asType}{<}\mathbf{short\ int}{>}((\mathbf{int})172)$

$\$\mathrm{heap}_{init}.\mathrm{a2} == \mathbf{asType}{<}\mathbf{short\ int}{>}((\mathbf{int})176)$

$\$\mathrm{heap}_{init}.\mathrm{b2} == \mathbf{asType}{<}\mathbf{short\ int}{>}((\mathbf{int})35)$

$\$\mathrm{heap}_{init}.\mathrm{M3} == \mathbf{asType}{<}\mathbf{short\ int}{>}((\mathbf{int})30323)$

$\$\mathrm{heap}_{init}.\mathrm{r3} == \mathbf{asType}{<}\mathbf{short\ int}{>}((\mathbf{int})170)$

$\$\mathrm{heap}_{init}.\mathrm{a3} == \mathbf{asType}{<}\mathbf{short\ int}{>}((\mathbf{int})178)$

$\$\mathrm{heap}_{init}.\mathrm{b3} == \mathbf{asType}{<}\mathbf{short\ int}{>}((\mathbf{int})63)$

$\$\mathrm{heap}_{init}.\mathrm{p1} == \mathbf{asType}{<}\mathbf{short\ int}{>}((\mathbf{int})1)$

Proof:

[Take goal term]

[1.0] $(\mathbf{int})2 \leq \mathbf{maxof}(\mathbf{short\ int})$

$\rightarrow$ *[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: $\mathbf{minof}(\mathbf{short\ int}) \leq (\mathbf{int})1$

Given:

$\$\mathrm{heap}_{init}.\mathrm{LIMIT} == (\mathbf{int})80$

$\$\mathrm{heap}_{init}.\mathrm{M1} == \mathbf{asType}{<}\mathbf{short\ int}{>}((\mathbf{int})30269)$

$\$\mathrm{heap}_{init}.\mathrm{r1} == \mathbf{asType}{<}\mathbf{short\ int}{>}((\mathbf{int})171)$

$\$\mathrm{heap}_{init}.\mathrm{a1} == \mathbf{asType}{<}\mathbf{short\ int}{>}((\mathbf{int})177)$

$\text{\$heap}_{init}.\text{b1} == \textbf{asType}\textbf{<short int>}((\textbf{int})2)$

$\text{\$heap}_{init}.\text{M2} == \textbf{asType}\textbf{<short int>}((\textbf{int})30307)$

$\text{\$heap}_{init}.\text{r2} == \textbf{asType}\textbf{<short int>}((\textbf{int})172)$

$\text{\$heap}_{init}.\text{a2} == \textbf{asType}\textbf{<short int>}((\textbf{int})176)$

$\text{\$heap}_{init}.\text{b2} == \textbf{asType}\textbf{<short int>}((\textbf{int})35)$

$\text{\$heap}_{init}.\text{M3} == \textbf{asType}\textbf{<short int>}((\textbf{int})30323)$

$\text{\$heap}_{init}.\text{r3} == \textbf{asType}\textbf{<short int>}((\textbf{int})170)$

$\text{\$heap}_{init}.\text{a3} == \textbf{asType}\textbf{<short int>}((\textbf{int})178)$

$\text{\$heap}_{init}.\text{b3} == \textbf{asType}\textbf{<short int>}((\textbf{int})63)$

Proof:

[Take goal term]

[1.0] **minof(short int)** $\leq$ **(int)**1

$\rightarrow$ *[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: **(int)**1 $\leq$ **maxof(short int)**

Given:

$\text{\$heap}_{init}.\text{LIMIT} == (\textbf{int})80$

$\text{\$heap}_{init}.\text{M1} == \textbf{asType}\textbf{<short int>}((\textbf{int})30269)$

$\text{\$heap}_{init}.\text{r1} == \textbf{asType}\textbf{<short int>}((\textbf{int})171)$

$\text{\$heap}_{init}.\text{a1} == \textbf{asType}\textbf{<short int>}((\textbf{int})177)$

$\text{\$heap}_{init}.\text{b1} == \textbf{asType}\textbf{<short int>}((\textbf{int})2)$

$\text{\$heap}_{init}.\text{M2} == \textbf{asType}\textbf{<short int>}((\textbf{int})30307)$

$\text{\$heap}_{init}.\text{r2} == \textbf{asType}\textbf{<short int>}((\textbf{int})172)$

$\text{\$heap}_{init}.\text{a2} == \textbf{asType}\textbf{<short int>}((\textbf{int})176)$

$\text{\$heap}_{init}.\text{b2} == \textbf{asType}\textbf{<short int>}((\textbf{int})35)$

$\text{\$heap}_{init}.\text{M3} == \textbf{asType}\textbf{<short int>}((\textbf{int})30323)$

$\text{\$heap}_{init}.\text{r3} == \textbf{asType}\textbf{<short int>}((\textbf{int})170)$

$\text{\$heap}_{init}.\text{a3} == \textbf{asType}\textbf{<short int>}((\textbf{int})178)$

$\text{\$heap}_{init}.b3 == \textbf{asType}<\textbf{short int}>((\textbf{int})63)$

Proof:

[Take goal term]

[1.0] $(\textbf{int})1 \leq \textbf{maxof}(\textbf{short int})$

$\rightarrow$ *[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) $\leq$ **(int)63**

Given:

$\text{\$heap}_{init}.\text{LIMIT} == (\textbf{int})80$

$\text{\$heap}_{init}.\text{M1} == \textbf{asType}<\textbf{short int}>((\textbf{int})30269)$

$\text{\$heap}_{init}.\text{r1} == \textbf{asType}<\textbf{short int}>((\textbf{int})171)$

$\text{\$heap}_{init}.\text{a1} == \textbf{asType}<\textbf{short int}>((\textbf{int})177)$

$\text{\$heap}_{init}.\text{b1} == \textbf{asType}<\textbf{short int}>((\textbf{int})2)$

$\text{\$heap}_{init}.\text{M2} == \textbf{asType}<\textbf{short int}>((\textbf{int})30307)$

$\text{\$heap}_{init}.\text{r2} == \textbf{asType}<\textbf{short int}>((\textbf{int})172)$

$\text{\$heap}_{init}.\text{a2} == \textbf{asType}<\textbf{short int}>((\textbf{int})176)$

$\text{\$heap}_{init}.\text{b2} == \textbf{asType}<\textbf{short int}>((\textbf{int})35)$

$\text{\$heap}_{init}.\text{M3} == \textbf{asType}<\textbf{short int}>((\textbf{int})30323)$

$\text{\$heap}_{init}.\text{r3} == \textbf{asType}<\textbf{short int}>((\textbf{int})170)$

$\text{\$heap}_{init}.\text{a3} == \textbf{asType}<\textbf{short int}>((\textbf{int})178)$

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: $(\mathbf{int})63 \leq \mathbf{maxof(short\ int)}$

Given:

$\$\mathrm{heap}_{init}.\mathrm{LIMIT} == (\mathbf{int})80$

$\$\mathrm{heap}_{init}.\mathrm{M1} == \mathbf{asType{<}short\ int{>}}((\mathbf{int})30269)$

$\$\mathrm{heap}_{init}.\mathrm{r1} == \mathbf{asType{<}short\ int{>}}((\mathbf{int})171)$

$\$\mathrm{heap}_{init}.\mathrm{a1} == \mathbf{asType{<}short\ int{>}}((\mathbf{int})177)$

$\$\mathrm{heap}_{init}.\mathrm{b1} == \mathbf{asType{<}short\ int{>}}((\mathbf{int})2)$

$\$\mathrm{heap}_{init}.\mathrm{M2} == \mathbf{asType{<}short\ int{>}}((\mathbf{int})30307)$

$\$\mathrm{heap}_{init}.\mathrm{r2} == \mathbf{asType{<}short\ int{>}}((\mathbf{int})172)$

$\$\mathrm{heap}_{init}.\mathrm{a2} == \mathbf{asType{<}short\ int{>}}((\mathbf{int})176)$

$\$\mathrm{heap}_{init}.\mathrm{b2} == \mathbf{asType{<}short\ int{>}}((\mathbf{int})35)$

$\$\mathrm{heap}_{init}.\mathrm{M3} == \mathbf{asType{<}short\ int{>}}((\mathbf{int})30323)$

$\$\mathrm{heap}_{init}.\mathrm{r3} == \mathbf{asType{<}short\ int{>}}((\mathbf{int})170)$

$\$\mathrm{heap}_{init}.\mathrm{a3} == \mathbf{asType{<}short\ int{>}}((\mathbf{int})178)$

Proof:

[Take goal term]

[1.0] $(\mathbf{int})63 \leq \mathbf{maxof(short\ int)}$

$\rightarrow$ *[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: $\mathbf{minof(short\ int)} \leq (\mathbf{int})178$

Given:

$\$\mathrm{heap}_{init}.\mathrm{LIMIT} == (\mathbf{int})80$

$\$\mathrm{heap}_{init}.\mathrm{M1} == \mathbf{asType{<}short\ int{>}}((\mathbf{int})30269)$

$\$\mathrm{heap}_{init}.\mathrm{r1} == \mathbf{asType{<}short\ int{>}}((\mathbf{int})171)$

$\$\mathrm{heap}_{init}.\mathrm{a1} == \mathbf{asType{<}short\ int{>}}((\mathbf{int})177)$

$\$\mathrm{heap}_{init}.\mathrm{b1} == \mathbf{asType{<}short\ int{>}}((\mathbf{int})2)$

$\text{\$heap}_{init}.M2 == \textbf{asType}\textbf{<short int>}((\textbf{int})30307)$

$\text{\$heap}_{init}.r2 == \textbf{asType}\textbf{<short int>}((\textbf{int})172)$

$\text{\$heap}_{init}.a2 == \textbf{asType}\textbf{<short int>}((\textbf{int})176)$

$\text{\$heap}_{init}.b2 == \textbf{asType}\textbf{<short int>}((\textbf{int})35)$

$\text{\$heap}_{init}.M3 == \textbf{asType}\textbf{<short int>}((\textbf{int})30323)$

$\text{\$heap}_{init}.r3 == \textbf{asType}\textbf{<short int>}((\textbf{int})170)$

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 $\leq$ **maxof(short int)**

Given:

$\text{\$heap}_{init}.LIMIT == (\textbf{int})80$

$\text{\$heap}_{init}.M1 == \textbf{asType}\textbf{<short int>}((\textbf{int})30269)$

$\text{\$heap}_{init}.r1 == \textbf{asType}\textbf{<short int>}((\textbf{int})171)$

$\text{\$heap}_{init}.a1 == \textbf{asType}\textbf{<short int>}((\textbf{int})177)$

$\text{\$heap}_{init}.b1 == \textbf{asType}\textbf{<short int>}((\textbf{int})2)$

$\text{\$heap}_{init}.M2 == \textbf{asType}\textbf{<short int>}((\textbf{int})30307)$

$\text{\$heap}_{init}.r2 == \textbf{asType}\textbf{<short int>}((\textbf{int})172)$

$\text{\$heap}_{init}.a2 == \textbf{asType}\textbf{<short int>}((\textbf{int})176)$

$\text{\$heap}_{init}.b2 == \textbf{asType}\textbf{<short int>}((\textbf{int})35)$

$\text{\$heap}_{init}.M3 == \textbf{asType}\textbf{<short int>}((\textbf{int})30323)$

$\text{\$heap}_{init}.r3 == \textbf{asType}\textbf{<short int>}((\textbf{int})170)$

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) $\leq$ **(int)170**

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)

$\$heap_{init}.$M2 == **asType<short int>**((**int**)30307)

$\$heap_{init}.$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)

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 $\leq$ **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)

$\text{\$heap}_{init}.\text{a1} == \textbf{asType}\textbf{<short int>}((\textbf{int})177)$

$\text{\$heap}_{init}.\text{b1} == \textbf{asType}\textbf{<short int>}((\textbf{int})2)$

$\text{\$heap}_{init}.\text{M2} == \textbf{asType}\textbf{<short int>}((\textbf{int})30307)$

$\text{\$heap}_{init}.\text{r2} == \textbf{asType}\textbf{<short int>}((\textbf{int})172)$

$\text{\$heap}_{init}.\text{a2} == \textbf{asType}\textbf{<short int>}((\textbf{int})176)$

$\text{\$heap}_{init}.\text{b2} == \textbf{asType}\textbf{<short int>}((\textbf{int})35)$

$\text{\$heap}_{init}.\text{M3} == \textbf{asType}\textbf{<short int>}((\textbf{int})30323)$

Proof:

[Take goal term]

[1.0] $(\textbf{int})170 \leq \textbf{maxof}(\textbf{short int})$

$\rightarrow$ *[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) $\leq$ **(int)30323**

Given:

$\text{\$heap}_{init}.\text{LIMIT} == (\textbf{int})80$

$\text{\$heap}_{init}.\text{M1} == \textbf{asType}\textbf{<short int>}((\textbf{int})30269)$

$\text{\$heap}_{init}.\text{r1} == \textbf{asType}\textbf{<short int>}((\textbf{int})171)$

$\text{\$heap}_{init}.\text{a1} == \textbf{asType}\textbf{<short int>}((\textbf{int})177)$

$\text{\$heap}_{init}.\text{b1} == \textbf{asType}\textbf{<short int>}((\textbf{int})2)$

$\text{\$heap}_{init}.\text{M2} == \textbf{asType}\textbf{<short int>}((\textbf{int})30307)$

$\text{\$heap}_{init}.\text{r2} == \textbf{asType}\textbf{<short int>}((\textbf{int})172)$

$\text{\$heap}_{init}.\text{a2} == \textbf{asType}\textbf{<short int>}((\textbf{int})176)$

$\text{\$heap}_{init}.\text{b2} == \textbf{asType}\textbf{<short int>}((\textbf{int})35)$

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: $(\mathbf{int})30323 \leq \mathbf{maxof(short\ int)}$

Given:

$\$\mathrm{heap}_{init}.\mathrm{LIMIT} == (\mathbf{int})80$

$\$\mathrm{heap}_{init}.\mathrm{M1} == \mathbf{asType}\mathbf{<short\ int>}((\mathbf{int})30269)$

$\$\mathrm{heap}_{init}.\mathrm{r1} == \mathbf{asType}\mathbf{<short\ int>}((\mathbf{int})171)$

$\$\mathrm{heap}_{init}.\mathrm{a1} == \mathbf{asType}\mathbf{<short\ int>}((\mathbf{int})177)$

$\$\mathrm{heap}_{init}.\mathrm{b1} == \mathbf{asType}\mathbf{<short\ int>}((\mathbf{int})2)$

$\$\mathrm{heap}_{init}.\mathrm{M2} == \mathbf{asType}\mathbf{<short\ int>}((\mathbf{int})30307)$

$\$\mathrm{heap}_{init}.\mathrm{r2} == \mathbf{asType}\mathbf{<short\ int>}((\mathbf{int})172)$

$\$\mathrm{heap}_{init}.\mathrm{a2} == \mathbf{asType}\mathbf{<short\ int>}((\mathbf{int})176)$

$\$\mathrm{heap}_{init}.\mathrm{b2} == \mathbf{asType}\mathbf{<short\ int>}((\mathbf{int})35)$

Proof:

[Take goal term]

[1.0] $(\mathbf{int})30323 \leq \mathbf{maxof(short\ int)}$

$\rightarrow$ *[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: $\mathbf{minof(short\ int)} \leq (\mathbf{int})35$

Given:

$\$\mathrm{heap}_{init}.\mathrm{LIMIT} == (\mathbf{int})80$

$\$\mathrm{heap}_{init}.\mathrm{M1} == \mathbf{asType}\mathbf{<short\ int>}((\mathbf{int})30269)$

$\$\mathrm{heap}_{init}.\mathrm{r1} == \mathbf{asType}\mathbf{<short\ int>}((\mathbf{int})171)$

$\$\mathrm{heap}_{init}.\mathrm{a1} == \mathbf{asType}\mathbf{<short\ int>}((\mathbf{int})177)$

$\$\mathrm{heap}_{init}.\mathrm{b1} == \mathbf{asType}\mathbf{<short\ int>}((\mathbf{int})2)$

$\$\mathrm{heap}_{init}.\mathrm{M2} == \mathbf{asType}\mathbf{<short\ int>}((\mathbf{int})30307)$

$\$\text{heap}_{init}.\text{r2} == \textbf{asType}<\textbf{short int}>((\textbf{int})172)$

$\$\text{heap}_{init}.\text{a2} == \textbf{asType}<\textbf{short int}>((\textbf{int})176)$

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 $\leq$ **maxof(short int)**

Given:

$\$\text{heap}_{init}.\text{LIMIT} == (\textbf{int})80$

$\$\text{heap}_{init}.\text{M1} == \textbf{asType}<\textbf{short int}>((\textbf{int})30269)$

$\$\text{heap}_{init}.\text{r1} == \textbf{asType}<\textbf{short int}>((\textbf{int})171)$

$\$\text{heap}_{init}.\text{a1} == \textbf{asType}<\textbf{short int}>((\textbf{int})177)$

$\$\text{heap}_{init}.\text{b1} == \textbf{asType}<\textbf{short int}>((\textbf{int})2)$

$\$\text{heap}_{init}.\text{M2} == \textbf{asType}<\textbf{short int}>((\textbf{int})30307)$

$\$\text{heap}_{init}.\text{r2} == \textbf{asType}<\textbf{short int}>((\textbf{int})172)$

$\$\text{heap}_{init}.\text{a2} == \textbf{asType}<\textbf{short int}>((\textbf{int})176)$

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)** $\leq$ **(int)**176

Given:

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

$\$heap_{init}.M1 == \textbf{asType}<\textbf{short int}>((\textbf{int})30269)$

$\$heap_{init}.r1 == \textbf{asType}<\textbf{short int}>((\textbf{int})171)$

$\$heap_{init}.a1 == \textbf{asType}<\textbf{short int}>((\textbf{int})177)$

$\$heap_{init}.b1 == \textbf{asType}<\textbf{short int}>((\textbf{int})2)$

$\$heap_{init}.M2 == \textbf{asType}<\textbf{short int}>((\textbf{int})30307)$

$\$heap_{init}.r2 == \textbf{asType}<\textbf{short int}>((\textbf{int})172)$

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 $\leq$ **maxof(short int)**

Given:

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

$\$heap_{init}.M1 == \textbf{asType}<\textbf{short int}>((\textbf{int})30269)$

$\$heap_{init}.r1 == \textbf{asType}<\textbf{short int}>((\textbf{int})171)$

$\$heap_{init}.a1 == \textbf{asType}<\textbf{short int}>((\textbf{int})177)$

$\$heap_{init}.b1 == \textbf{asType}<\textbf{short int}>((\textbf{int})2)$

$\$heap_{init}.M2 == \textbf{asType}<\textbf{short int}>((\textbf{int})30307)$

$\$heap_{init}.r2 == \textbf{asType}<\textbf{short int}>((\textbf{int})172)$

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) $\leq$ **(int)172**

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)

$\$heap_{init}$.M2 == **asType**<**short int**>((**int**)30307)

Proof:

[Take goal term]

[1.0] **minof(short int)** $\leq$ **(int)172**

$\rightarrow$ *[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: (int)172 $\leq$ **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)

$\$heap_{init}$.M2 == **asType**<**short int**>((**int**)30307)

Proof:

[Take goal term]

[1.0] **(int)172** $\leq$ **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 (19,29)

Condition defined at:

To prove: minof(short int) $\leq$ **(int)**30307

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)

Proof:

[Take goal term]

[1.0] **minof(short int)** $\leq$ **(int)**30307

$\rightarrow$ *[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: (int)30307 $\leq$ **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)

Proof:

[Take goal term]

[1.0] **(int)**30307 ≤ **maxof(short int)**

→ *[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) ≤ **(int)2**

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] **minof(short int)** ≤ **(int)2**

→ *[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 ≤ **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** ≤ **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) $\leq$ (int)177

Given:

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

$\$heap_{init}$.M1 == **asType**<**short int**>((**int**)30269)

$\$heap_{init}$.r1 == **asType**<**short int**>((**int**)171)

Proof:

[Take goal term]

[1.0] **minof(short int) $\leq$ (int)177**

$\rightarrow$ *[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: (int)177 $\leq$ 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)

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

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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) $\leq$ **(int)171**

Given:

$\$\text{heap}_{init}.\text{LIMIT} == (\textbf{int})80$

$\$\text{heap}_{init}.\text{M1} == \textbf{asType}<\textbf{short int}>((\textbf{int})30269)$

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 $\leq$ **maxof(short int)**

Given:

$\$\text{heap}_{init}.\text{LIMIT} == (\textbf{int})80$

$\$\text{heap}_{init}.\text{M1} == \textbf{asType}<\textbf{short int}>((\textbf{int})30269)$

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) $\leq$ **(int)30269**

Given:

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

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 $\leq$ **maxof**(**short int**)

Given:

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

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